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INTRODUCTORY LETTER

To The Honourable Paul Leduc,
Minister of Mines.

Sir,—The undersigned has the honour to submit the Forty-fifth Annual Report of the Department of Mines, issued in seven parts, as follows:—

Part I

Statistical Review of the Mineral Industry of Ontario for 1935, by A. C. Young.
List of Mines, Quarries, and Works, 1935.
Mines of Ontario in 1935, by D. G. Sinclair, E. C. Keeley, D. F. Cooper, E. B. Weir, A. R. Webster.
Mining Accidents in 1935, by D. G. Sinclair, E. C. Keeley, D. F. Cooper, A. R. Webster.
Classes for Prospectors, 1935–36, by E. M. Burwash.

Part II

The Eastern Part of the Sturgeon River Area, with Map No. 45a, by E. L. Bruce.
The Western Part of the Sturgeon River Area, with Map No. 45a, by H. C. Laird.

Part III

Geology of the North Central Part of the Lake of the Woods, with Map No. 45b, by Jas. E. Thomson.
Gold Deposits on Shoal Lake (West), by Jas. E. Thomson.

Part IV

Geology of the Birch-Springpole Lakes Area, with Map No. 45c, by W. D. Harding.

Part V

Natural Gas in 1935, by R. B. Harkness.
Petroleum in 1935, by R. B. Harkness.

Part VI

Geology of the Ramore Area, with Map No. 45d, by E. S. Moore.
Geology of the Afton-Scholes Area, by E. S. Moore.
Geology of the Burntbush Area, with Map No. 45e, by Robert Thomson.

Part VII

Lake Iroquois, with Map No. 45f, by A. P. Coleman.
Geology of the North Shore of Lake Ontario, by A. P. Coleman.
Geology of Pelee and Adjacent Islands, by E. M. Kindle.

Only Part I is bound with the Sessional Papers of the Legislature. All parts, together with accompanying geological maps as indicated above by number and letter, are available on application to the Department.

Respectfully submitted,

T. F. Sutherland,
Deputy Minister of Mines.

Department of Mines,
Toronto, 1936.

LETTER OF TRANSMISSION

To the Honourable Herbert Alexander Bruce,
Lieutenant-Governor of the Province of Ontario.

May it please Your Honour:—

The undersigned has the honour to transmit to you herewith, for presentation to the Legislative Assembly of the Province of Ontario, the Forty-fifth Annual Report, 1935, of the Department over which I have the honour to preside.

Respectfully submitted,

Paul Leduc,
Minister of Mines

Department of Mines,
Toronto, 1936.



PROVINCE OF ONTARIO
DEPARTMENT OF MINES

HON. PAUL LEDUC, *Minister of Mines* T. F. SUTHERLAND, *Deputy Minister*

FORTY-FIFTH ANNUAL REPORT

OF THE

ONTARIO DEPARTMENT OF MINES

BEING

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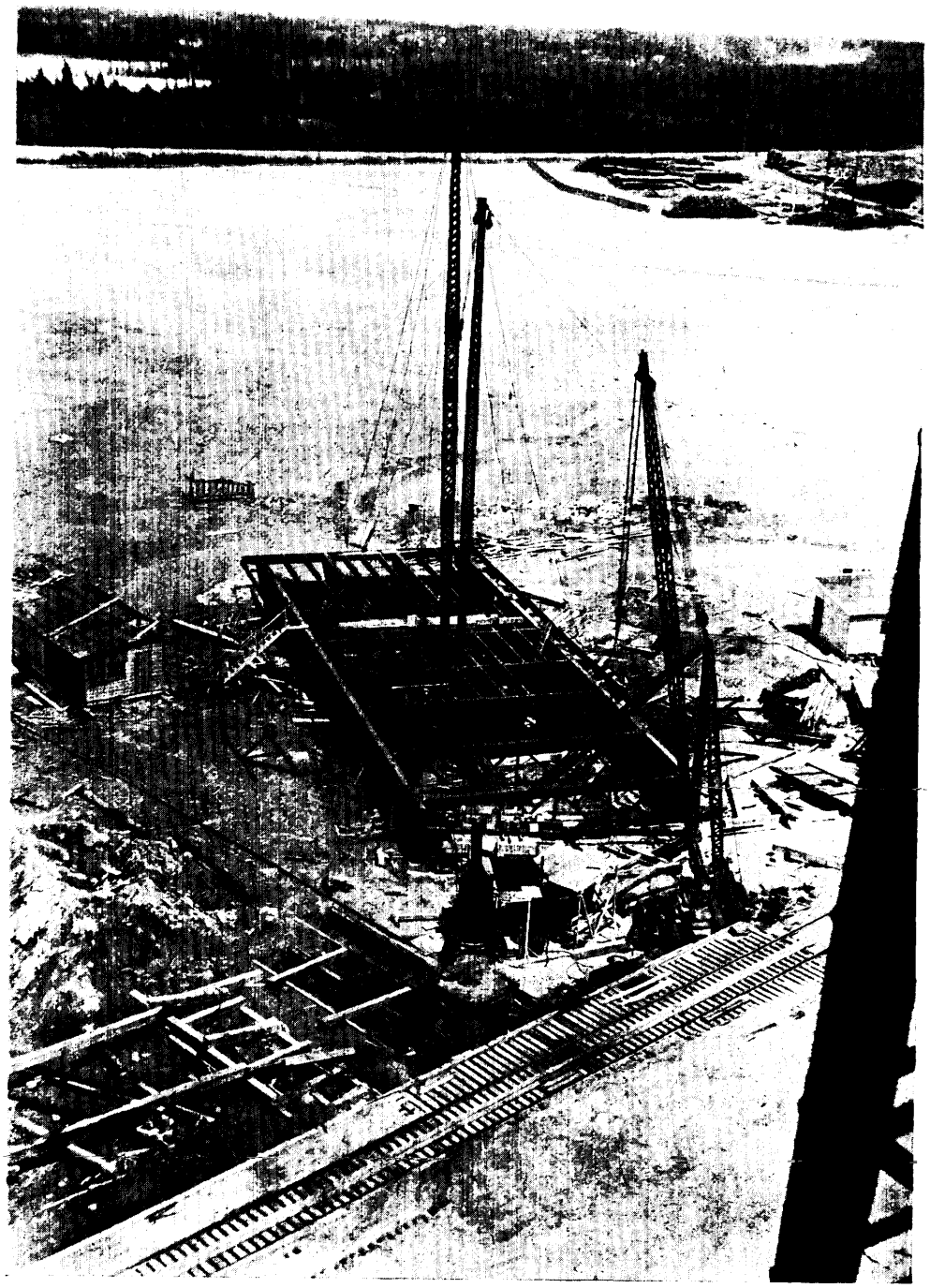
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View from the water tower of Lake Shore Mines showing construction of the steel deck for the new No. 5 shaft.

Statistical Review of the Mineral Industry of Ontario for 1935

By A. C. Young

GENERAL SUMMARY

Mineral Production

Mineral production for 1935 reached a new high of $159,580,955 and exceeded that of 1934, which was $145,854,173, by $13,726,782, a gain of 9.39 per cent.

Reference to the tables on pages 2 and 3 shows that each of the main groups, except structural materials, has improved its position. Metals rose from $129,273,033 to $142,888,565, an improvement of 10.5 per cent.; the non-metallic group, which has maintained its position between seven and eight millions of dollars during the past five years, showed a slight improvement of $213,086. Clay products have been very low in value since 1931, but with the gradual recovery of building this group is slowly regaining its former important position. Structural materials, which include cement, lime, stone, and sand and gravel, are dependent on heavy construction work, such as roads, foundations, and abutments. Cement showed rather a heavy drop due to a decline in consumption on highways, and stone also registered a drop. Conditions in this industry, although much below those obtaining during the prosperous years, are gradually recovering. The following excerpt from the *Monthly Review of Business Statistics* for December, 1935, describes the construction industry as follows:—

> The records of the construction industry are of great value for barometric purposes. During a time of depression, the existing plant and equipment, generally speaking, is more than sufficient to meet current demands for industrial products. Once the fixed capital equipment is again operated at a high percentage of capacity, corresponding to the state of affairs in the preceding period of maximum prosperity, the construction industry immediately acquires additional momentum. The awards in excess of $400,000,000 per year from 1926 to 1929 constitutes a fitting commentary upon the correlation of construction operations with economic progress. The decline in construction from 1930 to 1933 coincided with the recurrence of a major depression. While marked percentage gains were shown in the records of new business obtained by the construction industry in 1935, over the preceding year, the level was still low relative to the pre-depression years. The gain in contracts awarded in the 11-month period from $119,749,000 to $155,940,000 in 1935 was 30.2 per cent. Engineering projects took the lead in the main groups of construction, the total advancing from $47,610,000 to $64,325,000, a gain of no less than 35.1 per cent. The gains in residential and business contracts were 18.0 per cent. and 35.3 per cent., respectively, while the increase in industrial projects was 23.3 per cent.
>
> Employment in the building trades on the first of November, after seasonal adjustment, was only 60 per cent. of the average for the base year of 1926. The gain of about 16 per cent. over the same date of 1934 indicates, however, a betterment in building activity over the stagnant conditions of a short time ago.

The greatest prosperity, as may be seen in the tables, occurred in the metal-mining group, and the increases in the values of some of the items were important; for example, gold was up 5.4 per cent.; nickel, 9.9 per cent.; copper, 30.2 per cent.; and silver 56.5 per cent. A great improvement in employment was also apparent in this group. The number of wage-earners rose from 16,424 in 1934 to 18,869 in 1935, and wages paid from $24,973,938 to $29,381,598. More complete details are given in the sections that follow.

SUMMARY OF MINERAL STATISTICS, 1935

Product	Quantity[1]	Value	Employees	Wages
METALLIC				
Gold ..... oz.	2,220,336	$45,898,372	11,132	$17,839,318
Exchange equalization	.....	32,169,797	.....	.....
Silver ..... oz.	6,320,670	4,068,906	403	396,341
Copper in matte exported[2] ..... lbs.	12,544,439	627,222	[3]7,194	[3]11,005,124
Copper, metallic and in concentrates, exported ..... lbs.	239,483,489	18,668,743		
Nickel in matte, in speiss, and in ore exported; metallic nickel; and nickel content of oxides and salts ..... lbs.	138,516,240	35,345,103		
Platinum metals ..... oz.	190,107	5,407,392		
Selenium ..... lbs.	75,363	144,697		
Tellurium ..... lbs.	14,275	28,550		
Bismuth ..... lbs.	7,079	6,796		
Cobalt in metal, oxides, salts, ores, and residues ..... lbs.	681,419	512,705	[4]120	[4]121,253
Lead in concentrates exported ..... lbs.	22,532	706		
Chromite ..... tons	798	9,576	20	19,562
Total	.....	$142,888,565	18,869	$29,381,598
NON-METALLIC				
Arsenic, white ..... lbs.	2,558,789	$75,326	([5])	([5])
Diatomite ..... tons	100	4,600	12	$3,591
Feldspar, crude and ground ..... tons	8,656	75,003	40	20,337
Fluorspar ..... tons	75	900	2	800
Graphite, crude and refined ..... tons	.....	78,500	30	22,558
Gypsum ..... tons	38,247	164,807	77	99,137
Sulphur[6] ..... tons	13,292	132,920	.....	.....
Mica ..... lbs.	509,826	7,144	12	1,536
Mineral waters ..... Imp. gals.	19,900	1,477	.....	.....
Natural gas ..... M cu. ft.	8,157,256	4,894,353	1,273	1,219,520
Peat ..... tons	1,340	5,761	7	499
Petroleum, crude ..... bbls.	165,040	346,156	221	127,862
Phosphate ..... tons	70	60	.....	.....
Quartzite and quartz ..... tons	83,034	120,005	55	24,638
Silica brick ..... M	493	22,976	22	12,305
Salt ..... tons	320,003	1,698,508	274	309,354
Talc ..... tons	13,710	138,161	31	23,864
Total	.....	$7,766,657	2,056	$1,866,001
STRUCTURAL MATERIALS				
Cement, Portland ..... bbls.	1,243,836	$1,752,148	402	$334,833
Hydrated lime ..... tons	23,514	227,197	210	147,397
Quicklime ..... tons	198,338	1,478,106		
Sand and gravel ..... tons	8,154,618	2,095,610	230	134,751
Sand-lime products[7]	.....	138,555	51	31,758
Stone: limestone, trap, granite, sandstone . tons	2,122,941	1,863,892	792	407,042
Total	.....	$7,555,508	1,685	$1,055,781
CLAY PRODUCTS				
Brick, face ..... No.	28,064,195	$545,231	753	$397,799
Brick, common ..... No.	20,759,108	275,835		
Brick, fancy and ornamental ..... No.	12,935	728		
Brick, sewer ..... No.	60,295	970		
Tile, drain ..... No.	5,060,734	125,593		
Tile, structural, roofing, and floor	.....	168,128		
Sewer pipe, copings, flue-linings, etc	.....	196,647		
Pottery	.....	50,000		
Haydite and clay	.....	7,093		
Total	.....	$1,370,225	753	$397,799
TOTAL VALUE in Canadian funds	.....	**$159,580,955**	23,363	$32,701,179

[1]All tons in this table are 2,000 pounds.

[2]Copper in matte valued at 4½ cents per pound, and nickel at 18 cents.

[3]Employees and wages for nickel-copper mines, smelters, and refineries include statistics of the Ontario Refining Company.

[4]Employees and wages for silver-cobalt smelters and refineries.

[5]Employees and wages included with figures for silver-cobalt smelters and refineries ([4]).

[6]Tonnage given is sulphur content of sulphuric acid; no iron pyrites was sold in 1935.

[7]No deduction made for lime used in manufacturing.

COMPARATIVE VALUE OF MINERAL PRODUCTION, 1931–1935

Product	1931	1932	1933	1934	1935
METALLIC					
Gold (Canadian value)	$45,043,837	$53,418,449	$61,044,951	$72,808,688	$78,068,169
Silver	1,880,860	1,910,937	1,912,934	2,600,393	4,068,906
Platinum metals	2,812,834	1,998,911	1,501,233	6,187,992	5,407,392
Cobalt[1]	651,179	587,957	597,752	592,497	512,705
Nickel[2]	15,005,080	7,179,862	20,130,480	32,139,425	35,345,103
Copper, metallic and in matte	8,907,069	5,025,684	10,118,847	14,822,704	19,295,965
Selenium	32,108	.....	53,745	91,286	144,697
Tellurium	.....	.....	.....	25,599	28,550
Lead, pig and in ore	41,987	1,756	692	525	706
Bismuth	3,532	7,289	3,731	3,444	6,796
Molybdenite	280	.....	.....	.....	.....
Chromite	.....	.....	.....	480	9,576
Total	$74,378,766	$70,130,845	$95,364,365	$129,273,033	$142,888,565
NON-METALLIC					
Actinolite	$456	.....	.....	$365	.....
Arsenic, white	135,170	$98,914	$56,534	56,412	$75,326
Barite	.....	.....	60	.....	.....
Diatomite	840	309	1,298	1,920	4,600
Feldspar, crude and ground	103,008	42,920	45,350	61,665	75,003
Fluorspar	620	464	1,064	2,100	900
Graphite, crude and refined	32,149	18,483	16,145	64,998	78,500
Gypsum	374,469	186,176	112,319	141,389	164,807
Iron pyrites and sulphur[3]	65,080	33,320	81,960	145,980	132,920
Mica	23,465	2,752	9,371	9,059	7,144
Mineral waters	8,578	2,473	2,347	1,622	1,477
Natural gas	4,635,497	4,719,297	4,523,084	4,741,368	4,894,353
Peat fuel	1,096	10,107	900	7,343	5,761
Petroleum, crude	219,993	247,468	253,486	299,874	346,156
Phosphate	.....	.....	.....	.....	60
Quartzite and quartz	148,642	93,574	86,146	134,572	111,074
Silica brick	13,702	4,303	7,351	14,730	22,976
Salt	1,760,388	1,789,752	1,755,087	1,734,196	1,698,500
Talc and soapstone	122,044	111,585	142,134	135,978	138,161
Total	$7,642,308	$7,361,897	$7,094,636	$7,553,571	$7,766,657
STRUCTURAL MATERIALS					
Cement, Portland	$5,006,826	$2,288,975	$1,587,812	$2,403,590	$1,752,148
Lime, hydrated and quicklime	1,221,190	1,273,230	1,227,196	1,536,288	1,705,303
Sand and gravel	2,317,015	2,000,298	2,467,916	1,714,569	2,095,610
Sand-lime products[4]	253,228	78,398	69,785	146,009	138,555
Stone: limestone,trap,granite, etc.	3,197,297	1,655,016	983,268	1,965,507	1,863,892
Slate	.....	.....	.....	600	.....
Total	$11,995,556	$7,295,917	$6,335,977	$7,766,563	$7,555,508
CLAY PRODUCTS					
Brick, face	$1,278,954	$532,728	$351,292	$479,850	$545,231
Brick, common	622,777	286,928	163,338	227,276	275,835
Brick, fancy and ornamental	16,829	1,790	387	835	728
Brick, sewer	33,321	18,638	3,683	5,992	970
Tile, drain	244,368	144,579	179,015	137,699	125,593
Tile, structural, roofing, and floor	378,193	169,824	74,064	120,981	168,128
Sewer pipe, copings, flue-linings, etc.	696,964	451,786	185,138	226,005	196,647
Pottery	73,860	67,866	52,650	52,578	50,000
Haydite and clay	167,533	16,366	15,012	9,790	7,093
Total	$3,552,799	$1,690,505	$1,024,579	$1,261,006	$1,370,225
GRAND TOTAL	$97,569,429	$86,479,164	$109,819,557	$145,854,173	$159,580,955

[1]Cobalt in oxide, metallic cobalt, and cobalt content of residues marketed.
[2]Nickel in matte, oxide, and metallic nickel.
[3]Includes value of sulphuric acid produced.
[4]No deduction made for lime consumed in manufacturing. Note that the figures prior to 1934 refer to sand-lime brick only.

The table below shows the aggregate value of metals from the time production began in Ontario and of other minerals beginning with 1891. Since 1914 the statistics of annual production credit the province only with the value of the pig iron made from Ontario ore. This is but a small part of the total output, since the great bulk of the iron ore charged to the blast furnaces of the province is "lake" ore from the mines of Minnesota and Wisconsin. In the production tables, credit is taken only for the ore exported or shipped to points other than Ontario blast furnaces, since to include the value of the domestic ore converted into pig iron in Ontario would involve a duplication of this item.

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	.....	388,715		$4,316,958		4,705,673
1892	.....	864,382		4,509,757		5,374,139
1893	.....	614,762		5,505,991		6,120,753
1894	.....	842,750		5,244,008		6,086,758
1895	.....	616,055		4,554,083		5,170,138
1896	.....	963,288		4,271,715		5,235,003
1897	.....	1,038,089		4,480,452		5,518,541
1898	.....	1,689,002		5,546,875		7,235,877
1899	.....	2,055,592		6,361,081		8,416,673
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	.....	44,109,769	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	279,446	44,076,660	8,511,786	13,139,757	6,269,140	72,276,789
1924	196,749	52,130,314	7,555,283	12,398,465	5,137,865	77,418,676
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	—235	62,631,255	7,638,605	14,160,552	5,853,035	90,283,212
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	36,702	83,356,365	8,492,263	16,571,626	5,221,214	113,678,170
1931	1,926,222	72,452,544	7,642,308	11,995,556	3,552,799	97,569,429
1932	6,133,828	63,997,017	7,361,897	7,295,917	1,690,505	86,479,164
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
Total...	$89,617,751	$1,609,524,813		$649,981,306		$2,349,123,870

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

Metal Production

In the total production of metals in Ontario, noted hereunder, gold moved up from third to first place in 1927:—

METAL PRODUCTION TO DECEMBER 31, 1935

Metal or product	To December 31, 1934	1935	To December 31, 1935
Gold	$529,602,720	$45,898,372	$575,501,092
Exchange equalization	57,447,954	32,169,797	89,617,751
Nickel, including nickel oxides and salts	391,523,040	35,345,103	426,868,143
Silver	260,287,016	4,068,906	264,355,922
Copper[1]	160,048,576	19,295,965	179,344,541
Pig iron from domestic ore	84,775,556	.....	84,775,556
Cobalt[2]	26,521,766	512,705	27,034,471
Platinum metals	30,994,184	5,407,392	36,401,576
Iron ore[3]	9,463,516	.....	9,463,516
Lead	4,485,839	706	4,486,545
Zinc, in ore and concentrates	535,696	.....	535,696
Molybdenite	210,015	.....	210,015
Bismuth	154,903	6,796	161,699
Selenium	177,139	144,697	321,836
Tellurium	25,599	28,550	54,149
Chromite	480	9,576	10,056
Total	$1,556,253,999	$142,888,565	$1,699,142,564

[1]Includes small quantities of copper sulphate.
[2]Includes metal, oxide, salts, and cobalt contents of residues exported.
[3]Value of ore shipped out of the province.

Dividends.—During 1935 dividends were paid by 14 gold, 2 nickel-copper, and 3 silver-cobalt mining companies. Total payments by metal mines of the province are rated hereunder by groups:—

DIVIDENDS PAID BY METAL MINES TO DECEMBER 31, 1935

Industry	To end of 1934	1935	To end of 1935
Nickel-copper	$159,849,642	$13,865,195	$173,714,837
Gold	179,948,856	25,208,545	205,157,401
Silver-cobalt	97,983,781	367,000	98,350,781
Total	$437,782,279	$39,440,740	$477,223,019

Diamond-Drilling

During the past three years diamond-drilling in Ontario has been active. Twenty companies were operating in 1935, and the statistics which follow are complete. In 1934 there were 285 drills in use, and employment was given to 518 men, who received $759,285 in wages. The corresponding figures for 1935 are 171 drills, 608 men, and $891,644 in wages. Diamond-drilling operations afford an excellent yard-stick in appraising the general trend in mining development and prospecting. As these Ontario firms do considerable drilling in the neighbouring provinces, Quebec and Manitoba, and also much farther afield, statistics covering the work done in these outside areas are also shown. It should, however, be pointed out that the data for outside provinces may be incomplete.

DIAMOND-DRILLING OPERATIONS, 1934 AND 1935

Province	1934		1935	
	Holes	Core footage	Holes	Core footage
Ontario	3,891	672,011	5,156	883,840
Quebec	1,023	215,153	1,336	261,907
Manitoba	418	81,226	549	86,230
Saskatchewan and N.W.T.	31	5,791	31	10,525
Total	5,365	974,181 (184.5 miles)	7,072	1,242,502 (235.3 miles)

On the other hand consumption of diamonds used in drilling refers to footage drilled in all provinces in which work was reported, and is indicative of the trade available for diamond merchants as well as the amount of wear or wastage of these abrasives in our hard pre-Cambrian rocks. The total consumption of borts, ballas, and carbons was 43,680.69 carats, as shown below:—

CONSUMPTION OF DIAMONDS BY REPORTING FIRMS, 1935

Period	Borts	Ballas	Carbons
	carats	carats	carats
Diamonds on hand December 31, 1934	13,380.92	76.57	3,695.00
Purchased in 1935	47,743.73	79.98	2,878.95
	61,124.65	156.55	6,573.95
Diamonds on hand December 31, 1935 ..... deduct	19,507.38	71.30	4,695.78
Diamonds consumed (43,680.69) in 1935	41,617.27	85.25	1,978.17

Prospecting

An index of activity is afforded by the following table:—

MINING CLAIMS RECORDED, 1907-1935

Year	No.	Year	No.	Year	No.
1907	13,996	1917	1,936	1927	15,554
1908	4,634	1918	1,534	1928	15,046
1909	9,746	1919	2,918	1929	8,207
1910	5,792	1920	2,160	1930	3,886
1911	9,001	1921	2,459	1931	5,779
1912	3,104	1922	5,686	1932	4,945
1913	4,320	1923	6,092	1933	8,077
1914	1,913	1924	5,222	1934	16,888
1915	2,519	1925	4,751	1935	9,460
1916	2,470	1926	13,496		

It will be noted that 1934 was the most active year for claim-staking in the history of the province. In the Port Arthur mining division alone, 6,842 claims were recorded as a result of prospecting activity in the Little Long Lac and Sturgeon River gold areas, which lie east of Lake Nipigon close to the Canadian National railway.

METALLICS

Gold

General Summary

The production of gold from all sources in Ontario during 1935 totalled 2,220,336 fine ounces, valued at $78,068,169 in Canadian funds, as against 2,105,341

fine ounces, worth $72,808,688, during the corresponding period of the previous year. Of this year's output, 2,151,305 ounces were recovered by the auriferous quartz mines, and the balance, 69,024 ounces, from the refining of nickel-copper mattes.

The record of the gold mines alone, including the value of the silver recovered in the crude gold bullion, was $75,927,718 in 1935, as against $70,929,796 in 1934. Reference to the table for gold-mining will show that the Porcupine camp with eleven mines slightly improved its position. On the other hand the Kirkland Lake belt, also with eleven properties, was $765,394 below the high of 1934. This decline, however, was more than made up by increases in both Matachewan and Northwestern Ontario, where many new producers have appeared.

During 1935 important developments have taken place in all gold fields. Commencing with the eastern areas, the old Larder Lake camp has come to life after many years of inactivity. Omega Gold Mines, Limited, which was formed by Castle-Trethewey Mines, acquired the property of Canadian Reserve Mines, consisting of 22 mining claims formerly owned by the Crown Reserve Consolidated Mines, Canadian Associated Goldfields, and Kitchener Kirkland Gold Mines, and the mill, headframe, and underground layout have been completely overhauled or renewed. This one operation has stimulated interest in an area that was very prominently before the investing public during the past two decades.

The eastern Kirkland area (Gull Lake) has been active. At the Lake Shore a new shaft, now completed to the bed of the lake, will be sunk to depth. At the Wright-Hargreaves, a new internal shaft is under construction; and at the western edge of the camp the Macassa is developing to 3,000 feet in depth. Matachewan is now represented by three properties, Ashley, Young-Davidson, and Matachewan Consolidated. A deep shaft is being sunk on the Young-Davidson.

At Porcupine one of the most important developments has been the work undertaken by Noranda Mines in the eastern section of the area on the Pamour property, formerly owned by the Three Nations Mining Company, where a campaign of deep diamond-drilling carried on during the past summer has had favourable results. During the latter part of the season the Ontario Department of Mines made a special survey of this section of the area, using air service in preparing the map.

The most outstanding relative improvement, however, has taken place in the northwestern part of the province, including the Sudbury area. Twenty-eight mines throughout this area were active during the period, the production ranging from a few hundred dollars to almost a million.

Recently a new find of gold-bearing veins was made on the Sachigo river, located about 40 miles due east of the Manitoba boundary in about the same latitude as Gods lake. This area is roughly about 250 miles north of Superior Junction on the Canadian National railway.

Prospecting and development work have been carried on extensively throughout the province, and a pleasing feature is that interest is being maintained in the old established camps, in all of which extensions of the ore deposits have been found.

Production and Dividends

The following tables show the dividends paid by the various gold-mining companies, the production by areas in 1935, the total gold production from 1866 to 1935, and the annual production by mines in each area.

DIVIDENDS AND BONUSES PAID BY GOLD-MINING COMPANIES TO DECEMBER 31, 1935

Name of company	Date of incorporation	Authorized capital, $ or shares	Capital stock issued, $ or shares	Par value per share	Dividends and bonuses paid to end of 1934	Dividends and bonuses paid during 1935	Rate per cent., or per share 1935	Total dividends and bonuses paid to Dec. 31, 1935	Date when last dividend or bonus was paid
Anglo-Huronian, Ltd.	Oct. 16, 1933	2,000,000	1,252,605	No par	$501,042.00	$250,521.00	20c.	$751,563.00	Dec. 2, 1935
Buffalo Ankerite Gold Mines, Ltd.	Oct. 5, 1932	$1,000,000	577,007	$1.00	131,943.06	115,546.40	20c.	247,489.46	Nov. 15, 1935
Coniaurum Mines, Ltd.	July 4, 1929	6,000,000	2,717,447	No par	80,923.41	.....	.....	80,923.41	Aug. 15, 1932
Dome Mines, Ltd.[1]	Sept. 30, 1923	1,000,000	1,000,000	No par	21,557,847.15	3,813,336.00	$4.00	25,371,183.15	Oct. 21, 1935
Hollinger Consol. Gold Mines, Ltd.[2]	May 25, 1916	$25,000,000	$24,600,000	5.00	72,990,400.00	4,428,000.00	18%	77,418,400.00	Dec. 31, 1935
Howey Gold Mines, Ltd.	Mar. 12, 1926	5,000,000	5,000,000	1.00	500,000.00	250,000.00	5c.	750,000.00	Dec. 14, 1935
Kirkland Lake Gold Mining Co., Ltd.	Nov. 19, 1915	5,500,000	5,239,123	1.00	157,173.69	157,173.69	3c.	314,347.38	Nov. 1, 1935
Lake Shore Mines, Ltd.	Feb. 25, 1914	2,000,000	2,000,000	1.00	35,020,000.00	8,000,000.00	400%	43,020,000.00	Dec. 16, 1935
Macassa Mines, Ltd.	April 12, 1926	3,000,000	2,628,068	1.00	131,403.40	396,710.20	15c.	528,113.60	Nov. 1, 1935
McIntyre-Porcupine Mines, Ltd.[3]	Mar. 16, 1911	$4,000,000	$3,990,000	5.00	14,085,162.43	1,596,000.00	$2.00	15,681,162.43	Dec. 2, 1935
Northern Empire Mines Co., Ltd.	July 28, 1932	500,000	341,500	1.00	.....	170,500.00	50c.	170,500.00	Dec. 30, 1935
Porcupine Crown Mines, Ltd.	May 25, 1913	2,000,000	2,000,000	1.00	840,000.00	.....	.....	840,000.00	July 15, 1917
Rea Consolidated Gold Mines, Ltd.	April 5, 1911	$1,000,000	$200,000	5.00	12,000.00	.....	.....	12,000.00	1915
Schumacher Gold Mines, Ltd.[4]	Jan. 6, 1914	2,000,000	1,850,000	1.00	.....	.....	.....	.....	.....
Sylvanite Gold Mines, Ltd.[5]	June 13, 1913	3,300,000	3,299,500	1.00	1,352,795.00	659,900.00	20%	2,012,695.00	Dec. 31, 1935
Teck-Hughes Gold Mines, Ltd., The	Mar. 2, 1923	5,000,000	4,807,144	1.00	21,317,790.80	1,922,857.60	40c.	23,240,648.40	Oct. 1, 1935
Toburn Gold Mines, Ltd.[6]	Jan. 24, 1931	2,000,000	1,850,000	1.00	148,000.00	148,000.00	8c.	296,000.00	Nov. 21, 1935
Tough-Oakes Gold Mines, Ltd.	July 15, 1913	$3,000,000	$2,657,500	5.00	398,625.00	.....	.....	398,625.00	Dec. 27, 1916
Vipond Consolidated Mines, Ltd.	July 17, 1922	2,500,000	2,250,000	1.00	67,500.00	.....	.....	67,500.00	April 5, 1927
Wright-Hargreaves Mines, Ltd.[7]	June 16, 1916	5,500,000	5,500,000	No par	10,656,250.00	3,300,000.00	60c.	13,956,250.00	Oct. 1, 1935
Total	.....	.....	.....	.....	$179,948,855.94	$25,208,544.89	.....	$205,157,400.83	.....

[1]On April 22, 1922, the capital of Dome Mines Company, Limited, was reduced from $5,000,000 to $4,500,000, and $476,667 (repayment of capital not included in above table) distributed to shareholders in addition to dividends paid to September 30, 1923, when the new company, Dome Mines, Limited, issued 1,000,000 no par value shares at $7.00 per share. Of these 46,666 shares are transferred to a trustee and held in trust for the company.

[2]Hollinger Consolidated Gold Mines, Limited, is an amalgamation of the Acme Gold Mines, Limited; Millerton Gold Mines, Limited; and Hollinger Gold Mines, Limited. Dividends include $160,000 paid in 1915 by Acme, and $4,170,000 paid by Hollinger to May 25, 1916, the date of consolidation.

[3]The dividends are paid in United States funds.

[4]The Schumacher mine was sold to the Hollinger in 1922, and a total of $1,591,000, or 86 per cent. of the assets, distributed to shareholders, the final payment being made July 30, 1923.

[5]The rate of 25 per cent. includes 5 per cent. paid out of 1933 profits. The dividends are paid in United States funds.

[6]Formerly the Tough-Oakes Gold Mines, Limited.

[7]The authorized and issued capital was changed in May, 1927, from 2,750,000 shares of $1.00 par value to 5,500,000 shares of no par value.

PRODUCTION OF GOLD MINES, 1935

Area	Ore milled	Gold bullion shipped						Total value of bullion, Canadian funds
		Fine gold				Fine silver		
		Quantity	Value, standard[1]	Exchange equalization	Value, Canadian funds	Quantity	Value	
PORCUPINE BELT	tons	ounces				ounces		
Buffalo Ankerite	159,383	29,041.714	$600,345	$433,986	$1,034,331	2,618	$1,656	$1,035,987
Canusa	.....	27.504	569	405	974	4	2	976
Concordia (Jones-Porter)	230	16.083	332	241	573	14	7	580
Coniaurum	151,055	32,151.552	664,631	466,172	1,130,803	6,027	3,793	1,134,596
Dome	549,100	206,795.029	4,274,833	2,990,354	7,265,187	33,736	21,419	7,286,606
Gillies Lake–Porcupine	5,122	1,611.883	33,321	23,445	56,766	251	167	56,933
Hollinger	1,837,153	416,049.642	8,600,509	6,028,764	14,629,273	105,843	71,238	14,700,511
McIntyre-Porcupine	869,100	245,206.125	5,068,860	3,550,671	8,619,531	54,385	33,965	8,653,496
McLaren-Porcupine	600	108.791	2,249	1,579	3,828	18	12	3,840
Marbuan	59,380	8,145.135	168,375	121,721	290,096	711	446	290,542
Munro Croesus	1,237	724.460	14,976	10,503	25,479	48	34	25,513
Naybob (Hayden)	10,681	671.000	13,871	9,728	23,599	100	67	23,666
Paymaster Consolidated	79,845	16,028.371	331,336	232,541	563,877	5,008	3,199	567,076
Vipond (Anglo-Huronian)	106,393	11,864.500	245,261	172,008	417,269	2,628	1,693	418,962
Miscellaneous	.....	104.191	2,154	1,512	3,666	.....	.....	3,666
Total	3,829,279	968,545.980	$20,021,622	$14,043,630	$34,065,252	211,391	$137,698	$34,202,950
KIRKLAND LAKE BELT[2]								
Argonaut	24	27.686	$572	$401	$973	8	$5	$978
Barry-Hollinger	35,172	4,082.511	84,393	59,090	143,483	336	215	143,698
Bidgood	11,148	1,232.712	25,482	17,897	43,379	825	491	43,870
Kirkland Lake Gold	71,920	22,050.521	455,825	319,474	775,299	3,391	2,131	777,430
Lake Shore	836,322	461,018.700	9,530,102	6,658,528	16,188,630	112,678	71,090	16,259,720
Lucky Cross (S. Payne)	1	.296	6	4	10	.....	.....	10
Macassa	68,627	30,271.870	625,775	439,227	1,065,002	3,498	2,194	1,067,196
Miller Independence	31	101.805	2,105	1,472	3,577	21	13	3,590
Moffatt-Hall	7,912	2,243.351	46,374	32,569	78,943	806	555	79,498
Sylvanite	152,281	54,356.230	1,123,643	788,177	1,911,820	9,030	5,786	1,917,606
Teck-Hughes	[3]417,917	138,987.175	2,873,118	2,014,440	4,887,558	22,795	14,304	4,901,862
Toburn	35,360	20,199.895	417,569	293,171	710,740	5,630	3,521	714,261
Wright-Hargreaves	361,149	213,471.380	4,412,845	3,094,363	7,507,208	33,556	21,355	7,528,563
Total	1,997,864	948,044.132	$19,597,809	$13,718,813	$33,316,622	192,574	$121,660	$33,438,282

[1]The term "standard" here refers to gold at $20.671834 per fine ounce.
[2]Includes Larder Lake area.
[3]Includes 41,329 tons of tailings.

PRODUCTION OF GOLD MINES, 1935—*Continued*

Area	Ore milled	Gold bullion shipped						Total value of bullion Canadian funds
		Fine gold				Fine silver		
		Quantity	Value, standard[1]	Exchange equalization	Value, Canadian funds	Quantity	Value	
MATACHEWAN AREA	tons	ounces				ounces		
Ashley	47,366	12,486.139	$258,111	$181,171	$439,282	1,992	$1,249	$440,531
Matachewan Consolidated	48,362	10,113.568	209,066	146,704	355,770	1,650	1,048	356,818
Young-Davidson	229,793	20,150.169	416,541	292,302	708,843	7,150	4,537	713,380
Total	325,521	42,749.876	$883,718	$620,177	$1,503,895	10,792	$6,834	$1,510,729
SUDBURY DISTRICT								
Halcrow-Swayze	211	38.733	$810	$561	$1,362	15	$10	$1,372
Mac-Auer	45	8.248	171	119	290	5	3	293
McMillan	40,218	7,776.630	160,757	112,368	273,125	294	190	273,315
Total	40,474	7,823.611	$161,729	$113,048	$274,777	314	$203	$274,980
ALGOMA DISTRICT (Michipicoten and Goudreau areas)								
Algoma Summit	205	85.547	$1,768	$1,234	$3,002	8	$6	$3,008
Darwin	2,103	503.512	10,409	7,313	17,722	57	28	17,750
Jubilee	34,890	5,570.621	115,155	81,014	196,169	132	83	196,252
Parkhill	20,871	9,618.760	198,837	139,265	338,102	459	286	338,388
Van Sickle (S. B. Smith)	7,946	1,391.844	28,772	20,207	48,979	75	48	49,027
Total	66,015	17,170.284	$354,941	$249,033	$603,974	731	$451	$604,425
THUNDER BAY DISTRICT								
Ardeen (Moss)	5,884	849.143	$17,553	$12,264	$29,817	5,675	$2,714	$32,531
Caouette claims (Afton)	34	12.765	264	185	449	2	1	450
Dikdik (J. Bruce McMartin)	3,295	1,378.292	28,492	20,029	48,521	914	597	49,118
Harkness-Hays	17	63.382	1,310	922	2,232	31	20	2,252
Little Long Lac	62,073	31,454.131	650,215	456,365	1,106,580	2,710	1,689	1,108,269
North Shores	1,404	833.980	17,240	12,083	29,323	53	35	29,358
Northern Empire	45,736	18,278.242	377,845	265,765	643,610	2,638	1,686	645,296
St. Anthony	[4]44,550	8,583.600	177,439	124,454	301,893	1,958	1,259	303,152
Tashota	12,827	2,157.526	44,600	31,355	75,955	1,071	672	76,627
Total	175,820	63,611.061	$1,314,958	$923,422	$2,238,380	15,052	$8,673	$2,247,053

KENORA AND RAINY RIVER DISTRICTS								
Cedar Island (Kenora Prospectors)	3,095	656.762	$13,576	$9,588	$23,164	531	$342	$23,506
Clark	87	35.634	737	511	1,248	4	2	1,250
Cone, Russell C.[5]	.....	19.172	396	273	669	3	2	671
Duport	475	2,097.666	43,363	30,454	73,817	232	151	73,968
Vermilion Lake	18	7.076	146	102	248	2	1	249
Total	3,675	2,816.310	$58,218	$40,928	$99,146	772	$498	$99,644
PATRICIA PORTION								
Central Patricia	35,192	22,061.260	$456,047	$320,069	$776,116	2,297	$1,454	$777,570
Howey	484,966	37,673.912	778,789	546,518	1,325,307	12,185	7,643	1,332,950
J-M Consolidated (first quarter)	1,381	361.091	7,464	5,225	12,689	287	162	12,851
McKenzie Red Lake	36,117	15,113.456	312,423	218,989	531,412	2,771	1,811	533,223
Pickle Crow	37,277	24,925.493	515,255	361,861	877,116	2,572	1,629	878,745
Red Crest (Rowan Discovery)	174	109.038	2,254	1,562	3,816	24	12	3,828
Sol-D'Or	119	40.768	843	599	1,442	4	2	1,444
Total	595,226	100,285.018	$2,073,075	$1,454,823	$3,527,898	20,140	$12,713	$3,540,611
Miscellaneous prospectors	.....	89.180	$1,802	$1,260	$3,062	15	$8	$3,070
Dominion Reduction Co., clean-up[6]	.....	169.766	3,509	2,465	5,974	.....	.....	5,974
Total	.....	258.946	$5,311	$3,725	$9,036	15	$8	$9,044
Total for gold mines	7,033,874	2,151,305.218	$44,471,381	$31,167,599	$75,638,980	451,781	$288,738	$75,927,718
Nickel-copper refining	.....	69,023.958	$1,426,852	$1,002,101	$2,428,953	.....	.....	.....
In Cobalt ores	.....	6.700	139	97	236	.....	.....	.....
Total	.....	69,030,658	$1,426,991	$1,002,198	$2,429,189	.....	.....	.....
Total gold output, 1935	.....	2,220,335.876	$45,898,372	$32,169,797	$78,068,169	.....	.....	.....
CALENDAR YEAR 1934								
Porcupine Belt	3,711,714	949,799.57	$19,634,097	$13,275,684	$32,909,781	196,084	$92,989	$33,002,770
Kirkland Lake Belt	1,957,058	988,045.65	20,424,716	13,694,400	34,119,116	181,291	84,560	34,203,676
Matachewan Area	100,054	17,738.98	366,697	246,491	613,188	3,522	1,721	614,909
Northwestern Ontario	644,184	89,381.93	1,847,688	1,235,995	3,083,683	52,008	24,758	3,108,441
Miscellaneous	.....	60,374.48	1,248,051	834,869	2,082,920	.....	.....	2,082,920
Total gold output, 1934	6,413,010	2,105,340.61	$43,521,249	$29,287,439	$72,808,688	432,905	$204,028	$73,012,716

[4]Includes 10,012 tons of tailings.
[5]This production was derived from the Foley, Lucky Coon, and two other unnamed mining claims.
[6]Derived from unidentified gold ores treated at Cobalt during past years.

GOLD PRODUCTION, 1866–1935

(On the standard basis of $20.671834 per ounce, or one dollar = 0.048375 ounces)

Year	Total production, value	Porcupine belt		Kirkland Lake belt		N.W. Ontario[1]	
		Value	Per cent.	Value	Per cent.	Value	Per cent.
1866–1891[2]..	$190,258	.....	.....	.....	.....	.....	.....
1892–1909[3]..	2,509,492	.....	.....	.....	.....	.....	.....
1910.....	68,498	$35,539	51.8	.....	.....	.....	.....
1911.....	42,637	15,437	36.2	.....	.....	.....	.....
1912.....	2,114,086	1,730,628	81.8	.....	.....	.....	.....
1913.....	4,558,518	4,294,113	94.1	$86,316	1.9	.....	.....
1914.....	5,544,979	5,206,006	93.8	114,154	2	.....	.....
1915.....	8,501,391	7,462,111	88.6	551,069	6.5	.....	.....
1916.....	10,339,259	9,391,408	90.8	702,761	6.8	.....	.....
1917.....	8,698,735	8,229,744	94.5	404,346	4.6	.....	.....
1918.....	8,502,480	7,767,907	91.4	632,007	7.4	.....	.....
1919.....	10,451,709	9,941,803	95.1	486,809	4.7	.....	.....
1920.....	11,686,043	10,597,572	90.7	1,033,478	8.8	.....	.....
1921.....	14,692,357	13,103,526	89.5	1,524,851	10.4	.....	.....
1922.....	20,579,569	18,374,658	89.3	2,159,581	10.5	.....	.....
1923.....	20,136,287	17,313,115	85.9	2,719,939	13.5	.....	.....
1924.....	25,669,303	22,135,534	86.2	3,446,632	13.4	.....	.....
1925.....	30,206,432	24,733,120	81.8	5,385,256	17.8	.....	.....
1926.....	30,950,753	23,680,670	76.5	7,174,083	23.2	.....	.....
1927.....	33,627,040	23,851,857	70.9	9,674,114	28.7	.....	.....
1928.....	32,629,111	20,246,319	62	12,233,524	37.5	.....	.....
1929.....	33,535,226	19,281,286	57.6	14,046,596	41.8	$22,988	0.07
1930.....	35,886,558	17,758,842	49.6	17,172,770	47.9	461,730	1.3
1931.....	43,117,615	19,891,521	46.2	21,734,729	50.4	1,007,756	2.3
1932.....	47,284,621	21,422,117	45.2	23,782,313	50.3	1,607,831	3.4
1933.....	44,558,514	21,624,617	48.5	20,817,277	46.7	1,352,017	3
1934.....	43,521,249	19,634,097	45	20,424,716	46.9	2,214,385	5
1935.....	45,898,372	20,021,622	43.6	19,597,809	42.7	4,851,950	1.5
Total....	$575,501,092	$367,745,169	62.8	$185,905,130	32.3	.....	.....

[1]Recent production only. Gold output from 1866 to 1909, inclusive, came from Hastings county and Northwestern Ontario. No segregation of statistics can now be made.
[2]Estimated.
[3]Maximum yearly output was $424,568 in 1899.

Gold Mines of Southeastern Ontario (Peterborough, Hastings, and Frontenac Counties).—The earliest recorded discovery of gold in Ontario is referred to on page 27 of the Report of the Royal Commission (1890) on the Mineral Resources of Ontario, as follows:—

In the early part of August, 1866, gold was discovered by a man named Powell and a Dutch miner on the eastern part of lot 18, range 5, in the township of Madoc [Hastings county] belonging to Mr. J. Richardson, who, however, did not recognise it as the precious metal till informed of the fact by the late Mr. H. G. Vennor of the Geological Survey, who was then working in the neighbourhood. Mr. Vennor in his report for that year, addressed to Sir William Logan, described the gold as occurring in "a series of crevices or openings in a gold-bearing bed, formed of chloritic and epidotic gneiss (or schist) holding patches of dolomite and calcspar, the openings being nothing more than such as are so often met with in the dolomites and calc-schists of this region." The gold was found along with particles of black carbonaceous matter in a brown ferruginous earth filling the longitudinal crevices, parallel to the bedding, one of which had been struck at a depth of 4 and another at 15 feet from the surface at the time of Mr. Vennor's visit. Numerous small nuggets were also found enclosed in the adjacent dolomite and calcspar. The strata here dip nearly due north at an angle of 45°, and the gold-bearing bed is "overlaid by a siliceous ferruginous dolomite and underlaid by a band resembling an impure steatite." Its geological position is not far above the iron-bearing belt of that region. The Richardson mine has been worked at different times since the above date, and a good deal of gold extracted from it.

This discovery was followed by many others of the precious metal which have been made at different times in the townships of Marmora, Madoc, Elzevir, Kaladar, Lake and Tudor, and there is now a probability of gold-mining becoming an established industry in this region. One of the most notable of the attempts at gold mining in the district is that at the Gatling (since called the Canada Consolidated) mine in the township of Marmora. The gold here occurs in veins of quartz containing much mispickel and cutting a crushed syenite or a mixture of schist and syenite, close to a large area of the latter rock. Assays of twelve different samples of the ores of this mine gave an average of 1.9107 ounces or $39.47 to the ton of 2,000 pounds. In spite of this richness, the difficulty of separating the gold from the sulphide of arsenic is so great that only partial success has attended the working of the mine, after the expenditure of a large sum of money in buildings, machinery, working the mine and experimenting.

A considerable quantity of gold has been extracted from the Gladstone and Feigle mine, situated on the continuation of the same set of veins as the Canada Consolidated, at a distance of two or three miles to the northward of it. Another mine called the Dean and Williams on lot 8, range 9 of Marmora, about a mile and a half southward of the Canada Consolidated, was worked for a time with some success. At present it is reported that from six to eight dollars worth of gold per ton are being extracted at the Guinard mine, in Kaladar, from a set of small quartz veins cutting a rock which is described as a conglomerate with quartz pebbles in a matrix of micaceous schist.

Statistical records in the Department of Mines at Ottawa do not predate 1888, but according to Ottawa reports for 1866 an Inspector of Mines, a Mr. Campbell, in that year reported that the recovery from the Richardson property in Hastings county was valued at $1,500 or $2,000. Another statement, probably referring to the same year, was that 60 pounds of crude bullion, worth $15 to $20 per ounce, was exported to the United States and that the estimated value was $1,020. Other reports state that the Cook mine, on lot 7, concession IX, Marmora township, also in Hastings county, milled 1,000 tons prior to 1871, from which 500 ounces valued at $10,000 was recovered. The Feigle mine, lot 8, concession VIII, Marmora township, produced $4,000 prior to 1870. The property of the Canada Consolidated Gold Mining Company at Deloro, Marmora township, was credited with $9,926 prior to June 30, 1884, and the amount expended in development work approximated $350,000. The Gatling and the Thomas and Derry properties were active in 1871 and 1879, respectively.

The following excerpts from the Report of the Royal Commission, also give some indication of the extent of these early mining operations. D. E. K. Stewart stated that he commenced mining in Hastings county in 1878 and, under a lease on the Feigle, recovered about $20,000; the mill heads ranged from $3 to $50 per ton. The Gatling ore treated at Malone ran about $14 per ton. He also stated that some $30,000 to $40,000 worth of gold was recovered by a Mr. Osler, who operated a 20-stamp battery in the same area. Charles Taylor, at that time operating the Canada Consolidated, stated that the average ore ran about $15 to the ton. With two men he was treating 8 tons per day, and the recovery was from $100 to $150 per week. Deroche and Burrows, lot 25, concession VI, Kaladar township, in 1887 shipped 3 tons of rock to the mill at Malone, and the bar of gold recovered was valued at $65.

Statistics available to this Department do not contain any records of the above reports, and returns by gold producers were not obligatory until after the formation of the Bureau (now Department) of Mines in 1891. Partially complete individual statistics are available in this Department from 1897 on, but it was not until 1910, after the discovery of the rich fields at Porcupine and Kirkland Lake, that greater accuracy in ounces recovered and value was insisted upon. As a result the statistics covering gold-mining operations in this field and elsewhere in Ontario for the nineties and during the first decade of this century are more or less incomplete, and the table which follows does not represent all the gold recovered.

SOUTHEASTERN ONTARIO

PRODUCTION STATISTICS OF GOLD MINES, 1891–1922

(Value includes gold and silver, and exchange and equalization have been added since 1920)

Mine	Year	Quantity	Value
		tons	
Atlas Arsenic	1900, 1902, 1903	6,114	$44,667
Bannockburn	1895	.....	58
Belmont. *See* Cordova.			
Big Dipper	1907, 1909	52	340
Boerth	1900	.....	208
Canadian Goldfields. *See* Deloro.			
Cleveland	1908	239	5,475
Cobalt Frontenac	1919, 1922	.....	1,356
Cook Land	1901, 1902, 1904	1,483	6,989
Cordova (Belmont)	1892, 1893	560	5,450
	1898–1903	70,185	289,517
	1912–1917	16,194	45,426
Craig	1905, 1906	1,850	5,760
Crescent	1891, 1892	1,700	6,780
Deloro (Canadian Goldfields)	1897–1902	39,143	213,973
Gatling Pearce	1893	.....	1,918
Gilmour	1909, 1910	550	3,669
Golden Fleece. *See* Cobalt Frontenac.			
Ledyard	1893, 1894	55	236
Little Doris	1898	400	2,500
Sophia	1900	1,500	850
Sovereign	1900	262	861
Star of the East	1905, 1907	976	1,941
Total	.....	141,263	$637,974

Gold Mines of Algoma District.—The gold-mining region in Algoma district, which includes the Goudreau and Michipicoten areas as well as the areas bordering the northeast shore of Lake Superior, Sault Ste. Marie, and the North channel of Lake Huron, was the scene of some of the earliest mining ventures in Ontario. In 1770 the Jesuit Fathers experimented with native copper near Point Mamainse, and in 1848 copper was discovered near Bruce Mines, where the Montreal Mining Company successfully concentrated the ore and shipped the concentrates, which ran 15 per cent. copper, to England in 1853 and 1854. The property was closed down in 1865.

The first gold discovery in this district was made early in 1898 by an Indian, William Teddy, a member of the Michipicoten band of Indians, whose hunting grounds were in the area between Wawa and Bauldry lakes. The find was sold for $1,000. A staking rush then ensued, and most of the claims were located between Wawa lake and the Michipicoten river. The first inspector of the Michipicoten Mining Division, D. G. Boyd, opened a recording office in the old Hudson's Bay Post at Michipicoten River on April 29, 1898, which was one of the first recording offices in Ontario outside of Toronto. During this period, or until navigation closed that year, 152 miner's licenses were issued and 228 notices of mining claims registered and filed at Michipicoten River, and the fees totalled $2,316. The first machinery to be installed in this field was a stamp mill, which was built by Thomas Westcott, of Sault Ste. Marie. The stamps, which weighed 830 pounds each, were cast at Sault Ste. Marie as well as the frames. The vanner and the copper plates were bought from Fraser and Chalmers, of Chicago, and the crusher and ore feeder were supplied by A. K. Williams, Toronto. Power was provided by a second-hand plant purchased from a lumber company near by. The foundations of this plant were laid October 13, 1898, but no trace of it remains to-day.

The gold-producing mines of Algoma district are listed in the table on page 18. In the early years great difficulty was experienced in securing accurate and complete statistics, and the data shown do not by any means cover the entire production. The figures represent all the data available to this Department.

Gold Mines of Thunder Bay District.—An excerpt from the Report of the Royal Commission (1890) on the Mineral Resources of Ontario, page 25, regarding gold in Thunder Bay district runs as follows:—

The first discovery of gold in notable quantity was made in 1871 by Mr. Peter McKellar (following up a clue obtained from an Indian) near Jackfish lake, at what is now called the Huronian mine, situated on location H1 in the township of Moss. It here occurs in a true and persistent vein from 6 to 8 feet wide, of which from 2 to 5 feet are quartz, the rest being incorporated schist. The country-rock consists of interbedded talcoid, chloritic, dioritic and a little dolomitic schist, siliceous magnetite and massive diorite, all dipping north-west at angles of 65° to 80°. The vein runs north-eastward, cutting the strata at a small angle and underlying to the north-west side at an inclination of 15° from the perpendicular. Intrusive syenite appears about a mile to the north-east of the mine, and this may have had something to do with the enrichment of the vein. The gold occurs free and as sylvanite (or telluride of gold) associated with galena, iron and copper pyrites and blende, which, with the white quartz, constitute a beautiful looking ore. A 10-stamp mill was erected in 1883 at great expense, on account of the difficulties of transportation, and in 1884 some mining and milling were done. The gold secured is understood to have been equal to $21 to the ton, which was, however, far short of the whole amount contained in the ore. Work was resumed for three or four months in 1885, but, from the want of proper means of transportation to the mine, operations are for the present suspended. Openings have been made and similar ore obtained from a continuation of the same vein, called the Highland mine.

This property was later known as the Moss, and more recently as the Ardeen. The mine was reopened in 1932 and produced gold from that year to 1935, inclusive, operating a 200-ton mill.

The data shown in the table for Thunder Bay district on page 19 are all that are available to this Department and while covering the principal mines are known to be incomplete for the earlier years.

Gold Mines of Kenora and Rainy River Districts.—The earliest record of gold in Kenora and Rainy River is described on page 25 of the Report of the Royal Commission (1890) on the Mineral Resources of Ontario, as follows:—

Gold was discovered on Lake-of-the-Woods in 1878, or earlier. In the . . . Geological Survey report for 1881, page 15c, it is stated that "in 1879 I [A. R. C. Selwyn, the writer of the report] was presented by Mr. J. Dewe with a specimen from Hay island, of white quartz containing needle-like crystals of hornblende with a little calcspar, which showed distinct specks of gold. It was assayed by Mr. Hoffmann, chemist to the Survey, and found to contain 37.318 ounces of gold and 1.431 ounces of silver to the ton of 2,000 pounds." During the succeeding four or five years some mining was done at a few places around the northern part of this lake, and in some instances with the prospect of ultimate success, but owing to the impossibility of obtaining titles, on account of the dispute between the Dominion and the Ontario governments as to the ownership of the territory, it was impossible to obtain sufficient capital and no thorough test has yet been made to determine the real productiveness or otherwise of any of the mines. Trials have been made at several promising places, such as Sultana island, the Winnipeg Consolidated and the Pine Portage properties, and now that the matter of title is set at rest there is a probability that work will be prosecuted on a sufficient scale to determine the question whether gold is to be found in this region in paying quantities or not. It occurs both free and in combination with sulphides in veins of quartz more or less split up and interrupted, cutting green schists and not far from masses of syenite. These deposits would appear to lie towards the bottom of the series as developed at the Lake-of-the-Woods. Specimens of free gold in quartz have been shown to the writer as having been obtained not far from Taché, on the Canadian Pacific railway.

Statistics of production by the gold mines of Kenora and Rainy River districts were not collected during the eighties, and are incomplete for the nineties and also for the early years of this century (see tables on pages 22 and 23).

LARDER LAKE GOLD AREA

ANNUAL PRODUCTION STATISTICS BY MINES, 1911–1935

(Value includes gold and silver, and exchange premium and equalization have been added since 1920)

Year	Barry-Hollinger		Argonaut[1]		Miller Independence		Canadian Associated Goldfields		Telluride (Smelters Corp.)		Gold Hill		Total	
	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$
1911							[2]125	314					125	314
1912														
1913			480	4,005				[3]10,000					480	14,005
1914				5,204										5,204
1915														
1916														
1917														
1918	[4]1,502	10,051				1,283							1,502	11,334
1919			735	2,631									735	2,631
1920			4,637	29,888									4,637	29,888
1921				549										549
1922														
1923			4,818	73,262									4,818	73,262
1924			24,178	152,072									24,178	152,072
1925	8,136	56,978	28,515	214,183									36,651	271,161
1926	13,680	86,263	35,081	143,387									48,761	229,650
1927	25,714	175,692	27,873	127,448			11,966	34,595			39	865	65,592	338,600
1928	23,060	111,767	5,219	32,430			10,619	17,700			4,377	12,784	43,275	174,681
1929	22,343	151,758		9,959									22,343	161,717
1930	31,725	217,835	13	1,891									31,738	219,726
1931	31,958	234,512							80	835			32,038	235,347
1932	34,977	181,585							24	468			35,001	182,053
1933	5,459	71,766											5,459	71,766
1934	33,445	152,076	12	1,872									33,457	153,948
1935	35,172	143,698	24	978	31	3,590							35,227	148,266
Total	267,171	1,593,981	131,585	799,759	31	4,873	22,710	62,609	104	1,303	4,416	13,649	426,017	2,476,174

[1]The production shown for 1913 and 1914 was from La Mine D'Or Huronia, which has been known as the Argonaut since 1919. The values shown are exclusive of copper.

[2]Reddick mine, which was bought by Associated Goldfields in 1917.

[3]Associated Goldfields, which was acquired by Canadian Associated Goldfields in 1921.

[4]Patricia mine, afterwards called Barry-Hollinger.

MATACHEWAN GOLD AREA[1]

ANNUAL PRODUCTION STATISTICS BY MINES, 1922 AND 1932–1935

(Value includes gold and silver, and exchange premium and equalization have been added since 1920)

Year	Ashley		Young-Davidson		Matachewan Consolidated		Atlas[2]		White Rock[2]		Total	
	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$
1922	.....	.....	.....	.....	.....	.....	.....	.....	.....	987	.....	987
1932	6,805	70,142	.....	.....	.....	.....	.....	.....	.....	.....	6,805	70,142
1933	37,975	495,364	.....	.....	.....	.....	12	201	17	419	38,004	495,984
1934	43,532	456,830	51,842	134,511	4,680	23,568	.....	.....	.....	.....	100,054	614,909
1935	47,366	440,531	229,793	713,380	48,362	356,818	.....	.....	.....	.....	325,521	1,510,729
Total	135,678	1,462,867	281,635	847,891	53,042	380,386	12	201	17	1,406	470,384	2,692,751

[1]Includes West Shiningtree area (Atlas and White Rock mines).
[2]Acquired by Bilmac Gold Mines, Limited, in 1934.

SUDBURY DISTRICT[1]

ANNUAL PRODUCTION STATISTICS OF GOLD MINES, 1897–1935

(Value includes gold and silver, and exchange premium and equalization have been added since 1920)

Year	Crystal		Halcrow-Swayze		Lebel-Oro (Long Lake[2])		Mac-Auer		McMillan		Shakespeare		T.B. 69 (R. Downey)		Total	
	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$
1897	300	1,896	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	300	1,896
1898	160	1,602	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	160	1,602
1905	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4,550	37,963	.....	.....	4,550	37,963
1906	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8,641	.....	.....	.....	8,641
1907	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4,040	4,380	.....	.....	4,040	4,380
1908	270	1,500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	270	1,500
1910	.....	.....	.....	.....	3,294	18,553	.....	.....	.....	.....	.....	.....	.....	.....	3,294	18,553
1911	.....	.....	.....	.....	1,750	9,828	.....	.....	.....	.....	.....	.....	.....	.....	1,750	9,828
1913	.....	.....	.....	.....	20,646	114,833	.....	.....	.....	.....	.....	.....	.....	.....	20,646	114,833
1914	.....	.....	.....	.....	45,458	217,103	.....	.....	.....	.....	.....	.....	.....	.....	45,458	217,103
1915	.....	.....	.....	.....	44,271	282,123	.....	.....	.....	.....	.....	.....	.....	.....	44,271	282,123
1916	.....	.....	.....	.....	26,846	187,103	.....	.....	.....	.....	.....	.....	.....	.....	26,846	187,103
1932	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	12	2,993	12	2,993
1934	.....	.....	.....	.....	7	1,256	.....	.....	12,313	67,344	.....	.....	.....	.....	12,320	68,600
1935	.....	.....	211	1,372	.....	.....	45	293	40,218	273,315	.....	.....	.....	.....	40,474	274,980
Total	730	4,998	211	1,372	142,272	830,799	45	293	52,531	340,659	8,590	50,984	12	2,993	204,391	1,232,098

[1]Exclusive of West Shiningtree area (Atlas and White Rock mines), which is included in Matachewan gold area above.
[2]Acquired by Lebel Oro Mines, Limited, in 1920.

ALGOMA DISTRICT

Annual Production Statistics of Gold Mines, 1902–1935

(Value includes gold and silver, and exchange premium and equalization have been added since 1920)

Year	Algoma Summit (McCarthy-Webb)		Darwin (Grace[1])		Minto and Jubilee[2]		New Goodreau[3]		Parkhill		Miscellaneous		Total	
	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$
Prior to 1925	.....	.....	10,357	72,096	.....	.....	.....	.....	.....	.....	4,112	[4]14,521	14,469	86,617
1925	.....	.....	.....	41	.....	.....	.....	.....	.....	.....	.....	.....	.....	41
1926	.....	.....	.....	.....	.....	.....	415	1,847	.....	.....	.....	.....	415	1,847
1929	.....	.....	.....	.....	.....	.....	.....	.....	33	2,057	.....	.....	33	2,057
1930	.....	.....	750	588	1,074	2,559	.....	.....	.....	.....	.....	.....	1,824	3,147
1931	.....	.....	.....	.....	9,448	80,269	.....	.....	9,082	75,543	.....	.....	18,530	155,812
1932	.....	.....	.....	.....	18,765	185,171	117	474	16,822	166,009	.....	.....	35,704	351,654
1933	.....	.....	.....	.....	23,671	182,376	.....	.....	11,565	246,580	60	[5]282	35,296	429,238
1934	421	4,926	.....	.....	22,189	169,301	.....	.....	19,431	310,647	.....	.....	42,041	484,874
1935	205	3,008	2,103	17,750	34,890	196,252	.....	.....	20,871	338,388	7,946	[6]49,027	66,015	604,425
Total	626	7,934	13,210	90,475	110,037	815,928	532	2,321	77,804	1,139,224	12,118	63,830	214,327	2,119,712

[1]Acquired by Darwin Gold Mines, Limited, in 1934. Operated by the Algoma Commercial Company in 1902 and 1903, who produced 6,097 tons of ore, from which $48,708 was recovered; and by the Le Page Gold Mining Company from 1907 to 1910, who produced 4,260 tons, valued at $23,235.

[2]Production shown from 1930 to 1933 was from the Minto; in 1934, 11,946 tons came from the Jubilee; and in 1935 the whole production was from the Jubilee. Both mines are now owned by Minto Gold Mines, Limited.

[3]Acquired by Algold Mines, Limited, in 1934.

[4]The Havilah (Ophir), Galbraith township, $8,549 from 2,489 tons in 1893 and $4,435 from an estimated quantity of 800 tons in 1910 and 1911; the Norwalk (Manxman), $1,412 from 820 tons in 1904 and 1910; the Golden Reed, $125 from 3 tons in 1908.

[5]Soo Mining and Prospecting Syndicate.

[6]Van Sickle (S. B. Smith).

THUNDER BAY DISTRICT

ANNUAL PRODUCTION STATISTICS OF GOLD MINES, 1905–1935

(Value includes gold and silver, and exchange premium and equalization have been added since 1920)

Year	Ardeen (Moss[1])		Dikdik[2]		Harkness-Hays		Little Long Lac		North Shores (McKellar-Longworth[3])		Northern Empire		St. Anthony[4]		Tashota		Miscellaneous		Total	
	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$
Prior to 1932	.....	.....	.....	.....	[5]1	63	.....	.....	.....	1,707	.....	.....	35,331	160,502	34	315	[6]1,100	2,492	36,466	165,079
1932	25,363	196,473	.....	.....	32	1,474	.....	.....	179	15,480	.....	.....	.....	.....	.....	.....	.....	.....	25,574	213,427
1933	34,789	270,077	.....	.....	.....	.....	.....	.....	11	288	.....	.....	.....	.....	.....	.....	.....	.....	34,800	270,365
1934	38,143	216,094	230	37,638	.....	.....	5,485	85,480	.....	.....	22,507	195,647	21,618	123,198	.....	.....	.....	.....	87,983	658,057
1935	5,884	32,531	3,295	49,118	17	2,252	62,073	1,108,269	1,404	29,358	45,736	645,296	44,550	303,152	12,827	76,627	[7]34	450	175,820	2,247,053
Total	104,179	715,175	3,525	86,756	50	3,789	67,558	1,193,749	1,594	46,833	68,243	840,943	101,499	586,852	12,861	76,942	1,134	2,942	360,643	3,553,981

[1]Originally known as the Huronian; this mine produced in the seventies, but no records are available; acquired by Ardeen Gold Mines, Limited, in 1933.
[2]Acquired by J. Bruce McMartin in 1934, and by Sarmac Gold Mining Corporation in 1935.
[3]Acquired from Schreiber Gold Mines, Limited, by North Shores Gold Mines, Limited, in 1933.
[4]Records are incomplete; operations were reported 1905 to 1907, 1911 to 1913, 1917, 1918, 1921, 1929. This property was formerly called Northern Gold Reefs.
[5]W. S. Jackson claims; acquired by Harkness-Hays in 1925.
[6]Empress, 1,100 tons, $2,378 (no statistics available, data taken from report of J. H. Chewett, April 22, 1897); Mary J. Coveney, $114.
[7]Caouette claims (Afton).

PATRICIA PORTION OF KENORA DISTRICT

ANNUAL PRODUCTION STATISTICS OF GOLD MINES, 1911–1935

(Value includes gold and silver, and exchange premium and equalization have been added since 1920)

Year	Casey Summit[1]		Central Patricia		Howey		J-M Consolidated (Jackson Manion)		McKenzie Red Lake		Pickle Crow		Red Crest (Rowan Discovery)		Sol-D'Or[2]		Miscellaneous		Total	
	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$
Prior to 1929																	30	[3]307	30	307
1929																		[4]14,631		14,631
1930					110,438	460,857													110,438	460,857
1931					211,552	914,291													211,552	914,291
1932					284,664	1,268,780													284,664	1,268,780
1933					344,135	1,161,436									175	3,700		[5]505	344,310	1,165,641
1934	4,094	30,673	11,536	219,562	481,757	1,594,223	3,443	35,389							130	2,551		([6])	500,960	1,882,398
1935			35,192	777,570	484,966	1,332,950	1,381	12,851	36,117	533,223	37,277	878,745	174	3,828	119	1,444			595,226	3,540,611
Total	4,094	30,673	46,728	997,132	1,917,512	6,732,537	4,824	48,240	36,117	533,223	37,277	878,745	174	3,828	424	7,695	30	15,443	2,047,180	9,247,516

[1]Bought by Argosy Gold Mines, Limited, in 1935.

[2]This property was operated in 1933 by the Highgrade Syndicate and in 1934 by J. Hendrick, when it was acquired by Sol-D'Or Gold Mines, Limited.

[3]1911, J. Tingley, 30 tons, $57; 1923, R. McDonald, $124; 1924, N. McDonald, $126.

[4]Bathurst (Woman Lake), $3,107 (high-grade); Bobjo, $11,510 (high-grade); P. Edwards, $14.

[5]Geo. Singleton, $137; G. A. Rowan, $368.

[6]W. D. Cooper and P. A. Barry produced gold from the McIntyre Birch Lake property in 1934, statistics not available.

KENORA DISTRICT

PRODUCTION STATISTICS OF GOLD MINES, 1885–1935[1]

(Value includes gold and silver, and exchange and equalization have been added since 1920)

Mine	Year	Quantity	Value
		tons	
Baden-Powell[2]	1902, 1905	104	$1,273
Big Master	1902, 1903, 1905	5,027	39,261
Black Jack	1893	50	300
Britannia	1899	20	110
Cameron Island (Damascus)[3]	1898, 1906, 1934, 1935	572	76,790
Camp Bay	1904–1906	7,717	7,531
Cedar Island (Cornucopia)[4]	1896, 1932, 1935	3,168	29,019
Champion (Bad)	1900	[5]100	.....
Clark	1935	87	1,250
Combined	1904	37	220
Cornucopia. *See* Cedar Island.			
Crown Point	1900	150	900
Duport. *See* Cameron Island.			
Empire	1908	300	1,800
Glass Reef	1900	.....	171
Gold Hill	1886, 1893	220	19,610
Gold Panner	1900	100	900
Grace	1902, 1907, 1908	415	865
Kenora Prospectors and Miners. *See* Cedar Island and Mikado.			
Laurentian[6]	1906–1909	19,950	141,140
Mikado[7]	1896–1902, 1910, 1911, 1931	57,813	421,070
Minerva	1885	28	1,372
Olympia	1906, 1911, 1912	1,148	3,564
Ophir	1893, 1894, 1900, 1910	6,089	22,677
Quarry Island	1899	176	1,063
Regina[8]	1895–1899, 1902, 1904, 1905	24,597	133,799
Royal Sovereign	1902	.....	122
Rush Bay (Golden Horn)	1906, 1907	350	560
Sakoose (Golden Whale)	1899–1901	8,028	58,758
Sultana	1894–1902, 1904–1906	77,436	428,638
Sunbeam	1904	650	4,875
Treasure	1898	34	529
Twentieth Century	1902, 1903	8,688	43,586
Vermilion Lake (Botham)	1930, 1935	43	575
Wabigoon–Contact Bay[9]	1905,[10] 1916,[11] 1917,[11] 1918,[12] 1920,[13] 1923,[13] 1929	1,839	7,936
Wendigo	1900	[14]1,200	.....
Total	.....	226,136	$1,450,264

[1]In addition to the figures given and duplicating them in part, the following reduction plants carried on operations in Kenora, then called Rat Portage, and reported as follows: (1) Dominion Reduction Company (1895, 1897, 1900), 666 tons, $5,298; (2) Ottawa Gold Milling and Mining Company (1898–1900), 5,153 tons, $26,181; (3) Rat Portage Reduction Works (1900) milled 200 tons of Wendigo ore; no data of recovery made are available; (4) Keewatin Reduction Works (1900) milled 100 tons ore from Champion and 1,000 tons from Wendigo; no data of recovery made are available.

[2]Northern Lights Mines Company.

[3]Acquired by Duport Mining Company, Limited, in 1929.

[4]Acquired by Kenora Prospectors and Miners, Limited, in 1928. The mine was called Cornucopia prior to 1932.

[5]Reported milled in custom mill, no data.

[6]Operated by Imperial Gold Mines, Limited.

[7]Acquired by Kenora Prospectors and Miners, Limited, in 1928.

[8]Or Black Eagle; now owned by Horseshoe Mines, Limited.

[9]Contact Bay Mines, Limited, was incorporated in 1918 and acquired the Rognon, Redeemer, and Bonanza claims; the name was changed to Wabigoon–Contact Bay Mines, Limited, in 1923; and in 1935 the property was acquired by Northern Mines, Incorporated.

[10]Redeemer.

[11]Rognon.

[12]Redeemer (with exception of 8 tons, valued at $46, from Rognon).

[13]Bonanza.

[14]Milled in custom mill.

RAINY RIVER DISTRICT

PRODUCTION STATISTICS OF GOLD MINES, 1895–1935

(Value includes gold and silver, and exchange and equalization have been added since 1920)

Mine	Year	Quantity	Value
		tons	
Barker	1898	70	$490
Central Canada[1]	1934	350	742
Elizabeth	1912	50	400
Foley	1897, 1898, 1933–1935	5,553	51,403
	1934 (in concentrates)	15	1,255
Gold Winner	1900	15	70
Golden Crescent (A.D. 2)	1897	192	1,543
Golden Star	1898–1901, 1934	15,262	168,768
Hammond Reef	1897	977	3,857
Harold Lake	1895, 1896	1,131	11,236
Independence (Bennett tp.)	1898	125	1,906
Lucky Coon	1899, 1935	10	144
Manitou	1896	12	413
Olive	1897–1900	6,925	47,166
Saundary[2]	1934	13	435
Sawbill	1897–1899	2,416	8,982
W. E. Stone	1919, 1920	2	319
Total		33,118	$299,129

[1]Formerly the Walsh.
[2]Formerly the Headlight or Swede Boy.

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, 1934 AND 1935

Area	1934			1935		
	No. of wage-earners	Wages paid	Average wage per annum	No. of wage-earners	Wages paid	Average wage per annum
Porcupine	5,295	$8,541,490	$1,613	5,781	$9,433,723	$1,632
Kirkland Lake	3,525	5,706,528	1,619	3,589	5,687,611	1,306
Matachewan and West Shiningtree	1,373	1,672,151	1,217	297	507,430	1,709
Sudbury district[1]				82	115,929	1,414
Algoma district				233	325,108	1,395
Thunder Bay district				528	722,379	1,368
Patricia portion				533	933,542	1,751
Kenora and Rainy River districts				89	113,596	1,276
Operating but non-producing	1,195	1,059,506	886	997	1,072,443	1,076
Total	11,388	$16,979,675	$1,491	12,129	$18,911,761	$1,559

[1]Exclusive of West Shiningtree.

Gold-Milling Plants

The milling capacity in tons per day of plants operating, under construction, and idle at the end of 1935, and that of projected plants and proposed expansion of existing plants for 1936, are summarized as follows:—

DAILY TONNAGE OF GOLD-MILLING PLANTS AT ONTARIO MINES, 1935

Area and mine	Operating	Under construction	Idle	Proposed
PORCUPINE BELT:				
Buffalo Ankerite	500			
Canusa			25	
Concordia (Jones-Porter)	10			
Coniaurum	500			
Dome	1,500			
Gillies Lake-Porcupine	50			
Hollinger	5,000			
McIntyre-Porcupine	2,500			
McLaren-Porcupine	15			
Marbuan	175			
Munro Croesus	25			
Naybob (Hayden)	50			
Northern Turnbull			15	
Pamour		500		
Paymaster Consolidated	300			
Porcupine Peninsular			200	
Ross (Hollinger), Hislop township		100		
Vimy		25		
Vipond (Anglo-Huronian)	300			
KIRKLAND LAKE BELT:				
Barry-Hollinger	100			
Bidgood	65			
Golden Summit		25		
Kirkland Lake Gold	225			
Lake Shore	2,350			
Lucky Cross (Golden Gate)			20	
Macassa	200			
Miller Independence	25			
Morris Kirkland				100
Omega (formerly Canadian Reserve)		500		
Swastika (Teck-Otto Gold Mines, Ltd.)			50	
Sylvanite	350			
Teck-Hughes	1,300			
Toburn	105			
Wright-Hargreaves	1,100			
MATACHEWAN AND WEST SHININGTREE AREAS:				
Ashley	150			
Churchill			10	
Matachewan Consolidated	150			
Young-Davidson	700			
SUDBURY DISTRICT:				
Bousquet		50		
Gomak		35		
Halcrow-Swayze			25	
Lebel Oro (Long Lake)	200			
McMillan	150			
ALGOMA DISTRICT (Michipicoten and Goudreau)				
Algold (New Goudreau)	50			
Algoma Summit	20			
Darwin	60			
Minto	100			
Parkhill	100			
Shenango		50		
Stanley		50		
Van Sickle (S. B. Smith)	50			
THUNDER BAY DISTRICT:				
Ardeen (Moss)	200			
Centennial (L. B. United Mines)	50			

DAILY TONNAGE OF GOLD-MILLING PLANTS AT ONTARIO MINES, 1935—*Continued*

Area and mine	Operating	Under construction	Idle	Proposed
THUNDER BAY DISTRICT—*Continued*				
Dikdik (J. Bruce McMartin)	20			
Harkness-Hayes	25			
Little Long Lac	200			
North Shores	25			
Northern Empire	200			
St. Anthony	125			
Schreiber Pyramid		50		
Sturgeon River				50
Tashota	75			
KENORA AND RAINY RIVER DISTRICTS:				
Cedar Island (Kenora Prospectors)	50			
Duport				50
Golden Star			5	
Horseshoe				100
Saundary			5	
Wendigo		50		
PATRICIA PORTION:				
Argosy (Casey Summit)			50	
Central Patricia	125			
Howey	1,500			
Hudson-Patricia				50
J-M Consolidated	30			
McKenzie Red Lake	150			
Pickle Crow	200			
Red Crest	5			
Red Lake Gold Shore				125
Sol-D'Or	10	50		
EASTERN ONTARIO:				
Craig				100
Gilmour	100			
Total	21,575	1,485	405	575

Mint Receipts from Ontario Mines

The table below shows the record over a five-year period of receipts of crude gold bullion from Ontario mines at the Royal Canadian Mint.

RECEIPTS OF CRUDE GOLD BULLION FROM ONTARIO MINES AT THE ROYAL CANADIAN MINT, OTTAWA, 1931–1935

Year	Quantity	Precious metals		Total value (standard)	Buying rate in Canada for New York funds[1]
		Gold	Silver		
	crude ounces	fine ounces	fine ounces		cents
1931	1,762,481	1,441,602	171,408	$29,850,774	104.272
1932	2,865,271	2,248,106	300,927	46,554,898	113.580
1933	2,441,467	1,879,659	270,377	38,945,178	109.472
1934	2,668,456	2,031,719	292,445	42,134,234	.990
1935	2,798,831	2,195,386	310,104	45,578,512	100.54

[1]The average rate of premium on New York funds is based on the day to day record of current quotations. The Federal Department of Finance pays for gold in Canadian funds and reimburses producers by an amount equivalent to the exchange premium on New York funds. Export of gold is prohibited except under license. After April 19, 1933, when the United States forsook the gold standard, Canadian output was marketed in London.

The average monthly value of gold in Canadian funds in 1935 ranged from $34.948 in January to $35.493 in October, and dropped to $35.324 per ounce in December. The average for the twelve months was $35.19.

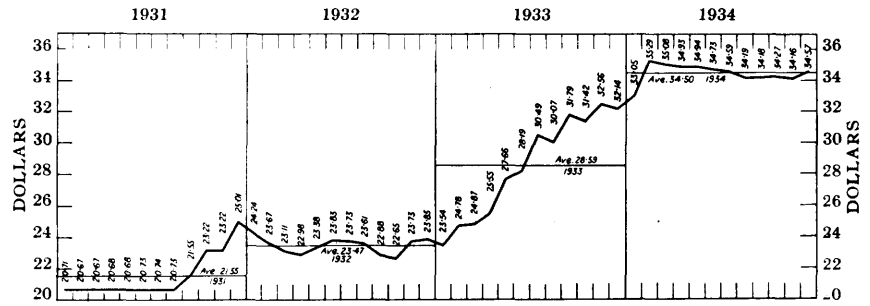


Chart of average monthly and yearly prices of gold in Canadian funds from 1931 to 1934, inclusive. No change in 1935.

Exchange Equalization

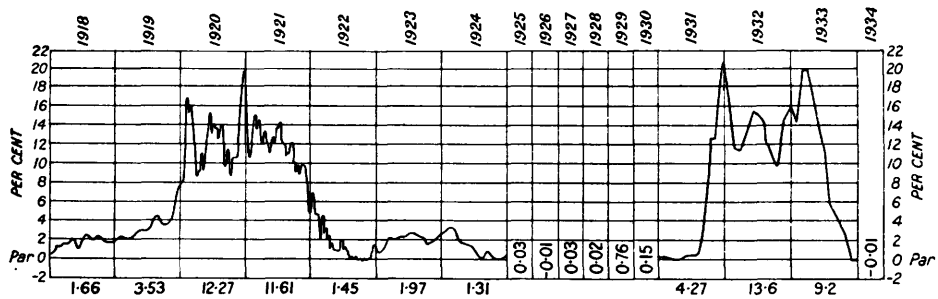
The figure for exchange equalization published for 1933, namely $16,486,437, refers to the actual quantity of gold marketed during that period. Owing to the fact that in former years some mines reported only the exchange received during the calendar year and not exchange actually due on the year's gold shipments, some small corrections have been made on the following table for the years 1931 and 1932, as follows: $81,728.42 received in 1933 should be credited to 1932, and $113,088.91 should be deducted from 1932 and credited to 1931. In 1930, the exchange did not overlap with 1931.

EXCHANGE EQUALIZATION RECEIVED ON GOLD MARKETED BY ONTARIO PRODUCERS, 1920–1935

Year	Porcupine	Kirkland Lake	Matachewan	N. W. Ontario	Other areas	Total
1920	$1,265,644	$110,354	.....	$257	.....	$1,376,275
1921	1,238,211	121,425	.....	.....	.....	1,359,636
1922	189,022	19,591	.....	.....	$8	208,621
1923	241,602	38,565	.....	29	.....	280,196
1924	172,722	24,028	.....	.....	.....	196,750
1925[1]	−2,607	−231	.....	.....	.....	−2,838
1926[1]	.....	−595	.....	.....	.....	−595
1927[1]	.....	.....	.....	.....	.....	.....
1928	.....	2,811	.....	.....	.....	2,811
1929	87,173	70,283	.....	.....	.....	157,456
1930	20,912	15,791	.....	.....	.....	36,703
1931	830,799	1,006,607	.....	61,857	26,958	1,926,221
1932	2,815,381	3,106,487	.....	211,959	330	6,134,157
1933	8,249,321	7,305,041	$143,866	[2]495,335	292,874	16,486,437
1934	13,275,684	13,694,400	246,491	1,235,995	834,869	29,287,439
1935	14,043,630	13,718,813	620,177	2,784,979	2,429,189	33,596,788
Total	$42,427,514	$39,233,370	$1,010,534	$4,790,411	$3,584,228	$91,046,057

[1]Discounts paid during years when Canadian funds were at a premium. Figures for the three years have been deducted to arrive at the net totals.

[2]Includes $26 from West Shiningtree.



Graph showing fluctuations of the buying rate in Canada for New York funds from 1918 to 1934, inclusive. The average yearly premium or discount rate is noted in percentage figures at the base of the chart. The exchange was practically at par throughout the whole of 1935.

World Output

The figures for the output by the leading gold-producing countries from 1931 to 1935, inclusive, in the following table are those published by the American Bureau of Metal Statistics.

OUTPUT BY THE LEADING GOLD-PRODUCING COUNTRIES, 1931–1935[1]

(One dollar = 0.048375 ounces)

	1931	1932	1933	1934	[2]1935
NORTH AMERICA:	fine ounces	fine ounces	fine ounces	fine ounces	fine ounces
United States[3]	2,395,878	2,449,032	2,536,913	2,916,373	3,618,843
Canada	2,693,892	3,044,387	2,949,309	2,972,074	3,283,121
Mexico	628,468	584,487	637,727	661,390	682,319
Newfoundland	12,221	17,661	15,689	12,000	15,000
Total North America	5,730,459	6,095,567	6,139,638	6,561,837	7,599,283
CENTRAL AMERICA AND WEST INDIES	67,730	82,238	87,075	130,000	*150,000
SOUTH AMERICA:					
Chile	21,381	37,778	147,392	237,656	264,398
Brazil	119,500	119,868	122,534	113,621	125,000
Colombia	194,274	248,249	298,242	344,140	328,991
Ecuador	59,616	65,629	60,667	66,427	70,000
Peru	80,182	86,101	96,781	98,861	*110,000
Guiana—British	10,183	13,926	23,352	27,510	*30,000
—Dutch	3,800	7,200	10,000	9,600	*10,000
—French	47,500	45,010	42,456	47,454	*50,000
Venezuela	42,310	77,087	95,720	109,053	115,000
Other South America	18,328	13,245	33,871	65,501	*65,000
Total South America	597,074	714,093	931,015	1,119,823	1,168,389
EUROPE:					
Czechoslovakia	1,055	2,283	3,803	7,587	*8,000
France	60,800	92,013	94,521	100,597	*100,000
Jugoslavia	(4)	(4)	70,344	71,342	76,485
Rumania	88,123	102,591	142,585	111,496	145,000
Russia and Siberia	1,700,000	1,990,000	2,667,100	4,262,770	5,500,000
Sweden	61,632	132,458	288,643	246,687	230,000
Other Europe	31,000	55,530	19,186	31,558	30,000
Total Europe	1,942,610	2,374,875	3,286,182	4,832,037	6,089,485

OUTPUT BY THE LEADING GOLD-PRODUCING COUNTRIES, 1931-1935—*Continued*
(One dollar = 0.048375 ounces)

	1931	1932	1933	1934	1935
OCEANIA:					
New South Wales	19,673	27,941	29,252	36,123	50,000
Queensland	13,147	23,263	91,997	115,471	102,990
Victoria	43,637	47,745	58,183	70,275	87,600
Western Australia	510,570	605,561	637,207	651,338	649,049
Tasmania	4,759	5,937	6,673	5,622	8,343
New Guinea	(5)	(5)	150,000	200,000	280,000
New Zealand	129,861	166,354	161,755	160,248	158,000
Other Oceania	62,455	121,071	18,800	22,500	30,000
Total Oceania	784,102	997,872	1,153,867	1,261,577	1,365,982
ASIA:					
British India	330,489	329,682	336,108	322,143	325,000
China	96,750	96,750	150,000	150,000	*150,000
Chosen (Korea)	274,754	276,002	328,040	350,000	400,000
Netherlands India	100,083	78,186	78,829	71,765	70,000
Formosa	18,133	25,045	72,242	121,518	*100,000
Japan	429,620	401,779	441,387	471,394	572,000
Other Asia	34,047	36,526	50,000	86,700	77,000
Total Asia	1,283,876	1,243,970	1,456,606	1,573,520	1,694,000
AFRICA:					
Belgian Congo	211,758	242,691	283,144	337,382	370,000
French West Africa	(6)	(6)	68,737	97,706	115,000
Madagascar	8,585	11,338	13,374	15,979	*20,000
Rhodesia	541,447	580,503	645,087	693,265	727,927
British West Africa[7]	267,300	292,510	338,110	384,268	425,000
Tanganyika	(6)	(6)	32,516	42,606	51,300
Transvaal, Cape Colony, and Natal	10,877,777	11,558,532	11,013,713	10,479,857	10,773,991
Other Africa	58,000	111,494	53,700	100,000	110,000
Total Africa	11,964,867	12,797,068	12,448,381	12,151,063	12,593,218
TOTAL FOR WORLD	22,370,713	24,305,683	25,502,764	27,629,857	30,660,357

[1]From the Year Book of the American Bureau of Metal Statistics, 1935.
[2]The 1935 compilation contains some preliminary data and conjectural figures (*) have been inserted where necessary.
[3]Production of the Philippine Islands is included with the United States.
[4]Included in "Other Europe."
[5]Included in "Other Oceania."
[6]Included in "Other Africa."
[7]Including Gold Coast.

Maximum Canadian production	3,283,121 ounces in 1935
Maximum Russian production	5,500,000 ounces in 1935
Maximum U.S. production	4,887,604 ounces in 1915
Maximum Transvaal, Cape Colony, and Natal production	11,558,532 ounces in 1932
Maximum World production	30,660,357 ounces in 1935

Nickel-Copper and Platinum Metals

The nickel-copper industry during 1935 eclipsed all records. As may be observed in the accompanying table, the tonnage of ore and concentrate treated has topped that of 1934 by more than 24 per cent. in quantity. Refined nickel and blister copper produced have shown corresponding increases in quantity. On the other hand, matte exported was slightly lower than in 1934 but considerably above the figures for 1933. Increases may also be observed in the quantity of gold and silver recovered, which are now important acquisitions to the pro-

duction of those metals. The production of metals of the platinum group has increased to such an extent that the Sudbury nickel-copper mines have become one of the world's most important sources of these precious metals. Since the year 1930, the entire Ontario production has been derived from the Sudbury area; it rose from 68,040 ounces in that year to a total of 200,109 in 1934. The 1935 output was slightly lower.

PRECIOUS METALS RECOVERED, 1931–1935

	1931	1932	1933	1934	1935
	ounces	ounces	ounces	ounces	ounces
Platinum metals:					
Platinum	44,725	27,284	24,746	116,177	105,335.28
Palladium	39,313	37,613	31,009	83,932	81,902.61
Rhodium, ruthenium, osmium, and iridium	7,605				2,869.00
Total ounces	91,643	64,897	55,755	200,109	190,106.89
Value	$2,812,834	$1,998,911	$1,501,233	$6,187,992	$5,407,392
Gold ounces	23,381	22,675	36,983	60,370	69,023.96
Silver ounces	822,971	663,795	1,026,370	1,882,293	2,243,746.00

The producing mines at Sudbury were operated at the following rates: the Frood, 10,500 tons of ore hoisted per day; the Creighton, 1,000 tons; and the Falconbridge, 1,000 tons per day.

A new shaft, No. 5, is now being sunk at the Creighton and has reached a depth of 2,100 feet. The final objective is 4,250 feet. At the Falconbridge a new shaft, which is to be 1,450 feet in depth, has been sunk to 1,350 feet.

NICKEL-COPPER MINING AND SMELTING, 1931–1935

Item	1931	1932	1933	1934	1935
	tons	tons	tons	tons	tons
1. Ore and concentrate shipped	1,690,192	790,614	1,533,887	2,903,310	3,608,437
2. Ore and concentrate treated	1,884,959	793,552	1,523,814	2,896,959	3,616,223
3. Blister copper produced in Ontario	49,786	29,682	60,398	95,826	119,720
4. Nickel produced in Ontario	15,939	7,063	20,748	35,487	40,191
5. Matte exported[1]	30,294	21,778	43,315	46,755	46,371
6. Nickel content of matte exported[2]	16,847	8,068	25,811	28,771	28,949
7. Copper content of matte exported[2]	6,620	8,825	12,323	6,692	6,272

[1]All matte was exported prior to 1918, when refining in Canada began at Port Colborne, Ont. The British America Nickel Corporation commenced refining operations at Deschênes, Que., in 1920, and closed down finally in July, 1924. In 1934 and 1935, a few thousand tons were brought back to Canada for treatment. These have been deducted.

[2]In 1932, after the reorganization of the metallurgical practice, the Orford process, i.e. the separation of the matte into copper tops and nickel bottoms, was carried out at Copper Cliff.

Dividends

Total dividends paid to the end of 1933 and payments in 1935 are given in the following table. For convenience of comparison Mond figures have been converted to dollars on the basis £1 = $4.8665. The Falconbridge Nickel Mines paid its first dividend in 1933.

STATISTICAL SYNOPSIS OF THE NICKEL-COPPER INDUSTRY IN ONTARIO, 1933, 1934, AND 1935

Year	No. of producing companies	No. of plants in Ontario	Capital invested[1]	Dividends paid	Salaried employees		Wage-earners		Selling value of products[2]	
					No.	Salaries	No.	Wages	Kind	Value
1933	2	4 mines 3 smelters 2 refineries[3]	$91,785,900	$2,746,330	46 71 98	$157,795 287,817 251,895	1,459 1,413 751	$2,238,271 2,040,548 971,614	Matte (exported) Metallic nickel Nickel oxide Converter copper Gold (standard) Silver Platinum metals Selenium	$21,197,469 9,005,195 764,508 388,303 1,501,233 53,745
Total			$91,785,900	$2,746,330	215	$697,507	3,623	$5,250,433		$32,910,453
1934	2	4 mines[4] 3 smelters 2 refineries[3]	$102,801,859	$10,126,014	45 107 121	$149,890 444,873 329,101	2,505 2,210 1,078	$4,037,707 3,185,306 1,380,448	Matte (exported) Metallic nickel Nickel oxide Converter copper Gold (standard) Exchange Silver Platinum metals Selenium and tellurium	$32,092,032 14,218,611 1,247,957 834,526 864,646 6,187,992 116,885
Total			$102,801,859	$10,126,014	273	$923,864	5,793	$8,603,461		$55,562,649
1935	2	4 mines[4] 3 smelters 2 refineries	$107,648,331	$13,865,196	43 119 141	$143,776 439,726 352,876	3,449 2,548 1,197	$5,789,096 3,633,678 1,582,350	Matte (exported) Metallic nickel Nickle oxide Converter copper Gold (standard) Exchange Silver Platinum metals Selenium and tellurium	$35,906,541 18,665,345 1,426,852 1,002,101 1,453,721 5,407,392 173,247
Total			$107,648,331	$13,865,196	303	$936,378	7.194	$11,005,124		$64,035,199

[1]The capital invested is exclusive of value of mineral lands. In the report for 1929, Volume XXXIX, Part I, the capital shown includes the book value for mineral lands, or a total of $74,077,808 for the lands.

[2]Figures do not include the output of the Ontario Refining Company.

[3]Plants Port Colborne and Copper Cliff.

[4]Includes Cuniptau.

DIVIDENDS PAID BY NICKEL COMPANIES TO END OF 1935

Company	Period (inclusive)	To end of 1934	1935
Canadian Copper Company	1894–1901	$1,975,000.00	.....
International Nickel Company[1] preferred	1906–1928	12,299,273.00	.....
International Nickel Company[1] common	1909–1928	65,811,694.00	.....
International Nickel Company of Canada, Limited[2] preferred	1929–1932	11,382,710.28	$1,933,898.75
International Nickel Company of Canada, Limited[2] common	1929–1932	40,374,198.06	10,933,626.75
Falconbridge Nickel Mines, Limited	1928–1933	1,715,640.76	997,669.77
Total	.....	$133,558,516.10	$13,865,195.27
Mond Nickel Company[3] deferred	1906–1914	£264,043	.....
Mond Nickel Company[3] preferred	1904–1929	2,556,359	.....
Mond Nickel Company[3] ordinary	1905–1929	2,581,984	.....
Total	.....	£5,402,386 or $28,291,126	.....
GRAND TOTAL	.....	$159,849,642.10	$13,865,195.27

[1]Successors to the Canadian Copper Company. The International Nickel Company paid dividends on the common stock from 1909 to 1919, inclusive, and again from 1925 to 1928, inclusive. Common stock outstanding was $41,834,600, and preferred stock $8,912,600, or a total of $50,747,200 at the beginning of 1928. On December 19, 1928, the authorized capital stock of $62,000,000 of the New Jersey company was reduced by changing the par value of the shares from $25 to $1 each, and at the same time the name of the company was changed to Nickel Holdings Corporation. On December 31, 1928, the authorized capital was further reduced to $993,425 fully issued or subscribed-for stock, consisting of $843,700 preferred stock and $149,725 common stock, par value in each case.

[2]Dividends paid by the International Nickel Company of Canada, Limited, on the common stock in 1929 were 90 cents per share, and $1.00 per share in 1930. Common stock was increased to 15,000,000 shares of no par value on July 25, 1930; as a result shares issued were increased from 13,758,208 to 14,584,025. Seven per cent. preferred stock (cumulative) now stands at $27,627,825. Dividends on common stock aggregated 45 cents a share in 1931.

[3]Upon completion of the exchange of stock under the amalgamation of the Mond and International companies, effective December 31, 1928, stock issued or issuable was as follows: $27,627,825 of 7 per cent. cumulative preferred, and 13,758,208 common shares without par value. Dividends paid on February 16, 1929, by the Mond company cover the 8 months' period ending December 31, 1928.

Demand for Palladium

Platinum and metals of the platinum group have heretofore been recovered mainly from placer workings, as in Russia, but of late years the recoveries in the refining of nickel-copper mattes from Sudbury have placed Ontario in the forefront of world producers. The Russian output has been estimated at 100,000 ounces, reliable statistics not being available. The state of Colombia was formerly a prominent producer of these metals, but production has fallen off. In 1935, according to *Mineral Trade Notes* of the United States Bureau of Mines[1] most of the crude platinum of Colombia was saved on dredges working in the Interdencia of Chaco near Andagoya. Production in 1935 totalled 38,628 ounces, which, with the exception of 24 ounces, was exported. The output was about 16,000 ounces less than in the previous year.

A note from a German publication *Metallwirtschaft* regarding palladium runs as follows:—

In the last three years leaf palladium has been on the market. It is made and used in the same way as leaf silver and gold. Palladium leaf has a platinum-white colour and has no tendency to tarnish or spot. The leaf is made of 99.8 per cent. pure metal. Palladium is easily worked, and alloys with other metals quite freely. It has a melting point of 1554° C., and its specific gravity is 12.16; this is 20 per cent. lighter than 18-carat gold. The tensile strength of the pure metal is very good, and its alloys have high tensile strength values. The chief sources of palladium to-day are the nickel-copper ores of Sudbury, Ont. It occurs in smaller quantities

[1]Vol. 2, No. 6, p. 11.

in South Africa, Russia, and South America. In recent years, leaf palladium has found many uses, and among others, for the gilding of the surface of wooden sculpture. It is also used extensively in the bookbinding industry for book titles and for ornamentation of the book covers. It can be printed not only on leather but on wood.

Palladium is used extensively as a dental metal, and in electro-technique. In dentistry, it often replaces gold, either alone or alloyed. It greatly improves dental alloys to which it is added, especially the alloys with platinum, gold, and silver. For the most part, the alloys are white, and in the jewellery trade it replaces "white gold" because it is much more easily worked. For such purposes it is often alloyed with chodium, or ruthenium, which produces a very strong alloy. In the electric industry, palladium is used for contacts, especially for telephone relays, because of its cleanliness and good conductivity. The use of palladium in future is likely to increase considerably because of its special properties, including its value as a catalyst.

The two operating nickel companies have both announced important additions to their plants at Sudbury for 1936. The International Nickel Company will add 40 per cent. to its smelting capacity. This enlargment has been necessitated mainly by the increased peace-time uses to which nickel is now being put and will permit the keeping of supplies of the refined metal on hand. It is understood that two reverberatory furnaces and eight converters are to be installed in a new addition to the smelter, which will be served by a new high stack. Employment in the nickel-copper industry during the year was at its highest level. This activity has an important bearing on other industries, such as lumbering and transportation.

Copper-refining was also active in 1935. The plant of the Ontario Refining Company at Copper Cliff, which has an annual capacity of 120,000 tons and is the largest copper refinery in Canada, treated 118,681 tons of blister copper and produced 109,765 tons of refined copper, 58,364 ounces of gold, 2,077,572 ounces of silver, 75,363 pounds of selenium, and 14,275 pounds of tellurium. Copper was produced in the form of wire bars, ingot bars, small ingots, cakes, billets, and cathodes.

A new development of great importance to Canada is the organization of companies to produce stainless steel and a large list of monel metal products.

The International Nickel Company of Canada, Limited, which has formed the Whitehead Metal Products Company of Canada, Limited, with a plant at Port Colborne, will manufacture monel metal products, range boilers, water-heating tanks, and gas heaters. The plant commenced operations in March, 1936.

The Fahralloy Canada, Limited, backed by Ventures, Limited, and Falconbridge, has taken over a plant at Orillia, which is now undergoing extensive alteration, with equipment being installed to manufacture nickel-steels now so widely in demand.

Silver-Cobalt

The silver-mining industry has brightened considerably in Ontario recently, owing to the improved price of the metal and more stable industrial conditions, with a consequent better market for the metal cobalt, which is associated with the silver. Refining of nickel-copper mattes has supplied important quantities of silver, and with that recovered from an expanding gold industry the production of this metal has improved.

The production was 6,320,670 ounces, valued at $4,068,906, during 1935, as against 5,523,938 ounces, worth $2,600,393, in 1934. The increase in quantity was due entirely to heavier shipments of silver concentrates and a much larger recovery in the refining operations of the nickel-copper industry.

During the year twenty-eight properties shipped silver-cobalt and cobalt ore. Eighteen of these are located at Cobalt, namely Cobalt Properties, Temiskaming, Cross Lake (O'Brien), Foster, Crown Reserve, Drummond, Beaver, Right-of-Way, Colonial, Nipissing, Cobalt Comet, Buffalo, Cobnor, Hudson Bay;

Yorkshire Cobalt, Dominion Reduction Company, Silver Queen, and Silver Cliff, and seven in South Lorrain, as follows, Wettlaufer, Bellellen, Canadian Lorrain, Frontier, Keeley, and Nipissing Lorrain; and three at Gowganda, Miller Lake O'Brien, Silverado, and Morrison. In most cases these operations were carried on by lessees and the shipments ranged from one ton, a carload lot, or several carloads to more than 4,000 tons from the Nipissing. The active demand for cobalt and for nickel-bearing ores has been the cause of this revival in operations.

The price of silver on the New York market for 1935 averaged 64.273 cents per fine ounce, as compared with 46.973 in 1934. World silver markets were demoralized early in December with offers flooding the market and no buyers, as the United States Treasury refused to bid for metal in the face of Far Eastern selling orders. The low of 49.75 cents was reached in December, at which point it finished the year.

The following table shows the total silver production for the years 1934 and 1935:—

SILVER PRODUCTION, 1934 AND 1935

Source	1934		1935	
	Fine ounces	Value	Fine ounces	Value
Sales of bullion by the reduction companies, smelters, and mines	2,681,104	$1,244,081	3,181,282	$2,051,089
Contained in silver-cobalt concentrates and residues exported	288,552	141,544	144,229	94,177
Estimated as recovered from concentrates treated outside of Ontario	299,084	146,094	299,632	181,181
In crude gold bullion	432,905	204,028	451,781	288,738
Recovered by nickel-copper refineries	1,822,293	864,646	2,243,746	1,453,721
Total	5,523,938	$2,600,393	6,320,670	$4,068,906

The following shipments of silver-cobalt ore in 1935 are taken from data compiled and supplied by A. A. Cole, mining engineer for the T. & N. O. railway: silver ore from Cobalt 1,902.49 tons, from South Lorrain 23.37 tons, and from Gowganda 229.02 tons, a total of 2,154.88 tons; cobalt ore from Cobalt 2,845.48 tons, and from South Lorrain 36.15 tons, a total of 2,881.63 tons. The total shipments by railway, therefore, were 5,036.51 tons, of which silver ores totalling 885.19 tons were shipped to Deloro, Ont., 895.19 tons to Noranda, Que., and 374.50 tons to Tadanac, B.C. The cobalt ores were largely exported, only 183.18 tons going to Deloro, while 2,386.36 tons were exported to Europe and 312.09 tons to the United States.

Shipments of silver mines by camps during 1934 and 1935 were as follows:—

SILVER SHIPMENTS BY CAMPS, 1934 AND 1935

Camp	1934			1935		
	Silver	Cobalt[1]		Silver	Cobalt [1]	
	fine ounces	lbs.		fine ounces	lbs.	
Cobalt	1,990,073	201,025	$59,867	2,737,592	437,728	$130,239
Gowganda	1,039,565	32,273	.....	829,195	20,818	No,pay
South Lorrain	.....	.....	.....	36,585	9,326	3,867
Total	3,029,638	233,298	$59,867	3,603,372	447,054	$134,106

[1]Figures represent the quantities paid for by the smelter and values received by the mines.

SHIPMENTS FROM SILVER MINES, SMELTERS AND REFINERIES, 1904–1935

Year	Bismuth		Copper[1]		Lead[1]		Nickel[2]		Cobalt[3]		Arsenic		Silver		Total
	Tons	Value	Tons	Value	Tons	Value	Tons	Value	Tons	Value	Tons	Value	Ounces	Value	Value
1904	.....	.....	.....	.....	.....	.....	14	$3,467	16	$19,960	72	$903	206,875	$111,887	$136,217
1905	.....	.....	.....	.....	.....	.....	75	10,000	118	100,000	549	2,693	2,451,356	1,360,503	1,473,196
1906	.....	.....	.....	.....	.....	.....	160	.....	321	80,704	1,440	15,858	5,401,766	3,667,551	3,764,113
1907	.....	.....	.....	.....	.....	.....	370	1,174	739	104,426	2,958	40,104	10,023,311	6,155,391	6,301,095
1908	.....	.....	.....	.....	.....	.....	612	.....	1,224	111,118	3,672	40,373	19,437,875	9,133,378	9,284,869
1909	.....	.....	.....	.....	.....	.....	766	.....	1,533	94,965	4,294	61,039	25,897,825	12,461,576	12,617,580
1910	.....	.....	.....	.....	.....	.....	504	.....	1,098	54,699	4,897	70,709	30,645,181	15,478,047	15,603,455
1911	.....	.....	.....	.....	.....	.....	392	.....	852	170,890	3,806	74,609	31,507,791	15,953,847	16,199,346
1912	.....	.....	.....	.....	.....	.....	429	14,220	934	314,381	4,166	80,546	30,243,859	17,408,935	17,818,082
1913	.....	.....	.....	.....	.....	.....	377	13,326	821	420,386	3,663	64,146	29,681,975	16,553,981	17,051,839
1914[4]	.....	.....	.....	.....	.....	.....	90	28,978	351	590,406	2,030	116,624	25,162,841	12,765,461	13,501,469
1915	.....	.....	.....	.....	.....	.....	35	28,353	206	383,261	2,490	148,379	24,746,534	12,135,816	12,695,809
1916	.....	.....	.....	.....	.....	.....	79	59,380	400	805,014	2,160	200,103	19,915,090	12,643,175	13,707,672
1917	.....	.....	53	$28,840	.....	.....	155	125,071	337	1,138,190	2,592	608,483	19,401,893	16,121,013	18,021,597
1918	.....	.....	72	35,712	3	$453	186	156,893	380	1,640,310	2,545	566,332	17,661,694	17,341,790	19,741,490
1919	.....	.....	110	40,976	12	1,296	276	188,418	298	1,019,479	2,834	485,360	11,214,317	12,738,994	14,474,523
1920	.....	.....	50	17,494	5	792	127	93,233	283	1,605,365	1,883	431,527	10,846,321	10,654,471	12,802,882
1921	.....	.....	103	34,504	3	270	10	7,665	126	616,235	1,491	233,763	8,261,931	5,564,594	6,457,031
1922	.....	.....	93	26,346	16	1,891	61	34,987	[5]776	1,333,676	2,059	299,940	10,711,127	7,658,802	9,355,642
1923[6]	9	$48,139	56	16,214	26	3,738	42	19,321	380	1,803,872	2,579	582,794	10,377,846	6,677,367	9,151,445
1924	6	16,079	55	14,290	45	7,295	130	26,862	476	1,662,526	1,915	323,186	10,361,945	7,009,984	9,060,222
1925	10	18,578	77	17,007	31	1,888	290	116,347	558	2,328,517	1,078	113,325	9,614,881	6,700,129	9,295,791
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
Total	75	$149,877	894	$276,845	331	$29,790	5,996	$1,362,565	15,631	$26,837,177	70,811	$5,759,333	426,764,915	$256,776,388	$291,155,975

[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]Includes 460 tons of speiss residues, worth $153,116.

[6]Recoveries of bismuth from base bullion were not reported prior to 1923.

DIVIDENDS AND BONUSES PAID BY SILVER-MINING COMPANIES TO DECEMBER 31, 1935

Name of company	Date of incorporation	Authorized capital	Capital stock issued	Par value per share	Dividends and bonuses paid to end of 1934	Dividends and bonuses paid during 1935	Total dividends and bonuses paid to Dec. 31, 1935	Date when last dividend was paid
Aladdin Cobalt Company, Ltd.	Aug. 23, 1912	$500,000	$500,000	$5.00	$75,000.00	.....	$75,000.00	April 30, 1917
Beaver Consolidated Mines, Ltd.	Mar. 1, 1907	2,000,000	2,000,000	1.00	710,000.00	.....	710,000.00	May 31, 1920
Casey Cobalt Silver Mining Co., Ltd.	Dec. 19, 1906	100,000	100,000	1.00	203,249.33	.....	203,249.33	April 22, 1914
Castle-Trethewey Mines, Ltd.	Jan. 20, 1922	2,000,000	[1]2,000,000	1.00	18,027.00	.....	18,027.00	April 15, 1925
Cobalt Central Mines Co., Ltd.	Dec. 13, 1905	5,000,000	5,000,000	1.00	192,845.00	.....	192,845.00	Aug. 25, 1909
Cobalt Comet Mines, Ltd.[2]	April 16, 1913	1,000,000	1,000,000	1.00	230,000.00	.....	230,000.00	April 1, 1915
Cobalt Properties, Ltd.	Aug. 24, 1931	25,000	25,000	1.00	32,500.00	97,000.00	129,500.00	Oct. 31, 1935
Coniagas Mines, Ltd., The[3]	Nov. 24, 1906	4,000,000	4,000,000	5.00	11,640,000.00	100,000.00	11,740,000.00	Jan. 10, 1935
McKinley-Darragh-Savage Mines of Cobalt, Ltd.[3]	April 27, 1906	2,500,000	2,247,692	1.00	5,955,391.86	.....	5,955,391.86	Oct. 1, 1920
Mining Corporation of Canada, Ltd.[3]	Nov. 23, 1916	8,300,250	8,300,250	5.00	7,573,937.47	.....	7,573,937.47	Dec. 19, 1929
Buffalo Mines, Ltd., The[4]	April 27, 1906	500,000	150,000	.50	2,787,000.00	.....	2,787,000.00	May 28, 1924
City of Cobalt Mining Co., Ltd.[5]	Jan. 7, 1909	1,500,000	1,500,000	1.00	145,000.00	.....	145,000.00	April 15, 1920
Cobalt Lake Mining Co., Ltd.[5]	Dec. 22, 1906	3,000,000	3,000,000	1.00	465,000.00	.....	465,000.00	May 29, 1914
Cobalt Townsite Mining Co., Ltd.[5]	May 8, 1906	100,000	45,011	1.00	1,042,259.61	.....	1,042,259.61	Nov. 11, 1914
Right of Way Mines, Ltd.[3]	Sept. 11, 1909	2,000,000	1,685,500	1.00	252,825.00	.....	252,825.00	Mar. 17, 1917
Cobalt Silver Queen, Ltd.	April 1, 1906	1,500,000	1,500,000	1.00	315,000.00	.....	315,000.00	Dec. 31, 1908
Crown Reserve Mining Co., Ltd.	Jan. 16, 1907	2,000,000	1,999,957	1.00	6,190,849.00	.....	6,190,849.00	Dec. 28, 1916
Foster Cobalt Mining Co., Ltd.	Feb. 14, 1906	1,000,000	915,588	1.00	45,000.00	.....	45,000.00	Jan. 1, 1907

Hudson Bay Mines, Ltd.[7]	July 16, 1909	3,500,000	3,200,050	5.00	778,909.42	.....	778,909.42	Aug. 31, 1913
Keeley Silver Mines, Ltd	June 22, 1922	2,000,000	2,000,000	1.00	2,240,000.00	.....	2,240,000.00	Mar. 15, 1928
Kerr Lake Mining Co., Ltd	Aug. 9, 1905	40,000	40,000	100.00	[8]10,521,000.00	.....	10,521,000.00	Oct. 13, 1927
La Rose Mines, Ltd	May 31, 1908	1,500,000	1,500,000	1.00	6,600,546.84	.....	6,600,546.84	Mar. 24, 1923
Lorrain Trout Lake Mines, Ltd	Mar. 20, 1923	1,500,000	1,500,000	1.00	150,000.00	.....	150,000.00	July 15, 1925
Nipissing Mining Co., Ltd	Dec. 16, 1904	250,000	250,000	100.00	[9]31,328,297.25	170,000.00	31,498,297.25	Dec. 24, 1935
Penn-Canadian Mines, Ltd	April 24, 1912	1,500,000	1,349,705	1.00	[10]175,461.65	.....	175,461.65	Sept. 10, 1917
Peterson Lake Silver-Cobalt Mining Co., Ltd	April 11, 1906	3,000,000	2,469,802	1.00	462,350.35	.....	462,350.35	Jan. 2, 1917
Right of Way Mining Co., Ltd.[11]	July 13, 1906	500,000	499,518	1.00	324,643.93	.....	324,643.93	Oct. 1, 1909
Seneca-Superior Silver Mines, Ltd	Sept. 29, 1911	500,000	478,884	1.00	1,579,817.20	.....	1,579,817.20	Dec. 15, 1916
Temiskaming Mining Co., Ltd	Nov. 5, 1906	2,500,000	2,500,000	1.00	2,159,156.25	.....	2,159,156.25	Jan. 31, 1920
Temiskaming and Hudson Bay Mining Co., Ltd	July 10, 1903	25,000	7,761	1.00	1,940,250.00	.....	1,940,250.00	Nov. 10, 1914
Trethewey Silver Cobalt Mines, Ltd	May 30, 1906 June 1, 1911	2,000,000	1,000,000	1.00	1,211,998.50	.....	1,211,998.50	Jan. 2, 1919
Wettlaufer Lorrain Silver Mines, Ltd	Nov. 30, 1908	1,500,000	1,416,590	1.00	637,465.50	.....	637,465.50	Sept. 22, 1913
Total [10]	.....	.....	.....	.....	$97,983,781.16	$367,000.00	$98,350,781.16	.....

[1]200,000 preferred shares, par $1.00, redeemed April, 1925, and capital reduced from $2,200,000 to $2,000,000.
[2]Cash assets amounting to $50,000 paid on April 27, 1917.
[3]Now owned by Cobalt Properties, Limited.
[4]In 1917 the capital stock of the company was reduced from $1,000,000 to $750,000; in 1918, from $750,000 to $500,000; and on December 21, 1919, from $500,000 to $150,000, but returning to shareholders amounts equal to the reduction in capital, leaving 300,000 shares issued of 50 cents each. The mine was sold to the Mining Corporation of Canada and operated by it in 1920 and subsequently; it is now owned by Cobalt Properties, Limited.
[5]Formerly owned and operated by Mining Corporation of Canada, Limited; sold to Cobalt Properties, Limited, in 1935.
[6]Succeeded Right of Way Mining Co., Ltd.; now owned by Cobalt Properties, Ltd.
[7]Name of company changed from Temiskaming and Hudson Bay in 1909.
[8]In addition a return of capital amounting to $600,000 was made on July 3, 1919, to stockholders of the Kerr Lake Mines, Limited.
[9]Includes $16,288,297.25 paid in dividends by the Nipissing Mines Company (the holding company) to the end of 1916
[10]Paid out of capital $40,491.15 on September 10, 1917, and an equal amount on April 24, 1918.
[11]Succeeded by Right of Way Mines, Ltd.
[12]Does not include dividends by private companies such as M. J. O'Brien, Limited.

Since 1904, silver shipments as reported by operators were as follows:—

SILVER SHIPMENTS BY CAMPS, 1904–1935

Year	Cobalt	Casey township	South Lorrain	Gow-ganda	Montreal R., Maple Mountain, etc.	Total	Average price per ounce (New York)
	fine ounces	fine ounces	fine ounces	fine ounces	fine ounces	fine ounces	cents
1904	206,875	.....	.....	.....	.....	206,875	57.221
1905	2,451,356	.....	.....	.....	.....	2,451,356	60.352
1906	5,401,766	.....	.....	.....	.....	5,401,766	66.791
1907	10,023,311	.....	.....	.....	.....	10,023,311	65.237
1908	19,424,251	500	13,124	.....	.....	19,437,875	52.864
1909	25,658,683	26,185	194,955	.....	18,002	25,897,825	51.502
1910	29,849,981	92,544	221,133	471,688	9,835	30,645,181	53.486
1911	29,989,893	114,789	933,912	468,687	510	31,507,791	53.340
1912	28,605,940	253,824	834,119	549,976	.....	30,243,859	60.835
1913	28,105,505	825,108	248,992	502,370	.....	29,681,975	57.791
1914	24,155,699	499,643	108,199	399,300	.....	25,162,841	54.811
1915	24,280,366	223,939	.....	242,229	.....	24,746,534	49.684
1916	19,008,517	445,900	77,280	383,393	.....	19,915,090	65.661
1917	18,327,258	.....	10,000	1,064,635	.....	19,401,893	81.417
1918	16,807,407	143,901	72,188	638,198	.....	17,661,694	96.772
1919	10,314,689	171,278	4,586	723,764	.....	11,214,317	111.122
1920	10,402,249	.....	8,253	433,352	[1]2,467	10,846,321	100.900
1921	7,673,535	1,101	328,886	258,292	117	8,261,931	62.654
1922	9,239,147	1,028	1,284,307	170,651	[2]15,994	10,711,127	67.528
1923	7,259,858	.....	2,955,646	160,761	1,581	10,377,846	64.873
1924	6,704,787	.....	2,633,058	598,057	.....	9,935,902	66.781
1925	6,252,115	.....	3,099,964	1,355,156	.....	10,707,235	69.065
1926	6,262,249	.....	3,044,584	1,236,640	.....	10,543,473	62.107
1927	4,482,543	.....	2,319,356	1,741,614	.....	8,543,513	56.370
1928	3,934,020	.....	1,133,952	1,677,429	.....	6,745,401	58.176
1929	4,823,529	.....	876,006	2,081,894	.....	7,781,429	52.993
1930	5,329,335	.....	1,754,989	2,141,234	[3]52	9,225,610	38.154
1931	3,706,880	.....	594,360	1,697,242	.....	5,998,482	28.700
1932	3,262,380	.....	22,144	1,374,780	.....	4,659,304	27.892
1933	2,397,118	.....	.....	1,244,812	.....	3,641,930	34.727
1934	1,990,073	.....	.....	1,039,565	.....	3,029,638	47.973
1935	2,737,592	.....	36,585	829,195	.....	3,603,372	64.273
Total	379,068,907	2,799,740	22,810,578	23,484,914	48,558	428,212,697	.....

[1]Includes 885 ounces from Silver Islet, Lake Superior.
[2]Silver Islet, Lake Superior.
[3]Nickel Hill Syndicate in the Sudbury area shipped silver-cobalt ore.

Iron Ore, Pig Iron, Steel, and Coke

As shown in the following table, foreign ore charges amounted to 931,569 long tons, the average price of which was $4.65 (American funds, sales tax extra) at lower lake ports. From this ore, 554,977 long tons of pig iron was produced, including 371,344 long tons of basic, 93,921 of foundry, and 89,712 of malleable.

IRON AND STEEL STATISTICS, 1931–1935

Year	Foreign ore smelted	Limestone for flux	Coke	Pig iron produced		Steel made	
				Quantity	Value	Quantity	Value
	long tons	short tons	short tons	long tons		long tons	
1931	568,886	149,454	320,133	318,645	$6,363,101	444,107	$15,099,638
1932	198,063	56,880	119,064	113,665	2,558,799	244,693	8,319,562
1933	182,060	46,944	113,102	110,562	2,066,049	258,841	8,800,594
1934	462,705	118,350	253,532	271,725	6,249,675	476,699	16,207,766
1935	647,597	172,609	339,551	391,792	9,011,256	584,239	19,864,126

At Montreal No. 1 pig iron (2.25 to 2.75 per cent. silicon) was quoted at $23.00, and malleable the same. No quotations were available for basic pig iron. Steel billets were quoted at $34.00 per long or gross ton at Hamilton.

PIG IRON, STEEL, AND FERRO- AND OTHER ALLOY PRODUCERS, 1935

Company	Location
Abrasive Company of Canada, Ltd.[1 2]	Hamilton.
Algoma Steel Corporation, Ltd.[2 3 4]	Sault Ste. Marie.
Canadian Atlas Steels, Ltd.[4]	Welland.
Canadian Carborundum Co., Ltd.[1 2]	Niagara Falls.
Canadian Electro Castings, Ltd.[4]	Orillia.
Canadian Furnace Co., Ltd.[2 3]	Niagara Falls.
Chromium Mining & Smelting Corporation, Ltd.[2]	Hamilton.
Dominion Foundries and Steel, Ltd.[4]	Hamilton.
Electro-Metallurgical Co. of Canada, Ltd.[2]	Welland.
Exolon Company, Ltd.[1 2]	Thorold.
Ford Motor Co.[4]	Ford.
Kennedy, Wm., and Sons, Ltd.[4]	Owen Sound.
Lionite Abrasives, Ltd.[1 2]	Stamford.
Steel Company of Canada, Ltd.[3 4]	Hamilton.
Superior Alloys, Ltd.[5]	Sault Ste. Marie.
Welland Electric Steel Foundry[4]	Welland.

[1]These firms produce ferro-silicon as a by-product in the manufacture of ferro-alumina.
[2]Ferro-alloys. [3]Pig iron. [4]Steel. [5]Calcium molybdate.

During 1935 the output of pig iron increased from 271,725 to 554,977 long tons, and although the increase amounts to 104.2 per cent. in quantity this figure remains considerably below the 769,359 tons produced in 1929, the peak year. The Algoma Steel Corporation at Sault Ste. Marie had a 450-ton furnace in operation during the year. The Steel Company of Canada at Hamilton also operated a 550-ton unit throughout the year, and the Canadian Furnace Company at Niagara Falls operated its 350-ton furnace for nine months, reporting no production during March, April, and May.

IRON BLAST FURNACES IN OPERATION, 1935

Company	Stacks operating	Furnaces		Location
		No. of stacks	Daily capacity	
			long tons	
Algoma Steel Corporation, Ltd....	1	4	1,600	Sault Ste. Marie.
Canadian Furnace Company, Ltd..	1	1	350	Port Colborne.
Steel Company of Canada, Ltd....	1	2	825	Hamilton.

Ferro-Alloys

Of the fourteen plants listed in the 1931 report only seven reported production, which with an additional plant, the Canadian Carborundum Company, Limited, not listed in 1931, produced a total of 57,424 long tons of various kinds of ferro-alloys in 1935, as against 32,932 tons in the previous year.

STATISTICS OF FERRO-ALLOYS PRODUCTION IN ONTARIO, 1931–1935

Year	No. of producing companies	Quantity produced	Kind of material
		long tons	
1931	8	46,440	Ferro-silicon, ferro-manganese,
1932	5	15,595	silicon spiegel, spiegeleisen,
1933	6	30,569	calcium manganese silicon,
1934	7	32,932	zirconium manganese silicon,
1935	7	57,424	calcium molybdate.

Coke

The coking industry in Ontario is carried on by the large iron and steel metallurgical works and by chartered companies operating in the cities supplying artificial gas to householders and industries.

The statistics shown in the following table are combined and show raw materials used and products made. These figures were supplied by the Dominion Bureau of Statistics.

COKING INDUSTRY, 1935

	Quantity	Cost at works
MATERIALS USED:		
Coal ..... tons	1,821,448	$8,038,691
Coke ..... tons	38,899	275,477
Oil ..... Imp. gals.	3,610,628	272,767
Absorbing and wash oil ..... Imp. gals.	107,114	13,746
Caustic soda ..... lbs.	472,142	14,805
Lime ..... tons	732	6,663
Oxide for purification ..... tons	3,153	35,233
Sulphuric acid 66° Be. purchased ..... lbs.	25,680,321	181,087
All other materials	.....	18,843
Total	.....	$8,857,312
GAS MADE:	M cu. ft.	
Retort coal gas	5,079,584	.....
Coke oven gas	14,412,246	.....
Carburetted water gas	2,068,114	.....
Oil gas and acetylene gas	12,287	.....
Total	21,572,231	.....
GAS CONSUMED:	M cu. ft.	
Sold	8,555,654	$7,381,526
Used in producing plants	6,227,591	939,036
Used in associated metallurgical works	5,824,168	871,318
Otherwise accounted for	361,342	97,985
Not accounted for	720,498	611,316
Total	21,689,253	$9,901,181
COKE AND BY-PRODUCTS MADE:		
Coke, including breeze ..... tons	1,334,081	$9,868,953
Tar ..... Imp. gals.	16,037,490	845,930
Ammonia liquor ..... lbs. NH_3	1,808,291	18,083
Ammonium sulphate ..... lbs.	30,388,313	310,327
Benzol ..... Imp. gals.	2,148,017	471,304
Other light oils	1,176,401	127,681
All other products	.....	392
Total	.....	$11,642,670
	COKE tons	BREEZE tons
COKE SOLD AND USED, AND STOCKS:		
Used by reporting companies	431,853	75,178
Sold for domestic use	710,525	13,353
Other uses	175,746	1,862
On hand, December 31, 1932	189,145	3,337

Coke statistics for the past five years, as collected by the Dominion Bureau of Statistics, are shown in the following table:—

COKE STATISTICS, 1931-1935

	1931	1932	1933	1934	1935
	short tons	short tons	short tons	short tons	short tons
Production	1,113,509	1,087,122	1,153,509	1,388,709	1,361,553
Imports	694,982	605,307	615,818	881,235	489,439
Total	1,808,491	1,692,429	1,769,327	2,239,944	1,850,992
Deduct exports	106	.....	.....	54	.....
Apparent consumption.	1,808,385	1,692,429	1,769,327	2,239,890	1,850,992

Chromite

The smelting of chromite has been commenced in Ontario at Sault Ste. Marie, the first unit of Chromium Mining and Smelting Corporation, Limited, having been started on August 23, 1935. The ore comes from the company mine east of Obonga lake. Demand for chromium and its alloys has greatly increased during the past few years. Recent world conditions for this mineral, as outlined in *Metal and Mineral Markets*, November 21, 1935, were as follows:—

The continued improvement in general industrial conditions in 1934 was reflected in increased demand for chromite in the United States. Requirements of the domestic chromite industry are met principally by imports of ore. Imports of ore in 1934, largely from Southern Rhodesia, Cuba, Turkey, and Greece, were 65 per cent. greater than those in 1933 but were 14 per cent. less than the average annual amount imported in the period 1925 to 1929. Domestic chromite production in 1934 was insignificant in relation to the needs of consumers. Chromite statistics, in long tons, follow:—

	1925-29 average	1930	1931	1932	1933	1934
Production	262	310	762	200	966	341
Consumption:						
Imports	224,357	362,617	212,528	89,143	116,511	[1]192,297
Domestic shipments	276	80	268	155	843	369
Apparent available supply	224,633	326,697	212,796	89,298	117,354	192,666
Prices per ton at New York, approximate average of all grades	$22.46	$21.50	$18.50	$18.00	$17.00	$19.00
Origin of imports, per cent. of total:						
Southern Rhodesia	52	45	32	17	10	25
New Caledonia	6	10	19	13	13	10
Turkey	.....	1	1	20	24	15
Greece (largely trans-shipments from Jugoslavia)	9	14	14	18	10	12
U.S.S.R. (Russia)	.....	4	8	5	11	10
Cuba	15	13	7	.....	20	26
Others	18	13	19	27	12	2
World production	428,000	551,000	407,000	291,000	384,000	[2]

[1]Imports for consumption; general imports not available.
[2]Data not available.

Preliminary work on the ore of the Obonga Lake deposits has been carried on at Niagara Falls, N.Y., and the operating company announced that the diamond-drilling campaign indicated some 225,000 tons of 17 per cent. chromite ore available. A mill of 100 tons daily capacity is now being completed. The concentrate will be shipped to the furnaces at Sault Ste. Marie, Ont.

In 1935 some 798 tons of crude ore were shipped. For purposes of compilation a value of $12.00 per ton was placed on this material.

Molybdenite

There was considerable interest observed during the past year in molybdenite, perhaps because the European demand was more pressing than formerly. This foreign market is the only one available to Ontario producers, as the United States tariff of 35 cents per pound on the metallic molybdenum content does not permit competition.

No shipments of concentrate were reported in 1935. The best known ore deposit, that of the Phoenix Molybdenite Corporation, Limited, situated on the west half of lots 27 and 28 in concession IV, Bagot township, Renfrew county, was actively developed from April to December. As many as 23 men were employed on the surface and underground, and 976 tons of ore were raised during the period, none of which was concentrated. Molybdenite occurs widely in Ontario in the southeastern section, Hastings, Lanark, and Renfrew counties, and also north of Sault Ste. Marie. During the war when prices were high many Ontario molybdenite properties were in operation. Molybdenum is used in the production of alloy steel.

Radium and Uranium

Although pitchblende, which is the source of radium and uranium, has not been produced in commercial quantities from Ontario ores, there is now a well-equipped extraction plant in successful operation at Port Hope, Ont., owned by the Eldorado Gold Mines, Limited, for the treatment of pitchblende concentrates from Great Bear lake, some 4,000 miles distant. The refinery, which commenced operating in 1933, was considerably enlarged in 1934, and in January, 1935, the concentrator at Labine Point was placed in commission.

In 1935 a total of 232,114 pounds of pitchblende and silver concentrates was treated chemically at Port Hope, from which radium and uranium products worth $420,000 were recovered. In addition, 116,902 ounces of silver were produced, having a value of $68,840. Of this silver, 89,041 ounces were contained in 16,840 pounds of silver-lead bars and 47,861 ounces in 4,746 pounds of silver sulphide.

NON-METALLICS

With the exception of sulphur, mica, mineral waters, quartz, and salt, every item in the non-metallic group showed an improvement in 1935; and in the case of salt, while the selling value was lower, the quantity production showed a considerable increase. This group though relatively small in production value is important and is closely related to the chemical and building industries and supplies much of the raw materials consumed by them. The total value of the non-metallic group in 1935 was $7,766,657, as against $7,553,571 in 1934, a slight increase. The details of quantities and values marketed are set out in the table "Summary of Mineral Statistics, 1935" on page 2.

Actinolite and Asbestos

Actinolite and asbestos do not appear in the statistics of Ontario's mineral production in 1935. With the exception of a small sample lot of 100 pounds, worth $1, no actinolite was sold. Development work was carried on at the asbestos property of Rahn Lake Mines Corporation in Bannockburn township during the year. About 400 tons of mill rock asbestos ore was placed on the stock pile and was expected to average about $8 to $10 per ton. No sales were reported however. An average of 5 men was employed throughout the greater part of the year.

Arsenic

Ontario production of white arsenic (As_2O_3) comes from the smelting of the silver-cobalt arsenides of Northern Ontario by the Deloro Smelting and Refining Company. The output in 1935 was 2,558,789 pounds, valued at $75,326, as against 1,647,513 pounds, worth $56,412, in 1934.

Barite

A small output of barite was reported in 1933 for the first time since 1923. Several deposits of this mineral are known to exist in the province. Although considerable investigation into markets has been undertaken, and several enquiries have been received from outside sources, no steady development work was under way at any of the Ontario deposits. Canada Night Hawk Mines, which is equipped for milling, did not report any work. The deposits in Yarrow township and at Tionaga were idle, and no shipments were reported.

Diatomite

Several deposits of diatomite have been under development for a number of years in Muskoka, but the production to date has been small. In 1935 some 100 tons, valued at $4,600, was reported as shipped from Martin's Siding by the Canadian Multi-Cell Company, as against 46 tons, worth $1,920, in 1934.

Feldspar and Nepheline Syenite

The feldspar industry is gradually gaining in production in Ontario, owing entirely to a slowly increasing domestic consumption. The United States duty, which formerly was $1.00 per ton, later reduced to 50 cents, is now fixed at 35 cents per ton under the new trade agreement. This reduction, however, is not expected to stimulate exports to any appreciable extent. With a free entry to the United States it is questionable whether Ontario spar could compete in any except the border states. The prevailing price of spar in Ontario is around $5.00 per short ton f.o.b. mines. In 1935, shipments from the mines of Ontario totalled 8,656 tons of crude material, valued at $75,003, of which $29,511 was the increase due to grinding. In 1934 the output was 7,302 tons, worth $61,665, of which $21,944 was the added value due to grinding operations.

Canadian Nepheline, Limited, which operates a nepheline deposit in Methuen township, Peterborough county, constructed a grinding plant of 24 tons capacity at Lakefield during 1935. No shipments, however, were reported. Mention of this deposit was made in Bulletin No. 98 (1934).

Fluorspar

Fluorspar is consumed as a flux in smelters and also in the chemical industries. The domestic consumption is not large and is confined mostly to Ontario. In 1935 a total of 75 tons, worth $900, was reported as shipped. In 1934 the ouput was 150 tons, valued at $2,100.

Graphite

Only one producer of graphite was active in 1935, the Black Donald Graphite Company, Limited, at its property on lots 16, 17, and 18 in concession III, Brougham township, Renfrew county, near the village of Calabogie. This deposit is the largest amorphous graphite mine on the American continent. In 1935 production to the value of $78,500 was reported, as against $64,998 in 1934.

Gypsum

The output of gypsum in Ontario rose from 33,234 tons in 1934 to 38,247 in 1935, and came from two companies: Gypsum, Lime and Alabastine, Canada, Limited, with a plant at Caledonia, and the Canadian Gypsum Company at Hagersville. The increase is indicative of the general revival in the building industry in Ontario. While the improvement in 1935 was important, the output figures still remain far below those of good times:—

GYPSUM SALES, 1931–1935

Grade	1931	1932	1933	1934	1935
	tons	tons	tons	tons	tons
Crushed	10,263	5,656	2,753	5,636	5,381
Fine-ground	451	364	795	376	187
Calcined, sold	1,606	217	165	226	121
Calcined, used in products	41,038	29,418	20,747	26,996	32,558
Total sold or used	53,358	35,655	24,460	33,234	38,247
Total value	$374,469	$186,176	$112,319	$141,389	$164,807
No. of workers	155	[1]98	[1]79	[1]69	77
Wages paid	$87,263	$85,036	$46,782	$53,718	$99,137

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

Iron Pyrites and Sulphuric Acid

The sulphur content of the acid manufactured at Copper Cliff by Canadian Industries, Limited, from sulphur fumes derived from the smelting operations, was 13,292 tons, worth $132,920, as against 14,598 tons, valued at $145,980, in 1934. No pyrite ore was shipped.

Mica

Despite a general pick-up in the mica trade of the United States, there was a decrease in the total production from Ontario mines. The position of higher grades, however, was improved, and the decline was due to the lower exports of scrap material to the United States.

In Ontario there were only five active producers during 1935, who reported shipments of 509,826 pounds, worth $7,144, as against 1,236,302 pounds, valued at $9,059, in the previous year. Prices have generally improved in the United States, where operations were being carried on to capacity. Scrap and by-product mica are bringing twice the price of the depression lows. Conditions in Ontario tend to reflect those in the United States.

The major portion of the provincial output is made by direct mining, in which large crystals are recovered and treated. There is little or no by-product mica such as is recovered in North Carolina from kaolin and feldspar deposits.

SHIPMENTS OF MICA, 1933, 1934, AND 1935

Grade	1933		1934		1935	
	Quantity	Value	Quantity	Value	Quantity	Value
	pounds		pounds		pounds	
Ground and rough	19,000	$239	2,459	$514	.....	.....
Thumb-trimmed	44,219	3,287	30,315	3,094	10,852	$3,223
Splittings and knife-trimmed	11	19	303	110	2,734	1,738
Scrap	1,268,200	5,820	1,203,225	5,341	496,240	2,183
Total	1,331,430	$9,371	1,236,302	$9,059	509,826	$7,144

The prices for the various sizes and grades of thumb-trimmed mica did not vary greatly from those reported by the producers in 1934:—

Size	Price per lb.	Size	Price per lb.
1 by 1 inch	$0.07	2 by 4 inches	$0.45
1 by 2 inches	.15	3 by 3 inches	.60
2 by 2 inches	.20	3 by 4 inches	.91
2¼ by 2½ inches	.40	3 by 5 inches	.95
2 by 3 inches	.30–.50	4 by 6 inches	1.35–1.75

Scrap mica, $9.00 per ton (net).
Rough-cobbed, 20 cents per pound.

Mineral Waters

Only three producers reported production of mineral water from Ontario wells in 1935, which amounted to 19,900 Imperial gallons, worth $1,477, as compared with 21,775 gallons, valued at $1,622, in the previous year. The production has gradually declined in Ontario to a fraction of the former output.

Natural Gas and Petroleum

The Natural Gas Commissioner of Ontario has supplied the following notes:—

Natural Gas

The production of natural gas in 1935 surpassed that of the year 1934 by approximately 500,000 M cubic feet, and in value by $150,000, the total produced being 8,158,825 M cubic feet and the value $4,938,084. The average retail price is down somewhat owing to discounts in certain areas. The increase in production is mainly due to a more active sales campaign by the larger gas companies aided by weather conditions. Several thousand new customers have been added during the year, notably in the city of London, where manufactured gas has been used heretofore. Natural gas was turned into the mains in October, 1935. The gas comes from the Dawn field through a 10-inch pipe line 55 miles long. No new fields were discovered, but the Dover and Eden fields were considerably extended and each has promise of further development.

Petroleum

Petroleum produced in 1935 shows a considerable increase, 25,000 barrels, over the previous year. The increase was common to all our larger fields excepting Mosa township. The Dover field leads in new development, followed by the Dawn field. Both these fields show considerable promise. By renovating wells from 40 to 60 years old in the eastern end of the Bothwell field and drilling a very few new wells, the production has almost doubled since 1931. Similar treatment in Oil Springs and Petrolia has caused an increase. Bothwell production now equals that of 1912; this field, of course, cannot be expected to be as stable as a newly discovered field; its decline will no doubt be rapid.

CRUDE PETROLEUM PRODUCTION, 1931–1935[1]

Field	1931	1932	1933	1934	1935
	barrels	barrels	barrels	barrels	barrels
Petrolia and Enniskillen township	57,515	58,871	57,298	57,938	59,282
Oil Springs	30,792	31,438	31,343	29,863	31,646
Moore township	3,739	3,272	2,192	2,963	3,263
Sarnia township	1,466	1,227	2,181	825	870
Plympton township	296	274	211	202	237
Bothwell	18,084	19,460	22,935	32,133	34,715
Thamesville	462	534	847	614	428
Dover township	891	453	763	558	13,117
Dawn township	.....	5,061	8,589	4,169	11,538
Onondaga township	34	543	946	601	431
Mosa township	8,517	8,429	8,168	9,031	8,788
Dunwich township (Dutton and Iona)	628	781	346	283	408
Tilbury East township	.....	.....	.....	.....	.....
Raleigh township	.....	.....	239	264	195
Brooke	.....	.....	.....	1,941	122
Total quantity	122,364	130,343	136,058	141,385	165,040
Value	$219,993	$247,468	$253,486	$299,874	$346,156
Average price per barrel	$1.80	$1.89	$1.87	$2.12	$2.10

[1]Information furnished by the Imperial Oil Refiners, Limited, of Sarnia, and others.

Peat

During the past year or two considerable interest has been exhibited in the peat bogs of Ontario. The names of operators and locations are given on page 69. The production by 4 operators during 1935 was 1,340 tons, valued at $5,761.

Quartz, Quartzite, and Silica Products

The output of quartz, quartzite, and silica products, which gained slightly in 1934, showed a decline in 1935, falling from 89,838 to 83,034 tons. On the other hand, silica products, reflecting improved building activity, showed a slight gain in quantity. Production figures for the past five years follow:—

QUARTZ, QUARTZITE, AND SILICA BRICK, 1931–1935

Year	Rock sold or used		Silica brick sold or used		Total value
	Quantity	Value	Quantity	Value	
	tons		M		
1931	97,888	$148,642	279	$13,702	$162,344
1932	66,135	93,574	93	4,303	97,877
1933	66,562	86,146	183	7,351	93,497
1934	89,838	134,572	369	14,730	149,302
1935	83,034	120,005	493	22,976	142,981

Salt

During 1935, seven companies produced salt or brine. This industry in part supplies the raw materials for two large chemical manufacturing companies: Canadian Industries, Limited, and Brunner Mond, Canada, Limited. While the quantity output rose from 276,751 to 320,003 tons in 1935, the value was slightly lower. Production figures covering a 5-year period follow:—

SALT SOLD OR USED, 1931–1935

Schedule	1931	1932	1933	1934	1935
	tons	tons	tons	tons	tons
Table and dairy	115,180	59,620	61,231	69,779	73,704
Fine		59,036	63,786	67,777	82,608
Coarse	17,678	15,673	14,086	14,730	17,997
Land	513	557	283	347	261
Total	133,371	134,896	139,386	152,633	174,570
Brine (salt equivalent)	97,928	96,242	104,721	124,118	145,433
Total sold or used	231,299	231,138	244,107	276,751	320,003
Value	$1,760,388	$1,789,752	$1,755,087	$1,734,196	$1,698,508
Wage-earners[1] No.	233	215	242	252	274
Wages	$259,646	$253,579	$261,214	$296,116	$309,354

[1]Workers at the Sandwich salt and chemical works are included.

Talc

Statistics covering a 5-year period show that the talc industry serves a fairly stable and assured market. Two companies were active at Madoc in Hastings county, where the industry is centred, both of them mining a high-grade product, which is milled and refined at the mines. The Geo. H. Gillespie Company, Limited, operates the Henderson mine, and the Canada Talc Company, Limited, the Conley mine.

TALC STATISTICS, 1931–1935

Year	Sales		Wage-earners, mine and mill	Wages paid
	Quantity	Value		
	tons		No.	
1931	11,806	$122,044	36	$29,419
1932	12,064	111,585	38	30,587
1933	15,114	142,134	43	31,813
1934	13,934	135,978	47	33,796
1935	13,710	138,161	31	23,864

STRUCTURAL MATERIALS

Building Permits

In 58 Canadian cities building permits in 1935 were valued at $46,236,702. Of this total 30 Ontario cities accounted for $23,704,388, as noted in the following table abstracted from the *Annual Review of Building Permits in Canada in 1935*, issued by the Dominion Bureau of Statistics, Department of Trade and Commerce, Ottawa:—

BUILDING PERMITS, 1920–1935

Year	30 Ontario cities, value	Wholesale prices index[1]	Toronto metropolitan area,[2] value	Wages index 1913=100[3]
1920	$58,636,365	[4]144	$30,049,413	180.9
1921	59,315,845	122.8	31,979,346	170.5
1922	81,396,259	108.7	36,405,625	162.5
1923	74,673,080	111.9	39,530,877	166.4
1924	57,330,141	106.6	29,636,428	169.1
1925	59,888,867	102.9	32,408,636	170.4
1926	65,373,757	100	31,588,124	172.1
1927	79,883,344	96.1	37,316,511	179.3
1928	104,777,566	97.4	59,817,568	185.6
1929	95,055,827	99	57,522,927	197.5
1930	69,042,946	90.8	38,371,587	203.2
1931	44,371,578	81.9	27,950,136	195.7
1932	16,887,761	77.2	9,461,050	178.2
1933	9,116,743	78.3	5,114,351	158
1934	14,351,380	82.6	8,396,775	154.8
1935	23,704,388	82.2	9,905,455	159.8

[1]Applies to average index numbers for Canadian wholesale prices of building materials on the basis of 1926=100, as compiled by the Dominion Bureau of Statistics. In 1913 the index was 67, dropping to a low of 60.5 in 1915.

[2]Includes York and East York municipalities.

[3]Average index numbers of wages in Canadian building trades as compiled by the Federal Department of Labour on the basis of 1913=100

[4]Peak year.

Construction Contracts

The value of Canadian construction contracts awarded for 1935, reported by the *McLean Building Review*, was $160,305,000, as compared with $125,811,500 in 1934. Ontario contracts in 1935 amounted to $70,872,800, or 44.2 per cent. of the total. Prices of materials were considerably below the peak of 1920, and decided drops were recorded in 1930, 1931, and 1932, but a perceptible recovery was recorded in 1934, which fell off slightly in 1935. Canadian construction contracts in 1933 were on a par with the war years, 1916–18, dropping below the $10,000,000 mark. Figures by classes of construction for a 5-year period follow:—

VALUE OF CONSTRUCTION CONTRACTS, 1931–1935

Classification	1931	1932	1933	1934	1935
Residential	$39,274,300	$14,143,200	$12,653,800	$17,578,600	$20,646,500
Business	28,819,400	16,925,600	9,716,100	15,795,600	20,340,800
Industrial	6,836,300	1,871,000	4,699,700	4,305,200	3,645,000
Engineering	50,522,300	16,352,000	15,503,800	25,678,900	26,240,500
Total	$125,452,300	$49,291,800	$42,573,400	$63,358,300	$70,872,800

Cement

Ontario's production of cement came from the two companies: the Canada Cement Company, with plants at Lakefield, Belleville, and Port Colborne, the first two being idle, although shipments were made from the Belleville plant; and the St. Marys Cement Company, with a plant at St. Marys, which was in operation throughout the year.

PORTLAND CEMENT STATISTICS, 1925–1935

Year	Operating plants	Sales		
		Quantity	Value	Average price per barrel
	No.	barrels[1]		
1925	4	3,462,358	$5,253,911	$1.52
1926	3	3,398,860	4,792,857	1.41
1927	4	3,751,786	5,144,326	1.34
1928	4	3,911,795	5,520,897	1.41
1929	4	4,624,712	6,608,246	1.43
1930	4	3,942,690	5,779,404	1.47
1931	4	3,470,056	5,006,826	1.44
1932	4	1,599,342	2,288,975	1.44
1933	3	1,095,845	1,587,812	1.45
1934	4	1,702,128	2,403,590	1.41
1935	2	1,243,836	1,752,148	1.41

[1]350 pounds.

Cement Products

In recent years the cement products industry in Ontario has assumed considerable importance. Since 1924 no data have been included in the tables of mineral production, as the raw materials entering into the manufacture of these products have all been accounted for. Cement products being so closely allied to the building industry, statistics are included so that complete information covering all structural materials is available under one cover. Monolithic construction is not included.

PRINCIPAL STATISTICS OF THE CEMENT PRODUCTS INDUSTRY, 1931–1935[1]

Year	No. of plants	Wage-earners, average No.	Salaries and wages	Cost of fuel and electricity	Capital invested	Value of products at works
1931	92	562	$599,640	$43,429	$2,995,610	$1,782,400
1932	69	352	308,898	27,692	2,286,460	737,326
1933	48	245	199,056	19,008	1,642,244	550,185
1934	54	251	274,045	24,394	1,784,166	687,176
1935	57	268	299,170	21,090	1,635,243	774,589

[1]Supplied by Dominion Bureau of Statistics, Ottawa.

CEMENT PRODUCTS MANUFACTURE, 1934 AND 1935[1]

Materials used	1934 Quantity	1934 Cost at works	1935 Quantity	1935 Cost at works
Portland cement....bbls.	64,755	$154,039	68,032	$156,937
Quicklime....bu.	8	8	4	4
Sand....cu. yds.	21,985	23,233	21,264	23,133
Gravel....cu. yds.	10,621	14,078	29,451	22,593
Crushed stone....cu. yds.	4,298	5,958	5,765	7,230
Cinders....cu. yds.	2,867	6,159	.....	6,875
Boxes, crates, lumber, etc....	.....	7,340	.....	9,629
Reinforcing....tons	145	9,741	159	10,022
Haydite....cu. yds.	9,120	31,921	4,318	8,638
Brass....	.....	11,350	.....	.....
Other materials....	.....	57,258	.....	93,811
Total....	.....	$321,085	.....	$338,872
Products made	**Quantity**	**Selling value**	**Quantity**	**Selling value**
Artificial stone....	.....	$32,314	.....	$43,307
Cinder blocks....M	617	72,509	700	94,480
Cement bricks....M	372	7,645	374	6,616
Cement hollow building blocks....M	1,251	179,814	1,796	228,832
Cement laundry tubs....No.	2,204	17,115	3,873	29,374
Cement posts, poles, etc....	.....	6,610	.....	.....
Cement sewer, culvert, and drain pipe....	.....	119,086	.....	148,353
Cement stucco....	.....	8,215	.....	7,323
Burial vaults....	.....	9,805	125	2,790
Haydite blocks....tons	5,019	40,248	2,562	22,348
Haydite roof slabs....tons	2,084	55,517	1,184	38,320
Other products....	.....	137,647	.....	152,596
Custom work and repairs....	.....	651	.....	250
Total....	.....	$687,176	.....	$774,589

[1]Supplied by Dominion Bureau of Statistics, Ottawa.

Lime

Lime is used quite extensively for chemical purposes in addition to being an ingredient of mortar and sand-lime brick. During 1935, 17 companies and individuals, operating 20 plants, reported sales that totalled 221,852 tons, valued at $1,705,303, as against 191,041 tons, worth $1,536,288, in 1934. Statistics for the past five years follow:—

LIME STATISTICS, 1931–1935

Year	Lime marketed or used: Hydrated Quantity	Hydrated Total value	Hydrated Per ton	Quicklime Quantity	Quicklime Total value	Quicklime Per ton	Fuel costs	Wage-earners	Wages
	tons			tons				No.	
1931...	34,284	$379,996	$11.08	113,267	$841,194	$7.43	$177,310	287	$216,337
1932...	23,518	255,223	10.85	143,185	1,018,007	7.11	204,546	203	154,361
1933...	19,733	220,291	11.16	126,460	1,006,905	7.96	188,317	210	111,637
1934...	22,281	249,038	11.18	168,760	1,287,250	7.63	173,951	187	116,020
1935...	23,514	227,197	9.66	198,338	1,478,106	7.45	324,295	210	147,397

Distribution of the quicklime and hydrated lime sold in 1935, as reported by the producing companies, was as follows:—

Industrial consumption	Quicklime		Hydrated lime	
	Quantity	Value	Quantity	Value
	tons		tons	
Building trades: finishing and masons	10,857	$67,145	20,650	$200,793
Sand-lime brick	5,041	30,558	583	5,404
Agriculture	76,166	569,402	.....	.....
Chemical and metallurgical industries:				
Smelters	4,725	25,420	75	694
Iron and steel	8,512	59,735	23	216
Gold-milling	24,087	173,686	3	28
Pulp and paper	3,827	21,399	668	6,010
Glass	5,003	34,558	.....	.....
Sugar	7,032	57,021	.....	.....
Tanneries	2,891	18,639	180	1,618
Fertilizers and insecticides	600	4,202	291	2,691
Dealers and others	2,251	16,647	260	2,561
Other chemicals[1]	47,346	399,614	781	7,182
Total	198,338	$1,478,106	23,514	$227,197

[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

A marked rise in the production of sand and gravel was noted in the dredging operations during 1935. Much of this increase was due to work done in Toronto harbour. Output from the pits of private operators was about the same as in the previous year.

OUTPUT OF SAND AND GRAVEL, 1934 AND 1935

Source	1934		1935	
	Quantity	Value	Quantity	Value
	tons		tons	
Private pit operators	551,145	$249,980	554,032	$238,878
Dredged from Great Lakes and rivers	464,507	292,467	1,764,645	426,430
Department of Northern Development	4,345,694	225,332	3,393,750	251,389
Department of Highways	620,000	310,000	383,096	149,366
Miscellaneous counties and townships	1,273,580	636,790	1,959,095	979,547
Estimate for other producers	.....	.....	100,000	50,000
Total	7,254,926	$1,714,569	8,154,618	$2,095,610

Sand-Lime Products

The past three or four years have been dull for marketing sand-lime brick. This is, in part, owing to a depressed construction industry, but competition of other products, such as cinder blocks and kindred materials has cut into this trade considerably. Four companies were active in the Toronto metropolitan area, and in addition to brick produced sand-lime building blocks, ready mixed mortar, and plaster. These items have been included in the table "Summary of Mineral Statistics, 1935," on page 2, under the title "Sand-lime products." It should be pointed out that in the table on page 3 the figures prior to 1934 refer to sand-lime brick only. The selling value in 1935 was $138,555, as against $146,009 in the previous year.

Stone

A new feature in the stone-production industry in 1934 was the inclusion of slate, which has been absent from the list of building materials for several decades. A slate quarry situated in the northwest corner of lot 5, concession VI, Madoc township, was worked fifty years ago and supplied roofing slates for a few buildings in various towns of Eastern Ontario. There is a potential market for roofing shingles, blackboards, granules, and slate flour. The new operator is Ontario Slate Mines, Limited, which later became Canadian Slate Products, Limited. This company carried on development work in 1935. An initial shipment of 120 tons of granules was made during 1934. The Crespay Slate Products, Limited, also commenced development work near Madoc. No shipments were reported by either company in 1935.

OUTPUT OF STONE, 1933, 1934, AND 1935

Variety	1933		1934		1935	
	Quantity	Value	Quantity	Value	Quantity	Value
	tons		tons		tons	
Limestone and marble...	1,225,754	$931,501	2,374,671	$1,808,663	2,065,932	$1,716,020
Trap	17,201	26,629	48,298	96,314	44,351	91,979
Granite	2,449	12,804	27,227	32,072	122	1,486
Sandstone	8,889	12,334	10,105	28,458	12,536	54,407
Slate	.....	.....	120	600	.....	.....
Total	1,253,907	$983,268	2,460,421	$1,966,107	2,122,941	$1,863,892

CLAY PRODUCTS

The following table shows in detail the quantities and values of the several kinds of clay products made and sold by Ontario producers:—

HEAVY CLAY PRODUCTS MARKETED, 1935

Kind		Quantity	Value
Brick:			
Soft-mud process	face, No.	5,552,987	$104,271
	common, No.	10,025,774	128,205
Stiff-mud (wire cut) process	face, No.	16,557,729	321,581
	common, No.	9,170,057	125,559
Dry-press	face, No.	5,953,479	119,379
	common, No.	1,563,277	22,071
Fancy or ornamental brick (including special shapes, embossed and enamelled brick), No.		12,935	728
Sewer, No.		60,295	970
Tile:			
Structural (hollow blocks, including fireproofing and load-bearing tile), tons		22,983	156,702
Roofing tile, No.		82,015	3,669
Floor tile (quarries), sq. ft.		48,923	7,142
Drain, No.		5,060,734	125,593
Sewer pipe (including copings, flue linings, etc.)		.....	196,647
Pottery (flower pots), from domestic clay		.....	50,000
Haydite and other products		.....	7,093
Total value		.....	$1,369,610

The value of clay products marketed for the last pre-war year, 1913, for the year of maximum output, 1922, and for the past five years is given below:—

VALUE OF CLAY PRODUCTS SOLD OR USED, 1913, 1922, AND 1931-35

Product	1913	1922	1931	1932	1933	1934	1935
Brick:							
Common	$3,283,894	$2,614,120	$662,777	$305,566	$167,021	$227,276	$275,835
Pressed, fancy, building tile, etc.	1,162,860	2,899,205	1,707,297	704,342	425,743	607,658	714,442
Pottery	52,875	88,889	73,860	67,866	52,740	[1]52,578	50,000
Drain tile	292,767	368,180	244,368	144,579	179,015	137,699	125,593
Sewer pipe	600,297	973,824	696,694	451,786	185,048	226,005	196,647
Haydite and other products	.....	.....	167,533	16,366	15,012	9,790	7,093
Total	$5,392,693	$6,944,218	$3,552,799	$1,690,505	$1,024,579	$1,261,006	$1,369,610

[1]Includes fire-clay blocks and shapes worth $90.

MISCELLANEOUS STATISTICS

Mining Company Incorporations

A summary of mining companes incorporated and licensed in Ontario from 1913 to 1935, inclusive, is given hereunder:—

MINING COMPANIES INCORPORATED AND LICENSED, 1913-1935

Year	Incorporated				Extra-provincial and mortmain companies licensed	
	No.	Nominal capital	"No par" companies		No.	Capital for use in Ontario
			No.	Shares		
1913	119	$78,000,000	.....	.....	12	$21,735,000
1914	80	39,030,000	.....	.....	13	5,445,000
1915	59	42,005,000	.....	.....	2	10,200,000
1916	83	109,079,500	.....	.....	8	7,011,650
1917	100	117,183,000	.....	.....	7	7,302,000
1918	59	49,800,000	.....	.....	7	15,000,000
1919	149	223,600,000	.....	.....	10	9,554,197
1920	119	146,094,000	.....	.....	12	9,435,000
1921	67	105,715,000	.....	.....	6	1,030,500
1922	91	181,040,000	.....	.....	6	830,000
1923	88	179,295,500	.....	.....	6	1,775,000
1924	85	156,485,000	.....	.....	2	200,000
1925	70	107,400,000	4	9,010,000	3	162,510
1926	145	165,655,750	28	22,386,500	6	4,850,000
1927	199	344,145,000	30	40,034,000	10	3,260,000
1928	211	495,575,000	28	30,778,400	17	7,208,500
1929	97	142,390,000	27	32,557,200	13	1,540,000
1930	37	23,234,600	20	16,808,909	6	5,525,000
1931	44	60,670,000	15	5,909,000	1	400,000
1932	43	58,766,000	12	5,844,000	0	.....
1933	95	158,365,000	21	23,165,000	8	1,290,000
1934	212	488,335,000	82	86,183,000	9	925,000
1935	116	205,320,000	24	18,054,500	1	40,000

Of the 140 companies incorporated in 1935, 116 had specified capital only, 24 were companies having shares without nominal or par value exclusively, and 5 companies had shares of both kinds.

EXTRA-PROVINCIAL COMPANIES LICENSED BY ORDER-IN-COUNCIL IN 1935

Name of company	Place of incorporation	Date of license (O.C.)	Value of land holdings in Ontario
Parry Sound Mining and Developing Company..	Massachusetts[1]	Jan. 25	$40,000

[1]Where a company is of foreign incorporation, or is incorporated in a province of Canada other than Quebec with which a reciprocity agreement exists, it is necessary for it to take out an Extra-Provincial License to do business in Ontario and to declare the amount of capital for use in Ontario.

MINING COMPANIES INCORPORATED IN ONTARIO IN 1935 HAVING SHARES WITHOUT NOMINAL OR PAR VALUE

Name of company	Head office	Date of incorporation	No. of shares
Avocalon Extension Syndicate, Limited	Toronto	Jan. 22	2,500
Blackburn Pattison Mines, Limited	Toronto	June 28	3,000,000
Brimac Exploration and Development, Limited	Toronto	April 1	40,000
Canadian Multi-Cell, Limited	Toronto	April 23	250,000
Corinth Mines, Limited	Toronto	Jan. 17	40,000
Crespay Slate Products, Limited[1]	Toronto	Oct. 14	250,000
Deseronto Refineries, Limited[1]	Deseronto	Sept. 4	50,000
Forty Five Mile Post Syndicate, Limited	Toronto	Jan. 9	25,000
Gachin Gold, Limited	Toronto	Aug. 29	550,000
Hanna Fuels, Canada, Limited	Toronto	Jan. 16	1,000
Hisbert Mines, Limited	Toronto	Jan. 16	3,000,000
Ingram Radium, Limited	Toronto	Aug. 26	4,000
Kir-Vit Gold Mines, Limited	Toronto	Dec. 3	10,000
Leacroft Mining Service, Limited[1] (private)	Toronto	Sept. 6	90,000
M. and R. Airways, Limited[1]	Toronto	May 17	10,000
Mac-Ryan Enterprises, Limited	Toronto	July 24	10,000
Minaura Mines, Limited	Toronto	Nov. 22	200,000
Mining Projects of Canada, Limited	Toronto	Dec. 13	1,000,000
North American Land and Minerals, Limited	Toronto	Nov. 4	3,500,000
O'Neill Thompson Gold Mines, Limited	Ottawa	Aug. 26	3,000,000
Peers Placer Gold, Limited	Toronto	July 8	1,000,000
Rush Bay Holding Company, Limited, The	North Bay	Jan. 26	12,000
Soo Diamond Drilling Company, Limited[1]	Sault Ste. Marie..	Jan. 12	10,000
Wineva Gold Mines, Limited	Toronto	Dec. 27	2,000,000
Total (24 companies)			18,054,500

[1]See also list with specified capital. Five companies having both specified capital and "no par" shares are included in both lists.

ONTARIO COMPANIES WITH SPECIFIED CAPITAL INCORPORATED IN 1935

Name of company	Head office	Date of incorporation	Capital
Adelaide Gold Mines, Limited	Toronto	Sept. 27	$3,000,000
Aerial Prospectors, Limited	Toronto	Feb. 26	100,000
Amorada Gold Mines, Limited	Toronto	April 3	3,000,000
Ardmore Properties, Limited	Toronto	May 17	40,000
Argosy Gold Mines, Limited	Toronto	May 2	3,000,000
Avon Exploration Company, Limited	Stratford	April 4	100,000
Ascot Gold Mines, Limited	Toronto	April 1	3,000,000
Athabaska Beaverlodge Gold Mines, Limited	Toronto	Mar. 15	3,000,000
Athabaska Grant Mines, Limited	Toronto	Mar. 28	25,000
Athabaska Portal Gold Mines, Limited	Toronto	April 6	3,000,000
Axis Gold Exploration, Limited	Toronto	April 1	40,0000

ONTARIO COMPANIES WITH SPECIFIED CAPITAL INCORPORATED IN 1935—*Continued*

Name of company	Head office	Date of incorporation	Capital
Baden Gold Mines, Limited	Elk Lake	Jan. 24	2,000,000
Beaverhouse Lake Gold Mines, Limited	Haileybury	June 8	3,000,000
Benneweiss Gold Mines, Limited	Toronto	Feb. 1	40,000
Big Master Consolidated Gold Mines, Limited	Toronto	April 2	3,000,000
Big Seven Gold Mines, Limited	Windsor	Oct. 5	40,000
Bluenose Gold Mines, Limited	Toronto	Jan. 21	3,000,000
Brazilian Gold Syndicate, Limited	Toronto	May 13	150,000
Buffalo Beardmore Gold Mines, Limited	Toronto	Jan. 18	3,000,000
Bullion Basin Mines, Limited	Toronto	Dec. 4	1,000,000
Canadian Nepheline, Limited	Toronto	Aug. 19	30,000
Canyon Creek Gold Mines, Limited	Toronto	Mar. 27	3,000,000
Capps Gold Mines, Limited	Toronto	July 9	3,000,000
Ceres Explorations, Limited	Ottawa	Feb. 2	250,000
Champion Long Lac Gold Mines, Limited	Toronto	May 10	5,000,000
Cincinnati-Porcupine Mines, Limited	Toronto	July 5	2,500,000
Corless Patricia Gold Mines, Limited	Toronto	Jan. 7	3,000,000
Crespay Slate Products, Limited	Toronto	Oct. 14	250,000
Dan Cushing, Limited	Toronto	Mar. 2	40,000
Darkwater Mines, Limited	Toronto	Oct. 22	1,500,000
Deseronto Refineries, Limited	Deseronto	Sept. 4	150,000
Duquesne Mines, Limited	Toronto	April 12	5,000,000
Elora Gold Mines, Limited	Toronto	Aug. 20	3,000,000
Emperor Gold Syndicate, Limited	Toronto	Dec. 2	100,000
Excelsior Gold Mines, Limited	Toronto	Feb. 19	100,000
Fairmac Silver Mines, Limited	Toronto	June 14	3,000,000
Falcon Gold Mines, Limited	Toronto	Sept. 10	2,500,000
Florence River (Quebec) Gold Mines, Limited	Toronto	Oct. 11	3,000,000
Fox Lake Gold Mines, Limited	London	May 13	1,000,000
Garth Chiboug Gold Syndicate, Limited	Toronto	May 21	100,000
Geraldton Long Lac Gold Mines, Limited	Toronto	Aug. 14	2,500,000
Gilmour Gold Mines, Limited	Toronto	Aug. 2	3,000,000
Gold Creek Mines, Limited	Toronto	Jan. 8	1,000,000
Gold Fern Mines, Limited	Toronto	April 1	2,000,000
Gold Quartz Mining Corporation, Limited	Toronto	Feb. 12	2,000,000
Goward Gold Mines, Limited	Toronto	Feb. 13	3,000,000
Gunter Galena Mines, Limited	Toronto	April 18	100,000
Harrison-Hibbert Mines, Limited	Toronto	May 30	1,000,000
Hottah Lake Gold and Radium Mines, Limited	Toronto	May 7	3,000,000
Hutchinson Lake Gold Mines, Limited	Toronto	June 27	3,000,000
Industrial Metal Recovery Corporation, Limited	Toronto	July 26	1,000,000
Joannes Gold Mines, Limited	New Liskeard	Aug. 29	3,000,000
Jowsey Denton Gold Mines, Limited	Toronto	Jan. 16	3,000,000
Jubilee Long Lac Gold Mines, Limited	Toronto	Feb. 9	3,000,000
Killeon Gold Syndicate, Limited	Toronto	April 26	35,000
Kittson Hazelton Gold Mines, Limited	Toronto	Jan. 2	3,500,000
Kotter Gold, Limited	Toronto	July 24	40,000
Lacoma Gold Mine, Limited	Toronto	May 11	3,000,000
Lake Expanse Gold Mines, Limited	Toronto	July 8	3,000,000
La Sarre Gold Mines, Limited	Toronto	June 11	3,000,000
Leacroft Mining Service, Limited[1] (private)	Toronto	Sept. 6	10,000
Legren Gold Mines, Limited	Kirkland Lake	June 26	250,000
Leitch Gold Mines, Limited	Toronto	July 23	3,000,000
Liberty-Lorne Gold Mines, Limited	Toronto	Mar. 9	2,500,000
Lost River Gold Mining Company, Limited, The	Kapuskasing	July 13	40,000
M. and R. Airways, Limited[1]	Toronto	May 17	40,000
Macaboug Exploration Company, Limited	Toronto	Sept. 11	75,000
Madsen Red Lake Gold Mines, Limited	Toronto	Mar. 8	3,000,000
Mann Consolidated Silver Mines, Limited	Toronto	July 3	3,000,000
Marten Rapids Gold Syndicate, Limited	Toronto	April 13	125,000
Mines Purchasing Corporation, Limited	Toronto	April 11	100,000
Morris Kirkland Gold Mines, Limited	Toronto	Jan. 11	2,500,000
Mud Lake Gold Mines, Limited	Toronto	Aug. 7	3,000,000

ONTARIO COMPANIES WITH SPECIFIED CAPITAL INCORPORATED IN 1935—*Continued*

Name of company	Head office	Date of incorporation	Capital
Murmac Lake Athabaska Mines, Limited	Toronto	April 5	3,000,000
New Golden Rose Mines, Limited	Toronto	April 4	3,000,000
Norcastle Gold Mines, Limited	Toronto	Aug. 7	1,500,000
Olive Gold Mines, Limited	Toronto	Jan. 4	3,000,000
Omega Gold Mines, Limited	McVittie	May 16	5,000,000
Orphan Gold Mines, Limited	Jellicoe	May 4	2,000,000
Parmoray Development and Mining Co., Ltd.	Toronto	Mar. 12	40,000
Perseverance Mining and Development Co., Ltd.	Toronto	May 17	100,000
Polaris Gold Mines (Canada), Limited	Toronto	April 12	3,000,000
Porcupine Reef Gold Mines, Limited	Toronto	Oct. 1	3,000,000
Porquin Gold Mines, Limited	Toronto	Aug. 27	3,000,000
Primrose Exploration Company, Limited	Ottawa	July 19	250,000
Producer Mines, Limited	Toronto	May 9	200,000
Prospectors' Interests, Limited	Toronto	April 9	100,000
Quebec Maidens Silver Prospectors, Limited	Toronto	May 29	25,000
Rhodes Exploration and Finance of Canada, Limited	Toronto	April 17	250,000
Rosedale Gold Mines, Limited	Toronto	May 3	3,000,000
Sagamore Mines, Limited	Toronto	Aug. 29	3,000,000
Sagawitchewan Gold Mines, Limited	Toronto	Mar. 1	3,000,000
Sand River Gold Mining Company, Limited	Toronto	Feb. 8	3,000,000
Shenango Gold Mines, Limited	Toronto	Mar. 14	3,000,000
Shinintree Gold Mines, Limited	Toronto	Mar. 19	1,000,000
Silverado Gowganda Mines, Limited	Toronto	April 27	2,000,000
Skookum Gold Mines, Limited	Toronto	Dec. 19	4,000,000
Soo Diamond Drilling Company, Limited[1]	Sault Ste. Marie	Jan. 12	30,000
South Tiblemont Gold Mines, Limited	Toronto	Feb. 7	2,500,000
Spooner Gold Mines, Limited	Toronto	Jan. 5	3,000,000
St. Albans Canadian Gold Holdings, Limited	Ottawa	June 18	100,000
States-Canadian Gold Mine, Limited	Toronto	June 6	60,000
Sycee Cobalt Silver Mines, Limited	Toronto	July 30	1,000,000
Tecumseh Gold Mines, Limited	Toronto	April 18	2,000,000
Tombill Gold Mines, Limited	Empire	Oct. 17	1,000,000
Transcanada Share Corporation, Limited	Toronto	Jan. 7	500,000
Trinova Cobalt Silver Mines, Limited	Toronto	July 11	1,500,000
Tyranite Mines, Limited	Kirkland Lake	Sept. 23	3,000,000
Universal Gold Investments, Limited	Toronto	Mar. 26	505,000
Val D'Or Mineral Holdings, Limited	Toronto	Sept. 5	750,000
Vanderbilt Gold Mines, Limited	Toronto	Sept. 12	500,000
Vortex Deloro Mines, Limited	Toronto	May 10	40,000
Wendigo Mines, Limited	Toronto	Jan. 4	2,000,000
Wesley Gold Mines, Limited	Toronto	Feb. 6	3,000,000
White Otter Mines, Limited	Hamilton	June 10	500,000
Wilport Gold Mines, Limited	Toronto	Nov. 14	3,000,000
Total (116 companies)			$205,320,000

[1]"No par" shares issued in addition. See list of companies having shares without nominal or par value.

Mining Revenue and Expenditures

The revenue of the Department of Mines for the fiscal year ending October 31, 1934, was $1,487,886.94, as compared with $942,721.62 in the previous year. Expenditures were $298,520.74. In February, 1935, the end of the fiscal year for provincial revenue accounts was changed by the Legislature from October 31 to March 31. The first table below covers a five months' period, November 1, 1934, to March 31, 1935, and the second, the fiscal year ending March 31, 1936.

REVENUE, DEPARTMENT OF MINES, NOV. 1, 1934, TO MAR. 31, 1935

ORDINARY:		
Sand and gravel—		
Royalties	$12,225.21	
Licenses	200.00	$12,425.21
Casual fees	$501.40	
Sale of record books, Unwrought Metal Sales Act	26.00	
Gas leases	400.00	927.40
Inspection—cable-testing fees		2,243.01
Assessment—		
Acreage tax	$10,725.56	
Gas tax	819.72	11,545.28
Chemical and assay—fees		878.10
Mine rentals—		
Mining leases	$3,002.87	
Licenses of occupation	4,534.14	7,537.01
Miners' licenses		16,6059.2
Fees—		
Recording	$34,785.93	
Miscellaneous	1,750.50	
Maps—sales	916.52	37,452.95
Natural Gas Commissioner—permits	$1,270.81	
Sulphur Fumes Arbitrator—damages	2,248.98	
Temiskaming Testing Laboratories—fees	4,766.71	
Salaries, expenses, etc	30.00	8,316.50
		$97,934.71
CAPITAL:		
Mining recorders—mining land sales		32.403.47
Total revenue		$130,338.18

REVENUE, DEPARTMENT OF MINES, APRIL 1, 1935, TO MAR. 31, 1936

ORDINARY:		
Sand and gravel—		
Royalties	$24,333.57	
Licenses	1,550.00	$25,883.57
Casual fees	$1,432.26	
Sale of record books, Unwrought Metal Sales Act	41.15	
Gas leases	5,770.00	
Expenses re lignite	12.00	
Dredging leases	112.00	7,367.41
Inspection—cable-testing fees		5,030.57
Assessment—		
Acreage tax	$42,554.20	
Profit tax	1,400,656.14	
Gas tax	33,626.14	1,476,836.48
Chemical and assay—fees		1,854.63
Mine rentals—		
Mining leases	$8,986.04	
Licenses of occupation	5,261.62	14,247.66
Miners' licenses		70,328.79
Fees—		
Recording	$106,125.29	
Miscellaneous	4,870.23	
Maps—sales	2,680.26	
Sale of machinery	150.00	113,825.78
Natural Gas Commissioner—permits	$1,487.51	
Sulphur Fumes Arbitrator—damages	4,284.37	
Temiskaming Testing Laboratories—fees	17,291.71	
Salaries, expenses, etc	102.00	23,165.59
		$1,738,540.48
CAPITAL:		
Mining recorders—mining land sales		49,103.27
Total revenue		$1,787,643.75

SUMMARY OF BUSINESS TRANSACTED IN THE SEVERAL MINING DIVISIONS DURING 1935

Schedule item	Fort Frances	Sudbury	Porcupine	Larder Lake	Sault Ste. Marie	Port Arthur	Kowkash	Timiskaming	Gowganda	Montreal River	Kenora	Red Lake	Total
1. Letters received	1,007	3,947	2,917	4,191	2,107	3,077	842	1,325	788	1,036	2,860	2,262	26,359
2. Letters written	1,194	3,549	2,891	4,063	2,014	2,887	861	1,090	665	1,144	2,662	2,109	25,129
3. Miner's Licenses issued	71	675	350	430	170	631	88	188	.....	91	278	363	3,335
4. Miner's Licenses renewed	142	694	450	1,018	269	1,126	69	425	69	241	209	401	5,113
5. Mining claims recorded[1]	207	2,013	729	1,258	429	1,815	84	290	205	276	874	754	8,934
6. Mining claims cancelled	223	2,227	484	2,010	144	2,310	35	313	129	523	426	416	9,240
7. Agreements, transfers, etc., recorded	96	1,169	351	664	406	2,262	49	91	136	236	525	411	6,396
8. Receipts for Miner's Licenses, Permits, Recording Fees, etc	$3,139.00	$25,808.25	$11,471.85	$19,747.00	$6,737.05	$33,290.65	$1,681.75	$5,529.00	$2,094.25	$4,798.25	$11,936.60	$13,526.50	$139,760.15
9. Receipts as Purchase Money or Rental	$1,420.73	$13,972.12	$6,671.30	$4,359.91	$2,663.98	$12,760.43	$635.02	$208.60	$404.45	$1,061.42	$1,431.69	$11,142.29	$56,731.94
10. Total remitted to Department	$4,559.73	$39,780.37	$18,143.15	$24,106.91	$9,401.03	$46,051.08	$2,316.77	$5,737.60	$2,498.70	$5,859.67	$13,368.29	$24,668.79	$196,492.09
11. Claims of which surveyors' plans were filed	.....	8	.....	20	32	157	12	7	16	9	7	86	354
12. Disputes entered	.....	8	2	12	3	36	.....	.....	.....	.....	10	12	83
13. Disputed cases decided by Recorders	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14. Appeals to Mining Court	.....	8	.....	12	.....	.....	.....	.....	.....	.....	.....	.....	20
15. Extensions of time granted	144	821	399	890	227	1,531	59	33	64	238	495	981	5,882
16. Certificates of Record granted	13	35	60	61	29	127	5	6	12	22	19	126	515
17. Certificates of Performance of Work granted	13	39	63	48	33	132	5	14	11	22	19	124	523
18. Claims for which papers were forwarded to the Department for issue of title	13	118	62	56	22	130	5	3	11	22	19	123	584
19. Forest Reserve Permits issued	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20. Substitute Miner's Licenses issued	3	7	4	9	1	14	2	.....	.....	4	1	4	49
21. Abstracts issued	286	1,717	932	1,464	497	3,939	182	169	377	552	1,088	1,268	12,471
22. Blue-prints sold	124	1,000	1,000	1,848	293	749	59	361	.....	501	249	233	6,412

[1]In addition, the claims recorded at the Department of Mines at Toronto were 829, making a total of 9,763 for the province, as compared with 3,886 in 1930; 5,779 in 1931; 4,945 in 1932; 8,077 in 1933; and 16,888 in 1934. The previous peak year was 1927, when 15,564 claims were recorded.

STATEMENT OF MONIES REMITTED BY MINING RECORDERS, NOV. 1, 1934, TO MAR. 31, 1935

Mining division	Name of recorder	Address	Purchase price	Maps	Miscellaneous fees	Miner's licenses	Recording fees	Total
Fort Frances	Alexander, J. A	Fort Frances	$1,059.00	$23.00	$196.00	$148.00	$640.00	$2,066.00
Kowkash	Bolduc, J. P	Tashota		5.25	12.50	89.00	628.00	734.75
Montreal River	Coghill, J. M	Elk Lake	923.83	20.25	81.75	165.00	1,151.00	2,341.83
Gowganda	Coghill, J. M	Elk Lake			15.50	42.00	228.00	285.50
Porcupine	O'Rourke, M. F	South Porcupine	4,679.56	66.25	159.25	459,00	2,002.56	7,366.62
Larder Lake	Ginn, H. G	Swastika	3,091.53	173.00	165.25	989.00	6,523.00	10,941.78
Red Lake	Holland, H. E	Goldpines	1,665.15	32.00	229.50	376.00	2,666.00	4,968.65
Sudbury	McArthur, T. A	Sudbury	13,768.71	56.50	203.25	704.00	3,062.00	17,794.46
Timiskaming	McAulay, N. J	Haileybury	49.00	19.25	24.00	383.00	841.00	1,316.25
Port Arthur	McGregor, C. F	Port Arthur	7,576.00	141.50	525.65	1,326.00	10,090.00	19,659.15
Sault Ste. Marie	Miller, W. N	Sault Ste. Marie	197.50	39.25	76.75	310.00	2,126.00	2,749.50
Kenora	Smith, J. D. C	Kenora	727.75	29.00	61.10	299.00	3,503.00	
Total			$33,738.03	$605.25	$1,750.50	$5,290.00	$33,460.56	$74,844.34

STATEMENT OF MONIES REMITTED BY MINING RECORDERS FOR THE FISCAL YEAR ENDING MARCH 31, 1936

Mining division	Name of recorder	Address	Purchase price	Maps	Miscellaneous fees	Miner's licenses	Recording fees	Sale of machinery	Total
Fort Frances	Alexander, J. A	Fort Frances	$998.63	$68.00	$666.50	$1,378.00	$1,365.00		$4,476.13
Kowkash	Story, M. A	Tashota	522.26	17.00	54.75	959.25	1,000.00		2,553.76
Montreal River	Bolduc, J. P	Elk Lake	378.55	133.80	186.45	2,294.00	3,103.65		6,096.45
Gowganda	Bolduc, J. P	Elk Lake	404.45		94.00	315.00	1,586.00		2,399.45
Porcupine	O'Rourke, M. F	South Porcupine	3,281.27	305.50	346.75	5,348.00	11,547.10		20,828.62
Larder Lake	Ginn, H. G	Swastika	4,330.97	508.25	473.75	9,236.00	12,630.70		27,179.67
Red Lake	Holland, H. E	Goldpines	12,607.52	118.25	593.25	5,087.00	8,946.00		27,352.02
Sudbury	McArthur, T. A	Sudbury	4,300.64	271.00	721.75	7,923.00	20,317.60		33,533.99
Timiskaming	McAulay, N. J	Haileybury	211.80	115.00	120.25	4,123.00	4,022.00		8,592.05
Port Arthur	McGregor, C. F	Port Arthur	5,907.30	294.00	1,122.43	9,899.00	21,783.00		39,005.73
Sault Ste. Marie	Miller, W. N	Sault Ste. Marie	3,025.98	70.00	197.25	2,566.00	4,546.30		10,405.53
Kenora	Smith, J. D. C	Kenora	599.05	134.25	293.10	3,006.00	10,016.00	$150.00	14,198.40
Total			$36,568.42	$2,035.05	$4,870.23	$52,134.25	$100,863.85	$150.00	$196,621.80

MINING CLAIMS RECORDED IN THE SEVERAL MINING DIVISIONS, 1907 AND 1916–1935

Mining division	1907	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935
Coleman[1]	291	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	70	75	175	98	137	313	237
Fort Frances	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	34	244	377	114	122	207	205
Gowganda	.....	51	113	52	145	215	101	55	33	444	220	96	24	40	348	194	109	203	329	933	874
Kenora	.....	45	32	48	31	25	53	168	150	77	229	935	140	520	368	319	12	56	40	84	231	84
Kowkash	.....	160	135	2	9	31	3	148	206	438	150	28	250	368	891	424	628	790	1,730	2,611	1,258
Larder Lake	3,813	783	160	423	1,015	712	918	2,344	1,736	1,219	890	1,532	3,141	1,781	424	661	1,127	156	444	627	276
Montreal River	866	56	294	293	134	81	143	174	400	471	471	290	126	156	48	.....	.....	.....	.....	.....	754
Parry Sound[2]	102	10	25	12	39	33	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Porcupine	.....	401	236	48	136	192	273	760	1,424	556	620	1,297	3,127	611	650	135	307	387	613	785	729
Port Arthur	317	172	180	66	171	108	120	296	222	300	494	1,278	982	1,269	691	338	609	475	900	6,842	1,815
Red Lake	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5,827	2,018	1,100	973	305	298	185	343	1,036	754
Sault Ste. Marie	291	44	135	199	90	90	216	541	498	284	451	395	735	702	487	318	276	92	450	532	429
Sudbury	456	464	262	168	673	267	319	701	436	559	546	1,367	3,351	6,424	2,164	807	1,597	1,986	2,362	1,549	2,013
Timiskaming	7,860	156	269	184	244	329	159	328	971	735	634	438	875	499	346	202	78	68	256	688	290
At Toronto	.....	128	95	39	231	87	145	171	116	139	226	203	795	1,576	1,186	171	142	356	307	534	476
Total	13,996	2,470	1,936	1,534	2,918	2,160	2,459	5,686	6,092	5,222	4,751	13,496	15,564	15,046	8,207	3,886	5,779	4,945	8,077	16,888	9,440

[1]Joined with Timiskaming since 1911. [2]Office at Parry Sound was closed in 1921, and records are now kept at the Department of Mines, Toronto.

Under *The Mining Tax Act*, a graduated tax is levied on the net profits of mining companies in excess of $10,000 per annum. The basic rate is 3 per cent. on profits up to $1,000,000. On profits over $1,000,000 and up to $5,000,000, the tax is 5 per cent.; and on profits in excess of the latter amount, the rate is 6 per cent. A part of this money is returned to organized municipalities.

The following statement, prepared by the Accounts Branch of the Department, gives details of the profit tax collected under the supervision of G. R. Mickle, Mine Assessor, for the year 1935:—

DETAILS OF PROFIT TAX

GOLD:		
Anglo-Huronian, Limited	$662.00	
Ashley Gold Mining Corporation, Limited	420.81	
Dome Mines, Limited	129,237.49	
Hollinger Consolidated Gold Mines, Limited	157,056.15	
Howey Gold Mines, Limited	8,649.85	
Kirkland Lake Gold Mining Company, Limited	983.35	
Lake Shore Mines, Limited	404,738.42	
Macassa Mines, Limited	8,289.39	
McIntyre-Porcupine Mines, Limited	116,233.75	
Minto Gold Mines, Limited	345.23	
Parkhill Gold Mines, Limited	976.19	
Sylvanite Gold Mines, Limited	11,461.13	
Teck-Hughes Gold Mines, Limited	77,127.63	
Toburn Gold Mines, Limited	3,995.74	
Wright-Hargreaves Mines, Limited	128,407.25	
		$1,048,584.38
SILVER:		
Beaver mine	$47.28	
Cobalt Properties, Limited	454.28	
Nipissing Mining Company, Limited	1,207.35	
O'Brien, M. J., Limited (O'Brien mine, $2,798.53; Miller Lake O'Brien mine, $5,114.42)	7,912.95	
		9,621.86
NICKEL-COPPER:		
Falconbridge Nickel Mines, Limited	$16,917.12	
International Nickel Company of Canada, Limited	325,532.78	
		342,449.90
Total		$1,400,656.14

The figures of monies derived from sales and leases, divided according to district, do not agree with corresponding items of the preceding revenue statements, which record collections of monies actually received during the periods. Details are given in the following tables, the first of which covers the five months, November 1, 1934, to March 31, 1935, and the second, the fiscal year ending March 31, 1936.

MINING LANDS SOLD AND LEASED, NOV. 1, 1934, TO MAR. 31, 1935

District	Sales			Leases			Total sales and leases		
	No.	Acres	Amount	No.	Acres	Amount	No.	Acres	Amount
Algoma	15	643.07	$1,785.37				15	643.07	$1,785.37
Cochrane	55	2,019.13	5,333.39				55	2,019.13	5,333.39
Kenora	24	659.77	1,655.21				24	659.77	1,655.21
Nipissing									
Patricia	28	1,097.75	3,191.52				28	1,097.75	3,191.52
Rainy River	9	303.60	759.00				9	303.60	759.00
Sudbury	117	4,498.37	17,816.63				117	4,498.37	17,816.63
Thunder Bay	41	1,599.81	4,188.30	7	298.32	$298.32	48	1,898.13	4,486.62
Timiskaming	25	853.41	2,229.62	9	391.71	416.73	34	1,245.12	2,646.35
Elsewhere	4	182.17	49.29				4	182.17	49.29
Total	318	11,857.08	$37,008.33	16	690.03	$715.05	334	12,547.11	$37,723.38

MINING LANDS SOLD AND LEASED FOR FISCAL YEAR ENDING MARCH 31, 1936

District	Sales			Leases			Total sales and leases		
	No.	Acres	Amount	No.	Acres	Amount	No.	Acres	Amount
Algoma	31	1,039.85	$2,878.48	10	394.60	$394.60	41	1,434.45	$3,273.08
Cochrane	45	1,697.70	4,988.88	....	.....	.....	45	1,697.70	4,988.88
Kenora	60	2,246.75	5,695.95	....	.....	.....	60	2,246.75	5,695.95
Nipissing	3	114.75	344.25	2	63.22	6.33	5	177.97	350.58
Patricia	168	6,755.09	17,316.96	....	.....	.....	168	6,755.09	17,316.96
Rainy River	12	504.85	1,406.13	....	.....	.....	12	504.85	1,406.13
Sudbury	45	1,621.44	5,405.26	16	678.95	80.60	61	2,300.39	5,485.86
Thunder Bay	87	3,230.88	8,762.78	5	226.22	235.04	92	3,457.10	8,997.82
Timiskaming	43	1,627.45	4,262.66	74	2,734.71	1,659.11	117	4,362.16	5,921.77
Elsewhere	1	200.00	50.00	....	.....	.....	1	200.00	50.00
Total	495	19,038.76	$51,111.35	107	4,097.70	$2,375.68	602	23,136.46	$53,487.03

The following is a comparative statement of mining licenses and renewals issued, claims recorded, profit tax, and total revenue during the past ten years:—

PROSPECTING ACTIVITY, PROFIT TAX, AND TOTAL REVENUE, 1926–1935

Year	Calendar year					Fiscal year[1]
	New miner's licenses issued	Miner's licenses renewed	Total licenses and renewals	Mining claims recorded	Profit tax	Total mining revenue
1926	6,631	5,521	12,152	13,486	$410,974.17	$838,415.81
1927	6,923	7,221	14,144	15,564	340,890.08	839,793.43
1928	6,059	8,688	14,747	15,046	356,033.83	968,243.84
1929	3,271	8,049	11,320	8,207	397,004.41	882,026.05
1930	1,554	5,885	7,439	3,886	502,525.38	1,017,030.67
1931	2,174	4,808	6,982	5,779	480,300.69	799,240.06
1932	2,035	3,670	5,705	4,945	515,153.59	793,759.20
1933	3,365	3,911	7,276	8,077	679,731.07	942,721.62
1934	7,409	4,757	12,166	16,888	1,073,824.46	1,487,886.94
1935	3,335	5,113	8,448	9,763	1,400,656.14	[2]1,917,981.93

[1]Up to and including 1934, the fiscal year was from November 1 of the previous year to October 31 of the year shown. The fiscal year now ends on March 31.

[2]Includes $130,338.18 for the five months' period November 1, 1934, to March 31, 1935, and $1,787,643.75 for the new fiscal year ending March 31, 1936.

Temiskaming Testing Laboratories

This plant, located at Cobalt and equipped for sampling and assaying, has been operated by the Department since July, 1921, under the management of A. A. Cole, mining engineer, of the T. & N. O. Railway Commission.

COMPARATIVE FINANCIAL STATEMENT OF THE TEMISKAMING TESTING LABORATORIES, 1922–1935

Year	Cash receipts	Earnings	Expenditures	Operating profit	Operating loss
1922	$18,096.19	$17,749.51	$19,173.19	.....	$1,424.68
1923	18,699.22	20,117.81	19,781.25	$336.56	.....
1924	26,032.20	25,417.61	23,206.66	2,200.95	.....
1925	19,922.37	20,041.08	20,043.31	.....	2.23
1926	20,302.51	21,119.98	20,658.19	461.79	.....
1927	19,387.66	19,400.55	20,012.09	.....	611.54
1928	14,875.58	14,369.66	18,181.68	.....	3,812.02
1929	19,604.70	21,690.60	18,088.41	3,602.19	.....
1930	25,070.27	24,316.82	24,153.03	163.79	.....
1931	18,522.88	20,770.06	23,553.61	.....	2,783.55
1932	13,323.28	11,150.42	15,219.64	.....	4,069.22
1933	6,206.68	6,508.49	13,318.18	.....	6,809.69
1934	9,816.20	11,359.81	12,762.68	.....	1,402.87
1935	15,149.00	15,405.80	15,212.83	192.97	.....

Provincial Assay Office

W. K. McNeill, Provincial Assayer and Chemist, reports as follows:—

The Provincial Assay Office, which was established in Belleville in 1898, as an aid in the development of the mineral resources of Ontario, is now situated in the East Block, Queen's Park, Toronto.

During the year 1935, a total of 5,407 samples were received at the office and reports on them issued. Of these, 3,548 were done free, as provided by R.S.O., Chap. 45, Sec. 69.

In addition complete analyses were made of 20 rocks for the geologists employed by the Department of Mines, and 218 samples were identified and reports on them issued. Several hundred samples were brought directly to the Laboratory; of these no records are kept.

Forty samples of peat were tested for the geologists of the Department and several samples of water for the Natural Gas Commissioner.

The work of the Branch was carried on with the assistance of T. E. Rothwell and W. F. Green, assayers and chemists, and Robert Stewart and William Ley, laboratory assistants.

The schedules of charges for the Provincial Assay Office and Chemical Laboratory may be obtained on application. Minerals and rocks not requiring chemical analysis are identified free of charge. Tests for radio-activity are free.

Draughting Office, North Bay

As mining claims are recorded in each mining division, sketches and recording notices are forwarded by the recorders to the Draughting Office, North Bay, and the same practice applies when surveys are filed. Tracings are prepared from the data furnished and blue-prints supplied to the recorders and to the general public at a nominal charge. North Bay is a convenient centre, and considerable time for Northern Ontario residents is saved through the mails compared with former practice when blue-prints were prepared at Toronto. The office was established in February, 1920. It is now in charge of A. D. Williams.

LIST OF MINES, QUARRIES, AND WORKS, 1935

METALLICS

Operator	Mine	Manager	Address
CHROMIUM			
Chromium Mining and Smelting Corp., Ltd.	Obonga Lake	A. R. Globe	Collins.
GOLD[1]			
Algold Mines, Ltd.	Algold	R. F. Mitchell	Goudreau.
*Algoma Summit Gold Mines, Ltd.	McCarthy-Webb (tp. 49, range 27)	F. A. Brant	Goudreau.
Alschbach Gold Mining Co., Ltd.	Alschbach	C. Alschbach	Goldthorpe.
*Anglo-Huronian, Ltd.	Vipond	W. R. Adam	Timmins.
Arbade Gold Mines, Ltd.	Arbade		10 Adelaide St. E., Toronto.
*Ardeen Gold Mines, Ltd.	Moss	W. R. Osborne	Tip Top Spur, via Port Arthur.
Argosy Gold Mines, Ltd.	Argosy	R. Massey Williams	Casummit Lake, via Sioux Lookout.
*Ashley Gold Mining Corporation, Ltd.	Ashley	J. W. Robertson	Elk Lake.
Atnel Mines, Ltd.	Atnel		Hawk Junction.
Bankfield Gold Mines, Ltd.	Bankfield	J. W. MacKenzie	Geraldton.
*Barry-Hollinger Mines, Ltd.	Barry-Hollinger		57 Bloor St. W., Toronto.
*Bidgood Kirkland Gold Mines, Ltd.	Bidgood	O. L. Knutson	Kirkland Lake.
Bilmac Gold Mines, Ltd.	Bilmac		33 Temperance St., Toronto.
Bob Tough Gold Mines, Ltd.	Bob Tough		207 Turner Bldg., Hamilton.
Bousquet Gold Mines, Ltd.	Bousquet	Lionel Brooke	171 Yonge St., Toronto.
Bramor Mining (Ontario), Ltd.	Bramor	G. F. Milne	Shiningtree.
*Buffalo Ankerite Gold Mines, Ltd.	Buffalo Ankerite Marbuan	Chas. L. Hershman	South Porcupine.
Buffalo Beardmore Gold Mines, Ltd.	Buffalo Beardmore	L. Bruce	Empire.
*Canusa Gold Mines, Ltd.	Canusa	Robt. Schram	South Porcupine.
Canyon Creek Gold Mines, Ltd.	Canyon Creek	E. B. James	Shiningtree.
*Caouette Claims (Afton)	Caouette claims		217 Bay St., Toronto.
Casey Contact Gold Mines, Ltd.	Brennan-Kenty	H. M. Parrington	Jellicoe.
Central Matachewan Mining Corp., Ltd.	Central Matachewan		330 Bay St., Toronto.
*Central Patricia Gold Mines, Ltd.	Central Patricia	A. J. Anderson	Pickle Crow.
Central Porcupine Mines, Ltd.	Central Porcupine	F. G. Stevens	Schumacher.
Churchill Mining and Milling Co., Ltd.	Churchill		45 Richmond St. W., Toronto.
*Clark Gold Mines, Ltd.	Clark	R. R. Clark	Dyment.

[1]The names of companies whose mines are producing are marked with an asterisk (*).

Operator	Mine	Manager	Address
	GOLD—*Continued*		
Cole Gold Mines, Ltd	Cole	John Y. Cole	Cole.
*Concordia Gold Mining Co., Ltd	Jones-Porter	C. L. Laederer	Timmins.
*Cone, Russell C. (under lease)	Lucky Coon	Russell Cone	Mine Centre.
*Coniaurum Mines, Ltd	Coniaurum	John Redington	Schumacher.
Consolidated Mining and Smelting Co. of Canada, Ltd.	Afton[1]	D. C. McKechnie	Sudbury.
	Cordova	C. A. Seaton	Cordova.
Consolidated Mining and Smelting Co. of Canada, Ltd. (under option).	Golden Horn.		
	McKenzie	A. S. Hudson	Matheson.
	Rich Rock	C. E. White	Flinton.
Cooper, W. D., and Barry, P. A. (under lease)	McIntyre Birch Lake.		
Corless Patricia Gold Mines, Ltd	Corless Patricia	W. M. Rice	Jackson Manion.
Coulson Consolidated Gold Mines, Ltd	Coulson		Painkiller Lake, via Matheson.
Craig Gold Mines, Ltd	Craig	E. B. E. de Camps	330 Bay St., Toronto.
*Darwin Gold Mines, Ltd	Darwin	M. H. Frohberg	Gold Park.
Delnite Mines, Ltd	Delnite	J. F. R. Akehurst	Timmins.
De Santis Porcupine Mines, Ltd	De Santis	Peter De Santis	Box 1299, Timmins.
*Dome Mines, Ltd	Dome	J. H. Stovel	South Porcupine.
Dumond Mining and Exploration Co., Ltd	Dumond	A. E. Dumond	New Liskeard.
*Duport Mining Co., Ltd	Duport	J. G. Cross	Kenora.
Edgelake Gold Mining Co., Ltd	Edgelake	J. M. Forbes	Box 128, Schumacher.
Edwards Gold Mines, Ltd	Edwards		302 Sterling Tower Bldg., Toronto.
Elizabeth Gold Syndicate	Elizabeth		9 Adelaide St. E., Toronto.
Falcon Gold Mines, Ltd	McConnell	Lionel Brooke	200 Bay St., Toronto.
*Fleming, P. M	Argonaut	P. M. Fleming	Haileybury.
Foley O'Brien Corporation, Ltd	Foley O'Brien		South Porcupine.
Fort Hope Consolidated Gold Mines, Ltd	Fort Hope		507 Confederation Life Bldg., Toronto.
Fox Lake Gold Mines, Ltd	Fox Lake	L. W. Adams	Espanola.
Franklin Gold Mining Co., Ltd	Ontario Champion		330 Bay St., Toronto.
*Gillies Lake–Porcupine Gold Mines, Ltd	Gillies Lake–Porcupine	G. C. Chase	Box 2048, Timmins.
Gilmour Gold Mines, Ltd	Gilmour	A. A. Kenniger	Gilmour.
Gold Eagle Gold Mines, Ltd	Gold Eagle	F. M. Passow	McKenzie Island.
Golden Arm Mines, Ltd	Golden Arm	W. S. Hall	Red Lake.
Golden Gate Mining Co., Ltd	Golden Gate	S. A. Pain	Swastika.
Golden Summit Mines, Ltd	Golden Summit	Wm. J. Simpson	Sesekinika.
Gomak Mines, Ltd	Gomak	R. D. Jones	Gogama.
Goward Gold Mines, Ltd	Goward	P. G. Ferguson	Haileybury.
*Halcrow-Swayze Mines, Ltd	Halcrow-Swayze		709 Excelsior Life Bldg., Toronto.

[1]The Afton property is now called the New Golden Rose.

Hard Rock Gold Mines, Ltd	Hard Rock	J. C. Dumbrille	Geraldton.
*Harkness-Hays Gold Mines, Ltd	Harkness-Hays	J. F. Anderson	Schreiber.
Hillside Gold Mines, Ltd	Hillside		645 Queen St. E., Sault Ste. Marie, Ont.
*Hollinger Consolidated Gold Mines, Ltd.[1]	Brennan David (Hislop)		Ramore.
	Hollinger	John Knox	Timmins.
Hollinger Consolidated Gold Mines, Ltd. (under option).	Horwood Lake (Smith-Thorne)	G. F. Gibbs	Tionaga.
Horseshoe Mines, Ltd	Horseshoe	Frank Williams	Box 811, Kenora.
*Howey Gold Mines, Ltd	Howey	Edward Futterer	Red Lake.
Hudson-Patricia Gold Mines, Ltd	Hudson-Patricia	J. M. Thompson	Narrow Lake, via Sioux Lookout.
Jellicoe Gold Mining Co., Ltd	Jellicoe		83 Richmond St. W., Toronto.
*J-M Consolidated Gold Mines, Ltd	J-M Consolidated	D. M. Thomson	Jackson Mansion.
*Kenora Prospectors and Miners, Ltd	Cedar Island	Hilding Johnson	Kenora.
Kirkland Consolidated Mines, Ltd	Kirkland Consolidated		702 Excelsior Life Bldg., Toronto.
Kirkland Gold Rand, Ltd	Kirkland Gold Rand	C. Spearman	360 St. James St. W., Montreal.
Kirkland–Hudson Bay Gold Mines, Ltd	Kirkland–Hudson Bay		Box 700, New Liskeard.
*Kirkland Lake Gold Mining Co., Ltd	Kirkland Lake Gold	P. J. Harris	Kirkland Lake.
Lafayette Long Lac Gold Mines, Ltd	Lafayette Long Lac	J. A. Brownlee	Geraldton.
La Fond Gold Mines, Ltd	La Fond		701 Excelsior Life Bldg., Toronto.
*Lake Shore Mines, Ltd	Lake Shore	E. W. Todd	Kirkland Lake.
L. B. United Mines, Ltd. (under option)	Centennial	L. K. Lytle	Gold Park.
Lebel Oro Mines, Ltd	Long Lake	Wm. D. M. Ross	Box 156, Sudbury.
Leitch Gold Mines, Ltd	Leitch	W. J. Hacker	Empire.
*Little Long Lac Gold Mines, Ltd	Little Long Lac	A. A. Barton	Oklend.
Longlac Lagoon Gold Mines, Ltd	Longlac Lagoon		85 Richmond St. W., Toronto.
*Macassa Mines, Ltd	Macassa	G. A. Howes	Kirkland Lake.
Macandrew Red Lake Gold Mines, Ltd	Macandrew	N. R. Morrison	Red Lake.
*Mac-Auer Gold Mines, Limited	Mac-Auer		University Tower, Montreal, Que.
McDonough Mining Syndicate, Ltd	McDonough		67 Yonge St., Toronto.
*McIntyre-Porcupine Mines, Ltd	McIntyre-Porcupine	R. J. Ennis	Schumacher.
Macjoe Sturgeon Gold Mines, Ltd	Macjoe	A. Rosenland	Jellicoe.
*McKenzie Red Lake Gold Mines, Ltd	McKenzie Red Lake	J. L. Ramsell	McKenzie Island.
*McLaren-Porcupine Gold Mines, Ltd	McLaren-Porcupine	J. M. McLaren	South Porcupine.
MacLeod-Cockshutt Gold Mines, Ltd	MacLeod-Cockshutt		85 Richmond St. W., Toronto.
*McMartin, J. Bruce	Dikdik	J. Bruce McMartin	941 Dominion Square Bldg., Montreal.
*McMillan Gold Mines, Ltd	McMillan	G. M. Miller	Sudbury.
Madsen Red Lake Gold Mines, Ltd	Madsen Red Lake	A. Honsberger	Red Lake.
Magnet Lake Gold Mines, Ltd	Magnet Lake		85 Richmond St. W., Toronto.
Manitoba and Eastern Mines, Ltd	Manitoba and Eastern	Jas. G. MacGregor	Timagami.
Martin Bird Syndicate	Martin Bird	John Campbell	Larder Lake.
*Matachewan Consolidated Mines, Ltd	Matachewan Consolidated	Thos. L. Wells	Elk Lake.
Matachewan Pioneer Syndicate	Matachewan Pioneer	H. A. Steven	Matachewan.
May-Spiers Gold Mines, Ltd	May-Spiers	Nelson Spiers	Red Lake.

[1]See also Young-Davidson Mines, Ltd.

Operator	Mine	Manager	Address
	GOLD—*Continued*		
*Miller Independence Mines (1924), Ltd	Miller Independence		39 New Bank of Toronto Bldg., London.
Milmac Mines, Ltd	Milmac		612 Queen St. E., Sault Ste. Marie.
*Minto Gold Mines, Ltd	Cooper	John Knox, Jr.	Wawa.
	Jubilee		
*Moffatt-Hall Mines, Ltd	Moffatt-Hall	C. F. Tuer	Haileybury.
Morris Kirkland Gold Mines, Ltd	Morris Kirkland	T. C. Fawcett	King Kirkland.
*Munro Croesus Mines, Ltd	Munro Croesus	J. E. Grant	Haileybury.
Murray-Algoma Mining Co., Ltd	Murray-Algoma	G. J. Lamb	Hawk Junction.
Murwood Gold Mines, Ltd. (under option)	Big Master	E. A. Boadway	Wabigoon.
*Naybob Gold Mines, Ltd	Haydèn	Robt. J. Naylor	Timmins.
Neville Canadian Gold Mines, Ltd	Neville Canadian		347 Bay St., Toronto.
*North Shores Gold Mines, Ltd	North Shores	D. E. Graham	Schreiber.
*Northern Empire Mines Co. Ltd	Northern Empire	R. J. Hendricks	Empire.
Northern Mines, Incorporated	Wabigoon-Contact		516 Wallbridge Bldg., Buffalo, N.Y.
Olive Gold Mines, Ltd	Olive	F. G. Huycke	Mine Centre.
Omega Gold Mines, Ltd	Omega	A. D. Campbell	Larder Lake.
Oro Plata Mining Co., Ltd	Oro Plata		1005 Federal Bldg., Toronto.
Pamour Porcupine Mines, Ltd	Pamour	R. M. Macaulay	Pamour.
*Parkhill Gold Mines, Ltd	Parkhill	R. E. Barrett	Gold Park.
*Paymaster Consolidated Mines, Ltd	Paymaster Consolidated	Chas. E. Cook	South Porcupine.
*Pickle Crow Gold Mines, Ltd	Pickle Crow	Alex. G. Hattie	Pickle Crow.
Porcupine Lake Gold Mining Co., Ltd	Porcupine Lake (Hunter)		112 Yonge St., Toronto.
Porcupine Peninsular Gold Mines, Ltd	Porcupine Peninsular		80 King St. W., Toronto.
*Red Crest Gold Mines, Ltd	Rowan Discovery	J. M. Wilson	Golden Arm, Red Lake.
Red Lake Gold Shore Mines, Ltd	Red Lake Gold Shore	W. P. Mackle	Red Lake.
Richelieu Gold Mines, Ltd	Richelieu		330 Bay St., Toronto.
Rickard Ramore Gold Mines, Ltd	Raty	H. Hollands-Hurst	Iroquois Falls.
*St. Anthony Gold Mines, Ltd	St. Anthony	R. P. Teare	Savant Lake.
Sakoose Gold Mines, Ltd	Sakoose		231 St. James St., Montreal, Que.
Selected Canadian Golds, Ltd. (under option)	Sultana		Bank of Commerce Bldg., Toronto.
Selected International Mines, Ltd. (under lease)	Cheltonia-Swastika	C. J. Poole	Swastika.
Shenango Gold Mines, Ltd	Shenango	Jack Owens	Oba.
Shinintree Gold Mines, Ltd	Shinintree	Lionel Brooke	Shiningtree.
*Smith, S. B	Van Sickle	Dr. S. B. Smith	Cleveland, Ohio.
*Sol-D'Or Gold Mines, Ltd	Sol-D'Or	Dr. H. S. Hicks	Narrow Lake.
South Shore Gold Syndicate	South Shore	R. J. C. Godden	Box 542, South Porcupine.
South Vermillion Gold Mines, Ltd	South Vermillion	A. Pacitto	Mine Centre.
Stanley Gold Mines, Ltd	Stanley	S. MacDougall	Wawa.

Straw Lake Beach Gold Mines, Ltd.	Straw Lake Beach	Frank Carnegie	Emo.
Sturgeon River Gold Mines, Ltd.	Sturgeon River	C. M. Bowyer	Jellicoe.
Supreme Gold Mines, Ltd.	Supreme	Walter F. Stewart	Savant Lake.
Swain, Harris, and Cavano	Swain-Harris-Cavano		Narrow Lake.
*Sylvanite Gold Mines, Ltd.	Sylvanite	C. E. Rodgers	Kirkland Lake.
*Tashota Goldfields, Ltd.	Tashota	A. Robertson	Tashota.
*Teck-Hughes Gold Mines, Ltd.	Teck-Hughes	R. J. Henry	Kirkland Lake.
Teddy Bear Valley Mines, Ltd.	Teddy Bear Valley	Edward H. Orser	Lightning River.
Thesaurus Gold Mines, Ltd.	Thesaurus		320 Bay St., Toronto.
*Toburn Gold Mines, Ltd.	Toburn	M. W. Hotchkin	Kirkland Lake.
Tombill Gold Mines, Ltd.	Tombill	R. J. Hendricks	Empire.
*Vermilion Operating Co. (under lease)	Vermilion Lake		Sioux Lookout.
Vimy Gold Mines, Ltd.	Vimy	Joseph Berini	Ramore.
Wells Longlac Mines, Ltd.	Magnet Lake	W. L. Brown	Geraldton.
Wells Longlac Mines, Ltd. (under option)	Stagee.		
Wendigo Gold Mines, Ltd.	Wendigo	C. L. Spencer	Kenora.
West Red Lake Gold Mines, Ltd.	West Red Lake		11 King St. W., Toronto.
*Wright-Hargreaves Mines, Ltd.	Wright-Hargreaves	M. W. Summerhayes	Kirkland Lake.
*Young-Davidson Mines, Ltd. (under agreement with Hollinger Consol. Gold Mines).	Young-Davidson		Elk Lake.
Young-Shannon Gold Mines, Ltd.	Young-Shannon Martin	C. T. Young	1 Toronto St., Toronto.

MOLYBDENITE

Phoenix Molybdenite Corporation, Ltd.	Phoenix	F. L. Stinson	Ashdad.

NICKEL AND COPPER

Cuniptau Mines, Ltd.	Cuniptau	Geo. M. Lee	Goward.
Falconbridge Nickle Mines, Ltd.	Falconbridge	Ernest Craig	Falconbridge.
International Nickel Co. of Canada, Ltd.	Creighton	S. J. Kidder	Creighton.
	Frood	F. J. Eager	Frood.
Van Nickel Mines, Ltd.	Delta	W. F. Taylor	Worthington.

RADIUM

Canada Radium Mines, Ltd.	Canada Radium	Frank Austin	Cheddar.

Operator	Mine or Works	Manager	Address
SILVER AND COBALT			
Bellorain Mines, Ltd	Bellellen	Max Kaplan	Kirkland Lake.
Cobalt Properties, Ltd	Cobalt Properties	Arthur Brocklebank	Cobalt.
Cobnor Silver Mines, Ltd	Cobnor	H. F. Fancy	Cobalt.
Comet Leasing Co. (under lease)	Drummond	Bruce Williams	Kirkland Lake.
Dean and Downey (under lease)	Wettlaufer	Ralph Downey	Cobalt.
Hudson Bay Mines, Ltd	Hudson Bay		Box 700, New Liskeard.
Martin, George (under lease)	Crown Reserve	George Martin	Cobalt.
Miller, H. G. (under lease)	Canadian Lorrain	H. G. Miller	Silver Centre.
	Keeley		
Morgenthalor, A. G	Beaver	A. G. Morgenthalor	2108 South Second St., Philadelphia.
Morrison Mines, Ltd	Morrison		165 Sparks St., Ottawa.
Mosher, Richardson, and Lafrange (under lease)	Buffalo	I. E. Mosher	Cobalt.
Nipissing Mining Co., Ltd	Nipissing	Hugh Park	Cobalt.
O'Brien, Ltd., M. J.	Cross Lake	W. A. O'Flynn	Cobalt.
	Miller Lake O'Brien	H. G. Kennedy	O'Brien.
O'Donald, J. C. (under lease)	Silver Queen	J. C. O'Donald	Cobalt.
Price, C. W. (under lease)	Foster	C. W. Price	Cobalt.
Rowe and Stuckey (under lease)	Frontier	Alfred Rowe	Silver Centre.
Sandoe and Moyle (under lease)	Temiskaming	Richard Sandoe	Cobalt.
Silver Cliff Syndicate (under lease)	Silver Cliff		Cobalt.
Silverado Gowganda Mines, Ltd. (under lease)	Silverado	F. E. Forster	347 Bay St., Toronto.
Sirola, Donald E. (under lease)	Colonial	Donald E. Sirola	Kirkland Lake.
Smith Cobalt Mines, Ltd	Smith Cobalt	D. G. Russell	Cobalt.
Wood, A. (under lease)	Dominion Reduction Co. mill	A. Wood	Cobalt.
METALLURGICAL WORKS			
Algoma Steel Corporation, Ltd	Iron blast furnace	Jas. H. Bell	Sault Ste. Marie, Ont.
Canadian Furnace Co., Ltd	Iron blast furnace	W. J. Higgins	Port Colborne.
Canadian Industries, Ltd	Acid and chemical plant	E. Jordon	Copper Cliff.
Deloro Smelting and Refining Co., Ltd	Silver-cobalt refinery	S. B. Wright	Deloro.
Falconbridge Nickel Mines, Ltd	Nickel-copper smelter	M. J. Tamplin	Falconbridge.
International Nickel Co. of Canada, Ltd	Nickel-copper smelter	Peter Macdonald	Copper Cliff.
	Nickel-copper smelter	Peter Macdonald	Coniston.
	Nickel refinery	H. W. Walter	Port Colborne.
Ontario Refining Co., Ltd	Electrolytic copper refinery	F. Benard	Copper Cliff.
Steel Company of Canada, Ltd	Iron blast furnace	R. A. Gillies	Hamilton.

NON-METALLICS

ACTINOLITE

Building Services, Ltd	Actinolite, Elzevir tp., Hastings co	Kenneth E. Rea	1529 Macgregor St., Montreal, Que.

ARSENIC

Deloro Smelting and Refining Co., Ltd	Silver-cobalt refinery	S. B. Wright	Deloro.

BARITE

Barytes Products, Ltd	Bellew, N. Burgess tp., Lanark co. (idle in 1935).	H. C. Bellew	Box 282, Montreal, Que.
Canada Night Hawk Mines, Ltd	Canada Night Hawk		305 Sterling Tower Bldg., Toronto.
Glendinning, H	Yarrow tp., Timiskaming dist. (idle)		387 Bloor St. E., Toronto.
Weaver (Minerals), Ltd	Tionaga, Penhorwood tp., Sudbury dist.		34 King St. E., Toronto.

DIATOMITE

Diatomite Products, Ltd	Martin's Siding, Muskoka dist	C. Lindley Wood	409 Metropolitan Bldg., Toronto.
Dominion Diatomite, Ltd. (now F. P. Macklem).	Lot 3, con. I, Perry tp., Parry Sound dist.	F. P. Macklem	642 King St. W., Toronto.
Air-Lite Silica Co., Ltd	Muskoka Falls	A. J. P. Care	32 Lyall Ave., Toronto.

FELDSPAR

Barr, Walter J	Renfrew, N. ½ lot 24, con. XVI, Fraser tp., Renfrew co.	W. J. Barr	Indian, C.N.R.
Bathurst Feldspar Mines, Ltd. (shipped only)	Bathurst, Bathurst tp., Lanark co	T. H. Craig	10 Victoria St., Perth.
Charette and Son, S	Lot 1, con III, Burwash tp., Sudbury dist.	S. Charette	Estaire P.O.
Craig, T. H	W. ½ lot 12, con. IX, Bathurst tp., Lanark co.	T. H. Craig	10 Victoria St., Perth.
Frontenac Floor and Wall Tile Co., Ltd	Grinding plant, Kingston	A. M. Perryman	Box 178, Kingston.
Gunter, Judson A	Sabine tp., Nipissing dist	J. A. Gunter	Princes Lake.
MacDonald, P	Hybla	P. MacDonald	Hybla.
Renfrew Minerals, Ltd	Quadeville	C. Lentz	Rockingham.

Operator	Mine, Quarry, or Works	Manager	Address
FLUORSPAR			
Stoklosar, Chas. A	W. ½ lot 3, con. I, Madoc tp., Hastings co.	Chas. A. Stoklosar	Madoc.
GRAPHITE			
Black-Donald Graphite Co., Ltd	Black Donald, Brougham tp., Renfrew co.	R. F. Bunting	Calabogie.
GYPSUM			
Canadian Gypsum Co., Ltd	Hagersville	W. E. Allen	Hagersville.
Gypsum, Lime and Alabastine, Canada, Ltd.	Caledonia	L. V. Robinson	Caledonia.
IRON PYRITES AND SULPHURIC ACID			
Canadian Industries, Ltd	Acid plants, Copper Cliff	G. G. Vincent	Copper Cliff.
Canadian Pyrites, Ltd	Caldwell mine, Flower station (idle in 1935)	O. M. Hook, Sec	1400 Guardian Bldg., Cleveland, Ohio.
MICA			
Bennett, H. V		H. V. Bennett	6 Church St., Perth.
Kent Bros. (buyers)		W. C. Kent	114 Gore St., Kingston.
Lee and Son, W. W	Bob's Lake mine	A. J. Lee	Bedford Mills.
Loughborough Mining Co., Ltd	Various prospects	General Electric Co	Schenectady, N.Y.
Martin, A. G. (buyer)		A. G. Martin	236 Besserer St., Ottawa.
30 Island Lake Mica Co	Frontenac and Lanark counties	S. H. Orser	Verona.
MINERAL WATERS			
Carlsbad, Ltd. (now T. R. Boyd)	Carlsbad Springs	T. R. Boyd	Carlsbad Springs.
Deneault, F	Bourget Springs	F. Deneault	Bourget.
Gurd and Co., Ltd., Chas	Caledonia tp., Prescott co		1016 Bleury St., Montreal, Que.

NEPHELINE SYENITE

Canadian Nepheline, Ltd	Lot 14, con. IX, Methuen tp., Peterborough co.	H. R. Deeth	Lakefield.

PEAT

Caledon Peat Co	Lot 27, con. I, Caledon tp., Peel co.	Burbidge and Pollock.	Box 445, Brampton.
Countryman, Gordon	Lot 22, con. IX, Winchester tp., Dundas co.	G. Countryman	Chesterville.
Fleming, John	E. ½ lot 20, W. ½ lot 21, Winchester tp., Dundas co.	J. Fleming	Morewood.
Hodgkins and Son, H. L	Con. IV, Wainfleet tp., Welland co		R. R. 2, St. Anns.
Hummel, Wm. L.	Lot 18, con. VII.Winchester tp., Dundas co. (idle in 1935).	W. L. Hummel	Chesterville.
Leasa, Wm	Lot 11, con. X, Ellice tp., Perth co	W. Leasa	Milverton.
Northern Peat Co	Lot 8, con. X, Ellice tp., Perth co	W. B. Brewer	Timmins.
Roe, Stephen	Lot 35, con. XIV, Elma tp., Perth co. (idle in 1935).	S. Roe	R.R 2, Milverton.
Runke and Sons, Geo	Lot 55, Waterloo tp., Waterloo co	A. Runke	115 Cameron St. N., Kitchener.

QUARTZ, QUARTZITE, AND SILICA BRICK

Algoma Steel Corporation, Ltd	Silica brick (quartz from Deroche tp.)		Sault Ste. Marie.
Dominion Mines and Quarries, Ltd	Killarney, north shore of Lake Huron, East Neebish island (idle).		340 University Ave., Toronto.
Falconbridge Nickel Mines, Ltd	Quarry on property	Ernest Craig	Falconbridge.
MacDonald, P	Hybla	P. MacDonald	Hybla.
Wright and Co	Quarry, Deroche tp., Algoma dist	Geo. S. Cowie	960 Queen St., Sault Ste. Marie.

SALT

Brunner Mond, Canada, Ltd	Amherstburg (brine for chemical use)	C. K. MacFetridge	Amherstburg.
Canadian Industries, Ltd	Sandwich (brine for chemical use and salt)		Box 1260, Montreal, Que.
Dominion Salt Co., Ltd., The	Sarnia	W. H. Spence, Sec.-Tr.	1610 Bank of Commerce Bldg., Toronto.
Goderich Salt Co., Ltd	Goderich	G. N. Dowker	Goderich.
Kincardine Salt, Ltd. (idle in 1935)	Kincardine (operated by Canadian Industries, Ltd.).		Box 1260, Montreal, Que.
Walker Salt Corporation, Limited[1]	Port Franks	G. C. Walker, Pres	London.
Warwick Pure Salt Co., Ltd	Highway No. 7, Warwick tp., Lambton co.	B. Witkon	R.R. 5, Watford.
Western Canada Flour Mills Co., Ltd	Goderich		287 MacPherson Ave., Toronto.

[1]Developing.

Operator	Mine, Plant, or Quarry	Manager	Address
TALC			
Canada Talc Co., Ltd.	Connolly—mill at mine	Roy Taylor	Madoc.
Geo. H. Gillespie Co., Ltd.	Henderson mine—mill at Madoc	L. Ashley	Madoc.
STRUCTURAL MATERIALS			
CEMENT			
Canada Cement Co., Ltd.	Belleville, plant No. 5 (idle in 1935)		Box 290, Station B, Montreal, Que.
	Lakefield, plant No. 7 (idle in 1935)		
	Port Colborne, plant No. 8		
St. Marys Cement Co., Ltd.	St. Marys		357 Bay St., Toronto.
LIME			
Bell, Harry	N. ½ lot 23, con. XII, Sullivan tp., Grey co.	Harry Bell	R.R. 4, Chesley.
Biederman, Albert G.	Wilberforce tp., Renfrew co.	Albert G. Biederman	R.R. 1, Golden Lake.
Brown's Lime Works	Owen Sound	Wm. Brown	491 9th Ave. E., Owen Sound.
Brunner Mond, Canada, Ltd.	Lots 6, 7, 8, con. I; lots 2, 3, con. II, Anderdon tp., Essex co.	C. K. MacFetridge	Amherstburg.
Cameron, W. M.	Ramsay tp., Lanark co.	W. M. Cameron	Carleton Place.
Canada Lime Co., Ltd.	Coboconk	Chas. R. Christie	114 Cluny Drive, Toronto.
Canada and Dominion Sugar Co., Ltd.	Wallaceburg		Wallaceburg.
	Chatham		Chatham.
Canadian Gypsum Co., Ltd.	Guelph	B. S. Bains	1221 Bay St., Toronto.
Chalmers Lime Works	Owen Sound (idle in 1935)	Miss M. Chalmers	689 7th Street W., Owen Sound.
Dominion Rock Products, Ltd.	Eganville		941 Dominion Square Bldg., Montreal.
Gallagher Lime and Stone Co., Ltd., The	Hamilton (idle in 1935)		Upper James St., Hamilton.
Gypsum, Lime and Alabastine, Canada, Ltd.	Beachville		Beachville.
	Elora (idle in 1935)		Elora.
	Hespeler		Hespeler.
	Milton		Milton.
	Limehouse (idle in 1935)		Limehouse.
Innerkip Lime and Stone Co., Ltd.	Beachville	C. E. Downing	Beachville.

Jamieson Lime Co.	Renfrew	J. A. Jamieson	Renfrew.
Laurentian Stone Co., Ltd.	Quarries	A. B. Robillard	82 Cremazie St., Hull, Que.
Morris, Stanley	Delta	S. Morris	Delta.
North American Cyanamid Co.	Quarry at Beachville, kilns at Niagara Falls.		Niagara Falls, Ont.
Rockwood Lime Co.	Lot 5, con. XI, Eramosa tp., Wellington co.	Geo. H. Dennis	Rockwood.
Shane Lime Co.	Eganville (idle in 1935)	Geo. R. Shane	Eganville.
Weppler, Henry	Lot 7, con. II, Glenelg tp., Grey co., (idle in 1935).	H. Weppler	R.R. 2, Priceville.

STONE (Limestone and Marble)

Billie and Son, Chas. V.	Perth	F. R. Billie	Smiths Falls.
Bolender Bros.	Haliburton	P. H. Bolender	Haliburton.
Bonter Marble and Calcium Co., Ltd., The	Marmora tp., Hastings co.	J. W. Bonter	Box 61, Marmora.
Bourgie, J. B.	Gregnon, con. VIII, Russell tp., Russell co.	J. B. Bourgie	Box 50, Embrun.
Brunner Mond, Canada, Ltd.	Lots 6, 7, 8, con. I; lots 2, 3, con. II, Anderdon tp., Essex co.	C. K. MacFetridge	Amherstburg.
Canada Cement Co., Ltd.	Thurlow tp., Hastings co.	J. H. Legate	Belleville.
Canada Crushed Stone Corp., Ltd.	Dundas, Town of	J. Stephens	R.R. 2, Dundas.
Hagersville Contracting Co., Ltd.	Walpole tp., Haldimand co.	Gordon Gilbertson	Hagersville.
Puslinch Quarry, Ltd.	Puslinch tp., Wellington co.		Dundas.
Queenston Quarries, Ltd.	Niagara tp., Lincoln co.	A. Michie	Box 148, Niagara Falls.
Coldwater Crushed Stone, Ltd.	Lots 19, 20, con. XIII, Medonte tp., Simcoe co.	A. E. Gooderham	49 Wellington St. E., Toronto.
Decewsville Crushed Stone, Ltd.	Decewsville (idle in 1935)		52 Elgin St., Hamilton.
Dibblee Construction Co., Ltd.	Stevens quarry, 2 miles south of Hawkesbury.	C. H. Covey	248 Albert St., Ottawa.
Dufferin Paving and Crushed Stone Co., Ltd.		H. H. Salmon	Fleet and Bathurst Streets, Toronto.
Hagersville Quarries, Ltd.	Walpole tp., Haldimand co.	W. L. McRae	Hagersville.
Kirkfield Crushed Stone, Ltd.	Eldon tp., Victoria co.	John Welch	Kirkfield.
St. Mary's Crushed Stone, Ltd. (idle)	St. Marys		St. Marys.
Fergus Quarry	Fergus	James Gow	Fergus.
Foster, R. R.	Merivale Road, Nepean tp., Carleton co., (idle in 1935).	R. R. Foster	86 Spadina Ave., Ottawa.
Grenon, Jas.	Casselman	B. Lesiault	Casselman.
Gypsum, Lime and Alabastine, Canada, Ltd.	Lot 18, con. III, N. Oxford tp., Oxford co.	T. F. Robinson	87 Wellington St. N., Woodstock.
	Lot 3, cons. VI, VII, Nassagaweya tp., Halton co.	R. S. Adams	Milton.
Hagersville Contracting Co., Ltd.	*See* Canada Crushed Stone Corporation.		
Hagersville Quarries, Ltd.	*See* Dufferin Paving and Crushed Stone Co.		
Haldimand Quarries and Construction, Ltd.	Hagersville	C. F. Anderson	Hagersville.
Halliday, Fred	Lot 23, Gloucester tp., Carleton co. (idle in 1935).		Cummings Bridge.

Operator	Quarry or Location	Manager	Address
STONE (Limestone and Marble)—*Continued*			
Henniger, M. G.	Kitley tp., Leeds co. (idle in 1935)	M. G. Henniger	Smiths Falls.
Highways, Department of	Various quarries	R. M. Smith	Parliament Bldgs., Toronto.
Innerkip Quarries, Ltd.	*See* Dufferin Paving and Crushed Stone Co		
Irvine Co., Ltd., The Edgar	Near Centreville (idle in 1935)	E. M. C. Goodwin	Alexandria.
Kingston Penitentiary	Portsmouth	Samuel Donaldson	Box 22, Kingston.
Kirby Co., Ltd., The T. Sidney	Gloucester tp., Carleton co.		215 Sussex St., Ottawa.
Kirkfield Crushed Stone, Ltd.	*See* Dufferin Paving and Crushed Stone Co.		
Lake St. John Quarry Co., Ltd.	Rama tp., Ontario co.	R. M. Craig	Longford Mills.
Lapierre, M.C.	Grey co.	M. C. Lapierre	1994 9th Ave. E., Owen Sound.
Law Construction Co., Ltd.	Owen Sound and Collingwood	B. J. Williams	19 Delevan Ave., Forest Hill.
Limestone Products, Ltd.	Con. V, Orillia tp., Simcoe co.	K. W. Peacock	1104 Hermant Bldg., Toronto.
McGinnis & O'Connor	Collins Bay, Frontenac co.	T. A. McGinnis	Kingston.
Middleton, J. N.	Ancaster village (idle in 1935)	J. N. Middleton	Ancaster.
Noranda Mines, Ltd.	Farr quarry, Haileybury		804 Royal Bank Bldg., Toronto.
North American Cyanamid Co.	Beachville		Niagara Falls, Ont.
Ornamental Stone Products	Portland tp., Frontenac co.	S. H. Orser	Verona.
Owen Sound, City of	City quarry, 8th Street West (idle in 1935)	Robt. Crannie	323 8th St. W., Owen Sound.
Pirson, John	Hydro dump, Stamford tp., Welland co.	John Pirson	Stevensville.
Puslinch Quarry, Ltd.	*See* Canada Crushed Stone Corp.		
Queenston Quarries, Ltd.	*See* Canada Crushed Stone Corp.		
Rayner Construction, Ltd.	Madoc	W. J. Smyth	29 Commercial St., Leaside.
Routly, H. T.	Rawdon tp., Hastings co.	H. T. Routly	21 Dundas Square, Toronto.
Silverstone Black Marble Quarries	Lots 8, 9, con. XII, Finch tp., Stormont co.	Carl Burd	St. Albert.
Walker Bros., Ltd.	Stamford tp., Welland co.	J. G. Walker	145 Geneva St., St. Catharines.
Wilford and Co., Ltd., R. F.	Victoria co.	C. Lindsay	Lindsay.
Windmill Point Crushed Stone Co., Ltd.	Ridgeway	R. E. Law	Ridgeway.
STONE (Granite)			
Appleby, Thos. A.	Leeds co. (idle in 1935)	T. A. Appleby	Garden St., Gananoque.
Billie, Chas. V.	Bathurst tp., Lanark co.	F. R. Billie	Smiths Falls.
Horne, Wm.	Butler	Wm. Horne	Butler, via Ignace.

STONE (SANDSTONE)

Campbell Sandstone Quarries, Ltd.	Carleton co.	M. N. Cummings	Westboro.
Corner, Austin A.	Peel co.	A. A. Corner	Terra Cotta.
Logan, Harry	Georgetown	H. Logan	Box 400, Georgetown.
Norton, A. W.	Halton co.	A. W. Norton	Limehouse.
Sykes, Thos.	Halton co.	Thos. Sykes	Georgetown.
Terra Cotta Quarries	Halton co.	J. L. Craine	Terra Cotta.

STONE (TRAP)

Building Products, Ltd.	Portland tp., Frontenac co.	A. de Wolfe	Verona, Ont.
Fort William, City of	Rifle range, City quarry	City Engineer	City Hall, Fort William.
Ontario Rock Co., Ltd.	Belmont and Methuen tps., Peterborough co.	H. L. Scott	R.R. 3, Havelock.

SAND-LIME BRICK

Harbour Brick Co., Ltd.	Fleet St. at Bathurst	K. M. Goodings	Fleet St., Toronto.
Hinde Bros.	134 Northland Ave., Toronto	Jas. H. Hinde	Mount Dennis.
Toronto Brick Co., Ltd.	Scarborough		897 Bay St., Toronto.
York Sandstone Brick Co., Ltd.	447 Victoria Park Ave., Toronto	W. A. Smyth	447 Victoria Park Ave., Toronto.

SAND AND GRAVEL (LICENSED DREDGING OPERATIONS)

Canadian Dredging Company	Lake Superior		Midland.
Cowley, Mrs. K.	Thames river		Chatham.
Gravel and Lake Services, Ltd.	Lake Superior		Box 148, Port Arthur.
Hadley's Chatham, Ltd.	Thames river		47 Wellington St., Chatham.
McLean and Sons, A. B.	Lake Superior		Brock St., Sault Ste. Marie.
McNamara Construction Co., Ltd.	Lake Simcoe		12 Industrial St., Leaside.
Montreal Trust Co., Ltd. (Trustee for Sin-Mac Lines, Ltd.).	Lake Superior		635 Common St., Montreal, Que.
National Sand and Material Co., Ltd.	Lake Erie		402 Harbour Bldg., Toronto.
Pyke Salvage Co.	St. Lawrence river		506 Princess St., Kingston.
Simpson and Sons, J. H.	St. Lawrence river		20 Thomas St., Brockville.
Tees Transit Co.	Niagara bar		16 New St., Hamilton.
Wallaceburg Sand and Gravel Co., Ltd.	St. Clair river		Wallaceburg.

Operator	Pit or Works	Manager	Address
SAND AND GRAVEL[1] (Pit Operations)			
Barnes Co., Ltd., Wm. R.	Spring Vale, Waterdown, Brantford		243 Cumberland Ave., Hamilton.
Consolidated Sand and Gravel, Ltd.	Paris		402 Harbour Bldg., Toronto.
Durham Stone and Sand Co., Ltd.	Durham.		
Fuller Gravel, Ltd.	Fuller.		
Waterford Sand and Gravel Co., Ltd.	Waterford.		
Foster, R. R.	Nepean and Gloucester tps., Carleton co.		86 Spadina Ave., Ottawa.
Hinde Bros.	Northlands Ave., York tp., York co.		134 Northlands Ave., Toronto.
Jupp Construction Co., Ltd., A. E.	Whitby tp., Ontario co.		170 Berkeley St., Toronto.
Newall, H.	Lot 35, con. VIII, Malahide tp., Elgin co.	H. Newall	R.R. 4, Aylmer.
Smythe Ltd., C.	Lambton Rd., Etobicoke tp., York co.		60 Carlton St., Toronto.
Woollatt Fuel and Supply Co., Ltd.	Essex co.		109 Ottawa St., Walkerville.

[1]Only operators producing 5,000 tons or over are listed.

CLAY PRODUCTS

Barnes Co., Ltd., Wm. R.	Hamilton	W. P. Barnes	243 Cumberland Ave., Hamilton.
Barnhard, W. H.	Lot 44, con. I, Hope tp., Durham co.	C. Barnhard	15 Park St., Stratford.
Belle River Brick and Tile Co.	Belle River	M. V. Pougnet	Belle River.
Brampton Pressed Brick Co.	Lot 9, Chinguacousy tp., Essex co.	C. H. Packham	Main St. N., Brampton.
Broadwell and Son, B.	Lot 12, con. IV, Gosfield S. tp., Essex co.	B. E. Broadwell	Box 137, Kingsville.
Canadian Pressed Brick Co.	Kenilworth Ave. S., Hamilton	J. C. Wright	195 Ottawa St. S., Hamilton.
Casemore and Son, R.	Keppel tp., Grey co.	H. O. Casemore	Shallow Lake.
Chapman Bros.	Lot 2, con. II, East York tp., York co.	H. W. Chapman	145 Dawes Road, Toronto.
Construction Materials, Ltd.	Horner Ave., Etobicoke, York co.	H. T. Harvay	Box 97, New Toronto.
Coultis and Son, Geo.	Lot 21, con. III, Bosanquet tp., Lambton co.	G. C. Henderson	Thetford.
Crang Booth, Ltd.	Wilson Ave., North York tp., York co.	H. T. Harvay	c/o Crang Booth, New Toronto.
Curtin, Frank	Lot 15, con. V, Ops tp., Victoria co.	John Curtin	R.R. 4, Lindsay.
Curtis Bros.	Lot 32, con. XII, Otonabee tp., Peterborough co.	Edwin Curtis	612 Stewart St., Peterborough.
Deller and Son, Albert	Brownsville	Albert Deller	Brownsville.
Deller, Wm. H.	Lot 5, con. V, Nissouri tp., Middlesex co.	Wm. H. Deller	R.R. 4, Thorndale.
Deller Bros.	Lots 11, 12, con. III, N. Norwich tp., Oxford co.	Alfred Deller	R.R. 2, Norwich.
Dochart Brick, Tile and Terra Cotta Works.	Arnprior	Geo. E. Baker	Arnprior.
Donaldson, G. A.	Lot 19, con. XIV, Culross tp., Bruce co.	T. G. Donaldson	R.R. 1, Greenock.
Douglas and Douglas	Lot 14, con. XII, Sombra tp., Lambton co.	J. P. Douglas	Wilkesport.

Dover Brick and Tile Works	Con. IX, Baldwin Rd., Dover tp., Kent co.	James McHardy	20 South St., Chatham.
Elliott, Jas. J	Korah tp., Algoma dist	Jas. Elliott, Jr	519 Wellington St. S., Sault Ste. Marie.
Elliott, Wm	Lot 11, con. I, Culross tp., Bruce co	Wm. Elliott	Glenannan.
Fort William Brick Co	Montreal St., Fort William	H. M. Piper	Fort William.
Foster Pottery Co	Hamilton	S. Foster	Main St. W., Hamilton.
Frid Bros., Ltd	Main and Macklin Sts., Hamilton	Arthur Frid	415 Dundurn St. S., Hamilton.
Godfrey and Co., Thos	Beckwith	Thos. Godfrey	Carleton Place.
Gomoll Brick and Tile Works	Lot 15, con. X, S. Himsworth tp., Parry Sound dist.	F. A. Gomoll	Powassan.
Grimsby Brick and Tile Works	Lot 23, Clinton tp., Lincoln co	Robert Crawford	Box 415, Grimsby.
Hallett, B. E	Tilbury	B. E. Hallett	17 King George Rd., Toronto.
Hamilton Pressed Brick Co	Wentworth co	Robert W. New	220 Main St. W., Hamilton.
Harper Brick Works	Greenwood Ave., Toronto	Albert Harper	348 Greenwood Ave., Toronto.
Hill, A. W	Lot 15, con. IX, Tilbury E. tp., Kent co.	A. W. Hill	R.R. 1, Coatsworth.
Hill, Aaron	Essex co	Aaron Hill	Essex.
Hitch, D. A	Ridgetown, Kent co	D. A. Hitch	Box 236, Ridgetown.
Hitch, Thos	First Ave., Yarmouth	Donald Hitch	Box 254, St. Thomas.
Hodder and Sons	Lot 9, con. A, Dunwich tp., Elgin co	Mrs. J. H. Hodder	Dutton.
Howlett and Sons, Ltd., Fred. W	King St., Petrolia Sydenham Ave., Brigden		Box 3, Petrolia.
Huntsville Brick Works	Lot 8, con. I, Chaffey tp., Muskoka dist.	Chas. H. Stevens	Box 308, Huntsville.
Interprovincial Brick Co., Ltd	Cooksville Milton, lots 1-46, Nassagaweya tp., Halton co. Cheltenham, Chinguacousy tp	W. E. Secker	672 Dupont St., Toronto.
Jackson, W. B	Maitland St., Brantford	W. B. Jackson	290 Rawdon St., Brantford.
Jamieson Lime Co	Renfrew	J. A. Jamieson	Renfrew.
Janes, D. A	No. 2 Highway, Middlesex co	D. A. Janes	Mount Brydges.
Jervis, W. J	Lot 13, con. B, N. Dorchester tp., Middlesex co.	W. J. Jervis	R.R. 3, Dorchester.
Johnson, James, Estate of	Stafford tp., Renfrew co	Lorne J. Fraser	Pembroke.
Koebel Bros	Lot 2, con. VII, Wellesley tp., Waterloo co.	J. Z. Koebel	St. Clements.
Lindsay and Sons, Earl	Lot 24, con. II, Chatham gore, Kent co.	Geo. C. Lindsay	R.R. 2, Wallaceburg.
McComb, Chester	Lot 17, con. XVI, London tp., Middlesex co.	Chester McComb	R.R. 2, London.
McCormick Bros	Lot 7, con. IV, Warwick tp., Lambton co.	T. L. McCormick	R.R. 5, Watford.
McFarlane, W. J	Forest	W. J. McFarlane	Forest.
Milton Brick, Ltd	Milton	R. Wheeler	148 Jane St., Toronto.
Moulton, John	Lot 33, con. IV, Greenock tp., Bruce co.	John Moulton	R.R. 2, Holyrood.
Napanee Brick and Tile Works	Lot 13, con. VI, Richmond tp., Lennox and Addington co.	R. L. Chapman	R.R. 3, Napanee.
National Fire Proofing Co., Canada, Ltd	Aldershot	E. M. Campbell	96 Bloor St. W., Toronto.
National Sewer Pipe Co	Swansea, Etobicoke tp., York co Aldershot, lot 3, con. I, E. Flamborough tp. Hamilton, Wentworth co	R. H. New	44 Victoria St., Toronto.

Operator	Works	Manager	Address
	CLAY PRODUCTS—*Continued*		
New Liskeard Brick Works	New Liskeard	David Dunn	Box 74, New Liskeard.
Ontario Brick and Tile Plant	Near Town of Mimico	Wm. L. McJannet	Inspector of Prisons, Parliament Bldgs., Toronto.
O'Reilly, T. E	Prescott Highway, Nepean tp., Carleton co.	Owen O'Reilly	320 Bay St., Toronto.
Ott Brick and Tile Mfg. Co., Ltd	Kitchener	Casper Braun	16 Andrew St., Kitchener.
Ottawa Brick and Terra Cotta Co., Ltd	Lot 19, Gloucester tp., Carleton co	A. N. G. Hellyer	32 Cameron St., Ottawa.
Owen Sound Brick Co., Ltd	Sixth St. E., Owen Sound	J. P. Leslie	Owen Sound.
Parks Tileyard, The H. W	Lot 7, con. V, Camden tp., Kent co	Geo. Parks	R.R. 2, Dresden.
Paxton, Fred R	St. Catharines	Fred R. Paxton	70 Herrick Ave., St. Catharines.
Phinn, Geo. A	Westminster and London tps., Middlesex co.	Geo. A. Phinn	St. James Park P.O., London.
Phippen and Sons	Dawes Rd., E. York tp., York co	H. W. Phippen	Box 11, Coleman P.O., Toronto.
Richardson and Son	Kerwood	J. Fred Richardson	Kerwood.
Rollins, D. W	Lot 11, con. I, Thurlow tp., Hastings co	D. W. Rollins	181 George St., Belleville.
Snelgrove, A	Beaverton	A. Snelgrove	Beaverton.
Sproat and Sproat	Lot 6, con. IV, Tuckersmith tp., Huron co.	W. M. Sproat	R.R. 4, Seaforth.
Standard Brick Co., Ltd	500 Greenwood Ave., Toronto.		
Sun Brick and Tile Co., Ltd	Don valley, York co	H. A. Bevens	33 Strathmore Blvd., Toronto.
Superior Brick and Tile Co., Ltd	Lots 11, 12, Paipoonge tp., Thunder Bay dist.	Wm. Baukey	426 Victoria St., Fort William.
Toronto Brick Co., Ltd	Don Valley, Todmorden 305 Greenwood Ave., Toronto		897 Bay St., Toronto.
Wagstaff, Chas., Estate of	Lot 14, con. V, Ops tp., Victoria co	L. N. Wagstaff	32 Simcoe St., Lindsay.
Wallace and Son, R	Lot 16, con. D, Widdifield tp., Nipissing dist.	Toronto General Trusts Corp.	253 Bay St., Toronto.
Wein, Aaron	Lots 1, 2, 3, con. V, Stephen tp., Huron co.	Aaron Wein	Crediton.
Weitzel, J. E	Lot 33, con. IV, E. Zorra tp., Oxford co	J. E. Weitzel	R.R. 1, Tavistock.
Wright and Sons, Geo	Lot 7, Tilbury W. tp., Essex co	F. M. Wright	Comber.

MINES OF ONTARIO IN 1935

By

Chief Inspector of Mines, D. G. Sinclair, Toronto; Inspectors, E. C. Keeley, Kirkland Lake; D. F. Cooper, Sudbury; E. B. Weir, Timmins; A. R. Webster, Toronto

CHROMIUM

Chromium Mining and Smelting Corporation, Limited

The Chromium Mining and Smelting Corporation, Limited, was incorporated in 1934, succeeding the Chromium Alloy Company, Limited. It has an authorized capitalization of 3,000,000 shares of no par value, of which 1,500,000 have been issued. The officers and directors of the company are: A. R. Globe, president and managing director; R. O. Denman, secretary-treasurer; F. J. Maw, R. S. Hart, and Scott Misener, directors.

The mine property is situated 26 miles south of Collins, a station on the main line of the Canadian National Railways, Thunder Bay district. The holdings include 12 patented claims and 35 unpatented claims, making a total area of about 1,900 acres.

Development work done on the property to date includes a large amount of surface-trenching, diamond-drilling, and underground development from a shaft 350 feet in depth. From the 100-foot level of this shaft 500 feet of cross-cutting and 120 feet of drifting have been done. Stations have also been cut at the 225-foot and 325-foot levels. No underground work was done at the mine in 1935.

Several ore zones have been found on the property. The largest and most extensively developed is known as the "E" zone, in which the 350-foot shaft has been sunk. In 1934, 12 diamond-drill holes, with total footage of 3,146 feet, were drilled in this zone. Officials of the company have stated that work done in this zone has indicated 225,000 tons of ore, 17 per cent. Cr_2O_3, in a section 770 feet in length and 300 feet in depth. The total amount of diamond-drilling done on the property is 6,150 feet in 33 holes. Ten of these holes were drilled in 1929–30; the remainder in 1934. Work at the property in 1935 consisted chiefly of surface work and the making of a tractor road between the mine and Collins, a distance of 26 miles.

In May, 1935, the refining and smelting plant of Superior Alloys, Limited, at Sault Ste. Marie, Ont., was purchased.

The following is taken from the company's first annual report:—

After alterations and repairs, silicon operations were started on June 23, and chromium on August 23. This plant was built in 1929 for the production of ferro-alloys, and a considerable amount of manganese ore was treated prior to the general slump in that year. In the fall of 1934, operations were again resumed in the production of silicon mainly for overseas markets.

The building is of the usual steel construction which is used in furnace rooms for operations of this type, floor space being 60 by 160 feet. At the time this plant was taken over, there was in operation, one 3,000 k.w. electric furnace producing ferro-silicon, and transformers and other electrical equipment for a second furnace suitable for the smelting of chromium ore. From this equipment, together with the furnace from Niagara Falls, N.Y., a furnace for the chromium smelting has been assembled. In addition to the above, there is a considerable quantity of furnace parts which can be brought together later for more capacity. The plant having been originally designed for the production of ferro-alloys, extensions and additions may be added with a minimum amount of alterations. The capacity of this plant is 350 tons of ferro-silicon per month at the present time. This is being marketed through well-established channels. Dependent upon the type of alloy processed, from 60 to 200 tons of chromium alloy is being produced monthly. A third furnace is being made ready for chromium and will add to the capacity.

In addition to the purchase of the plant of Superior Alloys, Limited, the company also secured by lease, with option to purchase, the FitzGerald laboratory, which adjoins your furnace plant. The FitzGerald Testing Laboratory is fully equipped with chemical laboratory, two electrical furnaces, and the usual allied equipment for research work. The plant also includes one of the finest libraries of its kind in Canada, the Fitzgerald Memorial and Metallurgical Library.

Ore milled in 1935 amounted to 1,200 tons. Early in 1935, 750 tons of chromium ore was hauled to Collins from the mine by tractor. This was stockpiled at Collins. Nine cars, a total of 400 tons, of this stock was drawn on during the year.

The average number of men employed during 1935 at the mine was 20. During the last seven months of the year an average of 44 men was employed at the smelter. A. R. Globe is general manager of the company's operations. The mine address is Collins.

GOLD

Algold Mines, Limited

Algold Mines, Limited, was incorporated in February, 1934, with an authorized capitalization of 2,500,000 shares of no par value. A first mortgage bond issue of $270,000, issued by New Goudreau Mines, Limited, stands against the property. The officers and directors are: W. R. Knox, president; J. G. Merrick, secretary-treasurer; J. J. Gray, M. C. Van der Voort, and Wm. Edwards, directors. The head office is at 45 Richmond Street West, Toronto.

The property is located in township 28, range 26, district of Algoma. By road, it is about 6 miles west of Goudreau on the Algoma Central railway. The mine address is Goudreau.

Previous operators sank a 425-foot and a 200-foot shaft, both of which are 2-compartment, 70-degree shafts. They established levels at 100, 120, 140, 200, and 400 feet, and mined two small stopes on the 100-foot level.

Algold Mines, Limited, started work in July, 1934. Underground operations were carried on from August, 1934, until the end of February, 1935, suspended until July, and then carried on until December, when they were again suspended.

The development work accomplished by this company from August, 1934, to the end of 1935, and the total in the mine at the end of 1935, on the various levels, was as follows:—

Level	Drifting		Crosscutting		Raising	
	1934-35	Total	1934-35	Total	1934-35	Total
	feet	feet	feet	feet	feet	feet
100-foot	365	865	40	95	.....	.....
120-foot	.....	35	.....	.....	.....	.....
140-foot	35	110	15	15	110	110
200-foot	318	1,388	40	625	.....	.....
400-foot	.....	470	.....	150	.....	.....
Total	718	2,868	95	885	110	110

The plant included a 1,100-cubic-foot Ingersoll-Rand electric compressor, and an 8½- by 10-inch air hoist.

An average of 12 men was employed during 1935. R. F. Mitchell was in charge, except for a short period during which Frank Williams had charge.

Anglo-Huronian, Limited

Anglo-Huronian, Limited, incorporated in 1933, has an authorized capitalization of 2,000,000 shares of no par value, of which 1,252,605 are issued. The officers and directors are: André Dorfman, president; J. H. Black, vice-president; J. Ingram, secretary-treasurer; G. C. Andrew, J. Ritchie, R. D. Stewart, F. H. Hamilton, E. Turk, and Sir A. Hamilton Grant, directors. The head office is at 80 King Street West, Toronto.

The company owns and operates the Vipond mine, which lies south of and adjacent to the Hollinger mine in Tisdale township, district of Cochrane. The following table shows the development work done on the various levels to July 31, 1934; the work accomplished during the last fiscal year, August 1, 1934, to July 31, 1935; and the total:—

DEVELOPMENT WORK BY LEVELS TO JULY 31, 1935

Levels	Previous to August 1, 1934			From August 1, 1934, to July 31, 1935			Total		
	Drifts	Cross-cuts	Raises[1]	Drifts	Cross-cuts	Raises	Drifts	Cross-cuts	Raises
	feet	feet	feet	feet	feet	feet	feet	feet	feet
100-foot	3,250	1,605	.....	59	.....	36	3,309	1,605	36
200-foot	7,089	5,703	157	25	.....	54	7,114	5,703	211
300-foot	6,999	2,021	815	11	.....	216	7,010	2,021	1,031
400-foot	7,601	5,005	579	180	.....	226	7,781	5,005	805
500-foot	8,193	5,287	757	20	.....	113	8,213	5,287	870
600-foot	4,445	2,797	371	250	157	457	4,695	2,954	828
733-foot	4,443	2,270	666	314	226	.....	4,757	2,496	666
866-foot	2,736	4,689	208	.....	.....	17	2,736	4,689	225
1,000-foot	3,888	5,336	10	664	609	186	4,552	5,945	196
1,200-foot	3,750	1,895	218	324	12	220	4,074	1,907	438
1,450-foot	2,807	2,131	1,227	622	192	12	3,429	2,323	1,239
Total	55,201	38,739	5,008	2,469	1,196	1,537	57,670	39,935	6,545

[1]No record available previous to August 1, 1931.

No shaft-sinking or winzing was done during the year, but for purposes of comparison with the preceding table a summary of the work on shafts and winzes to July 31, 1934, is set out below:—

SHAFT-SINKING AND WINZING TO JULY 31, 1935

	Feet
North Thompson (No. 3) shaft	1,200
North Thompson (No. 3) winze (an extension of No. 3 shaft)	250
Vipond (No. 1) shaft	400
Vipond (No. 4) winze (from the 300- to the 500-foot level)	200
Crown (No. 2) shaft	500
Crown (No. 5) winze (inclined, from the 500- to the 900-foot level)	400
Crown (No. 6) winze (from the 900- to the 1,100-foot level)	200

Diamond-drilling done between August 1, 1934, and July 31, 1935, amounted to 17,484 feet. In the same period the mill treated 104,764 tons of ore, which yielded $277,238.73, valuing gold at $20.67 an ounce. Previous to August 1, 1934, the total tonnage treated from the mine was 1,342,808 tons, which yielded $10,583,956.49.

The average number of men employed at the Vipond mine in 1935 was 149, of this number 106 worked underground, 17 in the mill, and 26 on surface. Robt. E. Dye was manager throughout the year; and was succeeded early in 1936 by W. R. Adam. The mine address is Timmins.

Arbade Gold Mines, Limited

Arbade Gold Mines, Limited, has an authorized capitalization of 3,500,000 shares of $1 par value, of which 2,112,939 have been issued.

The officers and directors are: C. A. Floyd, president; C. C. Floyd, secretary-treasurer; D. E. Sanderson and J. F. Kilawee, directors. The head office is at 10 Adelaide Street East, Toronto. The mine address is Matachewan.

The company owns 39 claims in Argyle and Baden townships, district of Timiskaming.

During 1935 a programme of surface development and diamond-drilling was carried out on the southwest group of claims. A mining plant was erected, and camps to accommodate 50 men were completed. A shaft was sunk to a depth of 60 feet.

An average of 7 men was employed.

Ardeen Gold Mines, Limited

Ardeen Gold Mines, Limited, was incorporated in December, 1933, with an authorized capitalization of 3,000,000 shares of $1 par value. In 1935 the capitalization was increased to 4,000,000 shares of $1 par value. The officers and directors are: H. G. White, president; Wm. Taylor, secretary-treasurer; Dr. V. M. Pierce, A. R. Miller, Jr., J. J. McInerney, C. G. Greenshields, James Cooper, and R. E. Allan, directors. The executive office is at 132 St. James Street West, Montreal, Que.

The property is located in Moss township, district of Thunder Bay, and is 18½ miles by road from Tip Top Spur on the Fort Frances branch of the Canadian National Railways.

Underground operations, which had been suspended in January, 1935, were resumed in August. Milling was resumed in the middle of November.

The lateral work accomplished from the resumption of operations until the end of the year consisted of 581 feet of drifting and 47 feet of crosscutting on the 1,000-foot level. Stoping was done on the 875- and 1,000-foot levels. A total of 3,871 feet of diamond-drilling was also done.

During November and December the 200-ton cyanide mill treated a total of 3,970 tons of ore.

An average of 28 men was employed during 1935 under the direction of W. R. Osborne. The mine address is Tip Top Spur, via Port Arthur.

Argosy Gold Mines, Limited

Argosy Gold Mines, Limited, incorporated in May, 1935, has an authorized capital of 3,000,000 shares of $1 par value, of which 1,489,905 shares were outstanding on December 31, 1935. The officers and directors are: F. L. Tretheway, president; J. B. Tyrrell, vice-president; V. H. Emery, managing director; A. L. Bishop and J. A. Wilson, directors. L. Appleyard is secretary-treasurer. The head office of the company is at 8 Wellington Street East, Toronto. The mine office address is Casummit Lake, via Sioux Lookout.

The property held by Argosy Gold Mines, Limited, consists of 21 claims at Casummit lake, about 100 miles north of Sioux Lookout in the Patricia portion of Kenora district. This property was purchased from Casey Summit Gold Mines, Limited, in May, 1935, along with all the other assets of that company. Argosy Gold Mines, Limited, also assumed all liabilities of its predecessor company.

Argosy Gold Mines, Limited, commenced dewatering the mine shaft on May 23. Underground development work was started on June 18. Development work on the partly explored No. 2 vein was continued on the 300-foot level, and a winze was started on the vein from this level to establish new levels at 400 feet and 500 feet. A crosscut was also started on the 300-foot level to intersect the No. 3 vein, which had not previously been developed underground.

Equipment was ordered late in the year to alter the 50-ton amalgamation mill, built and operated for a short time by Casey Summit Gold Mines, Limited, to a 75-ton cyanide mill.

Steam and Diesel engine power are used at this mine. When underground work was resumed, the new company installed a 650-cubic-foot air compressor with direct connection to a 150 h.p. Diesel engine. No other important changes were made in the mining plant.

An average of 42 men was employed at this mine from May, 1935, to the end of the year. R. Massey Williams is mine manager.

Ashley Gold Mining Corporation, Limited

The Ashley Gold Mining Corporation, Limited, has a capitalization of $3,000,000, in shares of $1 par value. The officers and directors are: J. H. C. Waite, president; G. C. Ames, secretary-treasurer; Charles McCrea, C. G. McCullagh, W. R. P. Parker, E. H. Rose, and C. E. Trafford, directors. M. F. Fairlie is managing engineer. The head office is at 350 Bay Street, Toronto. The mine address is Elk Lake.

The mine in Bannockburn township, district of Timiskaming, was operated continuously throughout the year.

The following is taken from the report of the president for the year ending December 31, 1935:—

Operating profits amounted to $54,295.69, as against $60,428.92 in the previous year. After writing off prior development costs of $63,607.11 and transferring $4,000.00 from contingency reserve, there was a net loss of $5,311.42. Net liquid assets increased by $77,513.22 during the year and amounted to $159,683.89 at December 31.

Development of new ore did not keep pace with production, and ore reserves decreased both in tonnage and grade. Estimated reserves at the end of the year amounted to 10,760 tons, averaging slightly less than 0.3 ounces per ton. In addition, there is a considerable quantity of backfill from the initial stoping operations, which, at the current price for gold and with mining costs written off, can be handsorted and treated at a small profit.

There were 47,367 tons of ore, with an average grade of 0.2636 ounces per ton, milled during the year, as compared with 43,532 tons averaging 0.315 ounces in 1934. The value of bullion produced amounted to $440,553.70, against $456,831.86 in the previous year. The total value of bullion shipments to the end of 1935 was $1,465,495.97.

The cost per ton of ore milled, including mining, development and exploration, milling, administration and head office, was $8.26. An appreciable reduction in operating costs was attained towards the end of the year.

Development and exploration work done during the year consisted of 5,265 feet of diamond-drilling, 2,097 feet of drifting, 727 feet of crosscutting, and 2,182 feet of raising.

In September a complete geological examination of the mine was made by an independent consulting geologist, who planned an extensive exploration programme, which is being carried out under his direction. As a result of this work several vein intersections have been located by diamond-drilling, but subsequent development by drifting, raising, etc., has failed to prove any considerable quantity of new ore. Unless new discoveries are made the life of this mine will be short.

An average of 120 men was employed. J. W. Robertson is resident manager.

Bankfield Gold Mines, Limited

Bankfield Gold Mines, Limited, was incorporated in April, 1934, with an authorized capitalization of 3,000,000 shares of $1 par value, of which 2,520,005

shares have been issued. The officers and directors are: C. D. H. MacAlpine, president; T. H. Stinson, vice-president; F. J. Bailes, secretary-treasurer; Jos. Errington, D. M. Morin, and J. H. C. Waite, directors. The head office is at 1006 Concourse Building, Toronto.

The property is located in the Magnet Lake section of the Little Long Lac area, Thunder Bay district. It is reached by a 3-mile road from Kenwell on the Long Lac–Port Arthur branch of the Canadian National Railways. The mine address is Geraldton.

Underground operations were carried on throughout 1935. The 3-compartment vertical shaft was continued to a depth of 552 feet, and levels were established at 275 and 525 feet. A station was cut at 400 feet. The work accomplished on the various levels was as follows:—

Level	Drifting	Crosscutting	Raising
	feet	feet	feet
150-foot	1,323	404	17
275-foot	901	377	51
525-foot	244	.....	.....
Total	2,468	781	68

In addition 2,237 feet of diamond-drilling was done from surface, and 1,416 feet from underground.

The plant included two 90 h.p. boilers, an 11- by 8-inch Ingersoll-Rand steam hoist, and a 750-cubic-foot Ingersoll-Rand steam compressor.

An average of 54 men was employed, of whom 19 were underground. J. W. MacKenzie was in charge.

Barry-Hollinger Mines, Limited

Barry-Hollinger Mines, Limited, is capitalized at 4,000,000 shares of $1 par value. The officers and directors are: Dr. E. Herbert Greene, president; J. P. Patterson, vice-president; D. McKinnon, secretary-treasurer; E. S. Williams, director. The head office is at 57 Bloor Street West, Toronto.

The mine, in the township of Pacaud, district of Timiskaming, was operated throughout the year with an average of 48 men. Operations ceased in January, 1936.

Development for the year consisted of 72 feet of drifting. Ore hoisted amounted to 35,172 tons. The total value of the production for the year was $143,698.26. Douglas Bryden was manager.

Bidgood Kirkland Gold Mines, Limited

Bidgold Kirkland Gold Mines, Limited, has an authorized capitalization of $2,000,000, in shares of $1 par value. The officers are: A. L. Herbert, president; N. W. Byrne, secretary-treasurer; W. Crawford, R. J. Neelands, H. Koza, A. E. Belcher, and O. L. Knutson, directors. O. L. Knutson is mine manager, and S. A. Pain is consulting engineer. Both the head office and mine office are at Kirkland Lake. The company owns 753 acres in Lebel township, district of Timiskaming.

During 1935 work at the mine was confined to the 500-foot level of the No. 2 shaft. The main crosscut was extended 280 feet to the south and tapped the vein system running across the north end of the Moffatt-Hall mine into Bidgood ground.

In this zone a total of 1,337 feet of crosscutting and drifting was carried out, and 1,471 feet of diamond-drilling.

The cyanide mill treated 6,960 tons of ore extracted from the Moffatt-Hall mine under lease during the first seven months of the year, but after July all production was from the Bidgood mine, from which 11,148 tons derived from stoping and drifting on the 500-foot level was treated.

The mill has been gradually stepped up and is currently treating 60 to 70 tons daily. The crusher and rolls are capable of handling 300 tons daily, and the ball mill 110 tons daily. A tube mill is being installed, and with a few additions the cyanide end of the mill can treat 150 tons a day.

The mining plant consists of a 1,000-cubic-foot Sullivan compressor driven by a 200 h.p. motor, a 720-cubic-foot compressor driven by a 125 h.p. motor, and an electrically driven hoist.

The mine water is handled by vertical triplex and horizontal duplex pumps, each handling 100 g.p.m., with a 250 g.p.m. centrifugal pump as a standby.

Production for the year amounted to 2,243 ounces of gold and 806 ounces of silver from the Moffatt-Hall lease and 1,308 ounces of gold and 855 ounces of silver from the Bidgood mine.

An average of 42 men was employed.

Bilmac Gold Mines, Limited

Bilmac Gold Mines, Limited, was incorporated in September, 1934, with an authorized capitalization of 2,000,000 shares of no par value. The officers and directors are: L. F. Hogarth, president; G. E. McVittie, vice-president; A. C. Laing, treasurer; W. R. Marchment, secretary; A. V. Kellum and Edward Coleman, directors. The head office is at 33 Temperance Street, Toronto.

The property consists of six claims in Macmurchy township, West Shining-tree area, district of Sudbury, and comprises the former White Rock, Atlas, Harvey Kirkland, and McVittie properties.

In October, 1934, sampling and mapping were started; and in February, 1935, underground work was commenced on the old White Rock property. Previous operators had put down a 2-compartment vertical shaft to a depth of 175 feet, established levels at 65 and 175 feet, and done 290 feet of drifting and 20 feet of crosscutting on the 65-foot level and 915 feet of drifting and 125 feet of crosscutting on the 175-foot level. They had also put up an inclined raise from the 65-foot level to surface, and mined a small stope on that level.

Work was suspended by the company in June, 1935, after the shaft had been deepened to 425 feet, and about 35 feet of crosscutting on a new level at 410 feet had been accomplished.

The plant included a 104 h.p. boiler, a 560-cubic-foot steam compressor, and a 9- by 8-inch Ingersoll-Rand double-drum hoist. There was an old mill on the property consisting of a jaw-crusher, a Tremaine stamp, and amalgamation plates.

An average of 35 men was employed during the period of work in 1935, of whom 10 were underground. J. E. Grant was manager, and Sydney Brown was superintendent. The mine address is Shiningtree.

Bob Tough Gold Mines, Limited

Bob Tough Gold Mines, Limited, was incorporated in September, 1933, with an authorized capitalization of 3,000,000 shares of no par value. The officers and directors are: R. R. Tough, president; H. J. Tiedt, vice-president;

J. H. Stevens, secretary-treasurer; Albert Levan, assistant secretary; E. B. Ratcliffe, managing director; F. H. Gage, R. E. Thompson, and H. J. Simons, directors. The executive office is at 207 Turner Building, Hamilton.

The property is located in McKinnon township, district of Sudbury, and is reached by a 16-mile road from Massey station on the Canadian Pacific railway.

During 1935 the installation of the plant was completed, and the 3-compartment vertical shaft was sunk 120 feet to a total depth of 150 feet. A level was established at 150 feet, where 118 feet of crosscutting was accomplished. Underground work was suspended in August, and surface work only carried on until the end of October, when all operations ceased.

The plant included a 99 h.p. horizontal return tubular boiler; a 750-cubic-foot Ingersoll-Rand compressor, driven by a 125 h.p. steam engine; and an 8- by 10-inch Jenckes single-drum hoist.

An average of 12 men was employed during the period of operation in 1935, of whom 5 were underground. E. B. Ratcliffe was in charge.

Bousquet Gold Mines, Limited

Bousquet Gold Mines, Limited, was incorporated in November, 1920, with an authorized capitalization of 2,000,000 shares of $1 par value. The capitalization was increased to 3,000,000 shares in 1935. The officers and directors are: Lionel Brooke, president; C. H. Hitchcock, vice-president; Globe Investment, Limited, treasurer; W. B. McPherson, secretary; H. P. Snelgrove, director. The head office is at 171 Yonge Street, Toronto. The mine address is Willisville.

The property consists of 20 mining claims located in two groups in township 11, district of Sudbury. By winter road it is 7 miles east of West River, on the Algoma Eastern railway.

During 1935 the 2-compartment vertical shaft was sunk an additional 134 feet, to a total depth of 468 feet, and a third level established at 450 feet. The lateral work accomplished in 1935, and the total to the end of 1935 on the various levels was as follows:—

Level	Drifting		Crosscutting	
	1935	Total	1935	Total
	feet	feet	feet	feet
150-foot	.....	605	.....	67
300-foot	177	447	.....	102
450-foot	526	526	136	136
Total	703	1,578	136	305

In addition 1,908 feet of diamond-drilling was done from underground.

Anglo-Huronian, Limited, optioned a large block of shares in the company at the beginning of the year, and was responsible for the work done from the middle of February until June, when the option was dropped. The company suspended all work for 1935 at the end of July.

The plant used included an 80 h.p. and a 60 h.p. boiler, a 500-cubic-foot steam compressor, and an 8- by 10-inch steam hoist.

An average of 29 men was employed from the first of the year until the end of July. C. W. MacDonald was in charge during the option period, and Lionel Brooke during the remaining time.

Buffalo Ankerite Gold Mines, Limited

Buffalo Ankerite Gold Mines, Limited, was incorporated in 1932 with an authorized capitalization of 1,000,000 shares of $1 par value. The number of shares issued and outstanding at the end of 1935 was 701,679; this includes shares to be issued to Marbuan Gold Mines, Limited, in consideration of the transfer of their net assets to this company. The officers of the company at the end of 1935 were: Geo. R. Feine, president; G. R. Loesch, vice-president; Henry Kobler, treasurer; R. P. Kinkel, assistant treasurer; E. G. Kinkel, secretary and managing director. The directors were: H. J. Tiedt, J. Betz, and A. J. Baldeck. The executive office of the company is at 1728 Rand Building, Buffalo, N.Y. The head office and mine office are at South Porcupine. The property is in Deloro township, district of Cochrane.

In 1935 plans were made for the acquisition of Marbuan Gold Mines, Limited, by Buffalo Ankerite Gold Mines, Limited. These plans were not approved by the shareholders of each company until January, 1936, but at this time the approval was given as of November 30, 1935.

The following is taken from the managing director's report to the shareholders for the fiscal year ending December 31, 1935:—

The recoveries for the year are indeed gratifying, having exceeded the $1,000,000 mark, the total recovery being $1,023,358.51 (Ankerite mill) and including the Marbuan mill for December, $1,056,653.85, as compared to $712,898.29 in the year 1934, with an average daily tonnage of 345.6 tons.

The operating profit, before depreciation and deferred development write-off, was $311,941.30. This shows considerable improvement over 1934.

During the fiscal year the company acquired by outright purchase claim H.R.951 on McDonald lake, lying about one mile northwest of the company's property, consisting of about 40 acres, for a reasonable cash consideration. This claim may prove of considerable importance to the company in the future.

The most important step taken by the company during the year was the acquiring of the properties of the Marbuan Gold Mines, Limited. This transaction was approved by the Marbuan Gold Mines, Limited, stockholders on January 22, 1936, and the transfer of its properties to this company has been completed. By the consummation of this transaction the mining area of the company has been increased from approximately 155 acres to 331 acres. The milling capacity has been increased by the acquisition of the Marbuan mill to approximately 700 tons per day, with possibilities of being able to increase tonnage in 1936.

During the year 1935 the company employed the Canadian Appraisal Company, Limited, of Montreal, to make a thorough appraisal of the buildings, machinery, and equipment. The report of the Canadian Appraisal Company shows the valuations as of June 29, 1935, as follows:—

	Buffalo Ankerite	Marbuan
Buildings, replacement value	$131,990.54	$71,222.53
Buildings, present value	102,785.48	50,381.85
Machinery and equipment, replacement value	406,940.08	192,252.46
Machinery and equipment, present value	296,019.54	127,055.50
Grand total, replacement value	538,930.62	263,474.99
Grand total, present value	398,805.82	177,437.35

The operation policy for 1936 includes the completion of the crosscut from the Marbuan winze to the No. 5-7 ore zone, the connecting of this crosscut with the main Ankerite shaft, crosscutting to the Nos. 1 and 2 veins from the main shaft on the 875- and 1,050-foot levels, and drifting east and west on these veins. Alterations will be made in the crusher plant and Ankerite and Marbuan mills to increase capacity, providing that the development work progresses sufficiently to warrant increased tonnage.

The broken ore reserves (Ankerite) have increased in grade and tonnage over 1934. The positive ore reserves as estimated have increased from 107,997 tons to 360,648 tons. The estimated values have, however, decreased from the per ton value shown in the 1934 report. We believe this value to be more in line with recoveries of 1935. The excellent values and widths shown in diamond-drill cores below the 875-foot level, north zone, are very encouraging indications of increasing values at depth. In the 1934 report of Marbuan the broken ore reserves were stated to be 12,375 tons of $3.75 grade. In the 1935 report this has been increased to 15,665 tons of $3.10 grade. In 1934 there were no positive ore reserves, and in 1935 there were 33,520 tons

of $2.97 grade. In 1934 the possible ore was given at 11,867 tons of $6.85 assay value. The 1935 report shows 34,740 probable and possible ore reserves with an average assay value of $2.63, all values above being at $20.67.

The following is taken from the report of the manager to the president for the year ending December 31, 1935:—

Production

During the period the mill treated 159,383 dry tons, yielding $1,023,358.51. Recovery per ton milled was $6.42.

Milling

Percentage of total possible running time	97.88
Tons treated per day	437.7
Tons treated per 24 hours' running time	447.3
Mill heads (at $20.67 per ounce)	$3.891
Mill tailings (at $20.67 per ounce)	$0.223

Mining

	Tons
Ore broken in stopes and stope preparation	170,170
Ore broken in development	33,522
Total	203,692

Development and Exploration

The objectives for 1935 were the development of the Nos. 5 and 7 vein structures on the 250-, 350-, 725-, and 875-foot levels, and the extensions of the Nos. 1 and 2 veins on the 475- and 600-foot levels.

	Feet
Drifts	6,892
Crosscuts	70
Raises	2,477
Shafts	466
Diamond-drilling	11,179.5
	cu. ft.
Stations and pockets	9,537.8

Lengths of ore developed on the different horizons follow:—

Level	Vein	Feet
250-foot	No. 91	180
350-foot	No. 91	43
475-foot	Nos. 89, 90, 91, 2	687
600-foot	Nos. 83, 1, 2	279
725-foot	Nos. 90, 91, 89	840
875-foot	Nos. 89, 90, 91, 92, 93	1,542

Shaft-Sinking

The main shaft was repaired, and the timbers were relined from the 475-foot level to the bottom. Shaft sets between the 600-foot level and the bottom were replaced and jacked back into position. Shaft-sinking preparations were completed late in September, and actual sinking started October 10; 466 feet of shaft was sunk and the 875-foot station partially cut by the end of the year. Serpentine entered the shaft above the 1,050-foot station location. The shaft section from this horizon to the 1,200-foot level is in serpentized peridotite and serpentine.

Shaft set intervals were reduced, and it was found necessary to spile the last 35 feet of the section. It appears that the shaft is in the main serpentine mass, and it is questionable whether it would be advisable to continue sinking in this location.

Costs

The total operating costs per ton milled (for a total of 159,383 tons), including workmen's compensation, silicosis, and fire insurance, follow:—

	Total cost	Cost per ton
OVERALL OPERATING COSTS:		
Exploration	$15,341.55	$0.096
Development	103,405.52	.648
Mining	366,362.93	2.299
Milling	124,862.62	.783
General expense and personnel loss	61,440.18	.385
Total	$671,412.80	$4.213
UNIT COSTS:		
Per ton of ore broken in stopes		$1.032
Per foot of drifts		12.859
Per foot of crosscuts		10.253
Per foot of raises		16.518
Per foot of diamond-drilling		1.240
Per foot of shaft (8 by 22 feet)		78.308

Ore Reserves

The development factor has improved over that existing at the end of 1934. It is not up to normal at present. The sinking of the main shaft with stations established at the 875- and 1,050-foot levels will expedite the development of the No. 5-7 and South zone veins on these levels. Diamond-drilling has proved the downward extension of the structures to the 1,100- and 1,000-foot horizons, respectively, with favourable results.

Broken ore reserves are estimated at 105,379 tons, with an assay value of $4.54, and positive ore reserves at 360,648 tons, with an assay value of $5.42 per ton, both values being based on gold at $20.67 per ounce.

Construction

Minor buildings were erected. The Marbuan steam plant was overhauled and is being used as a central heating unit for Marbuan and Ankerite. The necessary lines were installed to Ankerite. The tailings dam was increased in height to provide additional storage.

General

A second-hand Symons cone crusher was purchased and installed in the crushing plant. Two additional discs were purchased and installed on the American filter in the mill, raising the capacity of this machine to 500 tons plus. Costs have been reduced materially.

During 1935, the average number of men employed at the Buffalo Ankerite mine was 274, and at the Marbuan mine 110. Chas. L. Hershman was manager at both properties.

MARBUAN MINE

The following memorandum of the report on the operations of the Marbuan Gold Mines, Limited, for the year 1935 is taken from the annual report of the Buffalo Ankerite Gold Mines, Limited, for the same period.

This memorandum is made for the purpose of supplying general information regarding this property to Buffalo Ankerite Gold Mines, Limited, stockholders, although the property was not acquired until after the expiration of the year ending December 31, 1935.

Production

During the period the mill treated 59,380 dry tons, yielding $287,012.17. Recovery per ton milled was $4.833.

Milling

Percentage of total possible running time	85
Tons treated per day	162.3
Tons treated per 24 hours' running time	191
Mill heads (at $20.67 per ounce)	$2.61
Mill tailings (at $20.67 per ounce)	$0.189
Extraction, per cent	96.02

Mining

	Tons
Ore broken in stopes and stope preparation	58,105
Ore broken in development	9,413

Development and Exploration

The objectives for 1935 were the development of the indicated Nos. 3 and 5 structures on the 8th, 9th, and 10th winze levels.

	Feet
Drifts	3,914
Crosscuts	1,270
Raises	667
Diamond-drilling	7,596.6

Costs

The total operating costs per ton milled, including workmen's compensation, silicosis, and fire insurance, follow:—

Overall Operating Costs:	Per ton
Exploration	$0.159
Development	1.222
Mining	2.112
Milling	1.061
General expense and personnel loss	.489
Total	$5.043
Unit Costs:	
Per ton broken in stopes	$1.137
Per foot drifts	13.143
Per foot crosscuts	12.094
Per foot raises	15.903
Per foot diamond-drilling	1.185

Ore Reserves

Ore reserve calculations are based on extensions within the operating areas and the indicated possibilities beyond stope sections on all horizons.

Cre reserves	Tons	Assay value[1]
Broken	15,665	$3.10
Positive	35,520	2.97
Probable	18,380	2.70
Possible	16,360	2.55
Total	83,925	$2.85

[1]Gold at $20.67 per ounce.

Construction

The steam plant was overhauled and placed in operation as a central heating unit for both the Ankerite and Marbuan. All pipe-lines, steam and water, were replaced and insulated. A new fuse-house was built. The tailings dam was increased in height to provide additional storage.

General

A set of second-hand rolls were purchased and installed in the rock-house. Operating costs were reduced.

Canusa Gold Mines, Limited

Canusa Gold Mines, Limited, was incorporated in July, 1932, with an authorized capitalization of 1,500,000 shares of $1 par value. In December, 1935, the shareholders of the company authorized an increase in the capitalization to 4,500,000 shares of $1 par value. The officers and directors of the company in 1935 were: D. D. Wessels, president; Geo. Neukom, vice-president; Thos. R. Deacon, secretary; Robt. Schram, treasurer; H. Kendrick and P. Du Bois, directors. The head office is at 371 Bay Street, Toronto. The mine office address is South Porcupine.

The company holds 440 acres, 80 acres in Tisdale township and 360 in Whitney township, district of Cochrane. The claims are all in one group and were formerly held by the Scottish-Ontario Syndicate.

The following development work has been reported done at this property:—

	To Dec. 31, 1934	1935
	feet	feet
Shaft-sinking	320	.....
40-foot level:		
Drifting	140	40
Crosscutting	10	.....
Raising	15	15
100-foot level:		
Drifting	600	225
Crosscutting	305	150
Raising	240	.....
300-foot level:		
Drifting	225	.....
Crosscutting	790	.....
Raising	20	.....

There is a 25- to 50-ton amalgamation mill on this property. Only a small tonnage was milled in 1935. No bullion sales have been reported.

Other plant equipment includes one 40 h.p. locomotive-type boiler, one 20 h.p. marine-type boiler, two air compressors, capacities 850 and 300 cubic feet, a single-drum hoist, and electric motors to drive both compressors and hoist.

Operations were suspended at the property about September 1, 1935, with the exception of pumping operations. The average number of men employed was about 14. Robt. Schram was general manager during 1935.

Casey Contact Gold Mines, Limited

In June, 1934, the charter of Brookbank Gold Mines, Limited, incorporated in March, 1929, was acquired by Casey Contact Gold Mines, Limited. The authorized capitalization was increased in November, 1934, from 3,000,000 shares to 3,500,000 shares of $1 par value. The officers and directors are: F. W. Purdy, president; H. L. Walker, vice-president; E. M. Hand, secretary-treasurer; E. L. Cousins, A. K. Roberts, and H. F. Cassidy, directors. The head office is at 67 Yonge Street, Toronto.

The company acquired in 1934 the Brennan-Kenty east group of 12 claims, located about 8½ miles northwest of Nezah in the Sturgeon River area, district of Thunder Bay. Surface work and diamond-drilling was carried on until June, 1935, when underground work was started. A 2-compartment vertical shaft was sunk to a depth of 228 feet. A station was cut at 100 feet, and a level established at 200 feet. All work was suspended at the end of September owing to financial difficulties. A total of 408 feet of lateral work was accomplished on the 200-foot level.

The plant included a 165 h.p. locomotive-type boiler, a 6- by 8-inch Canadian Mead single-drum hoist, and a 275-cubic-foot Sullivan steam-driven compressor.

An average of 23 men was employed in 1935 to the end of September, under the direction of H. M. Parrington. The mine address is Jellicoe. There is a winter road to the property from Nezah.

The company also owns a group of 33 claims at Casummit lake, 100 miles north of Sioux Lookout, in Patricia portion of Kenora district.

At the beginning of 1936 arrangements were being made to change the name of the company to Brengold Mines, Limited.

Central Patricia Gold Mines, Limited

Central Patricia Gold Mines, Limited, was incorporated in 1931, succeeding Central Patricia Mines, Limited, formed in 1927. It has an authorized capitalization of 2,500,000 shares of $1 par value.

The officers and directors are: F. M. Connell, president; W. H. Connell, vice-president; Alan Cockeram, secretary-treasurer; J. H. Rattray, L. Cohen, and G. B. Webster, directors. The head office is at 85 Richmond Street West, Toronto.

The mine is situated in the Crow River area, district of Kenora, Patricia portion. The mine camp is about 110 miles north of Savant Lake Station on the Canadian National railway. It lies about 6 miles west of the property of the Pickle Crow Gold Mines, Limited. The holdings include 85 claims, which lie in several large groups in the surrounding area.

The following is an extract from the president's report for the year ending December 31, 1935:—

Following the addition to the mill in April, increasing the capacity to 100 tons per day, production was maintained at that rate throughout the balance of the year. The total yield was 22,061.26 ounces of gold and 2,296.96 ounces of silver, valued at $777,570.49, from 35,192 tons of ore treated.

A further addition to the mill was decided on in July to bring the milling capacity to 150 tons per day. All the necessary equipment has been purchased and it is expected to have the enlarged plant in operation by March 1, 1936.

Under the existing contract with the Hydro-Electric Power Commission of Ontario, power was delivered to the mine in April and has resulted in a considerable saving. With future requirements in mind, negotiations were opened with the commission for additional power. Your company has concluded a new contract, agreeing to purchase 800 horse-power per annum at $65 per horse-power for a period of seven years. Power exceeding the 800 horse-power is to be supplied at a $35 rate. After the seven-year period, all power is to be supplied at $35 per horse-power for the life of the mine. This new contract will come into effect when the additional power is delivered following the completion of the construction of a second unit at the Rat Rapids development site.

A further reduction in transportation costs was effected on the completion of the Root River portage development last July. Freight can now be transported from Hudson on the Canadian National railway to Doghole bay at the east end of Lake St. Joseph. Doghole bay is 21 miles from the property. The government is now considering the construction of a road from this point to the mine. The road is urgently needed for the general development of this new and proved mining area.

Patents were obtained on 46 mining claims held by your company, representing 2,024.16 acres, making a total of 64 claims, or 2,624.44 acres, on which patents have been acquired. The company has in addition 40 mining claims which will be patented when the required assessment work is completed.

During the coming year it is proposed to sink the main shaft from the 500- to the 1,000-foot level and also carry on further lateral exploration. The amount of development that can be done will be governed by the power available. Delivery of the extra power contracted for is not expected until the 1st of October next.

Development at the No. 2 operation (Springer) was carried out as planned, and the results of the work are covered in the mine manager's report. Power requirements at the main mine made it impossible to carry on further work at this operation for the time being, but in view of the satisfactory results obtained it is the intention of your directors to extend the present shaft to the 500-foot level and do further lateral work when the power is available.

At the close of the year, after treating 35,192 tons, the ore reserves amounted to 95,413 tons, averaging 0.64 ounces per ton.

The development at the main mine continues to be very satisfactory, and that at the No. 2 operation has indicated a substantial length of high-grade ore; and future development of this property shows much promise.

The following is taken from the mine manager's report for the year ending December 31, 1935:—

Production

During the year, 35,192 tons of ore were treated, from which was recovered $777,570.49. The average extraction was 97.36 per cent.

Development

Development was restricted to the opening of the known ore shoots. The "B" and "C" ore shoots were developed on the 3rd and 4th levels. This work has shown the ore to have

greater widths and lengths than previously estimated and has consequently increased the tonnage of ore available while maintaining the same grade.

Diamond-drilling has improved the outlook for increased ore reserves. Drilling was done from underground workings and at surface. A hole drilled from the station at the 500-foot level cut the "C" ore shoot at a vertical depth of 140 feet below that level. An ore intersection in this hole gave 0.55 ounces gold across a width of 9 feet. Shallow surface drilling was done 1,200 feet west of the shaft and has disclosed a new ore area. The results of this work indicate a section 233 feet long by 2.5 feet wide, with an average grade of 0.4 ounces gold. Further exploration of this showing will be undertaken by means of underground work on the 375-foot level. Preparations were made to sink the main shaft from the 500-foot to the 1,000-foot level.

ORE ESTIMATE

	Tons	Grade
		ounces
"A" ore body	6,395	0.59
"B" ore body	31,295	.60
"C" ore body	36,965	.68
"D" ore body	4,450	.52
Broken ore in stopes	16,308	.65
Total	95,413	0.64

Construction

During March and April, a complete change-over from steam to electric power was effected, and at the same time a second mill unit was installed and put into operation, raising the daily capacity from 50 to 100 tons. This change-over of the plant necessitated the construction of a new power-house and a new headframe.

The installation in the power-house of two new compressors, a double-drum hoist, and a standby unit was completed.

The following additional buildings were constructed and equipped: kitchen and dining hall (capacity 150 men), central heating plant, 5 houses, recreation building, machine shop.

No. 2 Operation (Springer)

A plant (electrically operated) was set up and a shaft sunk to 175 feet. A station was established at 150 feet and a total of 1,022.5 feet of crosscutting and drifting was done.

Four ore shoots, varying in length from 25 feet to 90 feet, were found to the west of the main crosscut, giving a total ore length of 198 feet, averaging 2.35 ounces over a width of 14 inches. It was necessary to suspend this work in order to have sufficient power available to carry on shaft-sinking operations at the main property. The results of the exploration to date are very satisfactory, and further sinking and development will be carried on as soon as hydro power is available.

Summary

The change-over from steam to electric power, together with the improved mine conditions, necessitated a complete rearrangement of the plant and camp buildings. The major expenditures have been completed, so the expense of the construction programme for the ensuing year should be moderate.

In July, it was decided to increase the daily capacity of the mill to 150 tons. Material and equipment for this purpose were purchased and the mill addition is now being erected. All work, apart from capital expenditures, has been written into the operating costs.

An average of 105 men was employed during the year. A. J. Anderson is mine manager. The mine address is Pickle Crow.

Central Porcupine Mines, Limited

Central Porcupine Mines, Limited, incorporated December, 1933, has an authorized capitalization of 5,000,000 shares of $1 par value. The officers and directors of the company are: E. Ward Wright, president; C. D. H. MacAlpine, vice-president; Geo. G. Blackstock, secretary-treasurer; W. J. Aikens, W. J. Hume, H. C. McCloskey. and Jos. Montgomery, directors. The head office is at 25 King Street West, Toronto. The mine office is at Schumacher.

The property held by Central Porcupine Mines consists of 13 claims, 520 acres, in the township of Tisdale, district of Cochrane. It lies south of the

Coniaurum mine and east of the McIntyre and Hollinger mines, and adjoins each. Development of this property has been carried on through the Goldale shaft of the Coniaurum mines, work being done from the 1,000-foot level. In 1934 a crosscut, approximately 2,220 feet in length, was started to reach Central Porcupine ground. About 1,303 feet advance was made in this crosscut in 1934. Early in 1935 a vein was encountered on Coniaurum ground, and crosscutting was temporarily held up while some development work was done on this vein. Work on the crosscut was later resumed and Central Porcupine ground was entered about 650 feet east of the northwest corner of the property. The crosscut was continued in a direction S.25°E., for 1,252 feet beyond the boundary. A line drive from a point 85 feet back of the face was then carried due east for 689 feet, from which point a crosscut was again started in a southerly direction. Only a few rounds had been taken from this crosscut at the end of the year. The total advance in 1935 was 2,908 feet. From the same level 3,109 feet of diamond-drilling was done in 1935.

The average number of men employed in 1935 was 32. F. G. Stevens is general manager of this property, and Chas. Workman is mine superintendent.

Churchill Mining and Milling Company, Limited

The Churchill Mining and Milling Company, Limited, was incorporated in March, 1918, and now has an authorized capitalization of 4,000,000 shares of $1 par value. The officers and directors are: W. R. Knox, president; K. G. Merrick, secretary-treasurer; D. Lieberman, H. H. Van Wart, and F. H. Geddes, directors. The head office is at 45 Richmond Street West, Toronto.

The property held by this company includes a group of four claims in Churchill township, in the West Shiningtree area, district of Sudbury.

Operations at this property, which were suspended in October, 1934, were resumed in July, 1935, and again suspended at the end of November. During 1935 a level was established at the bottom of the 109-foot, 2-compartment shaft, sunk in 1934, and a total of 70 feet of drifting and 154 feet of crosscutting was accomplished.

The plant included a 47 h.p. locomotive-type boiler, a 270-cubic-foot Sullivan compressor driven by a steam engine, and a 6- by 8-inch Jenckes hoist.

An average of 10 men was employed during the period of operation, under the direction of A. Lantagne.

Clark Gold Mines, Limited

Clark Gold Mines, Limited, was incorporated in October, 1934, with an authorized capitalization of 2,000,000 shares of $1 par value, 650,000 of which have been issued. The officers and directors are: R. H. Miner, president; A. J. Reece, vice-president; G. S. Andrews, secretary-treasurer; W. S. Lighthall, A. C. Dick, and M. A. Carton, directors. The executive office is at 7411 De Lanaudiere Street, Montreal, Que. The mine address is Dyment.

The property consists of a group of 15 claims located about 8 miles southwest of Dyment on the Canadian Pacific railway, district of Kenora.

Work was started in October, 1934, and carried on until November, 1935. Some open-cut mining was done, and several shipments of ore were made. Underground work was started in April, 1935, and suspended at the end of September, 1935. An old 2-compartment, 75-degree shaft, 75 feet deep, was slashed to vertical and timbered. A level was established at 68 feet, on which 20 feet of drifting was done.

The plant included a 310-cubic-foot gasoline compressor and a small air hoist. Buildings erected consisted of a power-house, blacksmith shop, and powder magazine.

An average of 21 men was employed during 1935, under the direction of R. R. Clark.

Cole Gold Mines, Limited

Cole Gold Mines, Limited, incorporated in November, 1933, has an authorized capitalization of 3,000,000 shares of $1 par value. The officers and directors of the company are: John Y. Cole, president; Wm. Exton, Jr., vice-president; Cecily Cole, secretary-treasurer. The executive office and the mine office are both located at Cole, a recently established post office.

The holdings of the company are located along the southwestern shore of the Pipestone Bay section of Red lake, in the Patricia portion of Kenora district.

The property is being developed through a 2-compartment shaft, which was sunk to 200 feet in 1933. In 1934, a large amount of development work was done on the 200-foot level and a number of veins were partially developed. In 1935, the 300-foot level was opened. Development continued on this level until about the middle of September, when sinking was again resumed, with an objective depth of 550 feet. This work was completed about the end of the year. Two new levels at 300 feet and 400 feet are to be opened.

Work to date has been carried on with a small steam-operated plant, which includes one 70 h.p. locomotive-type boiler, a Canadian Ingersoll-Rand 250-cubic-foot air compressor, and an 8- by 10-inch Jenckes hoist. Arrangements for the supply of electric power to the mine by the Hydro-Electric Power Commission of Ontario were recently reported to have been completed.

From 45 to 55 men were employed at the mine in 1935. John Y. Cole is manager of the property.

Concordia Gold Mining Company, Limited

The Concordia Gold Mining Company, Limited, is a subsidiary company of Associated Gold Mining and Finance Company, Limited. The company was incorporated in May, 1934, with an authorized capitalization of 3,000,000 shares of no par value, of which 1,501,000 shares are reported held by the parent company. The head office of the company is at 276 St. James Street West, Montreal, Que. The officers and directors of the company are: A. E. Ladouceur, president; Walter F. Costigan, secretary-treasurer; Theo. Lanctot and Stuart Grant, directors. C. L. Laederer is mine manager, and E. E. Elliott is mine superintendent. The mine address is Timmins.

The Concordia Gold Mining Company took over the property of Jones-Porter Mines, Limited, consisting of 14 claims in Deloro township, district of Cochrane. The underground workings consist of a 3-compartment shaft, 158 feet in depth, with station at 125 feet, at which level 177.8 feet of crosscutting and 55.7 feet of drifting had been done to December 19, 1935. During 1935, 10 diamond-drill holes were drilled from underground, and 8 from surface. Total footage in all these holes combined was slightly in excess of 2,400 feet.

During the year the plant was altered, and several additions were made. Buildings and equipment are as follows: office and staff residence; cookery; 2 bunk-houses; fully equipped assay office; blacksmith shop, with Climax drill-sharpener; superintendent's residence; oil-house; magazines; auxiliary boiler-house, with two vertical-type boilers, 25 to 30 horse-power each, used for heating and to supply part of the power required in the mill; a main boiler-house, under

construction, and 2 locomotive-type boilers of 100 h.p. each; and a large combination building, in which there is a fully equipped machine shop, welding shop, dry-house, engineering office, mill, and hoist-room. In the hoist-room there is an 8- by 10-inch Jenckes hoist; a Sullivan, steam-driven, 2-stage, 1,000-cubic-foot air compressor; a second compressor with a rated capacity of 180 cubic feet; and a 20 k.w. steam-driven lighting unit.

In a building attached to the hoist-room is a 12- by 14-inch Ingersoll-Rand 480-cubic-foot air compressor belted to a Hercules TXO 110 h.p. gasoline power unit. This power plant was installed in 1935 and supplies the air for the present mining operations.

The Canadian Straub mill, also installed in 1935, has a capacity of from 5 to 9 tons. It was put into operation in October; and it is estimated that about 230 tons were treated during October, November, and December. On December 15, 1935, the first shipment, 32.9842 ounces of bullion was sent to the Royal Mint.

During 1935 the average number of men employed monthly was 24.

Russell C. Cone

In the spring of 1935, Russell C. Cone obtained a lease on No. 5 vein on the Lucky Coon property, mining claim P. 655, located about 4 miles south of Mine Centre in the Rainy River district.

There is an old 2-compartment vertical shaft on this vein, which is reported to be 115 feet deep, but no headframe or buildings were left.

Work was started in June to move equipment into the property and to construct buildings. A small mill was completed and put in operation on October 1 to test ore from the dump, but was shut down a month later. The mill equipment included a jaw-crusher, Gibson rod mill, and amalgamation plates. A 20 h.p. boiler and a 5- by 7-inch single-drum hoist were taken into the property, but no underground work had been started by the end of the year.

An average of 5 men was employed under the direction of Russell Cone. The mine address is Mine Centre.

Coniaurum Mines, Limited

Coniaurum Mines, Limited, has an authorized capitalization of 6,000,000 shares of no par value, of which 2,717,947 shares have been issued. The officers and directors of the company are: Thayer Lindsley, president; A. L. Bishop, vice-president; H. Whittingham, secretary-treasurer; Alex. Longwell, H. Lindsley, H. S. Monroe, T. H. Rea, directors. The head office is at 25 King Street West, Toronto. The mine address is Schumacher. John Redington is mine manager.

The mine property consists of about 760 acres adjoining the McIntyre-Porcupine mine on its east boundary, in Tisdale township, district of Cochrane.

The property has been developed through two shafts and several winzes. The Main, or Bishop, shaft was deepened in 1935 to 3,700 feet. A second shaft goes down to the 1,000-foot level. Some 833 feet of winze-sinking was also done in 1935, bringing the total winze footage up to 1,678 feet.

The following is taken from the mine manager's report for the year ending December 31, 1935:—

Development

Development in various parts of the mine has consisted of considerable lateral work, as well as sinking and raising. The Bishop, or Main, shaft has now reached a depth of 3,700 feet.

Two new levels have been established: the 3,250-foot and the 3,500-foot. In addition, a winze is being put down near the east boundary of the West Goldale claim. This has now reached a depth of 900 feet below the 3,000-foot level. Considerable amounts of drifting and crosscutting have been done on the 1,000-, 1,750-, 2,000-, 3,000-, and 3,500-foot levels.

Exploration

The 3,250- and 3,500-foot levels are now under vigorous exploration. No. 10 crosscut is being driven on the 3,250-foot level to intersect the No. 7 vein fracture, which is located on the south side of the Coniaurum porphyry mass. On the 3,500-foot level M2 crosscut is being driven west to connect with the winze, where a level has already been established. From this point M2 crosscut will be driven due west to the McIntyre boundary.

Veins Nos. 7, 25, and 26 have been indicated on the 3,500-foot level and are now under exploration. Vein No. 24 on the 1,000-foot level has been driven on for some distance. This vein is located in the southwest portion of the property. On the 3,000-foot level, veins Nos. 21 and 22 have been developed for some distance. Both of these provided considerable ore for mill feed.

This year has been one of large expansion both underground and on surface. The full value of this will not begin to make itself apparent until about June of 1936. At that time we expect to bring into production at least two new levels.

Diamond-drilling, as in other years, has been carried on for the purpose of obtaining geological information, as well as for the location of ore bodies.

SUMMARY OF DEVELOPMENT

	Feet
Sinking	1,338
Drifting	2,481
Crosscutting	4,373
Raising	1,857
Diamond-drilling	12,942

The footage driven in ore was 1,684 feet, with an average value of 5 pennyweights per ton over a width of 4.8 feet. Vein No. 15 has been developed on the 350-foot, vein No. 15A on the 1,750-foot, and veins Nos. 21 and 22 on the 3,000-foot level.

Ore Reserves

Broken ore reserves are greater than those of last year and are now 200,067 tons. Stoping supplied 199,357 tons, and development another 17,622 tons of ore. The mill drew 151,055 tons, leaving a carry-forward of 200,067 tons of ore at the end of the year. Unbroken ore reserves are estimated at 171,320 tons, having an average grade of 4.1 pennyweights.

Milling

During the year the mill treated 151,055 tons of ore with an average recovery of $7.51 per ton, extracting 95.94 per cent. of the gold content, operating 354.73 days, or 97 per cent. of the possible running time. The mill was closed down for a period of ten days while making the change-over of crusher into the new crusher building.

New Equipment and Improvements to Buildings

A new hoisting engine, with a maximum speed of 1,800 feet per minute, was installed. A new headframe was erected, and the crushing plant rearranged to facilitate handling larger tonnage. Also some additional equipment was added to the machine shop. The new buildings consist of a fireproof hoist-house and electrical shop; an addition to the dry-house; and an addition to the main office for the use of the resident doctor, as well as a new residence to accommodate the physician.

Tailings Dam

A large tailings dam is now under construction. When complete it will have a storage capcity that will serve our requirements for many years. We are very fortunate in having this available space on our property.

The average number of men employed during the year was 296; of this number 211 were employed underground.

Consolidated Mining and Smelting Company of Canada, Limited

The Consolidated Mining and Smelting Company of Canada, Limited, is capitalized at $20,000,000, divided into 800,000 shares of $25. The officers and directors are: Jas. J. Warren, president; Jas. E. Riley, secretary-treasurer; Jas. J. Warren, Sir Edward Beatty, S. G. Blaylock, Henry Joseph, J. C. Hodgson,

F. G. Osler, R. S. McLaughlin, Sir Herbert Holt, W. A. Black, R. H. McMaster, Thayer Lindsley, Hon. R. R. Bruce, Sir Charles Gordon, and L. A. Campbell, directors. The head office is at 215 St. James Street, Montreal, Que. An office is maintained at 302 Bay Street, Toronto.

Afton Mine

The company started underground operations on this property in January, 1935, and carried them on throughout the year. The property is in Afton township, Timagami Forest Reserve, district of Sudbury.

Previous operators had driven a 200-foot adit, from which a 2-compartment vertical winze had been sunk to a depth of 150 feet. A level was established at that depth, on which 270 feet of crosscutting was accomplished.

During 1935 the winze was sunk an additional depth of 266 feet, to a total depth of 416 feet, and levels were established at 275 and 400 feet. The lateral work accomplished in 1935 consisted of 34 feet of drifting on the 150-foot level, 616 feet of drifting and 249 feet of crosscutting on the 275-foot level, 751 feet of drifting and 210 feet of crosscutting on the 400-foot level. During the year a total of 1,321 feet of diamond-drilling was done from underground, and 957 feet from surface.

The plant used included two 53 h.p. horizontal return tubular boilers, a 360-cubic-foot steam-driven compressor, and an 8- by 6-inch Ingersoll-Rand single-drum hoist.

New Golden Rose Mines, Limited, was incorporated in April, 1935, with an authorized capitalization of 3,000,000 shares of $1 par value to take over this property from Afton Mines, Limited, in return for 1,000,000 shares of New Golden Rose stock. Under the terms of the option Consolidated Smelters was to receive approximately 2,000,000 shares of New Golden Rose stock on an expenditure basis. This expenditure was completed during 1935 and the option fulfilled.

An average of 54 men was employed during 1935, of whom 23 were underground. D. C. McKechnie is mine manager, and W. E. Aitchison is superintendent. The mine address is Sudbury.

Cordova Mine

The company acquired the old Cordova property on the east half of lot 20, concession I, Belmont township, Peterborough county.

In 1935 the old No. 3 shaft was dewatered, retimbered, and enlarged to the 5th, or bottom, level. An additional 160 feet of sinking was done and new hoisting equipment installed. Some 22 feet of drifting and 36 feet of crosscutting was done, and 600 tons of ore and 5,000 tons of waste were hoisted.

C. A. Seaton was manager, employing 39 men. The mine address is Cordova.

Golden Horn Mine

In May, 1935, work was started under option at the old Golden Horn mine, Rush bay, Lake of the Woods, district of Kenora. It is about 22 miles southwest of Kenora.

Previous operators put down two shafts on this property to depths of 106 and 254 feet, and established levels at 100, 166, and 235 feet. They accomplished 231 feet of drifting and 65 feet of crosscutting on the 1st level, 362 feet of drifting and 31 feet of crosscutting on the 2nd level, and 118 feet of drifting and 285 feet of crosscutting on the 3rd level. A small amount of stoping was done. They constructed a small mill containing a jaw-crusher, rolls, Huntingdon mill, and three concentrating tables, with which some gold was produced.

The company dewatered the workings and carried on sampling work till the end of July, when the option was dropped.

The mill and cookery were all that remained of the old equipment. A 310-cubic-foot gasoline compressor was used to dewater the workings.

An average of 7 men was employed during the period of work, under the direction of C. E. White.

McKenzie Claims

The company has under option the McKenzie group consisting of 9 claims, or about 360 acres, in Garrison township, district of Cochrane.

The following work was done in 1935: shaft-sinking, 256 feet; crosscutting, 712 feet; and drifting, 293 feet; about 7,612 tons of waste were hoisted.

The plant consists of a gasoline compressor and a single-drum air hoist. An average of 20 men was employed at the property during the year. The mine address is Matheson. A. S. Hudson was manager.

Rich Rock

The company has under option the property of Rich Rock Mines, Limited, in Kaladar township, Lennox and Addington county. The property consists of 298 acres in lots 24 and 25, concession VI.

Work was started on April 24, 1935, and to the end of the year the following work was accomplished: shaft-sinking, 125 feet; crosscutting, 57 feet; and drifting, 30 feet. About 150 tons of ore and 1,700 tons of waste were hoisted.

C. E. White was manager, employing an average of 25 men. The mine address is Flinton.

Cooper and Barry

W. D. Cooper and P. A. Barry continued operations, on a lease basis, on the Birch Lake property of McIntyre-Porcupine Mines, Limited, to the end of 1935. This property consists of 8 claims on the north side of Birch lake, two miles east of the Argosy mine, in Kenora district, Patricia portion.

In 1934, mining was carried on from an open stope. In 1935, a shaft was started from the bottom of the stope, 42 feet below surface, and sunk to 98 feet. The ore was found to be cut off in this shaft by a horizontal fault. Some exploration work was done along the fault-plane, but the downward continuation of the ore was not found. Work was then resumed at the 42-foot level. Drifting was started from each end of the stope, and about 100 feet of lateral work was done. Some ore was taken down above the drifts. In September, 1935, about 20 tons of ore was being milled daily in a small stamp and amalgamation mill.

The lease was dropped about the end of the year, and since then part of the mill equipment has been removed from the property.

The average number of men employed in 1935 was 19.

Corless Patricia Gold Mines, Limited

Corless Patricia Gold Mines, Limited, was incorporated under the laws of Ontario on January 7, 1935. It is capitalized at 3,000,000 shares of $1 par value; 1,000,000 shares were issued for property. The officers and directors are: Edwin C. Graves, president; H. J. Carmichael, vice-president; Joseph Simpson, secretary-treasurer; Charles Buchanan and Robt. White, directors. The head office address is 25 Richmond Street West, Toronto. The mine address is Jackson Manion.

The property consists of 26 patented claims, approximately 1,000 acres, in Corless township, in the Woman Lake area, district of Kenora, Patricia

portion. It lies about 5½ miles west of the property of J-M Consolidated Gold Mines, Limited, and may be reached from Hudson by a canoe route through Lac Seul, Pakwash lake, Trout Lake river, and Woman river, to Woman lake, but the best route is by air from Hudson or Sioux Lookout. The planes land on Corless lake about one mile from the camp.

Work to date has consisted of trenching and diamond-drilling. Active development was begun in January, 1935. During the year 26 diamond-drill holes, averaging 184 feet in depth, were drilled. Further drilling is planned for 1936.

Ten log buildings have been erected on the property, including a fully equipped assay office.

A. A. Robins was manager during 1935, and was succeeded by W. M. Rice. An average of 15 men was employed at the property during the year.

Coulson Consolidated Gold Mines, Limited

Coulson Consolidated Gold Mines, Limited, has a capitalization of 3,000,000 shares of $1 par value, of which 1,378,980 shares have been issued. The officers and directors are: Nicholas Kinsella, president; A. Ritchie, secretary-treasurer; L. V. Sutton, Raymond Sutcliffe, G. S. Haines, and D. McKenna, directors. The head office is at 1809 Royal Bank Building, Toronto.

The property in Coulson township, district of Cochrane, operated throughout 1935. Underground work was suspended in November.

During the year the south shaft was deepened to 570 feet, and 1,000 feet of drifting and 1,500 feet of crosscutting were done on the 550-foot level.

An average of 35 men was employed. The mine address is Painkiller Lake, via Matheson.

Craig Gold Mines, Limited

Craig Gold Mines, Limited, has a capitalization of 5,000,000 shares of $1 par value, of which 1,923,252 shares have been issued.

The officers and directors are: F. W. Clements, president; W. N. Agnew, vice-president; F. J. Slater, secretary-treasurer; Geo. W. Scobell and Gerald D. Martin, directors. The head office is at 330 Bay Street, Toronto. The mine address is Madoc. The company owns nine claims in Tudor township, Hastings county.

Two shafts have been sunk, No. 1 to a depth of 245 feet and No. 2 to a depth of 200 feet. In No. 1 shaft, stations have been cut at 50, 125, and 225 feet. About 350 feet of drifting was done on the 50-foot level, and 110 feet on the 225-foot level. The mine operated from January to October 15, when work was temporarily suspended.

An average of 30 men was employed under the management of J. G. A. Stevenson. E. B. E. de Camps is consulting engineer and acting manager.

Darwin Gold Mines, Limited

Darwin Gold Mines, Limited, was incorporated in August, 1934, with an authorized capitalization of 3,000,000 shares of $1 par value. The officers and directors are: Geo. Royce, president; David Gross, Robert Fennell, R. E. Hore, and R. A. Darwin, directors. Corporation Management and Executives, Limited, is secretary-treasurer. The executive office is at 304 Bay Street, Toronto. The mine address is Gold Park.

The property is located in township 29, range 23, in the Michipicoten area, district of Algoma. It is about 7 miles by road from Wawa station on the Algoma Central railway.

Work was continued throughout 1935. The 2-compartment 60-degree shaft was sunk an additional 100 feet to a total depth of 543 feet, and a 5th level established at 533 feet on the incline. In July, a 3-compartment vertical shaft was started from surface, and by the end of the year it had reached a depth of 418 feet, with sinking still in progress. Stations had been cut at depths of 276 and 367 feet, connecting with the 3rd and 4th levels from the inclined shaft.

The development work accomplished on the various levels during the year, and the total to the end of 1935, was as follows:—

Level	Drifting		Crosscutting		Raising	
	1935	Total	1935	Total	1935	Total
	feet	feet	feet	feet	feet	feet
200-foot	.....	640	.....	106	.....	50
300-foot	198	957	205	431	232	347
400-foot	328	1,632	210	591	255	373
500-foot	645	645	50	50	112	112
Total	1,171	3,874	465	1,178	599	882

The 50-ton amalgamation-flotation mill, which has been on the property since 1929, was changed to an amalgamation-cyanidation circuit and put in operation on November 5. The equipment now includes a jaw-crusher, Marcy ball mill, Hardinge mill, Dorr Duplex classifier, Dorr Simplex classifier, 4 Pachuca tanks, 2 thickeners, 2 Oliver filters, and a Merrill-Crowe precipitation unit. By the end of 1935, the mill had treated a total of 2,086 tons of ore.

Additions to the plant during 1935 included a 42-inch double-drum electric hoist, and a 770-cubic-foot Ingersoll-Rand electric compressor. A steel headframe was erected for the new shaft. Buildings constructed included a shaft-house, blacksmith and machine shop, hoist-compressor house, dry-house, bunkhouse, and additions to the original mill building.

An average of 61 men was employed during 1935, of whom 30 men were underground. M. H. Frohberg was in charge of operations.

Delnite Mines, Limited

Delnite Mines, Limited, was incorporated in November, 1934, and is capitalized at 3,000,000 shares of $1 par value. This company is a subsidiary of Sylvanite Gold Mines, Limited, and Erie Canadian Mines, Limited. The latter company, a wholly owned subsidiary of Sylvanite Gold Mines, Limited, received Delnite shares for preliminary expenditures and development done during the summer of 1934 and the option to purchase other shares, so that if fully exercised Erie Canadian will hold 1,291,500 shares of the issued capital. There were 840,000 shares issued for the property, which consists of the property of the former La Roche Mines, Limited, and the Rendix or Martin claims, three patented claims located 3 miles southeast of Timmins in the township of Deloro, district of Cochrane. The officers and directors are: E. L. Koons, president; W. L. Marcy, vice-president; Welles V. Moot, managing director; C. L. Ingham, treasurer; W. S. Walton, secretary; Harry Yates, Jas. E. Day, and Jas. Savage,

directors. The head office of the company is at 603 Royal Bank Building, Toronto. The mine address is Timmins.

During 1935, a second bunk-house, 24 by 36 feet, and other small buildings were erected. A 60- by 16-inch air receiver was added to the mining plant, and the 10- by 12-inch air hoist was improved by alterations, including a gear-driven indicator. An electric pump was placed underground after the shaft was deepened. A magneto phone system and an electric cage-call system, to connect each level with the shaft-house and hoist-room, were installed.

An average of 37 men was employed during 1935. J. F. R. Akehurst is resident manager of the mine.

The following is an extract from the general manager's report for the fiscal year ending March 31, 1936:—

During the period, in addition to continuing work on the 125-foot level, the shaft was deepened and two new levels were opened up at the 250- and 375-foot horizons. A summary of the work done during the year is shown in conjunction with all previous work.

Development

SUMMARY OF DEVELOPMENT AND EXPLORATION, MARCH 31, 1936

	Drifting	Cross-cutting	Shaft-sinking	Shaft stations	Total	Diamond-drilling
	feet	feet	feet	feet	feet	feet
To March 31, 1935.....	1,233	903.5	138	25	2,299.5	7,099
April 1, 1935, to March 31, 1936.....	3,015.5	1,599	253	66.5	4,934	9,179
Total to March 31, 1936	4,248.5	2,502.5	391	91.5	7,233.5	16,278

In the 3,015.5 feet of drifting done during the year, 1,121 feet of ore were developed. In the 4,248.5 feet of drifting which has been done at the property since the beginning of operations, 1,439 feet of ore have been developed, which have an estimated average grade of 0.215 ounces over an average width of 5.1 feet. The average grade was calculated from channel sampling, in which all high assays have been reduced to 1 ounce. This combined footage and grade of ore is classified by levels as follows:—

Level	No. of ore shoots	Total length	Value at $20.67	Value at $35.00
		feet		
125-foot.....	5	445	$5.18	$8.75
250-foot.....	3	428	3.96	6.70
375-foot.....	3	566	4.24	7.17
Total.....	.....	1,439	$4.45	$7.53

Diamond-Drilling.—Of the 9,179 feet of drilling done during the year, 5,364 feet was done from surface and 3,815 feet from underground. As part of the surface drilling, a series of three holes were put down to cut, at 750 feet vertical depth, the zone being developed in underground operations. Results indicated vein structure similar to that found in the lateral work.

In the drilling from underground, in addition to the drilling required by current development work, a series of five holes has been put down to explore the values in the downward extensions of vein No. 301 at the 500-foot level. The holes were spaced 100 feet apart. The results secured in these holes indicate the same ore situation on this vein at the 500-foot horizon as has been found at the 375-foot level.

Structure.—The veins on which the drifting has been done are located in a basalt formation, which strikes in a general east-west direction and dips 50°–60°N. The main ore zone is a band of altered basalt, 200 feet wide, which lies between two roughly parallel bands of chlorite schist, which have resulted from intense alteration of previous basalt beds. To the north and south of the above area further basalt flows are shown by drilling. Vein indications and a quartz porphyry intrusive have been cut in this outer basalt, but the importance of the areas has not been determined.

The veins in the main ore zone follow the primary flow structure of the basalt. Where the normal strike and dip of the structure has not been disturbed, the veins of the Nos. 101 to 301 vein system have shown continuity of ore on the levels and in the drilling below the 375-foot level mentioned previously.

In the area 500 feet northeast of the shaft, a drag fold exists in the basalt beds, and the vein structure is irregular, resulting in a condition that does not permit straight-away development. The ore developed in this area has been found to be of higher grade than the average of the mine.

Plant and Equipment

The plant and equipment were maintained in good operating condition. A second bunkhouse was erected. A mine ventilation fan was installed on surface to exhaust from the two bottom levels. Expenditures on new buildings and plant were kept at a minimum pending a decision on a permanent building programme.

General

The total expenditures for the year were $118,684.35. The ore occurrences developed to date and the possible ore indicated by drilling both on and below the present workings, are encouraging.

De Santis Porcupine Mines, Limited

The name of the De Santis Gold Mining Company, Limited, was changed to De Santis Porcupine Mines, Limited, in June, 1935. The capitalization was reduced to $2,400,000 by the cancellation of 1,600,000 issued shares, and then increased to $3,000,000 by the creation of 600,000 additional $1 shares. Shareholders received one new share for each two of the old.

The officers and directors are: Peter De Santis, president and mine manager; Jos. V. Friel, vice-president; Giuseppe Giustini, secretary-treasurer; Theodore Schultze, T. Pomeroi, R. T. Payton, and Frank Prest, directors. The executive office is at 24½ Second Avenue, Timmins. The mine address is Box 1299, Timmins.

The company holds nine claims in Turnbull township and nine in Ogden township, district of Cochrane. It is on this latter group, lying about 4½ miles southwest of Timmins, that development work has been conducted in late years.

The property has been partially developed to a depth of 200 feet. The first shaft sunk was 210 feet in depth. Levels were opened at 90 and 200 feet below the collar. The total amount of crosscutting and drifting done to the end of 1935 on the 90-foot level was 327 feet. On the 200-foot level, the crosscutting and drifting amounted to 3,991 feet. During 1935 a main working shaft was started. It was raised to surface from the 200-foot level, and then then timbered from the surface down. A new timber headframe was erected and enclosed, but the proposed sinking below the 200-foot level had not been begun at the end of the year.

The average number of men employed in 1935 was 26. Fred Knutson was succeeded by H. McQuarrie as mine superintendent during the year.

Dome Mines, Limited

The authorized capital stock of Dome Mines, Limited, consists of 1,000,000 shares of no nominal or par value, of which 46,666 are held under an agreement in trust for the company; the dividends on these shares are returned to the treasury of the company. The mine property lies in Tisdale and Whitney townships, district of Cochrane.

The officers of the company are: Jules S. Bache, president and treasurer; J. H. Stovel, first vice-president; G. C. Miller, second vice-president; Morton F.

Stern, third vice-president; Alex. Fasken, secretary; E. P. Goetz, assistant treasurer and assistant secretary; C. C. Calvin, assistant secretary; John B. Robinson, assistant secretary.

The directors are: Jules S. Bache and Morton F. Stern, New York; G. C. Miller, Buffalo; Dwight B. Lee, Detroit; G. H. Harris and Simon N. Stein (who fills the vacancy caused by the death of Innis P. Allen), Rochester; Alex. Fasken, Frank E. Maulson, and Frederick Burnett, Toronto.

The death took place during 1935 of H. P. De Pencier, who for many years had been first vice-president and general manager of the company. This position has been filled by J. H. Stovel, who was formerly general superintendent. Robert E. Dye joined the staff of the mine as general superintendent early in 1936.

The office of the executive and financial department is at 42 Broadway, New York. The Toronto office is at 36 Toronto Street. The mine address is South Porcupine.

During 1935 there was an average of 738 men employed at the mine; of this number about 439 were employed underground.

The following is taken from the report of the general manager for the year ending December 31, 1935:—

During the year 635,700 tons were hoisted; of this 549,100 tons was ore, which was sent to the mill and treated, and 86,600 tons was waste, which was dumped on the surface. In addition, 4,600 tons of waste was dumped into old stopes.

The 549,100 tons of ore milled yielded bullion containing 204,842.595 ounces of gold, the yield per ton being 0.3731 ounces. In addition, there was recovered from the treatment of by-product, 1,952.434 ounces.

All values of ore, etc., will be expressed in pennyweights throughout this report. One pennyweight equals one-twentieth of an ounce, troy weight.

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

OPERATING STATEMENT

for the year ended December 31, 1935

EARNINGS:		
Bullion production (after deducting gold bullion tax and mint charges—$346,202.04)		$6,939,988.68
OPERATING AND MAINTENANCE EXPENDITURE:		
Development and exploration	$658,460.76	
Mining, including hoisting	731,369.56	
Crushing and conveying	120,313.78	
Milling	504,505.84	
Bullion expense	10,438.84	
Fire protection	6,673.02	
Warehouse expense	12,135.54	
Auditing expense	2,828.81	
Administrative expense:		
Mine office	111,293.90	
Executive office	70,305.19	
Registrar and transfer fees and expenses	11,810.33	
Municipal taxes	18,065.99	
Insurance	15,408.32	
Ontario corporation capital tax	1,220.20	
		2,274,830.08
NET OPERATING PROFIT FOR THE YEAR		$4,665,158.60

Development

The following table gives details of the development accomplished during the year:—

SUMMARY OF DEVELOPMENT BY LEVELS FOR THE YEAR 1935

Level	Stations	Drifts	Cross-cuts	Drift and crosscut slashing	Raises	Winzes	Box-holes	Raise, winze, and box-hole slashing	Total	Diamond-drilling
	feet	feet	feet	feet	feet	feet	feet	feet	feet	feet
1st	.....	81	.....	.....	.....	.....	44	.....	125	.....
3rd	.....	.....	.....	.....	28	.....	.....	.....	28	.....
5th	.....	.....	.....	.....	126	.....	.....	3	129	123
6th	.....	.....	30	11	.....	.....	.....	20	61	1,211
7th	.....	353	.....	41	186	.....	48	2	630	1,234.5
8th	.....	298	.....	17	32	.....	188	.....	535	.....
9th	.....	519	.....	56	115	.....	326	11	1,027	.....
10th	.....	756	.....	117	27	.....	354	14	1,268	.....
11th	.....	288	.....	32	53	.....	397	127	897	.....
12th	.....	397	7	37	150	.....	548	181	1,320	4,202.5
13th	.....	216	.....	16	134	.....	973	279	1,618	671
14th	.....	1,136	780	291	208	62	773	82	3,332	6,128.5
15th	.....	793	710	98	157	.....	601	262	2,621	6,360
16th	.....	289	260	141	.....	.....	.....	.....	690	.....
16th (No. 6 shaft)	.....	2,997	133	1,187	.....	.....	.....	.....	4,317	.....
17th	.....	84	.....	52	.....	.....	.....	.....	136	451
18th	16	493	.....	101	.....	650	.....	.....	1,260	.....
20th	.....	.....	.....	.....	.....	.....	.....	.....	.....	3,360.5
21st	20	.....	.....	6	.....	.....	.....	.....	26	.....
23rd	.....	324	51	7	.....	.....	.....	.....	382	.....
24th	.....	1,046	71	142	663	20	312	111	2,365	1,385
25th	.....	883	391	146	229	59	208	94	2,010	4,026
26th	.....	250	204	59	264	.....	10	43	830	4,851
27th	.....	447	6	6	111	.....	.....	24	594	7,474.5
Total..	36	11,650	2,643	2,563	2,483	791	4,782	1,253	26,201	41,478.5

Approximately 26,200 feet of drifting, crosscutting, raising, winzing, and box-holing, and 41,500 feet of diamond-drilling, has been done in the course of searching for and opening up the various ore bodies.

Above the 16th level, about 13,600 feet of development work was done, mostly in connection with known ore bodies or extensions of same.

At the directors' meeting, held at the time of the annual meeting of this company in the latter part of April, 1935, permission was given your management to proceed with the sinking of a main underground shaft from the 2,050-foot or 16th level. This shaft was to be located about 4,500 feet in an east-northeasterly direction from our No. 3 main shaft. The section of this new or No. 6 shaft will be approximately the same as the present No. 3 shaft and will have similar hoisting equipment and capacity. The hoisting equipment ordered for this shaft is designed for a depth of 3,000 feet, but can be used to 4,000 feet, if it is found desirable to do so. It is planned to sink this shaft at one lift to the 31st level, or 4,250 feet below the collar of No. 3 shaft. This will give us four new levels to explore as well as enable us to do further work in that area between the 18th and 27th levels. Further sinking may be done later from this point.

Drifting to the site of No. 6 shaft was started in May, and this drift reached the general area of the shaft in late December. In all, 3,000 feet of drifting was done, and 1,400 feet of old drift was slashed out to the size of this main haulage drift, which is 9 by 12 feet. A trolley haulage has been established on this drift capable of handling the normal capacity of the mine.

Considerable work remains to be done before sinking can be started from this level. The shaft has to be raised about 160 feet above the level, excavations have to be made for hoist-rooms, ore and waste pockets, a station, and a station storage yard, and rope-way raises from hoist-rooms to sheave wheels. It involves approximately 7,000 cubic yards of excavation. All necessary equipment has been ordered and is in process of manufacture or has been received and installed.

On the 16th level, in addition to the main development, about 700 feet of drifting was done. On the 17th level, a small amount of drifting was done in connection with known ore bodies.

Between the 18th and 23rd levels, approximately 1,300 feet of drifting and sinking was done in connection with establishing a second entry into the 23rd level. This work was completed in September, giving the needed ventilation to the lower levels and permitting a start at actual mining on these levels. In further development of the ore zones below the 23rd level, approximately 6,200 feet of development work was done; also 17,700 feet of diamond-drilling.

The vein structure in drift No. 2,504 has been further drifted on at the 26th and 27th levels, where lengths of 790 feet and 470 feet, respectively, have been established. Also several small, but not yet thoroughly understood ore occurrences in the greenstone to the north and west of this vein structure have been found on the 24th and 25th levels. No development has been attempted on these on the 26th and 27th levels as yet. All the ore occurrences on these levels are characterized by the presence of much visible gold.

The work done to date indicates the probability of securing over 425,000 tons of ore from the 23rd to the 27th levels. It is felt that the grade of this ore will be considerably better than the grade of the ore in the older areas of the mine.

Of the tonnage milled, the stopes yielded 466,600 tons, averaging 7.89 pennyweights per ton, and development work yielded 82,500 tons, averaging 5.95 pennyweights per ton; a total of 549,100 tons, averaging 7.59 pennyweights per ton.

The expenditure on mining was $731,369.56, or $1.33 per ton milled. The expenditure on development was $658,460.76, or $1.20 per ton milled. Of the $1.20 per ton, approximately 32 cents was chargeable directly to the major development work on the 16th level.

Ore Reserves

The ore reserves are estimated at 2,000,000 tons. This includes 773,700 tons of broken ore but does not include 300,000 tons indicated as probable ore between the 23rd and 25th levels.

The Mill

The following are the results of the mill operations during the year from a total of 549,100 tons treated:—

	Value per ton	Extraction per cent.
	dwt.	
Heads	7.5944	.....
Recovery	7.4610	98.24

The small plant treating old iron and other scrap produced 1,952.434 ounces.

Exploration

As hitherto, we have continued to examine prospects and properties. No new properties were taken up during the year.

General

Operating costs for the year were $4.143 per ton milled, as against $3.877 in the year 1934. Actual mine operating costs were slightly less than last year, the increase being due to development work in connection with No. 6 shaft.

The acquisition of the Foley O'Brien Corporation, Limited, in August, 1935, has added thirteen claims to our holdings. While it may be several years before our workings will reach this property, the trend of our ore bodies is all in the direction of these claims, and it is felt that these facts fully justify their purchase.

The death of our late general manager, Mr. H.P. De Pencier, late in November, was a severe loss to the company and to his many friends and admirers on our staff. His passing from the Dome picture is genuinely regretted by all.

Duport Mining Company, Limited

The Duport Mining Company, Limited, was incorporated in January, 1929, with an authorized capitalization of 2,000,000 shares of no par value. The officers and directors are: J. G. Cross, president; Thayer Lindsley, vice-president; W. J. Matthews, secretary-treasurer; W. C. Robinson and R. V. Whiteside, directors. The head office is at 215 Public Utilities Building, Port Arthur. The mine address is Kenora.

The property held by this company includes the Cameron Island mine, located at Shoal lake, district of Kenora. It is about 28 miles southwest of Kenora by air.

Underground operations were continued at the property until November 24, when they were suspended until after Christmas. During 1935 a total of 530

feet of drifting and 137 feet of crosscutting was done on the 124-foot, or 2nd level; a 2-compartment 75-degree winze was sunk from the second level to a depth of 120 feet; and a 3rd level was established at that depth, on which 376 feet of drifting and 318 feet of crosscutting was accomplished. A small high-grade lens on the second level was stoped out.

During the year 376.16 tons of ore was shipped to Tacoma, Wash., and 98.54 tons of ore to Flin Flon, Man. The average gold content of these shipments was 4.45 ounces per ton.

The plant included an 84 h.p. boiler, 40 h.p. boiler, 300-cubic-foot steam compressor, a 500-cubic-foot Diesel compressor, a 7- by 9-inch hoist on surface, and a 6- by 8-inch hoist underground.

An average of 22 men was employed, of whom 12 were underground. J. G. Cross was in charge of operations, with C. Nelson as mine captain.

Edgelake Gold Mining Company, Limited

The Edgelake Gold Mining Company, Limited, was incorporated in September, 1934. The authorized capitalization is 3,000,000 shares of $1 par value. The officers and directors of the company are: P. B. Cameron, president and manager; J. A. Picotte, vice-president; J. M. Forbes, secretary; K. G. Cameron, treasurer; Robert McKinnon and David Craig, directors. The executive office address is Box 128, Schumacher. The mine address is Tashota.

The property consists of ten claims, approximately 400 acres, surrounding the west end of Tashota lake, 1½ miles north of Tashota station on the transcontinental line of the Canadian National Railways, Thunder Bay district.

During 1935, with an average of 2 men per month over a 9-month period, the following construction work was done: a 34-foot headframe was erected over a shaft, sunk at an earlier date to a depth of 32 feet; a boiler- and hoist-room building, 30 by 30 feet, with a 30- by 16-foot wing, was erected; and an Ingersoll-Rand 460-cubic-foot compressor and a 50 h.p. boiler were installed. Other equipment includes a 20 h.p. portable locomotive-type boiler and a 6- by 8-inch Jenckes steam hoist. An assay office and a small cabin were also erected. The president and vice-president have done most of the work so far accomplished at the property. Activities ceased temporarily late in the fall of 1935.

Edwards Gold Mines, Limited

Edwards Gold Mines, Limited, has an authorized capitalization of 2,000,000 shares of $1 par value. The company was formerly known as Del Sol Gold Mines, Limited; the change of name was authorized by letters patent in April, 1935. The officers and directors were: H. C. Orton, president; J. B. Kleckner, vice-president; H. H. Huevelman, secretary-treasurer; Murdock L. Martin, assistant secretary; F. E. Matthews, Neill Richards, R. G. Orton, E. B. Tilton, and H. C. Miller, directors. The head office is at 302 Sterling Tower, Toronto. A business office is maintained at 231 South La Salle Street, Chicago, Ill.

The company acquired the Edwards property, located in township 48, range 27, district of Algoma, on which the Gold Lands Syndicate of Algoma sank a 2-compartment 80-degree shaft to a depth of 97 feet, and did 60 feet of lateral work at that depth.

Underground work was started in March and continued until June, during which period about 400 feet of additional lateral work was accomplished on the 97-foot level.

The plant included a 110-cubic-foot and 310-cubic-foot Gardner Denver gasoline compressor and a gasoline hoist.

An average of 8 men was employed during 1935 under the direction of J. A. S. Roussac.

The property is reached by road from either Goudreau or Lochalsh. The mail address is Lochalsh.

Elizabeth Gold Syndicate

The Elizabeth Gold Syndicate was formed in 1935 to acquire the old Elizabeth mine in Rainy River district about 10 miles north of Atikoken on the Fort Frances branch of the Canadian National Railways. W. L. Doyle is manager of the syndicate. The head office is at 9 Adelaide Street East, Toronto.

The Elizabeth mine was discovered in 1900 and worked until 1903. It was again worked during parts of 1912, 1913, and 1914. A 10-stamp mill was installed in 1902. The old workings include a 280-foot shaft, with levels at 65, 146, and 246 feet.

The syndicate started work in May. During the balance of the year the underground workings were dewatered and examined, in addition to surface work. Buildings and part of the old mining equipment were reconditioned. Operations were practically suspended for the winter at the end of the year.

An average of 15 men was employed during the period of operation, under the direction of C. N. Thompson.

Falcon Gold Mines, Limited

Falcon Gold Mines, Limited, was incorporated in September, 1935, with an authorized capitalization of 2,500,000 shares of $1 par value. The officers and directors are: W. G. Chapman, president; C. H. Hitchcock, vice-president; S. E. Cassan, secretary-treasurer; John Elliott and Lionel Brooke, directors. The head office is at 200 Bay Street, Toronto. The mine address is Sudbury.

The property consists of four claims in Falconbridge township, district of Sudbury, and was formerly known as the McConnell or Beckley property. It is about 7 miles northeast of Wanapitei village, to which it is connected by road.

Operations were started in March, 1935, by the parent company, South Tiblemont Gold Mines, Limited, and continued until Falcon Gold Mines, Limited, took it over in September. The latter continued work until the end of November, when operations were suspended.

Previous operators sank a 45-foot shaft and did some diamond-drilling. During 1935 the diamond-drilling was extended to a total of 3,000 feet. A power-house, blacksmith shop, office, bunk-house, and cookery were constructed, and a headframe was erected over the old shaft. A 20 h.p. boiler and a 6- by 8-inch steam hoist had been installed when operations were suspended.

An average of 5 men was employed during the period of work, under the direction of J. E. Jerome.

Foley O'Brien Corporation, Limited

The Foley O'Brien Corporation, Limited, which was incorporated in 1934, has an authorized capitalization of 2,100,000 shares of $1 par value. The officers and directors of the company are: Wm. H. Kinch, president; Samuel J. Dark, secretary-treasurer; John G. Ullmann, A. J. McNab, and Carroll Searls, directors.

The Foley O'Brien Corporation, Limited, purchased from Foley O'Brien, Limited, 520 acres located in concessions II and III of Tisdale township, district of Cochrane. This property adjoins the holdings of Dome Mines, Limited, on the northeast, and in 1935 it was purchased by Dome Mines, Limited.

The following work was done underground at this property before it was taken over by the Foley O'Brien Corporation, Limited:—

Shaft and level	Shaft-sinking	Drifts and crosscuts	Raises
	feet	feet	feet
No. 1 Shaft	79		
39-foot		80	
50-foot		10	
79-foot		65	
No. 2 Shaft	165		
165-foot		700	
Winze (from the 160- to the 250-foot level)	90		
250-foot		670	20
No. 3 Shaft	235		
80-foot		145	
230-foot		130	

The Foley O'Brien Corporation, worked on this property from July, 1934, to May, 1935. In this period they did the following work: Seventeen diamond-drill holes, having an aggregate depth of 14,757 feet, were drilled; five of these holes, totalling 2,882 feet, were drilled from the underground workings from No. 2 shaft; the rest were drilled from surface. (Former operators had drilled 6 holes totalling 2,477 feet.) Eight pits or trenches were dug with mechanical shovels and scrapers on that part of the property known as Slate Hill; dirt removed from these pits totalled 13,082 cubic yards. Hand-cleaning and washing in the bottom of these pits exposed about 2,300 square yards of bed rock. Hand-dug trenches totalled 2,053 linear yards; of this, 1,733 yards reached bed rock. The average depth of these trenches was about 5 feet, with a maximum depth of 15 feet. The total sampling amounted to 1,518.5 feet. This was divided as follows: surface, 704.4 feet; No. 1 shaft, 261.9 feet; No. 2 shaft, 552.2 feet. The No. 3 shaft was not pumped out by the Foley O'Brien Corporation.

A small wooden headframe and shaft-house were erected over the No. 2 shaft, and a 20- by 40-foot compressor- and hoist-house was built.

P. C. Benedict was manager of this property for the Foley O'Brien Corporation. The mine address is South Porcupine.

Fort Hope Consolidated Gold Mines, Limited

Fort Hope Consolidated Gold Mines, Limited, was incorporated in 1934, with an authorized capitalization of 3,000,000 shares of $1 par value, succeeding Fort Hope Gold Mines, Limited. The officers and directors are: J. C. Mackay, president; L. M. Reid, secretary-treasurer; R. D. Felton and C. Cooper, directors. The head office is at 507 Confederation Life Building, Toronto.

The property acquired consists of 16 claims at the northwest end of Eabamet lake, north of the Albany river, in the Patricia portion of Kenora district. The mine is about 115 miles northeast of Collins, a station on the Canadian National railway, from which it is most easily reached by air. Mail going to the mine is addressed to Collins.

In 1928, a 2-compartment shaft was sunk to a depth of 125 feet and about 300 feet of lateral work was done on the 100-foot level. No further work was

done underground until 1935, when the mine was pumped out and sampled. The mine had nearly refilled when it was inspected late in August, 1935. No work of consequence was being done at that time, and at the end of the month only two employees remained at the mine.

The mining plant on the property includes two 50 h.p. locomotive-type boilers, a 350-cubic-foot Canadian Ingersoll-Rand straight-line air compressor, and an 8- by 10-inch Rand sinking hoist.

About 160 cords of wood were cut early in 1935. This work and the examination work done in the spring and summer were in charge of R. Halet.

Fox Lake Gold Mines, Limited

Fox Lake Gold Mines, Limited, was incorporated in May, 1935, with an authorized capitalization of 1,000,000 shares of $1 par value. The officers and directors are: L. W. Adams, president; P. M. A. Hare, vice-president; J. W. Westervelt, secretary-treasurer; D. A. Anderson and Thomas C. Benson, directors. The head office is at 39 New Bank of Toronto Building, London, Ont.

The property includes a group of nine claims in Mongowin township, district of Sudbury, which was taken over from the Fox Lake Gold Syndicate on incorporation. It is on the Espanola–Little Current highway, about 12 miles south of Espanola.

The 25-ton amalgamation mill, the construction of which was started in November, 1934, was completed and put in operation in February, 1935. It was operated for two weeks and then shut down for the rest of the year. Surface work was carried on throughout 1935. Diamond-drilling was started in August and continued intermittently for the balance of the year.

An average of 11 men was employed under the direction of L. W. Adams. The mine address is Espanola.

Franklin Gold Mining Company, Limited

The Franklin Gold Mining Company, Limited, was incorporated in August, 1934, with an authorized capitalization of 3,500,000 shares of $1 par value. The officers and directors were: F. M. Sheehan, president; H. E. Martin, vice-president; M. E. Hoult, secretary-treasurer; G. A. Davis and A. T. McCabe, directors. The head office is at 330 Bay Street, Toronto.

The company took over the property of Ontario Champion Mines, Limited, situated in Haycock township, district of Kenora, 8 miles east of Kenora. Previous operators sank a 2-compartment 55-degree shaft to a depth of 230 feet and established levels at 130 and 230 feet, where 225 feet and 120 feet, respectively, of lateral work were accomplished. A 120-foot adit was also driven to intersect the shaft at a depth of 70 feet. A 70-foot section was stoped out to a height of 50 feet on the 130-foot level. In the spring of 1935 the company dewatered the underground workings and sampled them, but did not do any development work. Surface exploration and mapping was carried on until November.

The plant on the property includes two 40 h.p. locomotive-type boilers, a 10- by 12-inch Allis-Chalmers single-drum hoist, and a 400-cubic-foot Gardner compressor.

R. Adair was in charge. The mine address is Kenora.

Gillies Lake-Porcupine Gold Mines, Limited

Gillies Lake–Porcupine Gold Mines, Limited, was incorporated in January, 1933. It was formerly known as the Porcupine United Gold Mines, Limited,

which was a consolidation of Canadel Gold, Limited, Rochester Consolidated Mines Corporation, and Canadian Gold Mines, Limited, a merger which took place in 1928. The company is capitalized at 2,000,000 shares of $1 par value. The officers and directors are: Ray M. Stanley, president; Howard Thurston, vice-president; Frederick Grotz, secretary-treasurer; F. O. Tidy, A. R. Sproule, and Dr. H. H. Moore, directors. Bernard N. Hyman is general manager. G. C. Chase is resident manager. The head office is at 9 Toronto Street, Toronto. The mine address is Box 2048, Timmins.

The property now consists of six claims adjoining the holdings of both McIntyre-Porcupine Gold Mines and Hollinger Consolidated Gold Mines. It is adjacent to the former on the west end, and to the latter on the north side. Underground work to date has been confined to one claim, the northwest quarter of the north half of lot 2, concession II, Tisdale township, district of Cochrane.

The shaft has two compartments and is 947 feet deep. Levels have been opened at 100, 300, 500, 800, and 925 feet. About 6,780 lineal feet of drifts and crosscuts were driven by previous operators. The present operators commenced underground work on April 2, 1935. Development work during the remainder of the year comprised approximately 120 feet of drifting, 260 feet of raising, and 70 feet of winze-sinking.

During 1935, 5,098 tons of ore were milled, giving a recovery of 1,595.703 ounces of gold and 248.87 ounces of silver, the total value of which amounted to $57,276.95. Milling operations commenced April 3, 1935, at which time two recently installed Kennedy Nutt mills, with a rated capacity of from 10 to 15 tons, were put into operation. The overflow from these mills was passed over blanket tables and the concentrates were stored. Concentrates derived from a second unit, consisting of a Hardinge mill, 4½ feet by 16 inches, a classifier, and blanket tables, were also stored. Later a 6-cell flotation unit was installed to treat the tailings. In the fall of 1935, the two Kennedy Nutt mills were taken out, and a second Hardinge mill, 6 feet by 16 inches, was installed. A 12-inch by 18-foot double-rake Dorr classifier was also installed to classify the product from both ball mills. The installation of cyanide equipment to treat all the concentrates was completed at the end of the year.

No changes were made during 1935 in the mining plant, the principal items of which are: an Ingersoll-Rand single-drum, steam-operated hoist; a 150 h.p. locomotive-type boiler; and a 14- by 12-inch Chicago pneumatic single-stage air compressor, driven by a 100 h.p. General Electric motor.

The average number of men employed during the year was 30.

Gilmour Gold Mines, Limited

Gilmour Gold Mines, Limited, was incorporated in August, 1935, with an authorized capitalization of 3,000,000 shares of $1 par value. The officers and directors are: M. F. Burrows, president; J. Summers, secretary-treasurer; A. E. Broadley and Dr. R. A. Gemmill, directors. The head office is at 21 King Street West, Toronto. The mine address is Gilmour.

The property consists of 116 acres in Grimsthorpe township, Hastings county. All the development work on the property was done by previous operators. No 1 shaft is 85 feet deep, and during 1935 a station was cut at 75 feet. No. 4 shaft is 260 feet deep, with levels at 75, 125, and 250 feet. About 1,000 feet of drifting and 75 feet of crosscutting have been done from this shaft. About 500 tons of ore was hoisted during the period of operation in 1935.

Buildings on the property include an office, bunk-house, power-house,

hoist-house, assay office, mill, powder-house, and thaw-house. The 100-ton mill was put into operation in September.

An average of 15 men was employed. W. Hitchins was manager and was succeeded by A. A. Kenniger.

Gold Eagle Gold Mines, Limited

Gold Eagle Gold Mines, Limited, incorporated in February, 1934, is capitalized at 3,000,000 shares of $1 par value. The officers and directors are: W. F. Stafford, president; Millard C. Dorntge, treasurer; Bruce P. Davis, secretary; Chas. E. St. Paul, managing director; W. S. Rogers and J. T. Oliver, directors. The head office of the company is at 350 Bay Street, Toronto.

The holdings of this company consist of 24 claims on Mackenzie island in Red lake, Patricia portion of Kenora district, adjoining the south and west sides of the property of McKenzie Red Lake Gold Mines. The mine address is McKenzie Island, a post office established on the island in 1935 to serve these two mines.

The mining plant was installed on the property during the late summer and fall of 1934, and shaft-sinking was commenced late that year. The first station at the 125-foot level was being cut at the end of 1934. The following figures show the total amount of underground development work done up to August 27, 1935, when work was temporarily suspended.

	Feet
Shaft, vertical, 3 compartments	525
125-foot level (station only).	
250-foot level (drifting and crosscutting)	275
375-foot level " " "	400
500-foot level " " "	755

There is a good steam-operated mining plant on the property. No new additions were made to the plant during 1935. Alex. Gillies, the first manager of the property, was succeeded by F. M. Passow during the summer of 1935. An average of 33 men was employed during the first eight months of 1935.

Golden Summit Mines, Limited

Golden Summit Mines, Limited, has a capitalization of 2,500,000 shares of $1 par value, of which 1,650,000 have been issued. The officers and directors are: Wm. J. Simpson, president; Benjamin Kerr, Jr., vice-president; Gordon Belyea, secretary-treasurer; John M. Calder, J. G. Jarvis, Dr. J. J. Matheson, and Theodore G. Miller, directors. The head office is at 2374 Bloor Street West, Toronto. The mine office is at Sesekinika.

The company owns 460 acres in the townships of Maisonville and Grenfell, district of Timiskaming.

The property was operated throughout 1935, with an average force of 21 men, under the management of Wm. J. Simpson.

Development work consisted of 853 feet of crosscutting and 571 feet of drifting; 4,612 tons of ore was hoisted. A 35-ton mill was installed during the year.

Gomak Mines, Limited

Gomak Mines, Limited, was incorporated in December, 1933, with an authorized capitalization of 1,000,000 shares of $1 par value. The officers and directors are: C. N. Haldenby, president; Dr. W. H. Wright, vice-president;

F. O. Gallagher, secretary; Mrs. E. M. Clyde and R. M. West, directors. The head office is at 320 Bay Street, Toronto. The mine address is Gogama.

The property consists of a group of 17 claims in Chester township, Three Duck Lakes area, district of Sudbury. It is reached by a 21-mile winter road southwest from Gogama on the Canadian National railway.

Surface work and diamond-drilling were carried on until June, 1935, when a 2-compartment 65-degree shaft was started on claim S. 20,009. Underground development was suspended at the end of September after 75 feet of sinking and 180 feet of drifting on the 65-foot level, had been accomplished. Some diamond-drilling was done during October and November from underground.

At the end of the year a mill site had been excavated, and plans made to install a 20-ton amalgamation-flotation mill.

The plant included two 260-cubic-foot Ingersoll-Rand gasoline compressors, and a 5- by 7-inch Jenckes hoist. Buildings included a hoist-compressor house, blacksmith shop, office, bunk-house, and cookery.

An average of 10 men was employed during 1935, under the direction of R. D. Jones.

Halcrow-Swayze Mines, Limited

Halcrow-Swayze Mines, Limited, was incorporated in November, 1932, with an authorized capitalization of 2,500,000 shares of $1 par value. The officers and directors were: Horace F. Strong, president; H. A. Butt, vice-president; J. B. Allen, secretary-treasurer; W. J. Yeoell and Martin Shunsby, directors. The executive office is at 709 Excelsior Life Building, Toronto.

The property is situated in Halcrow township, Swayze area, district of Sudbury. By air, it is about 20 miles east of Chapleau on the Canadian Pacific railway.

All work was suspended at this property on February 15, 1935. The underground work accomplished during 1935 consisted of about 35 feet of raising on the 200-foot level, and the same amount on the 354-foot level, for sampling purposes. The 25-ton test-mill treated about 220 tons of ore in 1935.

About 15 men were employed under the direction of H. F. Strong.

Hard Rock Gold Mines, Limited

Hard Rock Gold Mines, Limited, was incorporated in January, 1934, with an authorized capitalization of 2,500,000 shares of $1 par value. The officers and directors are: T. H. Rea, president; Jos. Errington, vice-president; W. S. Walton, secretary-treasurer; A. B. Gordon and H. R. Aird, directors. The head office is at 603 Royal Bank Building, Toronto. The mine address is Geraldton.

The company continued development of its property in Ashmore township in the Little Long Lac area, Thunder Bay district, throughout 1935. The 3-compartment vertical shaft, started in 1934, was at a depth of 463 feet at the end of 1935, and sinking was in progress with an objective of 475 feet. Levels were established at 200 and 325 feet. During 1935, a total of 1,109 feet of drifting and 494 feet of crosscutting was accomplished on the 200-foot level, and 959 feet of drifting and 474 feet of crosscutting on the 325-foot level; 1,342 feet of diamond-drilling was done from surface, and 3,020 feet from underground.

There were no changes in the plant during the year. An assay office and a directors' lodge were constructed, and an automobile road from Geraldton to the property was completed.

An average of 39 men was employed, of whom 16 were underground. J. C. Dumbrille was in charge, with E. J. Bolger as engineer.

Harkness-Hays Gold Mines, Limited

Harkness-Hays Gold Mines, Limited, was incorporated in July, 1934, with an authorized capitalization of 3,000,000 shares of $1 par value. The officers and directors are: R. W. Lee, president; H. J. Sender, secretary-treasurer; Dr. H. L. Van Norstrand, H. L. Duncan, and W. J. Wadsworth, directors. The head office is at 310 Temple Building, Toronto.

The property consists of a group of 8 claims, situated 2 miles east of Schreiber on the main line of the Canadian Pacific railway, district of Thunder Bay.

During 1935 work was carried on from January until the middle of April, and from the middle of July until the end of the year. The underground work accomplished during the year consisted of 110 feet of drifting in No. 3B adit. A 220-cubic-foot Ingersoll-Rand gasoline compressor was used.

A 25-ton amalgamation mill was constructed and was operated intermittently during August and September, when a total of 119 tons of ore was milled. The equipment included a jaw-crusher, vibrating screen, 2 Kennedy Nutt units, 2 Wilfley tables, and two blanket tables, operated by a 20 h.p. Diesel engine.

About 500 tons of rock was mined from open cuts and the ore sorted out, some of which went to the mill.

An average of 13 men was employed during the period of operation. J. F. Anderson was in charge. The mine address is Schreiber.

Hillside Gold Mines, Limited

Hillside Gold Mines, Limited, was incorporated in August, 1934, with an authorized capitalization of 3,000,000 shares of $1 par value. The officers and directors are: E. V. McMillan, president; G. E. MacMillan, secretary; J. J. Phillips, treasurer; M. I. McMillan, M. Kuittinen, and H. Aarnio, directors. The executive office is at 645 Queen Street East, Sault Ste. Marie.

The property consists of thirty-five claims, located in the northeastern part of township 29, range 23, in the Michipicoten area, district of Algoma.

Underground work, which had been suspended in December, 1934, was resumed in the middle of March and continued until August, when all operations ceased for the balance of 1935. During this period the adit on claim S.S.M. 4,925 was driven a further distance of 390 feet, to a total of 790 feet, and 49 feet of crosscutting done. In addition an old 52-foot adit on claim S.S.M. 7,367 was driven a further distance of 56 feet, to a total of 108 feet.

In January, 1935, the construction of a power line and 50-ton mill was commenced. The power line, 1¼ miles long, was extended from the property of Stanley Gold Mines, Limited, and completed in March. Mill construction was suspended after the building was erected, and a jaw-crusher, Hardinge ball mill, and Wilfley table were set up. A 310-cubic-foot Ingersoll-Rand electric compressor was used for driving the main adit.

An average of 18 men was employed from the first of the year until August. D. S. Baird, J. A. Ogilvy, and Howard Webb were successively in charge.

Hollinger Consolidated Gold Mines, Limited

The authorized capital of Hollinger Consolidated Gold Mines, Limited, is $25,000,000, in 5,000,000 shares of $5 par value. At December 31, 1935,

4,920,000 shares were outstanding. The head office of the company is at Timmins. The general office is at 602 Royal Bank Building, Toronto.

The officers at December 31, 1935, were: Noah A. Timmins, president; Jules R. Timmins, vice-president; John B. Holden, secretary-treasurer; A. F. Brigham, consulting engineer; and John Knox, general manager. On January 23, 1936, the company sustained the loss, by death, of its president. Jules R. Timmins has now been appointed president; John B. Holden, vice-president and treasurer; and P. C. Finlay, secretary. The directors of the company are: Jules R. Timmins, John B. Holden, W. L. McDougald, Leo. H. Timmins, Wilson Bell, James Y. Murdoch, Allen A. McMartin, John I. Rankin, and N. A. Timmins, Jr.

The following tribute to the late Mr. Timmins is taken from the new president's statement to the shareholders under date of February 21, 1936:—

Before commenting in detail on the results of the operations of your company during the past year I desire to refer, on behalf of the board and myself, to the great loss sustained by your company through the death of our late president, Mr. N. A. Timmins, on the 23rd of January of the present year.

He was the last of the original five founders of the company, and president since its incorporation. No one had the interests of the company more at heart nor was more intimately associated with its affairs. The late Mr. Timmins was a man of vision, who had in full measure the pioneer spirit and the courage to back his convictions. He will be especially missed by his fellow directors, who have been associated with him for many years, as well as by the Hollinger organization. Not only our company, but the entire mining industry of the Dominion has suffered the great loss.

The following is taken from the general manager's report for the year ending December 31, 1935:—

PROFIT AND LOSS STATEMENT
for the year ending December 31, 1934

SOURCES OF 1935 INCOME:		
Net value of gold and silver produced	$14,704,625.19	
Less Dominion Government tax on bullion	577,783.55	
		$14,126,841.64
Interest on investments and other income		220,372.86
		$14,347,214.50
DISPOSAL OF 1935 INCOME:		
Milling charges	$1,189,388.67	
Mining charges	5,979,810.04	
Marketing bullion	106,306.43	
Workmen's compensation	141,922.93	
Silicosis assessment	130,779.17	
General charges	679,679.10	
		8,227,886.34
		$6,119,328.16
DEDUCT:		
Taxes—		
Province of Ontario:		
Corporation tax	$40,240.99	
Mining profits tax	157,056.15	
Royalties:		
Town of Timmins	51,398.09	
Township of Tisdale	12,770.18	
Municipal:		
Town of Timmins	68,416.15	
Township of Tisdale	2,980.76	
Dominion of Canada re 1933 income tax	1,263.79	
Miscellaneous	76.44	
Dominion, provincial, and municipal, reserved for	521,886.20	
		856,088.75
Net profit from operations before depreciation		$5.263,239.41

Depreciation:		
Plant	$23,709.89	
Investments in other companies and properties written down	4,917.07	
Expenditures on properties abandoned	219,954.03	
		248,580.99
NET PROFIT FROM OPERATIONS CARRIED TO SURPLUS ACCOUNT		$5,014,658.42

SURPLUS ACCOUNT

BALANCE BROUGHT FORWARD, JANUARY 1, 1935	$5,303,012.79
NET PROFITS FROM OPERATIONS	5,014,658.42
NET PROFITS FROM THE SALE OF SECURITIES AND OTHER ASSETS	34,843.85
	$10,352,515.06
PAID OUT IN DIVIDENDS	4,428,000.00
BALANCE CARRIED FORWARD, DECEMBER 31, 1935	$5,924,515.06

BULLION STATEMENT

INVENTORY, JANUARY 1, 1935:		
Solutions		$92,403.20
Slags, litharge, and miscellaneous		880.00
Precipitates held over		3,671.00
Gold in process to scavenger		4,500.00
Silver		3,987.94
Total		$105,442.14
GROSS VALUES PRODUCED IN 1935:		
Ore milled	$14,700,486.52	
Tailings loss	573,644.88	
		14,126,841.64
		$14,232,283.78
INVENTORY, DECEMBER 31, 1935:		
Solutions		106,298.72
Precipitates held over		4,160.00
Gold in process to scavenger		2,000.00
		$112,458.72
BULLION SHIPPED DURING 1935		14,119,825.06
		$14,232,283.78

YEARLY AVERAGE COSTS

Account	Sundries	Labour	Stores	Total	Per ton ore milled
General miscellaneous charges and administration	.....	$321,507.06	$124,599.16	$446,106.22	$0.2429
Surface services	.....	61,484.09	43,627.75	105,111.84	.0572
Fire insurance	$54,411.11	.....	.....	54,411.11	.0296
Group insurance	.....	74,049.93	.....	74,049.93	.0403
Marketing bullion	106,306.43	.....	.....	106,306.43	.0579
Workmen's compensation	.....	141,922.93	.....	141,922.93	.0772
Milling charges	.....	487,834.90	701,553.77	1,189,388.67	.6474
Mining charges	.....	4,208,872.15	1,770,937.89	5,979,810.04	3.2549
Silicosis assessment	.....	130,779.17	.....	130,779.17	.0712
Total charges	$160,717.54	$5,426,450.23	$2,640,718.57	$8,227,886.34	$4.4786

Employees

The average number of men employed during the year has been 2,889, distributed as follows:—

MINERS:		MECHANICS:		GENERAL:	
Exploration	32	Operation	119	Mill and refinery	226
Development	440	Maintenance	211	Technical	90
Production	1,463			Clerical	41
				Miscellaneous	157
				Outside properties	110
Total	1,935	Total	330	Total	624

The men employed at outside properties on December 31, 1935, were distributed as follows: Ross mine, 75; Smith-Thorne, 30; Hunter mine, 5.

The Mill

Milling results were as follows:—

Ore milled	tons	1,837,153
Average value per ton		$8.00
Gross value		$14,700,486.52
Deduct loss in tailings		573,644.88
Net value recovered		$14,126,841.64
Average tons per day		5,075
Per cent. of possible time run		87.6
Tons per 100 per cent. running time		5,793
Solution precipitated per ton ore	tons	0.99
Value per ton tailings		$0.31
Cyanide consumed per ton of ore	lbs.	0.479
Zinc consumed per ton of ore	lbs.	0.045
Zinc consumed per ton of solution	lbs.	0.045
Lime consumed per ton of ore	lbs.	2.110
Lead acetate per ton of ore	lbs.	0.008
Average value of pregnant solution		$7.78
Average value received per ounce of gold sold		$33.77

Ore Reserves

Our ore reserves on the 31st of December, 1935, consisted of 7,355,318 tons, of a total value of $51,918,222.00, having an average value of $7.06 per ton. These figures compare with 7,061,926 tons of a total value of $51,440,260.00, having an average value of $7.28 per ton, at the end of 1934.

In the calculations dealing with ore reserves, the statutory price of gold, namely $20.67 per ounce, has been taken as the basis of value, and the same minimum ore grade as used in former years continued.

Hollinger Mill

During the year alterations have been made to the central shaft crushing plant, which makes its efficiency compare favourably with the most modern plants.

Hollinger Mine

Operations in the upper levels demanded a greater tonnage of backfill than formerly. During the year, 1,224,004 tons of backfill were placed.

The subshaft from the 3,950-foot level, known as No. 25 shaft, has been sunk to the 5,000-foot level and will be continued for another 150 feet before development operations are commenced. The drift west from Schumacher shaft, mentioned in the last annual report, has been extended to a point immediately under the central shaft. No. 21 shaft, which is immediately west of the central shaft, has been sunk to the 3,800-foot level and will be continued to connect with the drift above mentioned, thus given improved ventilation to the lower workings.

Intensive exploration in the upper levels has been continued with gratifying results. Approximately 37 per cent. of the ore came from above the 800-foot level. This figure indicates the importance of this work to the future life of the mine. As a result of this policy it has been unnecessary to draw on the ore reserves below the 2,750-foot level. This will ultimately result in concentration of the mining operations to more restricted areas, allowing considerable decrease in operating costs.

As mentioned in the previous report, operations are still carried on on all levels from surface to the 3,950-foot. There have been no outstanding ore discoveries of note during the year, but general developments have been up to expectations. There has been a further increase of $500,000 in the ore reserves for the year.

Young-Davidson Mine

The operations have been satisfactory during the year. As intimated in the last report a shaft has been sunk to a depth of 475 feet and a station cut at the 262-foot level. Drifting has been extended from this station to the ore body, and crosscuts are now being driven to open up the ore body for production.

Some 229,793 tons were treated during the year. Operating profits amounted to $234,000. The recovery for the year was $3.12 per ton.

Hislop Property

The shaft was extended from the 150-foot level to a depth of 450 feet. Development work has been carried out on the 150-, 300-, and 450-foot levels. The results to date are in-

conclusive. A small mill has been erected on the property for test purposes and went into operation January 1.

Smith-Thorne Property

Work was started on the Smith-Thorne property at Horwood lake, district of Sudbury, in September, 1935. It is reached by a 17-mile winter road southwest from Tionaga on the Canadian National railway.

Buildings were constructed, a plant was installed, and the sinking of a 2-compartment 45-degree shaft was started on claim S. 25,339 on October 28. At the end of the year the shaft was at an inclined depth of 206 feet, and a station was being cut at 200 feet. It is planned to sink to 600 feet before starting lateral work.

The plant included a 42 h.p. boiler, an 8- by 6-inch Ingersoll-Rand steam hoist, a 315-cubic-foot and a 350-cubic-foot oil-engine compressor. Buildings erected included an office, cookery-bunkhouse, steel shop–dry house, boiler-house, and hoist-compressor house.

An average of 38 men was employed during the period of operation. G. F. Gibbs was in charge. The mine address is Tionaga.

Examinations and Explorations

The following is taken from the consulting engineer's report on outside properties for the year ending December 31, 1935:—

In all, 100 examinations on properties of varying merit were undertaken during the year, of which 82 were in Ontario, 17 in Quebec, and one in Manitoba. On some of them a limited amount of work has been done, and during the coming year several will be further investigated when favourable weather and transport conditions obtain.

Prospecting, development, and exploration work on outside properties (except the Young-Davidson and Hislop properties) involved an expenditure of $245,000.

Horseshoe Mines, Limited

Horseshoe Mines, Limited, was incorporated in February, 1929, with an authorized capitalization of 4,500,000 shares of $1 par value. The officers and directors are: Dr. T. B. Armstrong, president; John Aiken, vice-president; M. Abraham, secretary-treasurer; R. J. Dixon, director. The head office is at 801 Excelsior Life Building, Toronto.

The property of this company includes the old Regina mine in the Lake of the Woods area, district of Kenora. It is forty-five miles southeast of Kenora.

The mine was idle from September, 1934, until September, 1935. Work was carried on from September 10 until December 25, and then suspended. The work consisted of repairs to the buildings, a geological survey of part of the property, and repairs to the shaft.

A crew of 9 men was employed during the period of operation, under the direction of W. R. Sutton, who was succeeded by Frank Williams. The mine address is Box 811, Kenora.

Howey Gold Mines, Limited

Howey Gold Mines, Limited, was incorporated in March, 1926. The authorized capitalization of the company is 5,000,000 shares of $1 par value, all of which are issued. The officers and directors are: R. T. Birks, president;

W. S. Cherry, vice-president; H. C. McCloskey, secretary-treasurer; B. E. Martin, assistant secretary-treasurer; J. E. Hammell and John A. Northway, directors. Fraser D. Reid is general manager, Edward Futterer is resident manager, Ralph E. Sullivan is mill superintendent, and Robert Basserman is mine superintendent. The executive office of the company is at 717 Federal Building, Toronto; the head office and mine office are at Red Lake.

The company's holdings lie along both sides of the boundary between Dome and Heyson townships, at the southeast corner of the lower part of Red lake, in the Patricia portion of Kenora district. The greater part of the town of Red Lake is built on Howey property.

During 1935, a new hoist was bought and installed at the 1,000-foot level winze. This winze was completed to the 1,500-foot level early in the year. A new 50 h.p. Westinghouse motor was also bought to drive the hoist. The average number of men employed during 1935 was 218.

The following is taken from the general manager's report for 1935:—

SUMMARY OF WORK ACCOMPLISHED

	1935	1934	1933
Drifts, crosscuts, raises, etc.....feet	5,143.8	3,955	1,879
Shafts and winzes.....feet	249	177	200
Shaft stations, slashing, etc.....cu. yds.	52	296	3,860
Diamond-drilling (underground).....feet	4,185	3,629	1,837.6
Diamond-drilling (outside exploration).....feet	1,514	851	.....
Box-holes.....feet	442	972	1,883
Ore broken.....tons	650,156	502,508	414,611
Low-grade material discarded by sorting.....tons	82,746	85,648	53,170
Milled after sorting.....tons	402,220	396,109	290,965
Broken reserves in stopes (Jan. 1, 1936).....tons	456,958	301,990	276,526

EARNINGS STATEMENT

	1935	1934	1933
Total receipts from sale of gold and silver.....	$1,319,764.26	$1,594,222.51	$1,158,470.03
Total operating cost including Toronto office expense..	844,239.38	881,869.52	770,010.56
Operating profit.....	$475,524.88	$712,352.99	$388,459.47

MISCELLANEOUS OPERATING DATA[1]

	1935	1934	1933	Total from start of operations
Tonnage milled and sorted.....	484,966	481,757	344,135	1,978,213
Tonnage discarded by sorting.....	82,746	85,648	53,170	282,265
Tonnage milled.....	402,220	396,109	290,965	1,695,948
Value a ton hoisted.....	$1.76	$2.20	$2.73	$2.79
Value a ton material discarded by sorting	$0.21	$0.21	$0.54	$0.335
Value a ton of ore milled.....	$2.08	$2.64	$3.12	$3.20
Loss in tailings a ton milled.....	$0.127	$0.214	$0.24	$0.226
Loss a ton of ore hoisted (in milling and sorting).....	$0.141	$0.213	$0.286	$0.242
Net percentage recovery a ton of ore hoisted.....	92.1	90.3	89.5	91.3
Total net recovery of gold and silver....	$1,319,764.26	$1,594,222.51	$1,158,470.03	$6,715,955.81

[1]All values are figured on gold at $20.67 per ounce.

Analysis of Costs

	1935 (484,966 tons)		1934 (481,757 tons)		1933 (344,135 tons)	
	Total cost	Cost per ton milled and sorted	Total cost	Cost per ton milled and sorted	Total cost	Cost per ton milled and sorted
Mine operation	$467,385.23	$0.963	$497,155.74	$1.032	$445,033.50	$1.293
Outside exploration	4,326.53	.009	2,389.43	.005	484.39	.002
Crushing and conveying	40,294.21	.083	44,902.88	.093	34,918.07	.102
Ore sorting	14,200.53	.029	23,485.72	.049	15,612.00	.045
Milling	217,786.10	.450	217,909.85	.452	198,877.14	.578
General expense	67,451.02	.139	63,993.85	.133	48,277.67	.140
Total plant cost	$811,443.62	$1.673	$849,837.47	$1.764	$743,202.77	$2.160
Toronto office salaries and general expense	32,762.26	.068	32,028.69	.066	27,578.92	.080
Interest and exchange	33.50	.....	3.36	.....	.....	.....
Total operating expenses before depreciation, Dominion and provincial taxes, and pre-operating charges	$844,239.38	$1.741	$881,869.52	$1.830	$770,781.69	$2.240
Dominion and provincial taxes	39,472.01	.081	43,284.59	.090	13,016.83	.038
Depreciation (on 10 per cent. basis)	135,705.24	.280	132,749.76	.276	119,108.64	.346
Pre-operating charges	96,993.20	.200	96,351.40	.200	103,240.50	.300
Total cost	$1,116,409.83	$2.302	$1,154,255.27	$2.396	$1,006,147.66	$2.924

Capital Expenditures

Dwellings	$1,266.60
Incinerator	1,243.45
Motor-boat (net)	516.65
Surface pipe line	1,116.86
Miscellaneous surface	556.04
Electric hoist, underground	4,327.63
Miscellaneous, underground	1,418.30
Total	$10,445.53

Ore Reserves

The broken ore reserves as of December 31, 1935, amounted to 456,958 tons, compared to 301,990 tons the previous year. The unbroken reserves amount to 1,267,500 tons of ore, as compared to 1,853,000 tons the previous year.

In addition to this there is a possible 185,000 tons of ore in place indicated in the 1,175-foot level, west block, and 100,000 tons of ore that will in all probability be recovered from the permanent pillars. The total positive ore, and ore indicated as possible, amounts to 2,009,450 tons, with a gold content of between $3.00 and $3.50 a ton at the current price.

Exploration

The 1,175-foot level east drift was extended to a point 1,042 feet east of the shaft, in an attempt to establish the downward extension of the narrow ore body encountered in the 1,000-foot level east drift. Diamond-drilling indicated the presence of a number of short lenses of mineralized quartz, none of which were of sufficient size to be mined at a profit.

The 1,175-foot level west drift was driven to a point 545 feet west of the shaft, and the dike systematically diamond-drilled to establish the downward extension of the 1,000-foot level west ore body. The results obtained justified our including this west block of 185,000 tons in the ore reserves as probable ore.

The winze was sunk to a point 271 feet below the 1,315-foot haulage level. A station was cut at the 1,500-foot level, and the dike explored by drifting and systematic diamond-drilling over a length on the strike of 770 feet. This work disclosed a mineralized section 6 feet wide and 300 feet long, having an approximate value of $4.25 (gold at $35.00 an ounce) per ton. This,

however, cannot be classified as ore. The assay results and results generally from the work done on this level were disappointing.

Surface prospecting and a limited amount of diamond-drilling from the surface was done during the year, resulting in no developments of importance.

Hudson-Patricia Gold Mines, Limited

Hudson-Patricia Gold Mines, Limited, was incorporated in April, 1934, with authorized capitalization of 2,500,000 shares of $1 par value. The capitalization was increased in December, 1935, to 3,500,000 shares. The officers and directors of the company are: W. R. Salter, president; M. H. Lebel, vice-president; P. A. Lavallee, managing director; M. F. Blue, secretary-treasurer; J. L. A. Tetreault, A. J. H. St. Denis, C. H. Ackerman, and General B. R. Hepburn, directors. The head office of the company is at 200 Bay Street, Toronto. The mine office address is Narrow Lake, via Sioux Lookout.

The holdings of the company consist of 26 claims in the townships of Goodall and Dent in the Woman Lake area of the Patricia portion of Kenora district. This company succeeded Metals Development, Limited, the shareholders of which received one share of Hudson-Patricia Gold Mines, Limited, for each four shares of the old company held.

The following table shows the amount of work done up to April, 1934, when the property was taken over by the present operators; at December 31, 1934; and at December 31, 1935:—

	April, 1934	Dec. 31, 1934	Dec. 31, 1935
	feet	feet	feet
Shaft No. 1 (inclined)	100	100	100
100-foot level:			
Crosscutting	15	15	15
Drifting	312	320	320
Shaft No. 2 (vertical)	237	237	237
211-foot level:			
Crosscutting	900	1,749	1,851
Drifting	.....	1,061	1,312
Raising	.....	169	169
Winze (inclined 74° from 211-foot level)	.....	75	144
325-foot level:			
Crosscutting	.....	.....	133
Drifting	.....	.....	579

Mining operations underground were suspended in August owing to lack of funds. Later in the year the capitalization was increased. Plans for a 50-ton cyanide mill were drawn up and approved, and the equipment for this mill was purchased early in 1936.

J. M. Thompson is manager. The average number of men employed at the mine from January 1 to October 1 was 27.

J-M Consolidated Gold Mines, Limited

J-M Consolidated Gold Mines, Limited, incorporated in February, 1932, is capitalized at 3,500,000 shares of $1 par value, of which 2,329,341 shares have been issued. The officers and directors are: J. E. Day, president; Chas. Taylor, vice-president; T. J. Day, secretary-treasurer; Hon. J. D. Chaplin and F. L. Hutchison, directors. The head office of the company is at 1116 Federal Building, 85 Richmond Street, West, Toronto. The mine office address is Jackson Manion.

This company holds 34 claims in the Woman Lake area, Patricia portion of Kenora district. Access by water is from Hudson, through Lac Seul, Pakwash lake, Trout Lake river, and Woman river, to Woman lake. Aircraft reach the property in about an hour flying from Hudson or Sioux Lookout.

The following table shows the development work done up to December 31, 1934, the work accomplished during 1935, and the total:—

	To Dec. 31, 1934	1935	Total
	feet	feet	feet
Shaft	404	.....	404
Winzes (below the 375-foot level)	30	115	145
125-foot level:			
Drifts	730	305	1,035
Crosscuts	160	81	241
Raises	170	30	200
200-foot sublevel:			
Drift	50	31	81
250-foot level:			
Drifts	808	482	1,290
Crosscuts	212	57	269
Raises	170	30	200
375-foot level:			
Drifts	472	504	976
Crosscuts	288	.....	288
Raises	20	105	125
482-foot level:			
Drifts	.....	68	68
Crosscuts	.....	9	9

A cyanide mill of approximately 30 tons daily capacity was installed at this property early in 1934, and operated from May, 1934, to the end of March, 1935. Gross production from 3,448 dry tons milled during 1934 was $34,709.32; and from 1,381 dry tons milled in 1935, gross production was $13,464.99.

No major alterations or additions were made to the mining plant during 1935. The average number of men employed per month during 1935 was 38, divided as follows: underground, 12; mill, 11 (3 months only), and surface 23. D. M. Thomson is manager.

Kenora Prospectors and Miners, Limited

Kenora Prospectors and Miners, Limited, was incorporated in February, 1928. The company has an authorized capitalization of 1,000,000 shares of $1 par value. The officers and directors are: Thayer Lindsley, president; I. A. Lindsley, vice-president and managing director; A. G. Fulton, secretary-treasurer; I. F. Machin and Jos. Errington, directors. The secretary's address is 25 King Street West, Toronto. The head office and mine office are at Kenora.

The property includes the Cedar Island mine, located in Shoal lake, Lake of the Woods area, district of Kenora. It is 25 miles southwest of Kenora by air.

Work was continued throughout 1935 at the Cedar Island mine. During 1935 the Cornucopia, or No. 2 shaft, which is a vertical 2-compartment shaft, was sunk an additional 208 feet to a total depth of 601 feet, and levels were established at 393 and 500 feet. A total of 927 feet of drifting, 368 feet of crosscutting, and 40 feet of raising was accomplished on the 393-foot level; and 712 feet of drifting, 257 feet of crosscutting, and 9 feet of raising on the 500-foot level. In addition stoping was started on these two levels and on the 144-foot level at No. 1 shaft.

In June the construction of a 30-ton amalgamation-flotation mill was commenced. It was completed and put in operation on October 15. The equipment included a jaw-crusher, two ball mills, a thickener, a 6-cell flotation machine, and amalgamation equipment, operated by a 150 h.p. Diesel engine. By the end of the year a total of 3,095 tons had been milled.

The plant included a 55 h.p. boiler, a 20 h.p. boiler, an 11- by 9-inch Ingersoll-Rand steam hoist, and a 600-cubic-foot Diesel compressor.

An average of 45 men was employed during 1935, of whom 15 were underground. Hilding Johnson was superintendent.

Kirkland Consolidated Mines, Limited

Kirkland Consolidated Mines, Limited, is capitalized at 7,000,000 shares of $1 par value. The officers and directors are: Ira Scheifley, president; Ferdinand Frohe, vice-president; C. C. Tyx, secretary-treasurer; Geo. F. Pfeiffer, Kevin Killeen, Norman R. Davis, Richard W. Langford, directors. The head office is at 702 Excelsior Life Building, Toronto.

The company owns 1,200 acres: 4 claims in McVittie township, 14 in Gauthier township, and 14 in Grenfell township, district of Timiskaming. The mine was reopened on August 10, and closed on September 30, 1935. During the operating period 100 feet of drifting was done on the 250-foot level and 1,000 feet of diamond-drilling. Ten men were employed, and Ralph Hurd was manager.

Kirkland Lake Gold Mining Company, Limited

The officers and directors of the Kirkland Lake Gold Mining Company, Limited, are: J. B. Tyrrell, president; R. G. O. Thomson, vice-president; R. Graham, secretary; V. H. Emery, managing director; A. C. Matthews, J. A. Dalton, J. C. Haight, R. V. Le Sueur, and W. S. Walton, directors. The company owns 465 acres in the township of Teck, district of Timiskaming, and is capitalized at 5,500,000 shares of $1 par value. The head office is at 1312 Metropolitan Building, Toronto. The mine address is Kirkland Lake. P. J. Harris is superintendent. An average of 158 men was employed during the year.

The following is taken from the managing director's report for the year ending December 31, 1935:—

Analysis of Operating Costs

	Total cost	Cost per ton milled
Development and exploration	$109,365.34	$1.52
Stoping	160,118.93	2.22
Transporting ore, hoisting, etc.	91,747.57	1.27
Milling	87,890.42	1.22
Marketing bullion	9,715.49	.14
Taxes	18,495.20	.26
General and undistributed charges (rebuilding and strengthening shaft-house, addition to mill equipment, maintenance mine buildings, administration and management, insurance, workmen's compensation, portion of extension to Kirkland Lake Hospital and drainage tunnel, miscellaneous)	97,461.47	1.36
Total	$574,794.42	$7.99

Summary of Work Done in Mine

As a means of showing the distribution of the work done, the mine has been divided into three vertical sections or hoisting lifts, and percentages are shown from each.

1st hoisting lift.....from the 2,400-foot level to surface.
2nd hoisting lift.....from the 4,900-foot level to the 2,400-foot level.
3rd hoisting lift.....from the 5,800-foot level to the 4,900-foot level.

	Quantity	1st lift	2nd lift	3rd lift
		per cent.	per cent.	per cent.
Ore broken.....tons	86,064	54.2	29.2	16.6
Drifting.....feet	6,020	63.3	32.4	4.3
Crosscutting.....feet	943	68.4	16.8	14.8
Raising.....feet	492	34.6	.....	65.4
Slashing.....cu. ft.	40,176	74.4	21.7	3.9
Diamond-drilling.....feet	11,518	64.4	29	7.4
Distribution of all development.....	.....	67.6	25	7.4

It will be seen from this that the majority of the development was done in the upper levels of the mine.

Practically no attempt was made to develop new ore in the lower lift. It is necessary to carry to completion the stopes already started in this section on account of the comparatively short life of the timber, which, if left for any appreciable time, would have to be replaced. If this had not been the case, for economic reasons, work for the time being would have been susdended in this lift.

Production

Although there were 6,968 tons more milled than in the year previous, there was a gain in broken ore reserves for the year of 14,134 tons, bringing the total broken ore reserves to 33,648 tons.

MILLING STATISTICS

Ore milled.....tons	71,920
Average value per ton.....	$12.02
Gross value.....	$864,477.04
Loss in tailings.....	$85,921.92
Net value recovered.....	$778,555.12
Recovery per ton milled.....	$10.83
Average tons milled per day.....	197
Value in tailings per ton.....	$1.19
Per cent. extraction.....	90.1

During the year there were alterations and additions made to the mill equipment, which resulted in a considerable increase in the milling capacity, with an improvement in the extraction.

General

The surface plant was maintained in good repair, and a number of improvements were made for convenience and efficiency of operation. During the year much of the timber in the shaft-house had to be replaced, and considerable repairing done.

Also, your company had to bear, with the other mines of the camp, its share of the cost of the new Kirkland Lake Hospital extension and the drainage tunnel under the town of Kirkland Lake. Part of the cost of the latter, however, will not be due until 1936. All of the above unusual expenditures, which amounted to $12,950.50, have been charged and paid for out of operations.

Lafayette Long Lac Gold Mines, Limited

Lafayette Long Lac Gold Mines, Limited, has an authorized capitalization of 3,000,000 shares of $1 par value. The name of the company was changed from Swayze-Rand Gold Mines, Limited, in 1934. The officers and directors were: H. J. Martin, president; W. G. Chapman, secretary-treasurer; P. Roche, M. S. McLaughlin, and Lloyd Woods, directors. The head office is at 200 Bay Street, Toronto.

The property includes a group of 25 claims in Errington township, Little Long Lac area, district of Thunder Bay. It is located about 1¼ miles south of Geraldton on the Canadian National railway.

Diamond-drilling was carried on at this property during 1935. In December a small 2-compartment shaft was started. By the end of the year it had been sunk to a depth of 30 feet by hand-steel and windlass.

J. A. Brownlee is in charge. The mine address is Geraldton.

Lake Shore Mines, Limited

Lake Shore Mines, Limited, is capitalized at $2,000,000, in shares of $1 par value. The executive officers and directors are: Dr. W. P. St. Charles, president and treasurer; W. H. Wright, vice-president; A. L. Blomfield, managing director; Kirkland Securities, Limited, secretary; Albert Wende and Ernest Martin, directors. The mine and works are at Kirkland Lake, Teck township, district of Timiskaming.

An average of 1,397 men was employed during the year. E. W. Todd is mine superintendent.

The following is taken from the report of the superintendent for the fiscal year ending June 30, 1936:—

During the period, 873,101 dry tons of ore were milled, having a gross value of $16,361,529.69. The bullion produced yielded 463,427 fine ounces of gold and 104,721 ounces of silver.

PRODUCTION RECORD

Period	Months	Tons milled	Gross value of bullion[1]	Dividends paid
Mar. 1, 1918, to Nov. 30, 1918	9	14,948	$372,352.35	$100,000
Dec. 1, 1918, to Nov. 30, 1919	9	11,907	302,518.17	100,000
Dec. 1, 1919, to Nov. 30, 1920	12	18,889	525,278.38	80,000
Dec. 1, 1920, to Nov. 30, 1921	12	21,681	523,597.39	120,000
Dec. 1, 1921, to June 30, 1923	19	36,825	850,282.92	160,000
July 1, 1923, to June 30, 1924	12	24,223	590,119.98	160,000
July 1, 1924, to June 30, 1925	12	96,838	1,812,008.05	600,000
July 1, 1925, to June 30, 1926	12	125,676	2,233,475.85	700,000
July 1, 1926, to June 30, 1927	12	214,335	3,105,047.85	1,200,000
July 1, 1927, to June 30, 1928	12	237,962	3,629,317.57	1,600,000
July 1, 1928, to June 30, 1929	12	367,015	5,519,138.86	2,000,000
July 1, 1929, to June 30, 1930	12	467,648	6,609,728.42	2,600,000
July 1, 1930, to June 30, 1931	12	698,624	9,153,546.62	3,600,000
July 1, 1931, to June 30, 1932	12	834,434	13,798,128.33	6,000,000
July 1, 1932, to June 30, 1933	12	797,673	13,277,685.72	6,000,000
July 1, 1933, to June 30, 1934	12	836,991	16,382,274.27	6,000,000
July 1, 1934, to June 30, 1935	12	833,094	16,026,108.57	8,000,000
July 1, 1935, to June 30, 1936	12	873,101	16,361,529.69	8,000,000
Total	.....	6,511,864	$111,072,138.99	$47,020,000

[1]Includes exchange premiums.

DEVELOPMENT FOOTAGE FOR THE YEAR 1935–36

Level	Drifting	Cross-cutting	Raising	Box-holing	Sub-drifting	Shaft-raising	Shaft-sinking	Total footage	Diamond-drilling	Station-cutting
	feet	feet	feet	feet	feet	feet	feet		ft. in.	cu. ft.
Surface							93	93		
200-foot		91.2				97	173	361.2	357 10	8,520
400-foot		282.3				186.5	171.5	640.3	111 8	8,388
600-foot		188.2	20		41.9	186.4	28	464.5	32	9,372
800-foot		181.4	44		161	188.5		574.9	293 7	9,132
1,000-foot	47.1	305.2	233.4		266.6	185		1,037.3	406 5	8,484
1,200-foot		254.7			107.7	188.5		550.9		7,860
1,400-foot		140	394.4	53.5	203.3	183.9		975.1	587 4	6,420
1,600-foot	399.2	548.2			16.2	100.9		1,064.5	237 3	7,116
1,800-foot	446.9	604.2	199.7		37.2	188.5		1,476.5	948 4	8,160
2,000-foot	547.3	351	392.6	10.5	251.9	22.5		1,575.8	947 10	9,492
2,200-foot		291.6	230.6		332.4			854.6	713	4,968
2,325-foot		279.2	253.8	12.9	57.6	34.3		637.8	194 3	5,400
2,450-foot	69	250.1	149.5	20.4	116.3			605.3	170	
2,575-foot	58.9	41.3	450.1	31.5	204.2			786	586 9	
2,700-foot	281.5	96.5	681.5		370.8			1,430.3	1,146 4	
2,825-foot	957.5	274.4	226.7		184.8			1,643.4	1,304 10	
2,950-foot	1,772.2	200.7	620.5					2,593.4	1,655 3	
3,075-foot	506.3	249.9	721.5		86.2			1,563.9	2,995 11	
3,200-foot	1,243.6	76.2	526		41.8			1,887.6	1,771 10	
3,325-foot	151.8		49.5					201.3	332 3	
3,450-foot									137 4	
3,825-foot									357 3	
4,450-foot									410 8	
Total	6,481.3	4,706.3	5,193.8	128.8	2,479.9	1,562	465.5	21,017.6	15,697 11	93,312

SUMMARY OF ORE TRAMMED FOR THE YEAR 1935–36

Level	Development	Stoping	Total
	tons	tons	tons
200-foot		127	127
400-foot		160	160
600-foot	131	16,952	17,083
800-foot		21,152	21,152
1,000-foot	1,588	33,032	34,620
1,200-foot	488	5,447	5,935
1,400-foot	265	53,127	53,392
1,600-foot	320	6,465	6,785
1,800-foot	1,406	1,245	2,651
2,000-foot	2,143	52,659	54,802
2,200-foot	1,304	86,447	87,751
2,325-foot	1,297	57,486	58,783
2,450-foot	760	85,105	85,865
2,575-foot	1,476	118,079	119,555
2,700-foot	2,854	93,087	95,941
2,825-foot	3,267	96,451	99,718
2,950-foot	6,568	56,939	63,507
3,075-foot	6,910	40,658	47,568
3,200-foot	2,921	11,566	14,487
3,325-foot	596	846	1,442
3,450-foot		74	74
Total	34,294	837,104	871,398

SUMMARY OF DEVELOPMENT WORK PERFORMED SINCE THE BEGINNING OF OPERATIONS

	Feet
Drifting	128,333
Crosscutting	36,041
Raising	84,128
Subdrifting	18,623
Ore and waste passes	11,647
Shaft-sinking	7,998
Shaft-raising	2,902
Shaft-slashing	1,227
Winze-sinking	1,151
Diamond-drilling	120,629
	cu. ft.
Box-holing	342,272
Station-cutting	854,993
Sumps	57,068

STATEMENT OF COSTS FOR THE YEAR

	Cost per ton
Development	$0.457
Mining	3.409
Milling and refining	1.194
Marketing bullion	.243
General and administrative expense	.317
Operating cost	$5.620
Depreciation	.295
	$5.915
Provision for taxes	1.937
Total cost	$7.852

Development

Exploration for new ore was limited to clean-up work in intermediate levels of No. 2 vein and to the further opening of No. 1 vein to a depth of 3,200 feet. The total drifting amounted to 6,481 feet, of which 2,489 feet were driven in ore having an average grade of 0.655 ounces per ton across an average width in the drifts of 54.7 inches. The policy of stressing development of the No. 1 or hanging-wall zone in preference to the No. 2 or footwall ore bodies has been continued in order that stoping operations in the former may be brought in advance of mining in the latter.

No. 1 vein continued to yield average results under intensive development of intermediate levels, and the amount of ore provided from this zone increased. The proportion of the total, taken from No. 1 vein, is held abnormally high at present in order to conform with the policy referred to above; in future it may be expected to decrease somewhat.

No. 5 Shaft.—Sinking of the concrete caissons to rock through the bed of Kirkland lake was completed with entirely satisfactory results. A pilot raise was driven from the 200-foot level to connect with the inside of the shaft caisson, and a routine underground programme of crosscutting, raising, slashing, and installation of equipment was begun. At the end of the year crosscut connections with mine workings were completed to the 2,450-foot level, pilot-raising to the 1,800-foot level, and shaft-slashing to a depth of 613.5 feet below the collar. Steel sets were installed to 565.2 feet below the surface, and the fireproof lining placed to a depth of 425.2 feet below the shaft collar. The No. 5 shaft is to be sunk to a depth of 4,075 feet.

Stoping.—New sections of No. 1 and No. 2 veins were prepared for stoping on levels extending from the 2,825- to the 3,200-foot levels, and mining will proceed in these working places during the coming year. A filled square-set rill method of stoping has been adopted as most suitable to the ground conditions.

The length of ore exposed in drifts and not prepared for stoping at the end of the fiscal year amounted to 13,819 feet, having an exposed average width before slashing of 61 inches and an average grade of 0.70 ounces. These figures indicate that ore available for mining continues well in excess of requirements.

The total amount of backfill placed in stopes during the year amounted to 515,844 tons.

Additions to Surface Plant

A new assay office and research laboratory was built and equipped, using fireproof materials throughout. A hoist-room was built to house the new hoists for No. 5 shaft and the steel headframe completed. Minor additions and alterations were made to mill equipment.

Milling

Milling results have responded to improvements installed, the extraction being increased to 96 per cent. Operation of the flotation unit was discontinued with a resultant reduction in milling costs.

Supplies and Equipment Purchased, 1918-1936

An indication of the amounts spent by Lake Shore Mines, Limited, for supplies and equipment, purchased mostly in Canada, is given in the list below.

Explosives	$1,682,730
Lumber and timber (83 per cent. local)	2,061,156
Rock drills and parts	657,198
Pipe and fittings, plumbing supplies	576,344
Electrical supplies	852,812
Mill supplies	2,759,481
Machinery and parts	3,672,029
Building materials	612,043
Fuel	396,248
Steel products	1,513,301
Oils and lubricants	224,757
Groceries	580,247
Trucks and cars	63,611
Miscellaneous	1,378,534
Backfill	462,536
Power	3,394,332
Total	$20,887,359

Freight and express included in above materials, $1,555,750.

L. B. United Mines, Limited

L. B. United Mines, Limited, was incorporated in May, 1934, with an authorized capitalization of 3,500,000 shares of $1 par value. The officers and directors were: Dr. W. E. Tindale, president; Allen C. McLean, secretary-treasurer; P. J. Elward, M. A. Chadwick, and Stuart Fleming, directors. The executive office is at 767 Yonge Street, Toronto.

The company optioned the property of Centennial Gold Mines, Limited, located in township 29, range 22, in the Michipicoten area, district of Algoma, and started work on April 2, 1935. The property had been idle since December 4, 1934.

The 130-foot, 2-compartment, 33-degree shaft was deepened to 262 feet, and levels were established at 100 and 250 feet. During 1935, a total of 89 feet of drifting and 51 feet of crosscutting was accomplished on the 1st level, and 478 feet of drifting and 100 feet of crosscutting on the 2nd level. Connections were made on the 1st level with two old 110-foot shafts, which are situated on either side of the main shaft, where 47 feet of drifting had been done at that horizon.

A 50-ton amalgamation-flotation mill was installed and put in operation on October 22. By the end of the year it had treated a total of 2,587 tons of ore, obtained from development work and stope preparation. Flotation concentrates, totalling 34 tons, were shipped to Sault Ste. Marie, where the company has established a refinery.

The mill equipment included a jaw-crusher, Marcy ball mill, Dorr classifier, Deister table, 4-cell Denver Sub-A flotation unit, filter, and amalgamation equipment.

The plant included a 218-cubic-foot electric compressor, a 320-cubic-foot electric compressor, and a small electric hoist. Buildings erected in 1935 included an office, mill, cookery, and two bunk-houses.

An average of 33 men was employed during the period of work. A. D. McWilliams, J. E. Ronaldson, and L. K. Lytle were successively in charge of operations. The mine address is Gold Park.

Lebel Oro Mines, Limited

Lebel Oro Mines, Limited, was incorporated in April, 1920. Early in 1936 the capitalization was increased from 3,000,000 to 3,500,000 shares of $1 par value. The officers and directors are: L. K. Fletcher, president; A. B. Mortimer, secretary-treasurer; W. H. Englebright, E. J. Dwyer, and T. H. Rea, directors. The head office is at Room 10, 320 Bay Street, Toronto.

The property of this company includes the old Long Lake mine, located in township 69, district of Sudbury. It is 16 miles southwest of Sudbury.

Work was resumed at this property in May, 1935, after a suspension of six months. During the balance of the year the work consisted of dewatering the old workings and diamond-drilling 2,391 feet from underground and 1,458 feet from surface. At the end of the year the company was preparing to install a mining plant.

The 200-ton cyanide mill, constructed in 1934, did not operate during 1935. It had been built with the intention of milling the tailings from the original operation, and was not equipped with a grinding unit.

An average of 13 men was employed during the period of operation. The mine address is Box 156, Sudbury. Wm. D. M. Ross is mine manager.

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. The officers and directors are: K. J. Springer, president; W. E. Segsworth, vice-president; H. J. Mackay, secretary-treasurer; Dr. J. H. C. McClelland, and R. Cryderman, directors. The head office is 320 Bay Street, Toronto.

The property this company acquired consists of about 400 acres in Thunder Bay district, about 4 miles northwest of Beardmore station on the Long Lac–Port Arthur branch of the Canadian National Railways. It is reached by a 6-mile road from Beardmore.

Work was started in August. Following surface work and diamond-drilling, shaft-sinking was started early in November with a gasoline compressor and carried to a depth of 30 feet. The 3-compartment vertical shaft was then collared, a headframe erected, and a mining plant installed. Sinking was resumed on December 29, and was at a depth of 46 feet at the end of 1935. A total of 3,630 feet of diamond-drilling was done in 1935.

The plant included an 8- by 6-inch Ingersoll-Rand hoist and a 530-cubic-foot compressor, driven by a 114 h.p. Diesel engine. Buildings erected included an office, power-house, blacksmith shop, bunk-house, cookery, and stable.

An average of 27 men was employed under the direction of W. J. Hacker. The mine address is Empire.

Little Long Lac Gold Mines, Limited

Little Long Lac Gold Mines, Limited, was incorporated in January, 1933, with an authorized capitalization of 2,000,000 shares of no par value. The officers and directors are: Jos. Errington, president; Thayer Lindsley, vice-president; L. A. Macdonald, secretary-treasurer; D. M. Morin, A. B. Gordon, and D. M. Hogarth, directors. The head office is at 1331 Canadian Bank of Commerce Building, Toronto. The mine address is Oklend.

The property is two miles south of Geraldton, on the Port Arthur–Long Lac branch of the Canadian National Railways, district of Thunder Bay. There is an automobile highway from Geraldton to the mine.

Work was continued throughout 1935. Shrinkage stopes were mined on the 204-, 325-, 445-, and 570-foot levels, and preparations were being made to backfill empty stopes with waste rock.

The plant includes a 125 h.p. boiler, 94 h.p. boiler, a 1,250-cubic-foot Ingersoll-Rand electric compressor, and an Ingersoll-Rand electric double-drum hoist. Electric power was obtained from Cameron falls, 95 miles away.

An average of 170 men was employed during the year, of whom 71 men were underground. A. A. Barton is manager; D. A. Duff is mine captain; and A. Rennick is mill superintendent.

The following is an extract from the manager's report for the fiscal year ending December 31, 1935, and covering further operations to March 31, 1936:—

Construction

Although the mill was completed and went into operation in November, 1934, the past year was still one of construction. The mill was enlarged and the following equipment installed: a second dewatering thickener, two dewatering filters, a 10-cell Sub-A flotation machine, with conditioner tank, thickener, and filter for the treatment of residues. A roasting plant for the treatment of concentrates has been completed and went into operation on April 1. This plant consists of a 15-spindle Edwards roaster and a complete cyanide plant for the treatment of calcines. Another thickener and filter is now being added to the cyanide plant.

The shaft headframe has been raised 15 feet higher and the capacity of the shaft ore bin increased by 125 tons.

A 2,000-cubic-foot Bellis and Morcom compressor and a 125 h.p. stoker-fired boiler has been added to the power plant. Also, an underground air hoist has been installed for shaft-sinking.

This plant enlargement entailed the following costs:—

Mill enlargement and equipment	$75,510.00
Roasting plant and equipment	42,500.00
Power plant enlargement and the purchase and installation of a Bellis and Morcom compressor and a new boiler and stoker	19,329.75
Sprinkler system	12,827.75
Mill storage warehouse	422.65
Machine shop and blacksmith shop addition and equipment	4,652.22
Outside pipe systems	8,764.03
Power and light lines	1,383.97
Docks, sidings, and fences	1,544.87
Shaft-house and headframe	2,180.31
New barn	1,717.56
Powder magazine	882.69
Extensions to bunk-house, hospital, commissary	10,327.15
Employees' residences	19,934.81
Miscellaneous plant buildings	3,421.55
Total	$205,399.31
Further expenditures in mine and plant equipment	22,135.49
Total	$227,534.80

Production

The following is a report on mill operation and production for the year ending December 31, 1935:—

Dry tons milled		62,073
Gold production	ounces	31,445.81
Gold lost in residues	ounces	4,896.21
Calculated amount gold in mill heads	ounces	36,342.02
Calculated mill head assay	ounces	.585
Mill residue assay	ounces	.0788
Percentage recovery		86.51

During 1935 the mill operated 361 days, indicating 98.9 per cent. running time. Tonnage milled was increased from 160 tons to 200 tons per day on September 1. During the year consulting metallurgists concluded that the flotation of refractory sulpho-arsenides from the cyanide plant residue, with subsequent roasting, was fully warranted. This idea was put into practice with the flotation plant operating late in December.

The following figures are typical of mill performance at the present time:—

	Per cent.
Gold recovered by blanket plant	65
Gold recovered by cyanidation	21.7
Gold contained in flotation concentrate	10.5
Gold contained in flotation residue	2.8

Roasting Plant

The results obtained from the first week's operation clearly indicate that the performance is up to expectations; a total recovery of 95 per cent. is reasonably assured and, it is expected, will be further improved during the ensuing year.

Development

During the year new ore was developed on the 4th level, 400 feet south of the main vein to date 300 feet of 0.3 grade has been drifted on. Further new ore has been developed on 2nd, 3rd, and 4th levels, a parallel mineable vein zone about 200 feet long on the 2nd level and above the 3rd level. This parallel zone is connected to the main vein by a series of folded quartz veins, making at these points a mineable zone 80 feet in length by 50 feet wide. To date, no development has been done in this area below the 4th level.

Development work accomplished for the year and to March 31st, is as follows:—

		1935	Total
Drifting	feet	3,187.5	3,836
Crosscutting	feet	1,024	1,120
Slashing	cu. ft.	11,283	31,835
Raising	feet	976.5	1,336.5
Sumps	cu. ft.	2,004	.....
Station-cutting	cu. ft	.....	9,060
Shaft-sinking	feet	.....	166.5
Diamond-drilling:			
Surface	feet	14,966	19,667
Underground			
Exploration; grouting	feet	5,508	8,229

Ore Reserves

	Tons	Ounces gold per ton
Proven ore	85,910	0.565
Broken ore	22,435	.575
Probable ore	135,320	.484
Possible ore	77,090	.496
	320,755	0.515

Operating Costs

Operating costs have been slightly higher than anticipated, owing partly to construction, and an unusual amount of exploration development. Costs (62,073 tons) are as follows:—

	Total cost	Cost per ton
Exploration development and diamond-drilling	$109,732.70	$1.7678
Mining	153,195.34	2.4680
Milling	105,758.23	1.7038
Mine office and supervision	26,963.60	.4344
General expense at property	31,938.63	.5145
Administrative and general expense, Toronto office	24,238.47	.3905
Total	$451,826.97	$7.2790

It is expected that these costs will be lowered during the present year, due to less exploration, greater tonnage milled, and higher recovery.

Macassa Mines, Limited

The capitalization of Macassa Mines, Limited, is 3,000,000 shares of $1 par value. The officers and directors are: Robert A. Bryce, president; L. Soliague, secretary-treasurer; John D. Perrin, Henry M. Porteous, Thomas Riggs, and Arthur G. Slaght, directors. G. A. Howes is mine manager. The head office is at 85 Richmond Street West, Toronto. The mine office is at Kirkland Lake. About 145 men were employed at the mine during the year.

The company owns 6 claims, adjoining the Kirkland Lake Gold mine on the west, in Teck township, district of Timiskaming.

The following is an extract from the report of the mine manager for the twelve months ending March 31, 1936:—

Production

During the year, 69,455 dry tons of ore were treated, from which the gross recovery was $1,140,470.22 in bullion, or $16.42 per ton. In addition, sundry revenue amounted to $1,674.78. The average recovery in ounces per ton was 0.468, with a 93.81 per cent. extraction. The average daily milling rate was 189 tons at 96.62 per cent. running time.

Development

As intimated in the last annual report, the mine had reached the stage, both in hoisting facilities and working places, where a much more intensive exploration and development programme could be carried on. As a result, new ore was found on the 1,300-, 1,400-, 2,000-, 2,175-, 2,575-, 2,675-, and 3,000-foot levels. While the 3,000-foot (or bottom) level has still 1,010 feet east and 1,300 feet west to go before reaching the boundaries, the length explored has proved it to be the best level in the mine to date as regards lengths, widths, and grade of ore.

The abnormal exploration and development programme during the past year increased the costs but also increased the ore reserves. As there is still a great deal of exploration to be done both on the 3,000-foot level and all levels and sublevels above, it is deemed advisable to continue at the present rate of work, the object being to further improve the developed ore position. It was decided that opening up levels below the 3,000-foot would be done from a winze, having the hoist and storage pockets on the 3,000-foot level. It will be the same size as the present main shaft.

The cutting-out of an underground chamber on the 3,000-foot level for the hoist and headframe is nearly complete, and this cost is absorbed in the development cost figure below. Sinking will be under way in May. General mining costs were higher than last year for two reasons: (1) In certain sections stull stoping and backfilling had to be used to prevent dilution of ore; and (2) the broken ore reserve was increased over that of last year, the costs of which were completely absorbed during the year.

The summary of development work is as follows:—

	1935-36	1934-35	1933-34
	feet	feet	feet
Drifting	9,094.5	5,988	3,483.5
Crosscutting	1,697	1,033	349
Raising	1,700	1,409	744
Shaft-sinking	101	481	.....
Station-cutting	43	91	30
Total	12,635.5	9,002	4,606.5
Diamond-drilling	10,109	3,489	2,701.5

Ore Reserves

In the following estimate of ore reserves, only fully developed ore is included.

	Tons	Ounces per ton	Value per ton at $35
Unbroken ore	126,130	0.45	$15.75
Broken ore	13,605	.46	16.10
Surface dump	2,612	.43	15.05

In addition to the above-mentioned fully developed ore, there are lengths and widths of lower-grade ore throughout the mine, and also indicated ore of better grade, which as yet is not fully developed.

Mill

The mill operated efficiently throughout the year. A number of tests have been made, having as their object changes which we think would give us better extraction and lower costs per ton.

Operating Costs

No deferred development charges were set up during the year. Except for the items of capital expenditures listed below, all costs are included in the following, before provision for depreciation, pre-development, and taxes:—

	Cost per ton milled
Development and exploration	$2.80
Mining (stoping, tramming, pumping, etc.)	2.48
Milling	1.49
Administration, and general charges (including head office, Mint charges, and bullion-handling charge)	.97
Total	$7.74

Capital Expenditure

A total of $38,766.98 was spent on additions during the year, as against $72,249.79 in 1934-35. A good portion of it was on underground equipment, spare motors, and additional company dwellings. The itemized list is as follows:—

Residences (4)	$8,854.37
Substation	1,644.21
Machine shop	785.41
Assay office and refinery	1,576.78
Crusher plant and mill	8,000.59
Mine equipment	14,143.13
Office	404.35
Miscellaneous	3,358.14
Total	$38,766.98

It is planned to install during the year a new mine surface hoist and to transfer the original one underground for future work below the 3,000-foot level.

Mac-Auer Gold Mines, Limited

Mac-Auer Gold Mines, Limited, was incorporated in March, 1934, with a capitalization of 50,000 shares of no par value. The officers and directors were: S. P. Myers, president; C. E. Loy, vice-president; M. Auerbach, secretary-treasurer; L. Chatelle and M. G. Greenblatt, directors. The head office is at University Tower, Montreal.

The company acquired 10 claims in Davis township, and 9 claims in Scadding township, district of Sudbury, located at the north end of Ashganing lake, and work started on May 15, 1935. The property includes claim W.R. 35, on which are located two old inclined shafts, 100 feet and 32 feet deep, respectively, and about 200 feet apart. These shafts were dewatered and sampled, and the 100-foot shaft partially retimbered. About 30 feet of drifting was accomplished with a gasoline compressor at a depth of 50 feet in No. 1 shaft. A 10-ton amalgamation mill was erected and operated for about 10 days.

All work was suspended at the end of August and the mill equipment removed. Buildings constructed included a small mill building and a compressor-house of sheet metal, a canvas cookery-bunkhouse, and two small canvas buildings.

About 10 men were employed under the direction of H. I. Huestis.

McIntyre-Porcupine Mines, Limited

McIntyre-Porcupine Mines, Limited, has an authorized capitalization of 800,000 shares of $5 per value, of which 798,000 shares are issued.

The officers of the company are: J. P. Bickell, president; Bernard E. Smith, vice-president; E. D. Fox, secretary; Balmer Neilly, treasurer. The directors are: D. H. McDougall, Strachan Johnston, and R. S. McLaughlin. R. J. Ennis is general manager. The executive office of the company is at 15 King Street West, Toronto. The head office and mine office are at Schumacher.

The company's main property is at Schumacher, in the township of Tisdale, district of Cochrane. The company has also numerous holdings in other parts of the Dominion.

During 1935, McIntyre-Porcupine Mines employed an average of 1,209 men at their Schumacher property. Of this number, 923 were employed underground and 65 were regular mill employees.

The following is taken from the general manager's report for the fiscal year ending March 31, 1936:—

Production

Ore treated.....tons	873,000	
Value per ton (0.280 ounces)	$9.88	
Gross value	$8,621,410.67	
Bullion recovered:		
Gold (232,112.054 ounces at $35.17)		$8,162,825.88
Silver (46,048.30 ounces at $0.604)		27,813.26
Total value		$8,190,639.14
Recovered per ton (0.266 ounces)	$9.79	
Bullion melting, refining, and handling charges		90,800.26
		$8,099,838.88
Less Dominion production tax		105,587.58
		$7,994,251.30

PRODUCTION SINCE THE BEGINNING OF MILLING OPERATIONS IN 1912

Period	Months	Tons milled	Value per ton	Gross value	Recovery per ton	Total value	Price received per ounce for gold
1912	12	14,500	$7.00	$101,555.16	$5.25	$76,166.38	
1913	12	31,979	7.85	251,314.45	7.05	225,752.25	
Jan. 1, '14, to Mar. 31, '15	15	85,654	8.87	760,232.16	8.39	718,331.71	
Apr. 1, '15, to Mar. 31, '16	12	105,758	7.71	815,345.49	7.38	779,990.94	
Apr. 1, '16, to June 30, '17	15	195,307	10.00	1,954,793.28	9.55	1,864,914.28	
July 1, '17, to June 30, '18	12	178,327	10.05	1,793,197.55	9.61	1,714,258.00	
July 1, '18, to June 30, '19	12	179,874	9.78	1,759,627.40	9.29	1,671,646.03	
July 1, '19, to June 30, '20	12	188,835	11.52	2,175,891.31	11.02	2,080,178.44	
July 1, '20, to June 30, '21	12	171,916	11.67	2,005,672.00	11.08	1,904,326.36	
July 1, '21, to June 30, '22	12	193,971	10.69	2,074,088.40	9.99	1,937,105.07	$20.67
July 1, '22, to June 30, '23	12	240,615	9.96	2,397,303.00	9.35	2,249,741.63	
July 1, '23, to June 30, '24	12	360,140	9.69	3,488,863.00	9.14	3,291,178.22	
July 1, '24, to June 30, '25	12	400,259	9.43	3,774,068.00	8.86	3,546,637.52	
July 1, '25, to June 30, '26	12	460,909	8.72	4,020,326.00	8.25	3,804,774.90	
July 1, '26, to Mar. 31, '27	9	385,409	8.08	3,113,500.07	7.67	2,957,060.97	
Apr. 1, '27, to Mar. 31, '28	12	520,460	8.09	4,207,553.00	7.66	3,987,634.94	
Apr. 1, '28, to Mar. 31, '29	12	538,165	8.24	4,433,378.00	7.83	4,212,624.82	
Apr. 1, '29, to Mar. 31, '30	12	550,495	8.46	4,657,188.00	8.05	4,433,626.45	
Apr. 1, '30, to Mar. 31, '31	12	558,115	8.84	4,934,122.00	8.30	4,633,140.73	
Apr. 1, '31, to Mar. 31, '32	12	655,030	8.47	5,548,278.10	8.10	5,305,475.29	21.95
Apr. 1, '32, to Mar. 31, '33	12	736,300	8.45	6,224,493.40	8.12	5,981,714.69	22.79
Apr. 1, '33, to Mar. 31, '34	12	776,845	10.68	8,296,704.60	10.24	7,957,252.54	31.50
Apr. 1, '34, to Mar. 31, '35	12	862,100	10.23	8,819,660.27	9.78	8,430,670.26	34.67
Apr. 1, '35, to Mar. 31, '36	12	873,000	9.88	8,621,410.67	9.38	8,190,639.14	35.17
Total		9,263,963	$9.31	$86,228,565.31	$8.85	$81,954,841.56	

Mining

	Tons
Ore broken in stopes	773,976
Ore from development	72,716
Total	846,692
Ore hoisted	876,698

Development

Development work amounted to 35,410 feet. This includes 21,546 feet of drifting, of which 4,518 feet was on line and 17,028 feet in vein material; of this, 6,696 feet was in ore averaging 0.378 ounces per drift width.

ORE RESERVES, 1935–36

	Tons	Fine ounces gold	Value at $20.67	Value at $35.00
Estimated	3,393,905	1,059,962	$21,909,425	$37,098,670
Broken	180,815	51,748	1,069,630	1,811,180
Total	3,574,720	1,111,710	$22,979,055	$38,909,850
Average per ton		0.3120	$6.40	$10.88

SUMMARY OF DEVELOPMENT AND EXPLORATION, 1935–36

Period	Drifts	Cross-cuts	Raises	Winzes	Shafts	Stations	Sumps	Pockets and passes	Total footage	Total excavation	Diamond-drilling
	feet	feet	feet	feet	feet	cu. ft.	cu. ft.	feet	feet	cu. ft.	feet
1	1,817	1,064	78						2,959		4,532
2	1,699	1,150	170						3,019		4,180
3	1,268	1,092	35						2,395		2,627
4	1,269	914	130						2,313		4,010
5	1,447	1,066	107						2,620		4,607
6	1,734	1,049	216						2,999		4,199
7	2,407	660	80						3,147		4,179
8	2,231	1,176	122						3,569		4,188
9	1,860	1,061	32						2,953		5,310
10	2,068	1,304							3,372		4,681
11	1,981	1,223							3,204		5,380
12	1,765	1,069	26						2,860		5,967
	21,546	12,828	996						35,410		53,860
Previous to date	232,656.8	113,725.8	22,559.9	612.7	14,549.4	1,013,582	55,039	139,699	384,104.6	1,208,320	437,628
Total to date	254,202.8	126,553.8	23,555.9	612.7	14,549.4	1,013,582	55,039	139,699	419,514.6	1,208,320	491,488

Operating Costs

	Total cost	Cost per ton ore milled
MINING:		
Exploration	$93,258.29	$0.1068
Development	494,755.13	.5668
Breaking and stoping	2,497,447.19	2.8607
	3,085,460.61	$3.5343
Milling	609,489.38	.6982
Administration and general expense	100,286.31	.1149
Total	$3,795,236.30	$4.3474

ANALYSIS OF MINING COSTS PER TON MILLED

	Stoping	Drifting	Cross-cutting	Raising	Total cost	Cost per ton
Labour	$1,180,193.42	$161,820.75	$81,809.10	$8,061.23	$1,431,884.50	$1.6402
Explosives	100,483.98	60,807.27	36,793.70	1,555.27	199,640.22	.2287
Supplies	106,567.84	4,322.08	2,619.24	451.79	113,960.95	.1305
Power	79,056.79	15,497.72	7,522.49	1,797.09	103,874.09	.1190
Timbering	251,820.54	.....	.....	442.98	252,263.52	.2890
Shaft repairs	4,077.76	.....	.....	.....	4,077.76	.0047
Backfilling	210,683.27	.....	.....	.....	210,683.27	.2413
Retimbering	33,412.71	.....	.....	.....	33,412.71	.0383
Guniting	.....	1,286.37	7,267.21	.....	8,553.58	.0098
Steel-sharpening	36,413.21	13,871.35	7,269.01	760.00	58,313.57	.0668
Drill repairs	24,862.80	5,059.12	2,427.93	582.51	32,932.36	.0377
Surveying and engineering	33,638.17	6,804.55	3,275.45	747.18	44,465.35	.0509
Sampling and assaying	45,598.19	3,607.74	1,745.05	416.11	51,367.09	.0588
Pumping	12,575.66	2,442.30	1,185.45	275.39	16,478.80	.0189
Ventilating	14,377.66	2,615.80	1,176.30	294.07	18,463.83	.0212
Fire protection	888.98	.....	.....	.....	888.98	.0010
Underground lighting	11,050.64	.....	.....	.....	11,050.64	.0127
Tramming	113,114.32	20,375.07	9,797.26	2,242.17	145,528.82	.1667
Underground crushing	7,274.52	492.03	.....	.....	7,766.55	.0088
Hoisting	231,356.73	15,239.00	.....	.....	246,595.73	.2825
Total	$2,497,447.19	$314,241.15	$162,888.19	$17,625.79	$2,992,202.32	$3.4275
Exploration	.....	.....	.....	.....	93,258.29	.1068
Total	.....	.....	.....	.....	$3,085,460.61	$3.5343
Unit cost per ton	$2.8607	$0.3600	$0.1866	$0.0202	.....	.....

SUMMARY OF MILLING COSTS

	Labour	Supplies	Shop repairs and maintenance	Power	Total cost	Cost per ton
Crushing and conveying	$36,329.03	$29,883.43	$5,367.68	$18,930.10	$90,510.24	$0.1037
Flotation	48,696.67	116,984.96	8,817.22	66,811.91	241,310.76	.2764
Cyanidation	40,770.49	163,987.86	5,639.50	24,625.57	235,023.42	.2692
Refining	7,055.19	10,546.28	557.65	1,367.28	19,526.40	.0224
Assaying	6,347.22	2,775.10	1,311.53	2,020.12	12,453.97	.0143
Mill alterations	7,989.07	1,591.87	1,083.65	.....	10,664.59	.0122
Total	$147,187.67	$325,769.50	$22,777.23	$113,754.98	$609,489.38	$0.6982

ADDITIONS TO PLANT BUILDINGS AND EQUIPMENT

Miscellaneous surface buildings and equipment	$24,903.35
Aerial tramway for backfill	68,106.34
Miscellaneous underground equipment	40,823.30
Buildings and equipment at Mud lake	73,138.53
Total	$206,971.52

General

New ore developed during the year has been sufficient to fully maintain our ore reserve position. Development work on the upper levels has resulted in finding further extensions to previously worked ore bodies and, as anticipated, these areas continue to contribute large tonnages of good-grade ore.

On the lower levels from No. 12 internal shaft, some of the ground considered favourable for ore has been explored with fair results. Referring to the summary of mine development, it will be noted that No. 22 vein was developed for an additional 1,976 feet in ore averaging 0.360 ounces over drift width.

Outside Exploration

Fifty-seven properties were sampled and reported on during the year, and favourable recommendations were made on six. One of these was optioned, and others are under consideration.

Diamond-drilling on properties optioned in Chibougamau, mentioned in last year's report, did not confirm surface sampling, and the option was allowed to lapse.

The option on the O'Leary Malartic group of 19 claims in Guillet township, Lake Expanse district, Quebec, was completed, and we now own an 80 per cent. interest in these claims. A shaft was sunk to 375 feet, with levels at 125, 225, and 325 feet; and 1,824 feet of horizontal work developed 24,000 tons of ore, averaging 0.415 ounces per ton. Thirteen other claims adjoining this group were purchased outright, and our prospectors staked 15 claims also adjoining, bringing the total number of claims in this district to 47.

One one of the groups of claims purchased outright, commonly referred to as the Ranger group, a promising discovery was made. Trenching and diamond-drilling have indicated 41,000 tons of ore, averaging 0.31 ounces per ton from the surface to the 125-foot horizon, and established the continuity of the vein with payable values to the 300-foot horizon. A 3-compartment shaft is being sunk to a depth of 550 feet, and a 100-ton test mill is being erected.

McKenzie Red Lake Gold Mines, Limited

McKenzie Red Lake Gold Mines, Limited, incorporated February 1, 1933, has an authorized capitalization of 3,000,000 shares of $1 par value, of which 2,900,000 shares have been issued. The officers and directors are: W. G. Armstrong, president; F. D. Reid, vice-president; H. M. Anderson, secretary-treasurer; M. F. Fairlie, managing director; G. W. Quinn, director. John W. Shaw is consulting engineer, and J. L. Ramsell is resident manager. The head office is at 507 National Building, 347 Bay Street, Toronto. The mine office address is McKenzie Island.

The mine property consists of 11 claims on the northern end of Mackenzie island, in Red lake, in the Patricia portion of Kenora district. Summer transportation to the property is by barge from Hudson. Plane service from Hudson or Sioux Lookout lands passengers, freight, and mail at the mine. McKenzie Island P.O., established in 1935, is located at the mine. Electric power is supplied to the mine over the company's own line, which taps the Hydro line from Ear Falls to the Howey mine, near the Howey mill.

Underground work was started at this property in the summer of 1933. Development work done since that time to the end of 1935, and during the year 1935, is shown in the following table:—

	To Dec. 31, 1934	1935	Total
	feet	feet	feet
Shaft	272	189	461
Winze	305	.....	305
125-foot level:			
Drifts	838	285	1,123
Crosscuts	225	21	246
Raises	30	395	425
Box-holes	.....	.....	388
250-foot level:			
Drifts	1,133	1,295	2,418
Crosscuts	269	387	656
Raises	210	554	764
Box-holes	.....	.....	497
375-foot level:			
Drifts	616	882	1,498
Crosscuts	98	313	411
Raises	.....	351	351
Box-holes	.....	.....	100
450-foot level:			
Drifts	50	909	959
Crosscuts	.....	480	480
Raises	.....	79	79

Installation of machinery in the 125-ton cyanide mill, erected in the fall and early winter of 1934–35, was completed in February, and production commenced about March 1, 1935. Tonnage milled in 1935 was 36,117 tons, and production amounted to $530,857.65, including the premium on bullion sold.

The average number of men employed in 1935 was 88, divided as follows: mine, 45; mill, 8; construction, 13; and surface, 21.

McLaren-Porcupine Gold Mines, Limited

McLaren-Porcupine Gold Mines, Limited, incorporated in August, 1934, has an authorized capitalization of 3,000,000 shares of no par value. Of this number, 1,500,000 issued for property are pooled, 800,000 have been underwritten, and 700,000 remain in the treasury. The officers and directors of the company are: Dr. W. M. McLaren, president; J. M. McLaren, vice-president; J. J. Gallagher, secretary-treasurer; N. W. Kingsland and Gerard Ruel, directors. Both the head office and the mine office are at South Porcupine.

The property held by the company consists of about 300 acres in Deloro township, district of Cochrane. It is accessible by motor road from either South Porcupine or Timmins.

Buildings on the property consist of a cookery and bunk-house, 24 by 50 feet; an office, 16 by 18 feet; small log cabin, compressor-house and blacksmith house combined, magazine, and mill.

During 1935, mining was carried on from an open glory hole, which has now reached a depth of 50 feet . The material removed from this pit was sorted, and during the year approximately 300 tons was milled. One corner of the glory hole was recently slashed out and will be timbered to serve as a shaft, when proposed drifting from the bottom of the pit commences.

The mill equipment consists of a jaw-crusher, a recently added hammer mill, bin, Kennedy Nutt mill, and blankets. Power for the mill is supplied by Diesel engine. Mining equipment includes a Sullivan portable air compressor, 2-drill capacity; Climax rock drills; and a 5- by 6-inch Jenckes hoist.

During the year about 300 tons were milled with an approximate value of $5,000, as compared with about 100 tons milled in 1934 with an approximate value of $1,000.

The average number of men employed per month was 17. J. M. McLaren is general manager at the property.

J. Bruce McMartin

J. Bruce McMartin, 941 Dominion Square Building, Montreal, Que., is the owner of a group of 9 claims in Rickaby township, district of Thunder Bay, about 10 miles northeast of Jellicoe, on the Long Lac–Port Arthur branch of the Canadian National Railways.

During 1935 underground work was carried on at this property from January 1 to March 10, and from May 6 to November 1. When work was suspended on November 1, the underground development consisted of a 2-compartment vertical shaft, 262 feet deep, 218 feet of drifting and 40 feet of crosscutting on the 150-foot level, and 360 feet of drifting and 45 feet of crosscutting on the 250-foot level. Two small stopes had been mined on the first level, and one on the second level.

A 20-ton cyanide mill was erected early in 1935, and milling started on April 17. The mill was shut down on October 9, after treating a total of 3,295 tons of ore. A Diesel engine was used to supply power.

The mining plant included a 22 h.p. boiler operating an 8- by 10-inch hoist, and a 370-cubic-foot Ingersoll-Rand Diesel compressor.

An average of 23 men was employed under the direction of W. A. Coughlan.

McMillan Gold Mines, Limited

McMillan Gold Mines, Limited, was incorporated in December, 1926. The capitalization was increased in 1935 from 3,000,000 to 4,000,000 shares of $1 par value. The officers and directors are: G. M. Miller, president; G. A. Foot, vice-president; F. A. Lafferty, secretary-treasurer; W. J. Hussey, J. M. R. Corbet, C. B. Goldsborough, and R. L. Patterson, directors. The head office is at Sudbury. The property is about 60 miles southwest of Sudbury, in Mongowin township, district of Sudbury. The mine address is Footbanks.

Work was continued throughout 1935. Underground operations and milling were suspended on December 24, and a diamond-drilling campaign was started.

During 1935 a winze was sunk from the 625-foot level to a depth of 275 feet, and levels were established at depths of 750 and 875 feet. The development work accomplished on the various levels during the year and the total to the end of 1935 were as follows:—

Level	Drifting		Crosscutting		Raising	
	1935	Total	1935	Total	1935	Total
	feet	feet	feet	feet	feet	feet
225-foot	64	429	13	13	260	292
325-foot	.....	1,355	.....	504	90	392
425-foot	.....	333	.....	95	100	132
525-foot	.....	1,609	.....	639	310	355
625-foot	.....	768	.....	143	.....	.....
750-foot	177	177	14	14	.....	.....
875-foot	118	118	45	45	.....	.....
Total	359	4,789	72	1,453	760	1,171

Shrinkage stoping was done on all levels, except the 750- and 875-foot. The 125-ton mill treated a total of 40,213 tons during 1935, of which 33,814 tons was obtained from stoping, 633 tons from development, and the balance from surface dumps. A concentrating jig and amalgamation equipment were added to the mill circuit.

A total of 1,478 feet of diamond-drilling was done from surface, and 2,407 feet from underground.

An average of 82 men was employed during the year, of whom 49 were underground. Jas. G. MacGregor was consulting engineer; George C. Dunn was general superintendent; and W. R. Dennis was mill superintendent.

Madsen Red Lake Gold Mines, Limited

Madsen Red Lake Gold Mines, Limited, was incorporated in March, 1935. with an authorized capitalization of 3,000,000 shares of $1 par value. The officers and directors of the company are: F. R. Marshall, president; Jos. McDonough, vice-president; W. G. Hughson, secretary-treasurer; G. A. La Bine, A. J. Doane, and M. Madsen, directors. The head office of the company is at 67 Yonge Street, Toronto. The mine office address is Red Lake.

The holdings of this company, 29 claims, are situated at Faulkenham lake, about 7½ miles southwest of the Howey mine, in the Red Lake area, district of Kenora, Patricia portion. The property was bought from Jomac Gold Syndicate and Falcon Gold Syndicate. The claims were prospected and developed by surface trenching and 12 diamond-drill holes in 1935. A vertical shaft, which was started late in the same year with an objective depth of 325 feet, was down about 175 feet at the end of the year. It is located on the hanging-wall side of the vein, which dips toward it at 60 to 65 degrees. It is estimated the vein will be intersected by crosscuts about 200, 150, and 100 feet from the shaft on the 100-, 200-, and 300-foot levels, respectively.

Madsen Red Lake Gold Mines bought the steam plant used in the early stages of development of the McKenzie Red Lake mine. This plant was moved to the Madsen property after the freeze-up in the fall of 1935.

In December, 1935, there were 31 employees at the mine. A. Honsberger is mine manager.

Manitoba and Eastern Mines, Limited

Manitoba and Eastern Mines, Limited, is capitalized at 5,000,000 shares, of which 3,100,006 were issued, 2,000,000 shares being optioned to Bobjo Mines, Limited, for $202,500.

The property consists of 16 claims in Strathy township, district of Nipissing. The head office is at 25 King Street West, Toronto. The officers of the company are: W. E. Hurd, president; W. G. Chipp, treasurer; T. M. Mungovan, secretary; R. J. Jowsey and L. K. Fletcher, directors. The mine address is Timagami.

Underground operations were suspended in February, 1935. Surface exploration was carried on at the west end of the property during the summer and fall.

An average of 6 men was employed. Jas. G. MacGregor is general manager.

Martin Bird Syndicate

The Martin Bird Syndicate owns 9 claims in Hearst township, district of Timiskaming. The officers and directors are: S. J. Bird, president; G. O'Meara, secretary-treasurer; Dr. R. Armstrong, J. Martin, and D. Lough, directors. John Campbell is mine manager. The mine address is Larder Lake.

Buildings on the property include a log cabin, two bunk-houses, cook-house, office, compressor and hoist house, and headframe.

Operations were resumed in June, 1935, and continued to the end of the year. At the end of 1935 the shaft had been deepened to 140 feet, and a total of 700 feet of drifting and 420 feet of crosscutting had been done on the 125-foot level. Ore hoisted during the year amounted to 2,000 tons and waste to 1,500 tons. An average of 12 men was employed.

Matachewan Consolidated Mines, Limited

Matachewan Consolidated Mines, Limited, owns 21 claims, comprising 840 acres, in Powell and Cairo townships, district of Timiskaming. The authorized capital is 4,000,000 shares of no par value, of which 1,200,000 shares are issued to Matachewan Canadian Gold, Limited, shareholders. The balance of the stock is optioned to Ventures, Limited, and Sudbury Basin Mines, Limited, to be taken up as money is expended on the property. The officers and directors are: Thayer Lindsley, president; H. H. Sutherland, vice-president; H. Wittingham, secretary-treasurer; W. J. Boland and Jos. Errington, directors. Ernest Craig is general manager; and Thos. L. Wells is superintendent. The head office is at 25 King Street West, Toronto. The mine address is Elk Lake. During the year an average of 42 men was employed in the mine, 12 in the mill and 26 on surface, making a total of 81.

The following is a summary of the work done in 1935 as reported by the superintendent:—

Shaft-sinking amounted to 176 feet; raising, 99 feet; station-cutting, 86 feet; sumps, 1,878 cubic feet. Development work, by levels, was as follows:—

Level	Drifting	Crosscutting	Raising	Box-holing
	feet	feet	feet	feet
160-foot	151	492	67	105
260-foot	595	.....	.....	.....
Total	746	492	67	105

From surface, 204 feet of diamond-drilling was done; and from underground, 2,261 feet.

Ore hoisted amounted to 49,487 tons; waste, 9,680 tons; and ore broken in stopes, 73,296 tons.

The mill operated 365 days, treating 48,362 tons, with an average per day of 132½ tons.

The following figures show the gold and silver production, with the total gross value:—

	Fine ounces gold	Fine ounces silver	Total gross value
Bullion shipped	9,761.441	1,402.34	$344,265.14
Slag shipped	352.127	248.09	12,558.53
Total	10,113.568	1,650.43	$356,823.67

New construction completed during the year includes the following: headframe, shaft-house, ore bin, power-house and a direct-driven electric hoist and compressor, change-house with lockers and shower baths, new refinery.

Matachewan Pioneer Syndicate

The Matachewan Pioneer Syndicate, capitalized at 7,000 units of no par value, was formed to take over 9 patented claims in Cairo township, district of Timiskaming, which were staked in 1906. During 1935 the syndicate was under the management of C. G. Knott and G. W. Pinner. The head office address is 1109 Northern Ontario Building, Toronto.

During 1935 a 2-compartment shaft was sunk to a depth of 50 feet, and 42 feet of crosscutting was done. Five men were employed under the direction of H. A. Steven. The mine address is Matachewan.

At the beginning of 1936 arrangements were being made to refinance and form a company to be known as Matachewan Hub Pioneer Mines, Limited.

May-Spiers Gold Mines, Limited

May-Spiers Gold Mines, Limited, was incorporated in July, 1934, and is capitalized at 3,000,000 shares of $1 par value, of which 1,280,000 shares are issued. The officers and directors are: Otto May, president and managing director; Nelson Spiers, vice-president; C. M. Lamb, secretary-treasurer; Geo. C. McCullagh, director. The head office of the company is at 159 Bay Street, Toronto. The mine office address is Red Lake.

The mine property consists of 8 patented claims, located at the west end of Red lake, Middle Bay section, in the township of Ball, Patricia portion of Kenora district. A large part of this group of claims lies under water. The mining plant is located on an island about a thousand feet in length.

A mining plant has been taken in to the property and is partially installed. It includes two 80 h.p. John Inglis R.T. boilers, one 840-cubic-foot Sullivan straight-line air compressor, a 7- by 11-inch Stephens-Adamson steam hoist, and all necessary blacksmith and machine shop equipment. A complete set of camp buildings to house a crew of 36 men has been erected.

A shaft has been dug down to bed rock, a distance of 8 feet, and cribbed in preparation for drilling operations.

Work at the property was reported temporarily suspended late in the summer of 1935. An average of 6 men was employed for the first nine months of the year, under the direction of Nelson Spiers.

Minto Gold Mines, Limited

Minto Gold Mines, Limited, was incorporated in July, 1930, with an authorized capitalization of 8,000 shares of no par value. The officers and directors are: John Knox, Jr., president and manager; M. E. Knox, secretary-treasurer; A. Dorfman and J. Ingram, directors. The executive and mine offices are at Wawa.

The property consists of the Minto, Jubilee, and Cooper mines, all located in township 29, range 23, in the Michipicoten area, district of Algoma.

Underground operations were continued at the Jubilee mine throughout 1935. Open stoping was done on the 2nd, 3rd, and 4th levels, and the ore transported by truck from the Jubilee mine to the 100-ton cyanide mill at the Minto mine, where it was milled.

The mill operated 340 days during 1935 and treated a total of 34,890 tons of ore, of which 2,212 tons was obtained from the 2nd level, 9,980 tons from the 3rd level, and 22,798 tons from the 4th level.

The development work accomplished during the year at the Jubilee mine consisted of a 150-foot raise from the 2nd level to surface, 30 feet of drifting on the 3rd level, and 63 feet of drifting on the 4th level.

Work was done at the Cooper property from March 15 to July 15. Previous operators put down a 45-degree shaft to a depth of 65 feet. In 1935 a power line was constructed from the Jubilee-Stanley line to the old shaft, and a compressor-house, bunk-house, and cookery were erected. A 310-cubic-foot Ingersoll-Rand electric compressor was installed, and work was then suspended.

An average of 40 men was employed during 1935, of whom 18 were underground. John Knox, Jr., was in charge of operations; Frank McLennan was mine captain; and Wm. Hosking was mill superintendent.

Moffatt-Hall Mines, Limited

Moffatt-Hall Mines, Limited, has a capitalization of $5,000,000, in shares of $1 par value. The officers are: L. R. Moffatt, president; and C. F. Tuer, Haileybury, secretary-treasurer. The company owns 15 claims in Lebel township, district of Timiskaming.

The property was operated under lease during the first seven months of 1935 by the Bidgood Kirkland Gold Mines, Limited. An account of this operation appears on page 82 of this report.

Morris Kirkland Gold Mines, Limited

Morris Kirkland Gold Mines, Limited, was formed in January, 1935, with an authorized capitalization of 2,500,000 shares of $1 par value. The officers and directors are: George W. Morris, president; M. C. Smith, vice-president; Jas. E. Day, vice-president; L. H. Watts, treasurer; Roy Weldon, secretary; W. B. Robb, Dr. W. H. Bennett, C. F. Jordan, H. P. Armstrong, and L. B. Black, directors. The head office is at 902 Kent Building, Toronto. The mine address is King Kirkland.

The company took over the assets of Kirkland Gold Belt Mines, Limited, on a basis of one share of Morris Kirkland Gold Mines for three shares of Kirkland Gold Belt Mines. The property consists of 292 acres in Lebel township, district of Timiskaming.

At the beginning of the year the shaft was 768 feet deep, and 727 feet of crosscutting and 3,529 feet of drifting had been done. During 1935 the present owners did 75 feet of raising, 445 feet of crosscutting, 2,556 feet of drifting, and 740 feet of slashing. A 12,000-gallon sump was cut on the 500-foot level.

An average of 32 men was employed under the management of T. C. Fawcett.

Munro Croesus Mines, Limited

Munro Croesus Mines, Limited, owns 160 acres in Munro township, district of Cochrane, 12 miles east of Matheson. The authorized capital is 40,000 shares of $1 par value. The officers of the company are: Robert Coffey, president; J. E. Grant, Haileybury, vice-president and general manager; L. A. Lillico, secretary-treasurer.

Operations were renewed in July, 1935, and continued to the end of the year, with an average of 14 men. During that time there were 800 tons of ore and 200 tons of waste mined and hoisted. The production was 31 ounces of crude bullion, having an approximate value of $930, and 25 tons of concentrates, valued at $4,500.

At the end of the year the property was leased to Tellaurum Gold Mines, Limited, of which Douglas Mutch is president. The deal was financed through an option given to Thayer Lindsley on 2,000,000 shares of Tellaurum stock.

Murray-Algoma Mining Company, Limited

The Murray-Algoma Mining Company, Limited, was incorporated in January, 1934, with an authorized capitalization of 40,000 shares of no par value. The officers and directors are: Dr. A. Sinclair, president; E. G. Archer, vice-president; G. J. Lamb, managing director; E. L. Lamb, secretary-treasurer; T. E. Carmichael, director. The executive office is at 18 Lansdowne Avenue, Sault Ste. Marie.

The property consists of a group of 18 claims in township 28, range 24, district of Algoma, a short distance west of Hawk Junction on the Algoma Central railway.

During 1935 sampling was carried on until the end of March, and work was then suspended until July. During the balance of the year a 2-mile power line was constructed from Hawk Junction to the property. Buildings erected included a compressor-house, blacksmith shop, cookery, and stable. By the end of the year a 220-cubic-foot Sullivan compressor, driven by a 50 h.p. motor, and an 1,800-gallon centrifugal pump, driven by a 5 h.p. motor, had been installed. It is planned to do open-cut mining and to install a small mill during 1936.

An average of 7 men was employed from July to the end of the year, under the direction of G. J. Lamb. The mine address is Hawk Junction.

Murwood Gold Mines, Limited

Murwood Gold Mines, Limited, was incorporated in June, 1934, with an authorized capitalization of 3,000,000 shares of $1 par value. The officers and directors are: A. T. Gilles, president; J. A. Griffith, treasurer; R. E. Hore, Benjamin Meen, Robert Fennell, Dr. A. McD. Murray, and J. R. Gifford, directors. Corporation Management and Executives, Limited, is secretary. The head office is at 304 Bay Street, Toronto.

In October, 1935, work was started under option at the old Big Master mine, located on Upper Manitou lake, district of Kenora. It is about 20 miles south of Wabigoon on the Canadian Pacific railway.

Previous operators sank a shaft to 270 feet and established three levels, on which a total of 1,888 feet of lateral work was done. They also obtained about 5,000 tons of ore from stoping, which was treated in a 10-stamp mill.

By the end of 1935 the company had installed a mining plant, dewatered the mine, and repaired the old buildings and shaft. Sinking was started from the bottom of the 270-foot shaft on January 1, 1936.

The plant included a 45 h.p. boiler, a steam hoist, a 370-cubic-foot Ingersoll-Rand semi-Diesel compressor, and a 220-cubic-foot Ingersoll-Rand gasoline compressor.

An average of 16 men was employed during the period of operation. E. A. Boadway was in charge. The mine address is Wabigoon.

Naybob Gold Mines, Limited

Naybob Gold Mines, Limited, incorporated in January, 1934, has an authorized capitalization of 3,500,000 shares of $1 par value. The officers and directors are: R. J. Naylor, president; Richard N. Clarke, vice-president; H. J.

Haddleton, secretary-treasurer; Geo. E. Beggs, John G. Jones, Sherman J. Le Pard, and Jos. Montgomery, directors. The executive office is at 808 Genesee Valley Trust Building, Rochester, N.Y.; the head office is at 808 Federal Building, Toronto, and the mine office address is Timmins.

The mine was formerly operated by the Hayden Gold Mines Company, Limited. The property consists of 16 claims in Ogden and Deloro townships, district of Cochrane, about 4 miles south of the town of Timmins.

The property has been developed to date from a 2-compartment vertical shaft, 719 feet in depth. Levels have been established at 100, 200, 300, 400, 550, and 700 feet. Naybob Gold Mines, Limited, has worked on only the 300- and 700-foot levels. The following table shows the work done on these two levels:—

	To Dec. 31, 1934	1935
	feet	feet
300-Foot Level:		
Crosscutting	325	745
Drifting	40	390
700-Foot Level:		
Crosscutting	1,030	1,180
Drifting	835	1,324
Raising	48	219

The company added a ball mill to the old Hayden mill, which consisted of a flotation unit and a cyanide unit. This addition considerably increased the capacity. Milling began March 1, 1935. A maximum capacity of slightly over 100 tons per day was reached, but average tonnage milled to the end of October, when operations ceased for the year, was only about 44 tons. The total tonnage milled was 10,681 tons. The gross value of production was $23,338.29. A small refinery was erected in 1935.

The average number of men employed during the 10-month period of activity in 1935 was 43. Operations were suspended owing to lack of capital, and negotiations for refinancing are proceeding. Robt. J. Naylor is general manager of the mine.

Neville Canadian Gold Mines, Limited

Neville Canadian Gold Mines, Limited, was incorporated in March, 1934, with an authorized capitalization of 3,000,000 shares of no par value. The officers and directors are: E. H. Dickenson, president; P. A. Fisher, vice-president; J. H. Thomas, secretary-treasurer; T. M. Mungovan, W. H. Schneider, and L. J. Lahay, directors. The head office is at 347 Bay Street, Toronto. The mine address is Shiningtree.

The property consists of a group of 9 claims in Churchill and Macmurchy townships, in the West Shiningtree area, district of Sudbury. It is about 23 miles by road north of Westree, on the Canadian National railway.

Work was resumed at this property on March 14, 1935, after a suspension of three months. It was again suspended at the end of March, after the mine had been dewatered, and the first two levels sampled by the Reward Mining Company, of British Columbia.

The property remained idle until August 14 when Bramor Mining (Ontario), Limited, in return for stock in the company, commenced the erection of a 30-ton

mill. The mine was again dewatered while the mill building was constructed. Work was suspended on October 17 before any mill equipment was installed. G. F. Milne was in charge.

At the beginning of 1936 arrangements were being made to form a company, to be known as Ronda Gold Mines, Limited, to take over the property.

North Shores Gold Mines, Limited

North Shores Gold Mines, Limited, was incorporated in November, 1933, with an authorized capitalization of 3,000,000 shares of $1 par value. The officers and directors are: E. E. Watts, president; P. L. Howell, vice-president; H. A. Coon, secretary; J. A. Ross and R. N. Palmer, directors. The executive office is at 1022 Federal Building, Toronto.

The property is located about 3½ miles south of Schreiber, on the main line of the Canadian Pacific railway, district of Thunder Bay.

Work was continued throughout 1935. During the year three new adits were started, making a total of five on the property. A 130-foot 27-degree winze was put down from the 1st level adit on the strike of the vein, and a sublevel was established at the bottom. The lateral work accomplished in the various adits during 1935, and the total to the end of 1935, was as follows:—

Level	Relative elevation	Lateral work	
		1935	Total
	feet	feet	feet
1st level	zero	.....	930
Sublevel	—50	260	260
Crosscut level	—95	370	370
2nd level	—175	40	440
No. 11 vein	—175	75	75
Total	.....	745	2,075

Four small stopes were mined on the sublevel, and two on the 2nd level. The 25-ton amalgamation mill was operated for 192 days during 1935, and treated a total of 1,404 tons of ore.

An average of 37 men was employed during the year. D. E. Graham is in charge. The mine address is Schreiber.

In December a syndicate was formed from shareholders of the company to supply working capital in return for a mortgage on the property and buildings. The syndicate is to control operations during the life of the mortgage.

Northern Empire Mines Company, Limited

The Northern Empire Mines Company, Limited, was incorporated in July, 1932. The company has an authorized capitalization of 500,000 shares of $1 par value. The officers and directors are: Fred Searls, Jr., president; G. B. Agnew, vice-president; H. E. Dodge, secretary-treasurer; Carroll Searls and A. Douglas, directors. The executive office is at 14 Wall Street, New York. The mine address is Empire.

The property is located at Empire, on the Port Arthur–Long Lac branch of the Canadian National Railways, district of Thunder Bay.

Work was continued at this property throughout 1935. The 2-compartment

vertical shaft was sunk to a total depth of 667 feet. The development work accomplished during the year on the various levels was as follows:—

Level	Drifting	Crosscutting	Raising
	feet	feet	feet
150-foot	.....	18	.....
300-foot	509	135	86
450-foot	187	19	.....
600-foot	1,279	230	52
Total	1,975	402	138

The amalgamation-flotation-cyanidation mill was operated throughout the year. Additional equipment was installed in August, including two flotation units, two Dorr thickeners, and an Oliver filter, which permitted the tonnage milled to be increased from 125 tons to 150 tons per day. A total of 45,736 tons of ore was milled during 1935, which was obtained from cut-and-fill stoping on the 150-, 300-, and 450-foot levels, and from development work.

The plant included two 1,080-cubic-foot Ingersoll-Rand electric compressors and a double-drum electric hoist. Electric power was obtained from Cameron Falls, 55 miles away.

An average of 123 men was employed during 1935, of whom 82 were underground. R. J. Hendricks was in charge, with P. E. Corrin as mine captain and W. Hargraft as mill superintendent.

Northern Mines, Incorporated

Northern Mines, Incorporated, was incorporated in Delaware in 1934, with an authorized capitalization of 4,000,000 shares of $1 par value. The officers and directors for 1935 were: I. E. Haight, president; F. Erion, vice-president; F. Dobmeier, secretary-treasurer; W. B. Woodbury and E. W. De Wilton, directors. The executive office was at 516 Walbridge Building, Buffalo, N.Y.

In March, 1935, this company started work on the property of Wabigoon-Contact Gold Mines, Limited, located at Contact bay, Wabigoon lake, about 7 miles south of Dryden, in Kenora district. Previous operators had put down two 80-degree shafts on the property, No. 1 shaft to a depth of 63 feet without lateral work, and No. 2 shaft to a depth of 100 feet with 40 feet of drifting at the bottom.

The company dewatered and sampled the shafts and carried on surface work. A mining plant was being set up at No. 2 shaft, including a 10- by 12-inch steam hoist and three boilers, totalling 104 h.p., when operations were suspended early in September.

About 15 men were employed under the direction of W. L. Haight.

Olive Gold Mines, Limited

Olive Gold Mines, Limited, was incorporated in January, 1935, with an authorized capitalization of 3,000,000 shares of $1 par value. The officers and directors are: Dr. W. C. Ryckman, president; J. J. Hoefle, vice-president; C. V. Jacobs, E. J. Wolfe, and H. F. Lichtenstein, directors. The head office is at 372 Bay Street, Toronto. The mine address is Mine Centre.

The property consists of the old Olive mine, located 4½ miles west of

Mine Centre, district of Rainy River. The Fort Frances branch of the Canadian National Railways is within a short distance of the property.

Previous operators sank a 2-compartment 70-degree shaft to a depth of 251 feet, and established levels at 60, 135, and 245 feet. They did 867 feet of drifting on the 60-foot level, 290 feet on the 135-foot level, and 177 feet of drifting and 65 feet of crosscutting on the 245-foot level. A second shaft was connected with the 1st level 300 feet east of the first shaft; and a third shaft, 50 feet deep, was put down 290 feet east of the second shaft. Considerable stoping was done on all levels, and the ore milled in a 25-stamp mill.

Work was started in May, 1935. The underground workings were dewatered and sampled during June and July. In September the construction of buildings and the installation of a plant was started. By the end of the year a power-house, blacksmith shop, office, bunk-house, cookery, dwelling house, and assay office had been built. A 472-cubic-foot Ingersoll-Rand compressor, driven by a 100 h.p. semi-Diesel engine, and a 9- by 12-inch Jenckes hoist were installed, with the intention of starting underground work early in 1936.

An average of 7 men was employed during the period of work, under the direction of F. G. Huycke.

Omega Gold Mines, Limited

Omega Gold Mines, Limited, was incorporated in May, 1935, with a capitalization of $5,000,000 in shares of $1 par value.

The officers and directors are: J. P. Bickell, president; Balmer Neilly, assistant to the president; E. D. Fox, secretary-treasurer; Dr. A. F. Demary, A. Dorfman, and E. M. Thomson, directors. A. D. Campbell is manager. The executive office is at 15 King Street West, Toronto. The head office and mine office are at Larder Lake.

The company acquired the Costello and Crown Reserve properties in McVittie township, district of Timiskaming. Work was commenced on surface in July, 1935. The Crown, or No. 1, shaft was put into shape for mining operations, a small amount of rock work only being done. A new 75-foot headframe and hoist-house was erected at the shaft. Underground mining commenced in January, 1936.

A complete new 300-ton milling plant was constructed and brought into operation in January, 1936.

Power for the mine's operation was supplied after December 1 by the Hydro-Electric Power Commission of Ontario, which extended its 110,000-volt line from Kirkland Lake to a new substation at the mine.

The following is an extract from the manager's report, dated April 16, 1936:—

> The preparation of a report that covers only the first two months' production from a new plant presents certain difficulties, and the results set forth cannot be accepted as indicative of what may be normally expected from such plant after the preliminary and necessary adjustments have been completed. Actual construction of the plant commenced August 1 last, and in the interval the mill has been completed and put in operation and there has been provided the necessary shops, office, boarding house, and other essential and complementary plant and equipment.
>
> Shaft heads were renewed and re-equipped, and underground, on the 300- and 550-foot levels the crosscuts and drifts were enlarged to provide for production equipment. In addition, a certain amount of work in preparation for stoping and early development work was completed.
>
> The tonnage treated during the two months' operations under review came from surface dumps and from the work done underground in slashing and preparing for regular stoping operations. At present raises are started from the 550-foot level on either side of the main hoisting shaft and when completed to surface will provide for cut-and-fill stoping operations. Shaft stations and crosscuts have been enlarged; two connections between Nos. 1 and 2 shafts have been provided and, as soon as stoping operations are well organized, an aggressive plan for further underground development will be formulated and put in effect.

The milling practice finally adopted is an adaptation of the McIntyre system of flotation followed by cyanidation. The mill went into production with few mechanical difficulties and soon demonstrated its capacity to be in excess of 300 tons per day. Indeed, with slight changes and little or no additional equipment, this capacity can be increased to approximately 500 tons per day.

During February and March the mill treated 17,352 tons of ore, from sources previously described, for a net recovery of $60,992.30, and for a cost, as now computed, of approximately the same amount. As previously explained, these results are preliminary and will be gradually improved. Costs to date have averaged $3.70 per ton of ore treated.

Ore reserves are estimated at 440,000 tons, averaging 0.197 ounces per ton, and in addition to the ore thus computed, a considerable low-grade tonnage, though indicated, has not been developed sufficiently to permit its inclusion in a reserve calculation.

Pamour Porcupine Mines, Limited

Pamour Porcupine Mines, Limited, was incorporated in March, 1934, under a Dominion charter. The company is capitalized at 5,000,000 shares of no par value. The officers and directors are: J. Y. Murdoch, president; G. H. Rainville, vice-president; A. Lafontaine, secretary-treasurer; Jules R. Timmins, M. Kendall, E. Hibbard, T. N. Hay, and W. Meen, directors. R. M. Macaulay is general manager. The executive office is at 804 Royal Bank Building, Toronto. The mine office address is Pamour, a post office established in 1935.

Pamour Porcupine Mines, Limited, was formed by the Quebec Gold Mining Corporation to take over three properties known as Three Nations, La Palme, and Porcupine Grande, in all about 800 acres situated in the northeast corner of Whitney township, district of Cochrane, near the east end of the Porcupine area. The Temiskaming and Northern Ontario railway (Timmins branch) passes through the property, as does also the main highway. The property is 6 miles east of South Porcupine.

The following is taken from the general manager's report for the year 1935:—

Diamond-Drilling

Diamond-drilling from surface was continued until August, during which time 55 holes were drilled, aggregating 29,105.5 feet. This drilling intersected 2,337 feet of vein material, or about 8 per cent. of the footage drilled. The record is as follows:—

	Feet
Old drilling	6,569.8
1934—16 holes	5,966.5
1935—55 holes	29,105.5
Total drilling to date	41,641.8

Most of this drilling was done to locate ore at the 200-foot horizon. A few holes were drilled to locate ore at the 400-foot horizon, with only two holes to locate ore at the 600-foot horizon. Both these two holes cut ore at the 600-foot horizon.

Mine Development

The old No. 2 shaft and steam equipment was operated continuously and only shut down at the end of the year. A new large 5-compartment main shaft, located 1,100 feet east of No. 2 shaft, was started in the fall and was sunk and timbered to 356.4 feet deep. Stations were cut at the 200- and 300-foot levels. During the year 3,458.7 feet of development work was done, and the following is the development record of the mine:—

	1935	Total to date
	feet	feet
Shafts	356.4	686.4
Winzes	.....	33
Drifts	1,547.1	3,825.6
Crosscuts	1,304.9	2,752.4
Raises	250.3	490.3
Total	3,458.7	7,787.7

All drifting, crosscutting, and raising was done on the 200-foot level, and the muck was hoisted through the old No. 2 shaft until December, when the new main shaft was ready for use to the 200-foot level and underground work could be speeded up. The development work on the 200-foot level covers a distance of 1,600 feet along the bedding, opening up three different ore sections.

Ore Reserves

The property was diamond-drilled from the surface over the area east of No. 2 shaft, but only a restricted area was drilled sufficiently closely to allow of connecting up the ore intersections to form indicated ore. In this area, from No. 2 shaft east to diamond-drill hole No. 53, a distance of 3,000 feet, ore indicated by diamond-drilling aggregated 1,530,000 tons, averaging 0.261 ounces in gold.

Development underground on the 200-foot level so far has proved three ore sections to aggregate 726,000 tons, averaging 0.246 ounces in gold. In mining the above ore there will, of course, be dilution with waste and lower-grade ore, so the grade of ore sent to the mill will be somewhat less than given above.

Plant Construction

Construction of a mining plant was started in July and the following construction has been completed: main shaft-house, crusher building with conveyor runways and junction house, hoist- and power-house, substation, shops buildings, change-house, assay office, warehouse and office, central heating plant, elevated water tank, pumping plant, powder magazine, 3 bunk-houses, dining room and cook-house, 7 residences. Plant buildings are of permanent and substantial construction, steel frames on heavy concrete foundations, with a special copper-lined insulboard siding, covered with corrugated iron, or of brick and tile.

Power from the Ontario Hydro Commission's Abitibi development was contracted for in the summer, and a secondary transmission line was built from their substation at Timmins to the mine. Delivery of power at 26,400 volts to the mine substation began in October.

Plans have been completed for a first unit mill. The foundations are completed and erection will begin early in 1936.

Parkhill Gold Mines, Limited

Parkhill Gold Mines, Limited, was incorporated in April, 1929, with an authorized capitalization of 3,000,000 shares of $1 par value. The officers are: Sir Thomas Tait, president; A. P. Earle, vice-president; G. F. Racine, secretary-treasurer; C. F. Elderkin, G. M. McKee, Charles Adams, and Dr. C. A. Peters, directors. The executive office is at 1835 Beaver Hall Building, Montreal. The mine address is Gold Park. The property is located 6 miles from Wawa on the Algoma Central railway, in township 29, range 23, Michipicoten area, district of Algoma.

During 1935 the 2-compartment 40-degree shaft was sunk an additional 197 feet to a total depth of 1,500 feet on the incline; and levels, the 10th and 11th, were established at 1,332 and 1,450 feet.

Development footages accomplished on the various levels during 1935 were as follows:—

Level	Drifting	Crosscutting	Raising
	feet	feet	feet
2nd	36	.....	18
3rd	4	29	.....
4th	.....	.....	.....
5th	37	.....	.....
6th	41	18	67
7th	397	.....	.....
8th	373	69	177
9th	1,953	183	504
10th	1,597	92	259
11th	192	85	24
Total	4,630	476	1,049

A total of 20,714 tons of ore was obtained from the mine during 1935, of which 17,420 tons was from stoping and the balance from development. Stoping

was done by open-stoping methods on all levels from the 1st to the 10th, inclusive, although over half of the stope production was obtained from the 8th and 9th levels. A total of 1,371 feet of diamond-drilling was done from underground. An average of 97 men was employed, of whom 67 were underground. R. E. Barrett was in charge.

Paymaster Consolidated Mines, Limited

Paymaster Consolidated Mines, Limited, was incorporated in February, 1930. It has an authorized capitalization of 9,000,000 shares of $1 par value, 7,761,000 of which have been issued. The officers and directors at December 31, 1935, were: A. S. Fuller, president; E. H. Walker, vice-president; E. L. O'Reilly, secretary-treasurer; A. W. Hodgetts, assistant secretary; Chas. E. Cook, general manager; C. J. O'Brien and H. D. Rothwell, directors. The executive office is at 804 McKinnon Building, Toronto. The head office address and mine office address are both South Porcupine.

Paymaster Consolidated Mines, Limited, holds large acreages in Tisdale township, district of Cochrane. The chief property is the block of ground between the Dome mine and the Buffalo Ankerite mine. There are 6 shafts on this property having an aggregate depth of 3,099 feet. The old Dome Lake or No. 5 shaft and the West Dome (Heinze) or No. 6 shaft are the only two which have been used by this company. No. 5 shaft is 1,097 feet in depth, and No. 6 shaft, inclined at 62 degrees, is 456 feet in depth.

The following is an extract from the president's report to the shareholders for the fiscal year ending June 30, 1936:—

During the period covered by the report your company has produced bullion having a gross value of $782,533.48. This production is more than double the production for the preceding fiscal year. After deducting all costs of operation, including exploration and development, but before provision for depreciation on plant, buildings, and equipment, an operating profit of $166,539.09 has resulted.

All production to June 30, 1936, amounting to $1,111,288.63, has been taken from ore mined at our No. 5 and No. 6 shafts only. Your board now considers it advisable to open shafts No. 2 and No. 3, near the Buffalo Ankerite boundary, and these shafts have both been dewatered to the 400-foot level, and within the past few weeks our geologists and engineers and samplers have been examining the 100-, 200-, and 300-foot levels. As a result larger mining operations are contemplated.

Two 40-acre claims in Tisdale township, formerly known as the "Apex mine" and adjoining the No. 5 shaft section of our property to the northwest, have been acquired by purchase.

The following is taken from the report of the general manager for the fiscal year ending June 30, 1936:—

Mining

During the year an active development campaign was carried out, consisting of: deepening of No. 2 winze at No. 5 shaft from the 1,325-foot to the 1,575-foot level with stations and sump; excavating for winze headframe, bins, and hoist-room on the 400-foot level, No. 6 shaft, and sinking from the 400-foot level to the 1,050-foot horizon with intermediate levels at 525, 665, and 805 feet; excavating for a headframe, bins, and hoist-room at No. 3 winze in the 1,008 section at No. 5 shaft; drifting, crosscutting, and raising, which opened up new ore on the 600-, 750-, 900-, 1,050-, 1,200-, 1,325-, and 1,450-foot levels at No. 5 shaft, and on the 200-, 300-, and 400-foot levels at No. 6 shaft.

Work on the 1,575-foot level at No. 5 shaft is now under way, and a small amount of drifting has been accomplished on the new 525- and 665-foot levels at No. 6 shaft since sinking was completed. Stoping was carried out on all levels from the 400-foot to the 1,200-foot level at No. 5 shaft and from surface to the 400-foot level at No. 6 shaft.

Broken ore reserves were increased 561 per cent., from 9,500 to 62,798 tons.

Diamond-Drilling

As will be noted in the following tabulation a total of 32,178 feet of diamond-drilling was done. Three No. 10 "E" Mitchell diamond-drills were purchased, and the contracting of diamond-drilling discontinued. Costs on this work done to date show a saving of approximately 50 per cent. In addition to the above, a larger drill (Mitchell No. 20) has been ordered.

Summary of Stoping and Development

Drifting	feet	7,371
Crosscutting	feet	525
Raising	feet	600
Diamond-drilling	feet	32,178
Winzing	feet	927
Station- and sump-cutting	cu. yds.	713
Ore stoped	tons	151,770
Ore produced from development	tons	16,668
Waste hoisted	tons	19,756

Ore Reserves

Ore reserves, which during the year were increased 74.2 per cent., from 166,400 tons as of June 30, 1935, to 289,899 tons as of June 30, 1936, are as follows:—

	Tons	Ounces per ton
Ore blocked out, two or more sides	84,726	0.261
Probable ore	142,375	.228
Broken ore in stopes	62,798	.176
	289,899	0.227

Milling

During the fiscal year there were milled 113,971.7 dry tons of ore, having an assay value of 0.213 ounces per ton of ore milled. The average daily tonnage milled for July, 1935, was 201.3 dry tons per day, as compared with 401.9 dry tons per day for June, 1936, an increase of 99.65 per cent. The increased tonnage rate in the mill was due to the finer mill feed made possible by the installation of a vibrating screen and a gyratory crusher in the crusher-house.

Costs

The mining costs per ton broken for the year were as follows: No. 5 shaft, $2.46; No. 6 shaft, $3.07.

Following is an analysis of operating costs:—

	Total cost	Cost per ton milled
EXPLORATION AND DEVELOPMENT:		
Diamond-drilling, underground	$23,094.34	$0.20
Diamond-drilling, surface	320.46	.....
Surface exploration	199.56	.....
Outside exploration	229.12	.....
Development No. 5 shaft	74,815.84	.66
Development No. 6 shaft	34,486.09	.30
Sinking, stations and sumps, No. 5 shaft	20,047.23	.18
Sinking, stations and sumps, No. 6 shaft	2,727.82	.02
Station-cutting No. 5 shaft	1,759.68	.02
Total	$157,680.14	$1.38
MINING:		
No. 5 shaft	$258,195.35	.....
No. 6 shaft	143,615.34	.....
	$401,810.69	.....
Less for breaking 54,466.3 tons more than drawn from stopes	144,335.70	.....
Total	$257,474.99	$2.26
Ore transportation	$21,737.83	$0.19
Sorting and skipping	5,398.48	.05
Crushing and conveying	25,570.02	.22
Milling	97,140.52	.85
General expense	42,888.33	.38
Total operating costs	$607,890.31	$5.33

General

The saving effected by the change over to Hydro-Electric Power Commission power has been sufficient to completely pay for all the new equipment and the cost of installation. In addition there has also been paid to the Hydro-Electric $3,170.16 on the total of the required deposit of $15,000.00

A 24- by 14½- by 12-inch Canadian Ingersoll-Rand X.V.H.E. 2 air compressor with a capacity of 1,586 C.F.M. actual, and driven by a 300 h.p. synchronous motor was purchased and put in operation at No. 5 shaft. Two 1½-ton storage-battery locomotives and 40 additional ore cars were purchased and put in service at No. 5 shaft.

The blacksmith and steel-sharpening shop at No. 6 shaft was destroyed by fire. The loss was fully covered by insurance. All steel sharpening, blacksmithing, and plate work has now been centralized in the newly equipped shop at No. 5 shaft.

During 1935 the average number of employees at the mine was 192, divided as follows: underground, 121; mill, 17; and surface, 53. A. Pugsley is underground superintendent, and D. Robinson is mill superintendent.

Pickle Crow Gold Mines, Limited

Pickle Crow Gold Mines, Limited, incorporated in January, 1934, is capitalized at 3,000,000 shares of $1 par value. The officers and directors of this company are: J. E. Hammell, president; A. L. Smith, vice-president; Robt. Fennell, secretary-treasurer; G. A. Cavin, assistant secretary-treasurer; Mrs. Eola Hammell and B. H. Budgeon, directors. The executive office of the company is at 930 Canadian Bank of Commerce Building, Toronto. The head office and the mine office of the company are at Pickle Crow.

The company's property consists of 59 claims in the Pickle Lake–Crow River area, in the Patricia portion of Kenora district. The main claims of the property were originally staked in 1928, and early development work was done by Northern Aerial Minerals Exploration, Limited. The property is reached by airplane from Hudson, Sioux Lookout, or Collins, on the Canadian National railway, to Pickle lake, from which point a truck road, constructed during the summer of 1935, leads to the property, 8 miles east of the lake. Supplies are taken in by water from Hudson over Lac Seul, up the Root river, across a marine railway to Lake St. Joseph, and thence to Doghole bay, which is about 25 miles from the property. From here supplies are transported to Pickle lake by plane during the summer and by tractor during the winter. Supplies are also freighted by tractor from Savant Lake during the winter.

A mining plant was taken into this property in 1933. The sinking of a 3-compartment shaft was commenced in September, 1933. Since that date operations have been continuous. At the end of 1934, the shaft was down 380 feet; and by the end of 1935, it was 789 feet deep. The following table shows the amount of development work by levels done at this property to the end of 1934 and at the end of 1935:—

Level	Crosscutting		Drifting		Raising		Diamond-drilling	
	To Dec. 31, 1934	To Dec. 31, 1935	To Dec. 31, 1934	To Dec. 31, 1935	To Dec. 31, 1934	To Dec. 31, 1935	To Dec. 31, 1934	To Dec. 31, 1935
125-foot	126½	126½	707	1,427	.....	134	347	1,189
250-foot	222	222	1,135	1,135	177	177	1,268	1,337
375-foot	379	379	1,478	1,529	73	88½	2,180	2,180
500-foot	.....	166½	.....	226	.....	.....	.....	202
625-foot	.....	155½	.....	.....	.....	.....	.....	.....
750-foot	.....	222	.....	.....	.....	.....	.....	.....
Surface	.....	.....	.....	.....	.....	.....	3,107	6,604
Total	727½	1,271½	3,320	4,317	250	399½	6,902	11,512

A mill, comprising both amalgamation and cyanide units and having a daily capacity of 150 tons, was constructed during the latter part of 1934 and the winter of 1935. The mill was first turned over on April 17, 1935, and actual milling operations were started on May 1, 1935. During the last eight months of the year the mill treated 36,200 tons, having a gross value of $874,088.72.

During 1935 the following additions were made to the plant equipment: a 1,000-cubic-foot Ingersoll-Rand cross-compound, electrically driven compressor; the 600-cubic-foot Ingersoll-Rand steam-driven compressor was converted to an electrically driven compressor; an Ingersoll-Rand, 42- by 30-inch, class PE-I, 8,000-lb. pull, electric hoist and 60 h.p. motor; a Fairbanks-Morse horizontal split-case, double-action suction, centrifugal pump (for fire protection); and a Continental industrial type engine with automatic starter (attached to pump). An emergency power unit has also been installed. This consists of a gasoline engine and electric generator, which generates 125 horsepower, sufficient to operate all necessary mill units and to light the buildings in case of failure of the main power supply.

The following buildings were erected or completed during 1935: mine warehouse, 26 by 58 feet; machine shop, 26 by 60 feet; mine dry, 30 by 40 feet; compressor and hoist room, 31 by 78 feet; refinery, 14 by 16 feet, equipped; shaft-house and steel headframe, 60 feet in height, completed; standby power unit building, 14 by 16 feet; bunk-house, 26 by 30 feet; 2 dwellings, 22 by 25 feet and 24 by 28 feet; cookery warehouse, 16 by 40 feet; 2 warehouses at Doghole bay, 24 by 60 feet and 24 by 30 feet.

An average of 102 men was employed at the mine during 1935. Alex. G. Hattie is mine manager.

Porcupine Lake Gold Mining Company, Limited

The Porcupine Lake Gold Mining Company, Limited, was incorporated in 1927, and at that time took over the property of the old Porcupine Lake Gold Mines, Limited; it has an authorized capitalization of 3,000,000 shares of no par value. The officers and directors are: C. E. Calvert, president; H. H. Sutherland, vice-president; Geo. McKeown, secretary-treasurer; J. R. L. Starr and H. J. Batkin, directors. The head office of the company is at 112 Yonge Street, Toronto. The property, often called the Hunter mine, is located at the northeast corner of Porcupine lake, Whitney township, district of Cochrane.

The mine workings consist of a shaft, inclined at 65 degrees, and one level about 275 feet below the collar of the shaft. About 700 feet of crosscutting and drifting was done on this level by Porcupine Lake Gold Mines, Limited, before the mine was closed down in 1914. From that year until 1927 the property was idle. In 1927 it was pumped out and sampled, and some diamond-drilling was done. Work ceased again in June, 1928, and it was not until November, 1935, that the mine was again pumped out.

Work commenced in September, 1935, with the repairing of several of the old buildings and a diamond-drilling programme. About 2,000 feet of diamond-drilling was done from surface by the Porcupine Lake Gold Mining Company. The mine was pumped out early in November, and on the 23rd of the month Hollinger Consolidated Gold Mines became interested in the property, and sampled it and drilled 8 diamond-drill holes from underground, with a total footage of 1,764 feet. Hollinger completed this work in December, and no further work was done to the end of the year.

The mining equipment now on hand at the property includes an 80 h.p. boiler, which was reconditioned in October; a Jenckes straight-line air compres-

sor, steam-driven, with a steam cylinder, 10 by 12 inches, and an air cylinder, 12 and 7½ by 12 inches; and an 8- by 10-inch steam hoist, built by Ottumwa Iron Works.

Wm. Sixt was in charge of the work done by the Porcupine Lake Gold Mining Company. Geo. M. Henderson was superintendent.

Red Lake Gold Shore Mines, Limited

Red Lake Gold Shore Mines, Limited, incorporated in December, 1927, has an authorized capitalization of 5,000,000 shares of no par value, of which 4,500,000 shares are outstanding. The officers and directors are: Chas. E. St. Paul, president and managing director; Ira E. Hough, vice-president; Dr. Robt. W. Breuls, secretary-treasurer; Chas. V. Gallagher and Henry A. Newman, directors. The head office is at 244 Bay Street, Toronto. The mine office is at Red Lake.

The holdings of this company consist of 23 claims in the townships of Dome and Heyson, Red Lake area, in the Patricia portion of Kenora district. The mine shaft is about a mile west of the town of Red Lake. The present programme of work was commenced in June, 1934, although surface-trenching had been done on the property some years ago. Shaft-sinking was started late in the summer of 1934. At the end of 1934, the shaft was down 182 feet, with a level at 180 feet; at the end of 1935, it was 435 feet deep, with additional levels at 300 and 425 feet. The following table shows the development work accomplished during the past two years:—

	At Dec. 31, 1934	At Dec. 31, 1935
	feet	feet
Crosscutting	127	220
Drifting	80	1,429
Raising	.....	157

Equipment for a mill to be built in 1936 has been purchased. The initial capacity will be 125 tons, and provision will be made for enlarging the capacity to 250 tons if needed.

In 1935, electric power was made available at the mine. The formerly steam-driven compressor of 750-cubic-foot capacity was electrified. The mine pump was also electrified. A new Ingersoll-Rand double-drum hoist was installed in 1935. New buildings erected in 1935 included an assay office, a combined pipe- and machine-shop, and enlargements to the hoist- and compressor-building.

The average number of employees in 1935 was 34. W. P. Mackle is mine manager.

Richelieu Gold Mines, Limited

Richelieu Gold Mines, Limited, incorporated in May, 1934, is capitalized at 3,000,000 shares of $1 par value, of which 1,614,407 shares have been issued. The officers and directors are: A. B. Stodart, president; W. R. P. Parker, vice-president; W. J. McDonough, secretary-treasurer; H. R. Drummond-Hay and R. Spreckels, directors. The head office of the company is at 330 Bay Street, Toronto. The mine office address is Savant Lake.

The property consists of 24 claims, totalling 854 acres in Thunder Bay district. Fifteen of these claims are in one group, located on a peninsula extending southward into the northeast bay of Sturgeon lake, about 10 miles

southeast of Savant Lake station on the transcontinental line of the Canadian National Railways. The sixteenth claim, 104 acres, adjoins the St. Anthony Gold mine, about 4 miles to the southwest. In addition to the above holdings, the company recently acquired 8 claims, comprising approximately 400 acres, known as the Iron Duke group, 6 miles south of the main group.

On the main group, a 2-compartment shaft was started in December, 1934. By the end of 1934 it had reached a depth of 115 feet. Sinking continued in 1935 to a depth of 278 feet. Levels were established at 125 and 250 feet, and exploration by drifting was actively carried on to September 17, 1935, when the mine was closed down.

The mining plant at this property includes two boilers, one of 70 and one of 150 horse-power; a Canadian Ingersoll-Rand 2-stage air compressor, of 614-cubic-foot capacity; and a Canadian Ingersoll-Rand, 8- by 6-inch reversible steam hoist.

The average number of men employed up to September 17, 1935, was 35. J. G. Harkness was mine manager from the commencement of operations till the mine shut down.

Rickard Ramore Gold Mines, Limited

Rickard Ramore Gold Mines, Limited, was incorporated in October, 1934, with a capitalization of 3,000,000 shares of $1 par value. The officers and directors are: W. H. C. McEachern, president; E. Wise, secretary-treasurer; J. W. Morrison, consulting engineer; H. Hollands-Hurst, mine superintendent; and Jas. Travis, director. The head office is at 601 Concourse Building, Toronto. The mine office is at Iroquois Falls.

The company acquired claims Nos. 18,405, 18,406, 18407, 19,629, and 19,630 in the township of Rickard, district of Cochrane. The property, which was staked in 1917, was formerly known as the Raty mine. A mining plant was installed and camps were erected.

Previous operators had sunk an inclined shaft to a depth of 100 feet and had done over 700 feet of lateral work on the 100-foot level. The present company began operations in December, 1934, and at the end of 1935 the lateral work amounted to about 1,000 feet. Some 10,000 feet of diamond-drilling and considerable surface-trenching has been done.

St. Anthony Gold Mines, Limited

St. Anthony Gold Mines, Limited, was incorporated in 1921 with an authorized capitalization of 3,000,000 shares of $1 par value. The capitalization was increased to 3,300,000 shares in 1934. All shares are issued. The officers and directors at the end of 1935 were: H. P. Bellingham, president and general manager; R. F. Taylor, vice-president; R. F. Cairns, secretary-treasurer; R. Robertson and D. M. Bellingham, directors. The head office of the company is at 159 Bay Street, Toronto. The mine office address is Savant Lake.

The mine property, in the Sturgeon Lake area, lies 12 miles south of Savant Lake station on the main line of the Canadian National Railways, in Thunder Bay district. A 3½-mile wagon road from Savant Lake station leads to the north end of the North arm of Sturgeon lake. From this point transportation to the mine is by water. Large scows and power-boats are used to transport supplies over the water route.

The following is taken from the president's report for the fiscal year ending December 31, 1935:—

Continuous mining and milling operations were carried on throughout the year, and a total of 44,550 tons of ore was treated. The actual cost of mining and treating this ore was $5.18 per ton.

The total bullion production for the year was $303,151.80, as against $123,263.57 in the year 1934, an increase of $179,888.23, or 146 per cent. There was an operating profit of $73,516.61. After charging $37,520.73 for depreciation, $17,269.00 for development, $16,684.44 for the balance of rehabilitation, and sundry write-offs and provisions for Dominion and provincial taxes, the sum of $2,042.44 was transferred to earned surplus.

The following is taken from the mine manager's report for the year ending December 31, 1935:—

Mine

A total tonnage of 34,912 tons of ore was broken and 34,538 tons delivered to the mill. This ore, with the exception of 700 tons recovered from the development work on the 500-foot level was drawn from the 250-foot and 350-foot levels. Ore was mined over widths from 5 to 15 feet as against an original width calculated at 5 feet. The balance of the tonnage was derived from the old mill tailings.

A total of 842 feet of drifting and crosscutting was accomplished during the year. The drifting accounted for 579 feet distributed as follows: 250-foot level, 191 feet; 350-foot level, 148 feet; 500-foot level, 240 feet.

The crosscutting done was in connection with the new inclined shaft and distributed as follows: 150-foot level, 114 feet; 250-foot level, 84 feet; 350-foot level, 65 feet.

Summary of Work Accomplished to Date

	Feet
New inclined shaft	121
Old shaft	150
Winzes and raises	500
Drifts	5,164
Crosscuts	1,693
Total	7,628

After the 500-foot level was dewatered, drifting was carried on and the main vein was exposed for a total length of 330 feet, with an average grade of 0.40 ounces of gold per ton. This level is much drier than the upper levels, and pumping is carried on only 4 per cent. of the time.

The management decided that economical mining required the excavation of an inclined shaft from the 500-foot level to the surface. This work was started near the end of the year, and a total footage of 121 feet had been excavated by December 31. This new shaft will improve the working conditions considerably, in comparison with the system of hoisting through a series of winzes, which is not efficient and is more costly. Operating through the new inclined shaft will permit us to save labour costs in tramming, mucking, cage-tending, and hoisting, together with power costs, and should, in the aggregate, account for the majority of the capital outlay during the year 1936.

At this time the small amount of development work that has been done north in the granodiorite does not justify my making any estimate as to ore reserves in this section of the mine, although the vein intersections are large and may be profitably mined on a large tonnage basis.

Mill

The mill operated 90 per cent. of the possible running time. The tonnage treated was as follows:—

	Tons	Ounces per ton
Old mill tailings	10,012	0.17
Underground ore	34,538	.26
Total	44,550	.....

The average tons milled per day of 24 hours' running time was 136.63 tons. The total gold bullion recovered and shipped was 8,538.6 fine ounces. The total silver bullion recovered and shipped was 1,957.7 fine ounces. The average recovery was 91 per cent. The average cost of milling was $1.473 per ton. A new crusher, amalgam barrels, and blanket tables were added to the mill circuit during the year.

Hydro-Electric Power Plant

The power plant was damaged by fire due to lightning. It was found, however, that the undamaged generator supplied sufficient power to carry on all mining and milling operations. The cost of repairs to the plant was fully covered by insurance.

The rapids, about a mile below the power plant, were lowered during the summer, which improved the gross head approximately one and a half feet. This improvement in the gross head relieves us of any further anxiety with regard to power shortage. The plant is now operated by 3 employees where 4 were employed.

General

Building construction work throughout the year was confined to minor changes in the bunk-house and the erection of a new cabin at the power site. A new stable was erected at the mine. A steam-heating system was installed throughout the mine buildings.

Two major accidents were reported during the year. One of the employees was injured in the mill and fully recovered, the other accident occurred in the mine and proved fatal. An average of 114 men was employed throughout the year. Mine timber and cordwood are being recovered as near to the mine property as possible.

Developed Ore

While the character of the ore in the mine is difficult to sample, there is, in my opinion, one year's ore available at this time. However, the opening-up of the ore on the 500-foot level for a distance of 330 feet would indicate there is a continuity of ore to a greater depth than now opened up and as formerly indicated by diamond-drilling.

R. P. Teare was manager throughout the year, employing an average force of 108 men.

Sakoose Gold Mines, Limited

Sakoose Gold Mines, Limited, was incorporated in June, 1934, with an authorized capitalization of 3,000,000 shares of $1 par value. The officers and directors were: A. H. Acres, president; M. J. Maloney, vice-president; D. McGrory, secretary-treasurer; M. S. Shulman, director. The head office is at 231 St. James Street, Montreal, Que. The mine address is Dyment.

The property of this company includes the old Sakoose mine, located about 6 miles south of Dyment, in Kenora district.

During 1935 the new 2-compartment vertical shaft was continued to a depth of 143 feet. All work was suspended in May.

In August, the assets of the company were taken over by Nordic Sturgeon Gold Mines, Limited, but no work was undertaken by them at this property during 1935.

An average of 31 men was employed during the period of operation in 1935 under the direction of D. H. Traynor.

Selected Canadian Golds, Limited

Selected Canadian Golds, Limited, was incorporated in March, 1932, with an authorized capitalization of 10,000 preferred shares of $100 par value, and 15,000 common shares of no par value. The officers and directors were: D. M. Hogarth, president; G. G. Blackstock, secretary-treasurer; Halstead Lindsley, R. Livermore, W. T. McEachern, Quincey Shaw, and C. D. H. MacAlpine, directors. The head office was at the Bank of Commerce Building, Toronto.

The company continued work, until March 1, under their option, on the old Sultana mine, located about 7 miles southeast of Kenora, and then dropped the option. The work accomplished in 1935 consisted of 79 feet of drifting on the 4th level, 136 feet of drifting on the 7th level, and 1,703 feet of diamond-drilling from underground.

A crew of 23 men was employed under the direction of Cameron McDonald.

Selected International Mines, Limited

Selected International Mines, Limited, an English company, with a capitalization of £1,000, in shares of £1 par value, leased the property of Cheltonia-

Swastika Mines, Limited, in June, 1935. C. F. Davies is chairman of the board of directors. Thomas Evans and J. J. L. Helou are directors. The head office is at 33 Chancery Lane, London, W.C.2, England. C. J. Poole was manager at the property, employing 18 men. The mine address is Swastika.

The property consists of 5 claims in Eby and Otto townships, district of Timiskaming. The operating company did 105 feet of shaft-sinking and 60 feet of lateral work on the 100-foot level.

Shenango Gold Mines, Limited

Shenango Gold Mines, Limited, was incorporated in March, 1935, with an authorized capitalization of 3,000,000 shares of $1 par value. The officers and directors are: Louis Normandin, president; Bruce Cameron, vice-president; James Hutchison, secretary-treasurer; Jack Owens and William Cromar, directors. The head office is at 1107 Bank of Hamilton Building, Toronto.

The property consists of a group of 4 claims in Hawkins township, and one of 12 claims in Walls township, district of Algoma.

During 1935 work was confined to the group in Hawkins township, where open-cut mining was done on a small scale. In November the construction of a 25-ton amalgamation mill was started. By the end of the year the mill building was completed and the installation of equipment begun, with the expectation of starting up the mill in March, 1936. The equipment will include a crusher, Morley mill, rolls, ball mill, and amalgamation equipment, to be operated by gasoline engines.

It is expected that ore for the mill will be obtained from open-cut operations. A 220-cubic-foot gasoline compressor was installed in December.

Buildings erected included the mill, blacksmith shop, office, 2 bunk-houses, and cookery. The mill is located about three-quarters of a mile east of Langdon, on the Algoma Central and Hudson Bay railway, and about 5 miles from Oba. The mine address is Oba. About 15 men were employed under the direction of Jack Owens.

Shinintree Gold Mines, Limited

Shinintree Gold Mines, Limited, was incorporated in March, 1935, with an authorized capitalization of 1,000,000 shares of $1 par value. The officers and directors were: Lionel Brooke, president; C. H. Hitchcock, vice-president; W. B. McPherson, secretary-treasurer; Gilbert Bennett and W. J. Laforest, directors. The head office is at 171 Yonge Street, Toronto. The mine address is Shiningtree.

The property consists of claims W.D. 1,406 and T.R.S. 2,507, totalling 126 acres, in Macmurchy township, West Shiningtree area, district of Sudbury. It is 26 miles by road northeast of Westree on the Canadian National railway. Previous owners did some surface stripping and put down a vertical shaft to 36 feet.

The company started work in May. The old shaft was cleaned out and timbered into two compartments, and sinking started with hand-steel and windlass. By the end of the year the shaft had reached a depth of 100 feet, and a level had been started at that depth, on which 26 feet of drifting had been done.

Buildings erected consisted of a bunk-house, cookery, and blacksmith shop. No mining plant or headframe was installed.

An average of 9 men was employed during the last eight months of 1935, under the direction of Lionel Brooke.

S. B. Smith

Dr. S. B. Smith, Cleveland, Ohio, is the owner of claim S.S.M. 301, formerly known as the Van Sickle mine, located in township 29, range 23, in the Michipicoten area, district of Algoma. It adjoins the east boundary of the Parkhill mine. The mine address is Gold Park.

During 1935 the 2-compartment 45-degree shaft was sunk an additional 149 feet, to a total depth of 289 feet on the incline, and a second level established at 261 feet.

Stopes were started on both levels during the second half of the year, from which 6,122 tons of ore was obtained on the first level and 1,534 tons on the second level, by open-stoping methods.

The 15-ton mill installed in 1934 was replaced by a 50-ton mill, which started operating on June 1. The equipment included a Telsmith crusher, ball mill, rake classifier, four Wilfley tables, and amalgamation equipment. By the end of the year the mill had treated a total of 7,946 tons of ore.

A 312-cubic-foot electric compressor was added to the plant. An assay office was constructed in addition to the mill.

Operations were suspended early in January, 1936. An average of 38 men was employed during 1935, of whom 20 were underground. J. C. Canfield was in charge.

Sol-D'Or Gold Mines, Limited

Sol-D'Or Gold Mines, Limited, incorporated in September, 1934, has an authorized capitalization of 3,000,000 shares of $1 par value. The officers and directors elected at the first annual meeting are as follows: C. M. Edwards, president; E. R. Bremner, vice-president; F. W. Runge, A. B. Wright, and G. W. Mitchell, directors. A. W. Reynolds is secretary-treasurer for the company. The head office is at Room 505, 140 Wellington Street, Ottawa. The mine office address is Narrow Lake.

The company's holdings, which consist of 24 patented claims and 14 unpatented claims, lie in the northeast corner of Honeywell township, the northwest corner of McNaughton township, and in the block immediately north of these two townships. These claims take in part of the western end of Grace or Rainbow lake, a small lake south of Birch lake in the Patricia portion of Kenora district. Most of these claims were formerly held by T. W. Bathurst, Limited, and more recently by Rainbow Lake Gold Mines, Limited.

The most important discoveries made to date on this property are on claim No. 10,790. Five narrow veins carrying visible gold have been discovered within a few rods of each other. In 1932–33 a Jack Nutt mill was taken into the property, and several hundred tons were milled. The ore was taken from an open cut on the No. 3 or centre vein. The cut has a maximum length of 250 feet and a maximum depth of 40 feet. The ore was sorted before being sent to the mill. The value of production, from 400 tons milled from this cut in 1932–33, is reported as about $10,000.

Sol-D'Or Gold Mines erected a new mill in 1935 and equipped it with a Mitchell jaw-crusher, a 10-ton Straub ball mill, amalgamation plates, and a Straub table. A new 9 h.p. Diesel engine was bought to supply power for the mill. Milling was commenced about October 1 and continued for two and a half months. In this period 119.38 tons were milled, and the value of production was $1,390.78.

The following exploration and development work has been done on the property by Sol-D'Or Gold Mines and by former operators: 800 feet of trenching,

ranging from 5 to 40 feet in depth, including the open cut from which mill feed has been taken; 2,000 feet of stripping and a number of test pits; 3,000 feet of diamond-drilling (done in the winter of 1934–35). No shaft-sinking has been done on the property.

Buildings include a log-cabin office, log-construction bunk-house, warehouse, powder magazine, cap-house, and pump-house. The last three buildings were erected in 1935.

Milton Hersey Company, Limited, was engaged to direct the operations at the mine and to act as consulting engineers. They have placed Dr. H. S. Hicks in charge of the property as mine manager. An average of 9 men was employed at the mine during 1935.

South Vermillion Gold Mines, Limited

South Vermillion Gold Mines, Limited, was incorporated in April, 1934, with an authorized capitalization of 1,500,000 shares of $1 par value. The officers and directors were: A. E. Broadley, president; A. Pacitto, vice-president; G. McLaughlin and F. J. McFarlane directors; M. F. Burrows, secretary-treasurer. The head office was at 21 King Street East, Toronto.

The property owned by this company consists of a group of three claims located on Bad Vermilion lake, about 3 miles southwest of Mine Centre, Rainy River district.

The 2-compartment vertical shaft was sunk an additional 5 feet by hand-steel during January, 1935, to a total depth of 45 feet. During the balance of the year a bunk-house and cookery were constructed, and surface work was carried on intermittently.

A 300-cubic-foot Ingersoll-Rand compressor and a 175 h.p. boiler were obtained but not put in use.

A. Pacitto was in charge. The mine address is Mine Centre.

Stanley Gold Mines, Limited

Stanley Gold Mines, Limited, was incorporated in November, 1933, with a capitalization of 2,000,000 shares of $1 par value. The officers and directors are: H. E. Perry, president; J. C. MacKay, vice-president; Mrs. Stanley Siscoe, secretary-treasurer; and Armand Bastien, director. The head office was at 231 St. James Street West, Montreal, Que. The mine address is Wawa.

The property is located in township 29, range 23, in the Michipicoten area, district of Algoma. It is about 5 miles by road from Wawa on the Algoma Central railway.

Work was supended at this property at the end of December, 1934, following the death of Stanley Siscoe, who had been privately financing the work. A 2-compartment inclined shaft had been sunk to a depth of 300 feet, and levels had been established at 123 and 256 feet. A total of 648 feet of drifting and 97 feet of crosscutting had been done on the 123-foot level, and 778 feet of drifting and 71 feet of crosscutting on the 256-foot level.

The property remained idle until December 29, 1935, when dewatering of the mine was started in preparation for the resumption of underground work.

S. MacDougall is in charge of operations.

Straw Lake Beach Gold Mines, Limited

Straw Lake Beach Gold Mines, Limited, was incorporated in August, 1934, with an authorized capitalization of 2,500,000 shares of no par value. The

officers and directors are: W. E. Segsworth, president and secretary; L. L. Steindler, vice-president and treasurer; R. J. Jowsey, J. D. Conover, and J. A. Gairdner, directors. The head office is at 67 Yonge Street, Toronto.

The property consists of a group of 9 claims at Straw lake, district of Kenora, which were taken over from Straw Lake Beach Gold Mines Syndicate, Limited. It is about 35 miles north of Fort Frances, and is reached by a 70-mile route from Emo on the Canadian National railway.

During 1935 operations were carried on until the end of October, when they were suspended for the winter. The 2-compartment vertical shaft was deepened to 320 feet, and a second level established at 300 feet. The total footage of lateral work underground when operations were suspended consisted of 558 feet of drifting and 92 feet of crosscutting on the 100-foot level and 719 feet of drifting and 77 feet of crosscutting on the 300-foot level. A total of 1,560 feet of diamond-drilling was done from surface during 1935.

The plant used included a 310-cubic-foot Ingersoll-Rand gasoline compressor and a 6- by 8-inch Ingersoll-Rand air hoist.

An average of 19 men was employed during the period of operation in 1935. Frank Carnegie was in charge, with A. J. MacDonnell as contractor. The mine address is Emo.

Sturgeon River Gold Mines, Limited

Sturgeon River Gold Mines, Limited, was incorporated in August, 1934, with an authorized capitalization of 3,000,000 shares of $1 par value. The officers and directors were: A. L. Bishop, president; J. M. Wood, vice-president; C. S. Kennedy, secretary-treasurer; F. D. Reid, general manager; A. Longwell, W. T. Brown, and Fraser Raney, directors. The head office is at 320 Bay Street, Toronto.

The property consists of a group of 7 claims in the Sturgeon (Namewaminikan) River area, district of Thunder Bay, about 8 miles northwest of Nezah station, on the Long Lac–Port Arthur branch of the Canadian National railway.

A 3-compartment vertical shaft was started on May 9, 1935, and completed to a depth of 523 feet. Levels were established at 125, 250, 375, and 500 feet. The work completed on these levels to the end of 1935 was as follows:—

Level	Drifting	Crosscutting	Raising
	feet	feet	feet
125-foot	213	29	44
250-foot	277	24	57
375-foot	426	40	87
500-foot	361	180	.....
Total	1,277	273	188

A total of 3,200 feet of diamond-drilling was done from surface in 1935.

The plant included two 70 h.p. locomotive-type boilers, a 750-cubic-foot Babcock and Wilcox steam compressor, and a 9- by 8-inch Ingersoll-Rand double-drum hoist. Buildings erected included a hoist-compressor house, boiler-house, blacksmith-machine shop, assay office, dry-house, 2 bunk-houses, office, cook-house, and manager's residence.

An average of 46 men was employed throughout 1935. C. M. Bowyer was in charge. The mine address is Jellicoe in summer and Nezah in winter.

Supreme Gold Mines, Limited

Supreme Gold Mines, Limited, was incorporated in February, 1934. The authorized capitalization is 2,000,000 shares of $1 par value. Officers of the company are: Walter F. Stewart, president and manager; H. M. Richardson, vice-president; Harry J. Beck, secretary-treasurer. There is also an advisory board of three: Frank Grew, John Rennie, and Walter G. Lumbers. The head office is at 314 Metropolitan Building, Toronto. The mine office address is Savant Lake.

In September, 1935, the company held 32 claims, east of Couture lake between the North and the Northeast arms of Sturgeon lake, in Thunder Bay district.

A mining plant was freighted into this property in the spring of 1935. It includes one Case boiler of approximately 25 h.p., a 240-cubic-foot Schram portable gasoline compressor, a Ledgerwood tandem-drum hoist, and a tractor. This mining plant has not been set up. Buildings include a combined cookery and bunk-house, office, residence, and powder magazine.

Work during 1935 was confined chiefly to prospecting and trenching. There were 7 men employed at this property at the end of the summer.

Swain, Harris, and Cavano

Messrs. Swain, Harris, and Cavano hold 9 claims, Nos. 12,254–62, three miles south of the west end of Birch lake in the Patricia portion of Kenora district. On these claims they discovered a rusty zone in which fairly coarse residual gold is found. During the summer of 1935, they carried on small-scale mining operations on claim No. 12,258, digging up rusty, oxidized material out of small pits, packing it to a stream a few hundred feet distant, and there passing it over crude ripples and blankets on cradles. In this way, handling about half a ton of material per day, they recovered a heavy concentrate of arsenopyrite and gold, but the value of their concentrate is unknown. No report of a shipment of bullion or concentrate had been received up to the end of the year.

The post office address is Narrow Lake.

Sylvanite Gold Mines, Limited

Sylvanite Gold Mines, Limited, has an authorized capital of 3,300,000 shares of $1 par value. The officers and directors of the company are: Edward L. Koons, president; William L. Marcy, vice-president; W. S. Walton, secretary; Clark L. Ingham, treasurer; Welles V. Moot, managing director; C. E. Rodgers, general manager; Alfred H. Sharpe and Harry Yates, directors. The head office is at Kirkland Lake, and the executive office is at 300 Erie County Bank Building, Buffalo, N.Y.

The property is situated in the township of Teck, district of Timiskaming. An average of 270 men was employed during the year.

The following is taken from the general manager's report for the fiscal year ending March 31, 1936:—

Ore Reserves

Comparing broken ore reserves as at March 31, 1935, with the figure for the same date in 1936, we have, respectively, 82,990 and 82,415 tons, showing a negligible change, notwithstanding the substantial increase in tons treated last year.

Operating Costs

	Total cost	Cost per ton ore milled
1932:		
Development and exploration	$184,936.28	$1.962
Mining	285,365.41	3.026
Milling	112,630.68	1.194
General charges	43,863.49	.465
Administrative charges	24,594.16	.261
Bullion selling expense[1] (insurance, shipping, and Mint refining charges)	5,615.12	.060
Total	$657,005.14	$6.968
1933:		
Development and exploration	$227,278.95	$2.364
Mining	249,907.58	2.599
Milling	105,168.81	1.094
General charges	44,083.76	.459
Administrative charges	23,437.97	.244
Bullion selling expense (insurance, shipping, and Mint refining charges)	4,823.89	.050
Total	$654,700.96	$6.810
1934:		
Development and exploration	$235,067.63	$2.391
Mining	217,517.25	2.213
Milling	111,849.51	1.138
General charges	42,160.87	.429
Administrative charges	34,774.84	.353
Bullion selling expense (insurance, shipping, and Mint refining charges)	5,912.90	.060
Total	$647,283.00	$6.584
1935:		
Development and exploration	$242,173.47	$1.938
Mining	263,644.48	2.109
Milling	151,620.64	1.213
General charges	39,314.93	.315
Administrative charges	39,000.00	.312
Bullion selling expense[2] (insurance, shipping, and Mint refining charges)	5,525.11	.044
Total	$741,278.63	$5.931
1936:		
Development and exploration	$211,169.44	$1.372
Mining	348,251.50	2.262
Milling	167,324.47	1.087
General charges	47,641.25	.310
Administrative charges (partly mine)	59,116.83	.384
Township drainage tunnel expense	5,914.12	.038
Kirkland District Hospital building expense	3,868.15	.025
Bullion selling expense:		
Insurance, shipping, and Mint refining charges	5,834.38	.038
Mint handling charge	16,750.88	.109
Total	$865,871.02	$5.625

[1]The item "bullion selling expense" was included with the item "general charges" in previous annual reports.

[2]Mint bullion handling charge, effective for the month of April, 1934, at 35 cents per ounce, amounted to $1,007.70, which together with bullion tax was deducted from production.

Production

The mill extraction, based upon Mint assays, plus tailing loss, was 95.95 per cent. for the full year; 96.27 per cent. for the last six months, and 96.40 per cent. for March. Mill heads were lowered slightly to permit inclusion of a greater amount of low-grade and marginal ore.

Fiscal year ending March 31	Tons milled	Production	Average recovery, troy ounces per ton
1931	83,034	$837,013.97	0.49
1932	94,276	948,926.13[1]	.49
1933	96,140	912,377.15[1]	.40
1934	98,311	1,558,912.87[1]	.52
1935	124,956	1,584,817.39[2]	.41
1936	153,942	1,931,891.87[3]	.36

[1]Including exchange on bullion.
[2]Including exchange on bullion, after bullion tax is deducted.
[3]Including exchange on bullion, after deducting bullion tax effective for period April 1, 1935, to May 31, 1935, but before deducting Mint handling charge of 35 cents per fine ounce gold, effective for period June 1, 1935, to March 31, 1936.

Mining

Year	Ore broken			Waste			Total ore and waste broken
	In Stopes	From development	Total	Hoisted to surface	Used for backfill	Total	
	tons	tons	tons	tons	tons	tons	tons
1933	66,130	37,467	103,597	21,774	5,347	27,121	130,718
1934	54,423	31,971	86,394	25,457	5,838	31,295	117,689
1935	93,883	37,161	131,044	11,812	10,623	22,435	153,479
1936	111,091	42,183	153,274	12,576	7,607	20,183	173,457

During last year drifting and subdrifting through ore amounted to 3,342.5 feet. This represented 36.4 per cent. of the total advance. Structural features and geological evidence encountered generally throughout the sections mined, remained favourable.

Development and Exploration

Class of work	Year ending March 31, 1934	Year ending March 31, 1935	Year ending March 31, 1936	Total from beginning of operations to March 31, 1936
	feet	feet	feet	feet
Drifting	4,399.5	8,985	8,837	57,227.5
Crosscutting	2,347	2,688	2,875.5	27,701
Raising	2,464.5	1,905.5	1,392.5	15,131
Sublevel drifting	1,473.5	1,268.5	349.5	9,640
Box-hole raising	429	352	301	6,945.5
Winzing	97.5	.....	.....	97.5
Shaft-sinking	612	.....	.....	5,654
Total	11,823	15,199	13,755.5	122,396.5
Per cent. of crosscutting to total of crosscutting and drifting	34.8	23.2	24.6	32.6
	cu. ft.	cu. ft.	cu. ft.	cu. ft.
Shaft stations and sump excavations	19,140	840	1,420	207,278
	feet	feet	feet	feet
Diamond-drilling	6,713	15,952	19,359	96,385

No. 2 Shaft.—A continued programme of extensive exploration on and between levels was carried out during the year. Particular attention was given to further successful development near the 875-foot level and below the 2,500-foot level, mentioned in last year's report. Approximately one-half of the footage of ore drifted on this year was in these horizons. Upper level work, also continued in volume and wide extent, was productive to an encouraging degree. In addition, ore was developed at the 1,750-foot level on the south vein system, west of the major fault, in an area where previous exploration had been disappointing.

No. 4 Shaft.—Of the ore sent to the mill, this part of the property produced 21,552 tons. Considerable exploration has yet to be completed here and this, with clean-up operations, is expected to continue to furnish a fair volume. Beginning with 1933, the tonnage of ore coming from this section of the mine was, respectively, 51,916 tons, 47,189 tons, 36,362 tons, and 21,552 tons.

Additional Buildings and Equipment.—These included an extension to the main office, which enlarged the directors' quarters, store-house, engineering office, and general office. A section and fire-wall were also added to the machine shop–steelshop building. Three-ton aluminum skips replaced the two-ton steel units previously used. One agitator and one filter were added to the mill and some additional experimental equipment was purchased for the mill laboratory.

Summary

Promising areas in both sedimentary and igneous formation responded well to development, and general conditions appear to warrant continued confidence in profitable operation. Earnings were substantial and in excess of dividend requirements.

Compared with the previous period, the year ending March 31, 1936, showed: production increased by $347,074.48; 28,986 more tons treated; milling costs reduced by 12.6 cents per ton; and a decline in operating costs of 30.6 cents per ton. Persistent experimental work in the mill has resulted in increased extraction and tonnage, and will be continued.

Tashota Goldfields, Limited

Tashota Goldfields, Limited, incorporated November, 1932, has an authorized capitalization of 3,000,000 shares of $1 par value, of which 2,894,598 shares have been issued. The officers and directors are: H. H. Vaughan, president and managing director; Thomas Arnold, vice-president; P. W. Ogden, secretary-treasurer; W. A. Eden, H. Preston Corsan, W. A. RuKeyser, and R. J. R. Stokes, directors. Both the head office and the mine office of the company are at Tashota. The management of this property is controlled by Minefinders, Limited, whose head office is at 100 Adelaide Street West, Toronto.

The property consists of 9 patented claims and 9 unpatented claims, in one group, with a total area of 642.24 acres, lying about 15 miles south of Tashota station on the main line of the Canadian National Railways, in Thunder Bay district. In winter, access to the property is by way of a 17-mile road; in summer it is reached by an 18-mile canoe route, starting from Paska Siding, and a 6-mile wagon road. A third route by airplane was established in the fall of 1935 from Robinson Lake Siding, 2 miles west of Tashota, to Onaman lake, 4 miles southeast of the mine, and thence by a 4-mile wagon road to the property.

Tashota Goldfields, Limited, succeeded Tashota Gold Mines, Limited. The latter company started underground operations in 1928. To the end of 1935 the following development work had been done: crosscutting, 924 feet; drifting, 2,134 feet; raising, 392 feet; diamond-drilling, 13,415 feet.

Early in 1935 a 50- to 75-ton mill was installed. From April 25 to December 31, 1935, the tonnage milled was 12,828 tons. A Denver jig and blankets catch the coarser gold, and this concentrate is treated in an amalgamation barrel. The greater part of the gold is recovered in a flotation concentrate, which is shipped to a smelter for further treatment. On account of the high cost of summer transportation of this product from the mine to the railway, only about one-third of this had been shipped and treated at the end of the year.

The average number of men employed at the mine in 1935 was 68; of this number, 22 were underground, 6 in the mill, 10 working as construction labourers, and 29 on surface. A. Robertson was acting mine superintendent at the end of the year.

Teck-Hughes Gold Mines, Limited

Teck-Hughes Gold Mines, Limited, has an authorized capital of 5,000,000 shares of $1 par value, of which 4,807,144 shares are issued. The officers and directors are: Albert W. Johnston, chairman of the board; D. L. H. Forbes,

president and general manager; George C. Miller, vice-president; H. C. McCloskey, secretary; K. P. Emmons, treasurer; P. Nugent Tapley, assistant-treasurer; J. W. Stephenson, assistant-secretary; John F. Lash and John F. Thompson, directors. R. J. Henry is general superintendent. The head office is at Kirkland Lake, and the executive office is at 25 King Street West, Toronto. An average of 635 men was employed during 1935 at the mine in Teck township, district of Timiskaming.

The following is an extract from the general superintendent's report for the 12 months ending August 31, 1935:—

During this period the mills treated 383,958 tons of ore from the mine and 40,290 tons of tailing. The total recovery in bullion and precipitate was the equivalent of 144,384.37 Troy ounces of fine gold, and 4,610.25 ounces of this came from retreatment of tailing. After deducting the bullion tax of $338,281.44, the realizable value of the gold and silver production was $4,678,-875.02. With addition of income from investments, the gross revenue was $4,810,545.03, or $11.34 per ton.

The total operating cost amounted to $2,194,202.93, or $5.17 per ton milled. After making provision of $279,453.66 for taxes other than the bullion tax, and adding $19,027.50, a profit derived from the sale of bonds, the surplus for the twelve months was $2,355,915.94. Following is an analysis of operating costs:—

	Total cost	Cost per ton of ore treated	Cost per ounce of gold produced
Development and exploration	$332,317.78	$0.78	$2.30
Mining	1,083,287.05	2.55	7.50
Milling	456,809.26	1.08	3.16
General expense	286,502.52	.68	1.98
Examination of new properties	35,286.32	.08	.25
Total	$2,194,202.93	$5.17	$15.19

During the year the sinking of the No. 3 winze was completed at the 50th level, a depth of 6,100 feet below surface. On the 49th and 48th levels, drifting in the ore zone was begun during August. Lateral development on the 47th and 46th levels had exposed on September 1 a total of 463 lineal feet of ore at an average grade of 10.41 pennyweights over 7.8 feet of width. Development of the block of levels from 41 to 45 inclusive, was practically completed during the year, and the ore found totalled 2,065 feet at an estimated average grade of 9.46 pennyweights per ton. Development footage for the year was as follows:—

	Feet
Drifting	7,236
Subdrifting	4,376
Crosscutting	1,903.5
Raising	4,989.5
Winzing	771.3
Total development	19,276.3

Diamond-drill exploration amounted to 18,449.1 feet. Ore produced from drifting and crosscutting totalled 12,655 tons.

The technical estimate of "positive ore" reserve at September 1 is as follows:—

	Tons	Gold content in troy ounces	Average grade in pennyweights per ton
Broken ore	243,660	86,551.7	7.10
Blocked ore	440,049	193,504.5	8.79
Total	683,709	280,056.2	8.19

Teddy Bear Valley Mines, Limited

Teddy Bear Valley Mines, Limited, has a capitalization of $10,000,000, in shares of $1 par value. The property consists of 1,500 acres in Holloway and Harker townships, district of Cochrane. Finances for development are furnished by the Teddy Bear Valley Syndicate, which has an office at 503 Royal Bank Building, Toronto. C. Ellwood Hoffman is president.

From April 16 to August 9 operations at the property were confined to diamond-drilling, 602 feet of drilling being done from surface and 2,310 feet underground.

Total development work at October 31 consisted of two shafts, 32 feet and 300 feet deep, 922 feet of drifting and crosscutting on the 150-foot level, and 186 feet on the 275-foot level.

Operations were suspended for the winter months. Edward H. Orser is consulting engineer. The mine address is Lightning River.

Thesaurus Gold Mines, Limited

Thesaurus Gold Mines, Limited, has an authorized capitalization of 3,000,000 shares of $1 par value. The officers and directors are: W. L. Forrest, president; G. W. Adams, secretary-treasurer; M. Conkey and P. E. F. Smiley, directors. The head office is at 320 Bay Street, Toronto.

The property consists of 16 claims in Baden township, district of Timiskaming.

There is a 300-foot shaft on the property, and about 300 feet of lateral work had been done on the 100- and 300-foot levels prior to the end of 1924.

In July, 1935, the mine was pumped out, and a small amount of lateral work was done on the 300-foot level. Operations ceased in September. Harry Crawford was manager, employing 8 men.

Toburn Gold Mines, Limited

Toburn Gold Mines, Limited, has a capitalization of 2,000,000 shares of $1 par value. The officers and directors are: H. A. Guess, president; R. F. Goodwin, vice-president; G. A. Brockington, secretary; Charles Earl, assistant secretary; J. C. Emison, treasurer; E. C. Corson, assistant treasurer; W. J. Boland and James Moore, directors; F. G. Hamrick, comptroller and auditor. The New York office is at 120 Broadway, and the Toronto office at 217 Bay Street, in care of W. J. Boland.

The mine is in Teck township, district of Timiskaming. During 1935 an average of 133 men was employed. M. W. Hotchkin, Kirkland Lake, is manager.

The following is an extract from the president's report for the year ending December 31, 1935:—

Your company was formed in January, 1931, to take title to an option upon the Tough-Oakes Burnside gold property in the Kirkland Lake district of Ontario and, later, purchased the property. The property, although idle for several years prior to that time, was the first producer in Kirkland Lake district and contained several miles of underground workings and several shafts, the more important being the main hoisting shaft from surface to the 1,090-foot level and an interior shaft from the 1,090-foot level to the 1,850-foot level, and it was equipped with a mining plant and a cyaniding mill of 100 tons daily capacity.

The foregoing general information is given for the enlightenment of such of the minority stockholders as may have acquired share ownership since the issuance of the last annual report, and for these there is also given the information that of the total of 1,850,000 shares issued of your company, Premier Gold Mining Company, Limited, owns 1,490,000.

Your manager's summary of the exploration and development work done upon your property for the calendar year 1935 is as follows:—

During the year a small amount of surface cross-trenching was done in deep overburden in an effort to trace the eastward continuation of the No. 7 vein, but the results of this trenching were not conclusive. Total development work done during the year 1935 amounted to 8,826 feet, all of which was above the 1,090-foot level. This development consisted of 3,939 feet of drifting, 1,293 feet of sublevel drifting, 2,351 feet of crosscutting, 1,055 feet of raising, 17 feet of winzing, and 171 feet of slashing. Of this total, approximately 2,962 feet was done on ore, breaking 8,738 tons, which was sent to the mill. Approximately 91 per cent. of the year's development was confined to the A-200, No. 3 shaft, 400-, 800-, 893-, 1,018-, and 1,090-foot levels.

The most important development results for the year 1935 were:—

1. Location of the No. 410 drift vein structure, west of the dike fault, which is considered to be the eastward continuation of the North vein system in the Kirkland Lake camp. Its vertical extensions were identified in the No. 306 drift, at the A-300-foot level, and in the Nos. 548, 678, 804, and 928 drifts.
2. The location of the downward extension of the No. 7 vein, east of the dike fault in the No. 211 drift east, at the A-200-foot level, which indicates excellent possibilities for both downward and eastward continuity.
3. Extending the ore on the nearly vertical No. 11 vein to the 800-foot level on the west side of the dike, and from the 100-foot level to the 300-foot level, east of the dike fault.
4. The location of the No. 921 drift vein east of the dike from its junction with the North branch of the South break, in the No. 1,031 stope upward to the No. 808 drift on the 800-foot level.
5. Locating ore on the North branch of the South break to the east of the dike, in the Nos. 1,031 and 1,099 drifts.

Production figures for 1935, compared with those of the year 1934, are:—

Year	Tons milled	Average ounces gold per ton	Ounces fine gold produced	Percentage mill recovery
1934	36,230	0.583	20,401	96.6
1935	35,360	.592	20,200	96.5

The estimated ore reserves broken and unbroken at December 31, 1934, were 60,550 tons, averaging 0.63 ounces gold per ton, and at December 31, 1935, were 82,650 tons, averaging 0.57 ounces gold per ton. This means that 57,460 tons of new ore, averaging 0.52 ounces gold per ton were found and opened up by the exploration and development of 1935.

Earnings for the year 1935, after deducting administration and taxes, but before deduction of $60,894.25 depreciation and depletion, were $280,118.32.

Tombill Gold Mines, Limited

Tombill Gold Mines, Limited, was incorporated in October, 1935, with an authorized capitalization of 1,000,000 shares of $1 par value. The officers and directors are: P. E. Hopkins, president; Fred Searls, Jr., first vice-president; D. E. Thomas, second vice-president; A. W. Burt, secretary; Carroll Searls, assistant secretary; Henry E. Dodge, treasurer; T. A. Johnson, H. D. Smith, W. R. G. Johnson, and C. R. Ellis, directors. The head office and mine office are at Empire. The executive office is at 171 Yonge Street, Toronto.

The property consists of a group of six claims in Lindsley township, district of Thunder Bay, located immediately to the west of the property of Bankfield Gold Mines, Limited, near Magnet lake.

The Newmont Mining Company of New York has optioned a minority interest in this company, under an agreement which gives them the management of the company.

Work was started in November, and by the end of 1935 a bunk-house, cookhouse, warehouse, blacksmith shop, and powder magazine had been erected. A vertical 3-compartment shaft had been sunk with hand-steel to a depth of 21 feet, and a headframe constructed. A mining plant, including a 60 h.p. locomotive-type boiler, a portable Diesel compressor, and an 8- by 6-inch Ingersoll-Rand double-drum hoist, was in transit to the property.

R. J. Hendricks was in charge.

Vimy Gold Mines, Limited

Vimy Gold Mines, Limited, owns 320 acres in Hislop township, district of Cochrane. The company is capitalized at 1,000,000 shares of $1 par value. The officers and directors are: Douglas Jones, president and manager; Joseph Berini, vice-president; Frank N. Bowes, secretary-treasurer; Nelson A. McDougall and J. A. Mongeon, directors. The head office is at Timmins, and the secretary's office is at 906 Excelsior Life Building, Toronto. The mine address is Ramore.

A 25-ton mill was installed on the property in 1935 and operated for a short time with ore from an open cut. A 2-compartment shaft, begun late in the fall, had reached a depth of 35 feet at the end of the year.

Joseph Berini was in charge of the work, employing about 20 men.

Wells Longlac Mines, Limited

Wells Longlac Mines, Limited, was incorporated in June, 1934, with an authorized capitalization of 3,000,000 shares of $1 par value. The officers and directors are: A. J. Felton, president; A. W. Burt, vice-president; F. E. Forster, secretary-treasurer; E. C. J. McCracken and Chas. Palmer, directors. The head office is at 347 Bay Street, Toronto.

The option which the company held on the Stagee property in the Mine Centre area was dropped at the end of February, 1935, after a total of 125 feet of drifting had been completed on the 100-foot level.

The property owned by the company consists of 15 claims in the Magnet Lake section of the Little Long Lac area, district of Thunder Bay. It is to the east of the Bankfield property.

During 1935 surface work and diamond-drilling were carried on at this property. During the year 4,062 feet of diamond-drilling was done, making a total of 24,641 feet accomplished to the end of 1935. No construction work was done, nor was any machinery installed during the year. The equipment of the company used at the Stagee property was brought to Kenwell, 3 miles from the Magnet Lake property, and stored there.

W. L. Brown was in charge of the work at the Magnet Lake property. The mine address is Geraldton.

Wendigo Gold Mines, Limited

Wendigo Gold Mines, Limited, was incorporated in October, 1933, with an authorized capitalization of 2,000,000 shares of $1 par value. The capitalization was increased to 3,000,000 shares in July, 1935. The officers and directors were: H. D. Tudor, president; H. G. Young, vice-president; H. R. Tudhope, secretary-treasurer; A. J. Bolton and W. G. Cameron, directors. The head office is at 701 Dominion Bank Building, Toronto.

The property of this company is located at Witch bay, on the Lake of the Woods, district of Kenora, and is 22 miles southeast of Kenora.

The mining plant installed included a 100 h.p. boiler, a 375-cubic-foot Ingersoll-Rand steam compressor, two 525-cubic-foot Ingersoll-Rand steam compressors, and an 8¼- by 10-inch Ingersoll-Rand hoist.

In 1935 underground work was carried on from the first of the year until the middle of February, during which period 341 feet of drifting and 66 feet of crosscutting was accomplished on the 500-foot level, and 1,855 feet of diamond-drilling from underground. Operations were not resumed until the middle of

December, when a start was made to take down backs on the 100-foot level in preparation for stoping.

At the end of September the construction of a 50-ton amalgamation-cyanidation mill was commenced, and at the end of the year it was expected that it would be completed and in operation in February, 1936.

The mill equipment includes a Dodge crusher, Allis-Chalmers ball mill, Dorr rake classifier, two blanket tables, two Dorr agitators, two Dorr thickeners, two Oliver filters, and a Merrill-Crowe precipitation unit. It is to be operated by a 264 h.p. Ruston Diesel engine, direct-coupled to a 219 k.v. a. generator.

An average of 31 men was employed during 1935, under the direction of C. L. Spencer. The mine address is Kenora.

West Red Lake Gold Mines, Limited

West Red Lake Gold Mines, Limited, is capitalized at 3,000,000 shares of $1 par value, of which 1,999,205 shares have been issued. The officers and directors of the company at December 31, 1935, were: F. J. Bailes, president; H. Hunter, secretary-treasurer; W. S. Hall, A. J. Doane, B. Johnston, and W. T. McEachern, directors. The head office is at 11 King Street West, Toronto.

The property consists of 27 claims in four groups located in the townships of Todd and Ball in the Pipestone Bay section of the Red Lake area, Kenora district, Patricia portion. The main group consists of 9 claims, totalling approximately 375 acres. The mining plant is on claim No. 10,057, approximately 21 miles west of the Howey gold mine.

Operations were resumed at this mine in July, 1935, after an eight months' period of idleness, during which period the company was reorganized. During July, the plant was reconditioned and the mine dewatered. Underground exploration work was carried on throughout August and most of September. During October some diamond-drilling was done from surface, but all operations were again suspended on October 27, 1935. During the four months' period when operations were carried on, an average of 16 men was employed, under the direction of C. H. E. Stewart.

The following figures show the amount of development work done at the property in the past two years:—

	1934	1935	Total
	feet	feet	feet
Shaft (vertical 2-compartment)	200	17	217
Crosscutting	95	49.7	144.7
Drifting, 200-foot level	280	347	627
	cu. ft.	cu. ft.	cu. ft.
Station-cutting	1,260	724	1,984

No additions were made to the plant or equipment during 1935.

Wright-Hargreaves Mines, Limited

Wright-Hargreaves Mines, Limited, has an authorized capital of 5,500,000 shares of no par value. The officers and directors of the company are: E. L. Miller, president and managing director; W. H. Wright, vice-president; P. H. Gerhard, secretary; Gerard F. Miller, treasurer; M. W. Summerhayes, general

manager; Oliver G. Donaldson and James Y. Murdoch, directors. The head office is at Fort Erie. The mine address is Kirkland Lake.

An average of 779 men was employed during 1935 at the mine in Teck township, district of Timiskaming.

The following is taken from the general manager's report for the fiscal year ending August 31, 1935:—

During this period 350,196 tons of ore were treated, containing 211,674 ounces fine gold and 31,716 ounces fine silver. There was realized from marketing this bullion, $6,844,539.20.

The average grade of the ore going to the mill at $20.67 per ounce was 0.625 ounces, or $12.919 per ton, with a recovery of 0.605 ounces, or $12.503 per ton, an extraction of 96.78 per cent.

ANALYSIS OF OPERATING COSTS

	Total	Cost per ton milled
Development, exploration, and pumping	$488,238.04	$1.394
Stoping	713,853.98	2.038
Transporting ore (hoisting, etc.)	260,997.94	.745
Milling charges	462,896.59	1.322
General surface charges	35,476.49	.101
Stock transfer, dividend, and annual report expense	13,632.13	.039
Employees' group insurance, silicosis, workmen's compensation, property taxes, and insurance	69,584.97	.199
General and undistributed charges (storehouse, hospital, maintenance miscellaneous mine buildings, mine management and administration, exchange, legal expenses, miscellaneous)	141,857.96	.405
Depreciation buildings and equipment	292,287.17	.835
Marketing bullion	23,148.06	.066
Mint bullion handling charge	21,375.92	.061
	$2,523,349.25	$7.205
Provision for taxes (exclusive of bullion tax)	470,000.00	1.342
Amount written off, shaft No. 4	85,299.62	.244
Total	$3,078,648.87	$8.791

PRODUCTION RECORD, 1921–1935
(Based on gold at $20.67 per ounce)

Year	Tons milled	Value per ton	Gross value	Recovery per ton	Bullion produced	Dividends
1921 (8 mos.)	36,081	$13.96	$503,302	$13.00	$468,665	.....
1922	66,181	12.49	827,447	11.52	762,752	$412,500
1923	79,242	10.48	830,992	9.52	754,978	206,250
1924	84,487	14.16	1,194,217	12.89	1,088,725	206,250
1925	147,939	14.49	2,148,554	12.93	1,913,401	550,000
1926	153,392	15.66	2,400,795	14.02	2,150,844	893,750
1927	209,164	11.77	2,455,460	10.51	2,151,916	1,237,500
1928	256,331	8.36	2,144,002	7.20	1,845,923	825,000
1929	188,238	10.29	1,938,552	9.25	1,741,872	.....
1930	220,430	12.20	2,687,828	11.03	2,431,896	275,000
1931	266,352	11.73	3,124,533	10.93	2,912,308	825,000
1932	295,525	12.85	3,796,295	12.00	3,546,903	1,100,000
1933 (8 mos.)[1]	193,441	13.56	2,623,456	12.63	2,443,760	550,000[2]
1934[3]	330,741	13.68	4,525,150	13.07	4,321,945	2,750,000
1935	350,196	12.92	4,524,193	12.50	4,378,326	3,300,000
Total	2,877,740	$12.41	$35,724,776	$11.44	$32,914,214	$13,131,250

[1]In 1933, the fiscal year closing changed from December 31 to August 31; the years 1921 to 1932, inclusive, are calendar years.

[2]April and July dividends only.

[3]The 12 months of the fiscal year ended August 31, 1934.

SUMMARY OF DEVELOPMENT AND EXPLORATION
August 31, 1935

	Drifting	Shaft-sinking	Cross-cutting	Raising	Total footage	Diamond-drilling	Excavation
	feet	feet	feet	feet	feet	feet	cu. ft.
August 31, 1934..	136,626	10,681	48,110	9,178	204,595	104,391	398,168
Fiscal year.....	20,483	535	3,892	1,298	26,208	16,801	85,384
August 31, 1935.	157,109	11,216	52,002	10,476	230,803	121,192	483,552

MILLING STATISTICS
September 1, 1934, to August 31, 1935

Ore milled	tons	350,196
Average value per ton		$12.919
Gross value	$4,524,193.19	
Loss in tailings	145,867.02	
Net value recovered		$4,378,326.17
Average tons milled per day		959.44
Per cent. of possible running time		95.94
Tons 100 per cent. running time		1,000
Solution precipitated	tons	1,369,884
Solution precipitated per ton of ore	tons	3.91
Value per ton in tailings		$0.417
Per cent. extraction		96.78
Cyanide consumed per ton of ore (K.C.N.)	lbs.	0.535
Zinc consumed per ton of ore	ounces	1.956
Zinc consumed per ton of solution	ounces	0.500
Lime consumed per ton of ore	lbs.	3.595
Steel consumed per ton of ore, ball mills	lbs.	2.685
Steel consumed per ton of ore, tube mills	lbs.	2.593
Cost of flotation reagents consumed per ton of ore		$0.048
Average value of pregnant solution per ton		$3.166
Average h.p. consumed per day		2,410
Average h.p. consumed per ton milled		2.513
Power cost per h.p. consumed		$55.43

N.B.—All values at $20.67 per ounce.

ORE RESERVES ESTIMATE

	Tons	Ounces	Grade	Value at $20.67 per ounce
On hand August 31, 1934	1,185,204	0.639	$13.20	$15,643,197
Developed in fiscal year	409,649	.507	10.48	4,292,223
	1,594,853	0.604	$12.50	$19,935,420
Milled in fiscal year	350,196	.625	12.92	4,524,193
Ore reserves, August 31, 1935	1,244,657	0.599	$12.38	$15,411,227

ADDITIONS TO PLANT, BUILDINGS, AND EQUIPMENT
September 1, 1934, to August 31, 1935

Mill structure and equipment	$20,754.67
Shops and equipment	4,279.28
Power-house and electrical equipment	53,422.88
Assay office	102.00
General surface and buildings	24,498.44
Sprinkler system	6,718.88
Tailings disposal	29,107.41
Underground equipment	7,449.54
Substation	2,427.37
New buildings	1,325.67
Offices	6,465.47
Total	$156,551.61

Development

The policy outlined in our report of 1933, to as soon as possible complete the development and mine out a number of the upper levels, with the object of reducing the maintenance cost of of having so many levels producing and, too, the need as deeper workings are opened up, to facilitate ventilation, has been rigorously followed. The results have been the finding of considerable new tonnages of ore of lower grade. At the present time we have 28 operating levels, none of which can yet be abandoned.

This programme together with the fact that the present developments are in the more easterly and westerly areas, where the ore occurrences are more scattered and of somewhat lower grade, has resulted in the percentage of ore developed and the grade of ore found being lower. There were 409,649 tons of new ore developed, and after deducting 350,196 tons milled, 59,453 tons were added to ore reserves. Of the 20,483 feet of drifting, 7,654 feet was on ore.

The preparations for sinking an interior shaft to open up the mine below the 3,900-foot level, as outlined in our last report, were completed, and the sinking of this shaft is now actively being carried out. There were 535 feet of shaft work done during the year, all in the new interior shaft, 290 feet above the 3,900-foot level and 245 feet below that level. At the present writing the depth of this shaft is 4,300 feet.

Milling

It is satisfactory to note that the per cent. extraction is considerably better than our pilot mill work indicated, and while the extraction for the whole period under review is 96.78 per cent., the extraction for the last quarter was 97.04 per cent.

General

The trouble which existed in the refining of our precipitates, and referred to in our last report, has been completely overcome and our new process is enabling us to check satisfactorily with the Mint, the difference in assays during the twelve months' period being only 0.013 per cent.

Young-Davidson Mines, Limited

The officers and directors of Young-Davidson Mines, Limited, are: Gideon Grant, president; C. G. Knott, vice-president; F. M. McKay, secretary-treasurer; Jacob A. Davidson, W. C. Young, Roy Driscoll, directors. The capitalization is $3,000,000, in shares of $1 par value.

The company owns a property in Powell township, district of Timiskaming, which is being operated under agreement by the Hollinger Consolidated Gold Mines, Limited. An account of the work done on the property appears on page 115 of this report. The mine address is Elk Lake.

Young-Shannon Gold Mines, Limited

Young-Shannon Gold Mines, Limited, was incorporated in 1932, with an authorized capitalization of 3,000,000 shares of no par value. The officers and directors are: C. T. Young, president; S. J. Defoe, secretary; W. C. Huff, treasurer; and A. J. Bolton, director. The head office is at 1 Toronto Street, Toronto. The mine office is at Gogama.

The property includes a group of claims at Clam lake on the west boundary of Chester township, district of Sudbury. Work was suspended at this property in February, 1935, after a 2-compartment vertical shaft had been sunk to a depth of 100 feet, and 100 feet of lateral work done at that depth.

Work was then transferred to the property of the Martin Syndicate, consisting of a group of 25 claims at the north end of Three Duck lakes in Chester township, west of and adjoining the Gomak property. During the balance of the year about 600 feet of diamond-drilling was done, as well as surface trenching and pitting. Operations were carried on under a percentage of profits agreement.

An average of 4 men was employed during 1935, under the direction of C. T. Young.

GRAPHITE

Black Donald Graphite Company, Limited

The officers of the Black Donald Graphite Company, Limited, are: R. F. Bunting, president and manager; W. B. Bunting, vice-president; R. A. Telfer, secretary-treasurer.

The mine and refinery in Brougham township, Renfrew county, operated almost continuously during 1935. Graphite to the value of $78,500 was produced.

An average of 9 men was employed in the mine, and 25 in the refinery. The mine address is Calabogie.

GYPSUM

Canadian Gypsum Company, Limited

The Canadian Gypsum Company, Limited, has a capitalization of $300,000, divided into 3,000 shares of $100 par value. The officers and directors of the company are: S. L. Avery, president; R. G. Bear, secretary-treasurer; O. M. Knode, C. F. Henning, Otis Wack, and J. E. MacLeish, directors. The head office is at 1221 Bay Street, Toronto. The head office officials are: B. S. Barns, agent and comptroller, and F. B. Gibbs, manager. Otis Wack, Windsor, N.S., is director of operations.

The company operates a gypsum mine and plant near Hagersville, in Oneida township, Haldimand county. All commercial gypsum products are produced at the plant, which includes a mill, wall board and block manufacturing buildings. During 1935 some 19,569 tons of rock were hoisted. An average of 53 men was employed. W. E. Allen, Hagersville, is superintendent.

The company also operates a quarry and lime plant at Guelph; a large gypsum quarry at Windsor, N.S.; a gypsum mill at Hillsborough, N.B.; a gypsum calcining mill at Iona, Cape Breton; and a winter gypsum storage depot at Deep Brook, N.S.

Associated with the company is the Gypsum Packet Company, Limited, operating four 7,000-ton freight and passenger steamers between Nova Scotia and United States ports.

Gypsum, Lime and Alabastine, Canada, Limited

Gypsum, Lime and Alabastine, Canada, Limited, has a capitalization of 2,000,000 shares of no par value. The officers are: R. E. Haire, president and manager; S. H. J. Reid, secretary-treasurer; W. E. Armstrong, Henry Cockshutt, H. J. Haire, Jas. R. Inksater, G. H. Kranenberg, J. E. McConnell, R. S. McCurdy, N. L. Nathanson, W. C. Pitfield, and John F. Cameron, directors. The head office is at Paris, Ont.

The mine and mill at Caledonia, Seneca township, Haldimand county, was operated throughout the year. L. V. Robinson was superintendent, employing an average of 92 men.

There were hoisted 28,461 tons of rock. Of this, some 2,716 tons of crushed and fine-ground gypsum were sold, and the rest was manufactured into land-plaster, stucco, Paristone, Gyproc, dry Insulex, gypsum lath, and other building products.

In addition to the Caledonia mine, the company operates gypsum plants at Montreal, Winnipeg, Vancouver, and Calgary.

Lime plants are situated at Beachville, Elora, Hespeler, Milton, Limehouse, and Puslinch, Ont., and at St. Mark and Joliette, Que.

Quarries are operated at Mabou, N.S.; Gypsumville, Man.; and Salmon River, B.C. The alabastine plant is at Paris, Ont.

MOLYBDENITE

Phoenix Molybdenite Corporation, Limited

The Phoenix Molybdenite Corporation, Limited, has a capitalization of 1,000,000 shares of $1 par value, of which 700,000 are issued. The property is in Bagot township, Renfrew county. The officers and directors are: F. L. Stinson, president and manager; E. A. Dempster, vice-president; W. G. Chipp, secretary-treasurer; Geo. Joynt and John Thomson, directors. The head office is at 710 Excelsior Life Building, Toronto. Work was started on May 17, 1935, and continued to the end of the year with an average force of 15 men. The mine address is Ashdad.

The following work was done during the year: drifting, 631 feet; cross-cutting, 422 feet; shaft-sinking, 65 feet; station, 12 by 12 by 12 feet; ore hoisted, 976 tons; waste hoisted, 2,974 tons.

NICKEL AND COPPER

Cuniptau Mines, Limited

Cuniptau Mines, Limited, has an authorized capital of 3,000,000 shares of $1 par value, of which 2,500,000 shares have been issued. The property consists of 62 claims in Strathy township, district of Nipissing.

The officers of the company are: B. W. Watkins, president; A. L. Herbert, vice-president; W. G. Watkins, secretary-treasurer; Gordon McLaughlin and Ian MacLaren, directors. The Mining Research Corporation are consulting engineers. Geo. M. Lee is mine manager. The mine address is Goward. The head office is at 465 Bay Street, Toronto.

In January, 1935, a small quantity of ore was tested in the 50-ton blast furnace. During the rest of the year operations were confined to surface exploration, with an average force of 10 men.

In November funds were raised by the sale of treasury stock to enable the purchase of concentrating and converter equipment, and to carry on further underground work.

Falconbridge Nickel Mines, Limited

The officers and directors of Falconbridge Nickel Mines, Limited, are: Thayer Lindsley, president; N. F. Parkinson, secretary-treasurer; Halstead Lindsley and J. G. Hardy, vice-presidents; W. S. Morlock, director. The authorized capital is 5,000,000 shares of no par value. The head office is at 25 King Street West, Toronto.

The company operates a nickel-copper mine, concentrator, and smelter in Sudbury district, and a refinery at Kristiansand, Norway. Ernest Craig is general superintendent of operations in the Sudbury district; J. R. Gill, assistant general superintendent; E. J. Martin, mine superintendent; R. C. Mott, concentrator superintendent; and M. J. Tamplin, smelter superintendent. During

1935 an average of 567 men was employed, of whom 185 were underground. The mine address is Falconbridge.

The following is an extract from the annual report of the company for the year ending December 31, 1935:—

As heretofore, interruptions to continuous operation were due entirely to necessary periodic repair campaigns in the single-unit smelting plant.

Mine Development

Development footages attained during the year, and combined over all levels, distribute as tabulated below:—

Drifting and crosscutting (including slashing)	feet	5,708
Raising (including slashing)	feet	1,813
Ore passes (including slashing)	feet	869
Fill passes (including slashing)	feet	416
Box-holes		6
Diamond-drilling	feet	4,805
Station-cutting	cu. ft.	47,389
Loading station	cu. ft.	7,620
Shaft-sinking	feet	856

Practically all lateral work along the ore zone was confined to the 500- and 1,200-foot levels. On the former, an advance of 986 feet was made easterly in ore averaging 15.1 feet in width, though of slightly below mine average grade. This drive continues in ore at 1,600 feet from No. 5 shaft. On the 1,200-foot level, 153 feet and 807 feet were driven east and west, respectively, from No. 5 shaft in ore of mine average grade, with a mean width of 12.5 feet. Both these faces continue in ore.

No. 5 shaft was deepened 856 feet to a point slightly below the 1,400-foot level. Stations were established on the 200-, 325-, 1,200-, and 1,400-foot levels, and a loading station commenced at 1,350 feet. Stations for three levels between the 500- and 1,200-foot horizons are yet to be taken out. As the 1,200-foot level is a main haulageway, considerable work was carried out in anticipation of the large tonnage to be handled. A pump sump of sufficient size to accommodate a large volume of water is being excavated.

Steps were taken during the year to abandon the shrinkage method of mining and adopt the cut-and-fill system, with the conversion of active shrinkage stopes to the new practice. In preparation for this, as well as to back-fill the old stopes as they are emptied, a fill pass system was established near No. 1 shaft and two further series of passes were commenced, one located west of No. 1 shaft and the other east of No. 5 shaft. Ore passes were completed from the 350- to the 750-foot levels. At present, cut-and-fill stopes are yielding 25 per cent. of the ore hoisted, and this figure will be increased as the shrinkage reserves are drawn.

Ore Reserves

Ore reserves, computed as at December 31, 1935, are tabulated hereunder:—

	Tons
Ore reserves as at December 31, 1934	2,960,238
Plus new ore added 1935	1,436,780
Total	4,397,018
Less: drawn during 1935	337,543
Total ore reserves (averaging 1.93 per cent. nickel and 0.91 per cent. copper), December 31, 1935	4,059,475

Mining

The results of mining activities during the year are set out in the following table:—

Broken Ore in Stopes

	Tons
Balance December 31, 1934	509,742
Broken during 1935	170,196
Total	679,938
Less: hoisted from stopes during 1935	292,601
Broken ore reserves December 31, 1935	387,337

ORE HOISTED

From stopes, 1935	292,601
From development, 1935	25,781
From concentrating dump, 1935	16,762
From development dump, 1935	2,399
Total ore to crushing plant, 1935	337,543

Crushing, Sorting, and Transportation

From 337,543 tons of ore delivered to the crushing plant, 35,206 tons, or 10.4 per cent., of waste was eliminated by sorting. The balance, amounting to 302,337 tons, was transported over the aerial tramway to the treatment plant bins.

Smelter

The reduction plant was in operation 346.93 days, or 95.3 per cent., of possible time. That the plant is being burdened beyond its limit is reflected in higher metallurgical losses as the result of slightly increased production.

Results of operation tabulate as below:—

	Short tons
Total ore treated	302,510
Matte produced	10,029.50
Nickel in matte produced	5,651.55
Copper in matte produced	2,597.26
Metals per ton of ore:	Pounds
Nickel	40.97
Copper	19.71
Metallurgical losses per ton of ore:	
Nickel	3.43
Copper	2.54

Construction

An extensive construction programme at No. 5 shaft embraced the erection of a steel headframe, power-house with hoisting and compressor equipment, change-house with office accommodation for the mine staff, carpenter shop, combined drill-steel and repair shop, central heating plant and substation. All buildings are of steel and concrete-block construction with fireproof roofing. A substation was also erected at the property by the Hydro-Electric Power Commission, and 25-cycle power at 26,400 volts was being delivered before the end of the year. Standard-gauge track to the extent of almost 1½ miles was laid during the year to tie in the future ore and backfill handling system. Additional grinding, flotation, and thickening equipment was added in the concentrator.

Housing facilities were further increased by the erection of a number of dwellings. In addition, a spacious community hall was built for the use of employees and their families.

Refinery

The refinery, which is located in Norway, operated very steadily throughout the year, keeping in step with the somewhat increased matte production. A certain amount of additions and alterations took place, which raised the total capacity of the plant, including capacity for custom matte, to 7,000 short tons of nickel annually, at which rate it occasionally operated.

Custom matte was received regularly at a rate of 1,000 long tons of nickel annually. The plant for separation of precious metals started delivery of gold, silver, platinum, and palladium. The quality was found satisfactory, and the marketing took place without difficulty. The quality of the nickel and copper was maintained to the satisfaction of the market at the high quality previously set.

For the year 1935, the amount of metals in matte received from the smelter, the refinery production, the metals in process, and metals in matte on hand at the end of the year is set out in the following table:—

	Nickel	Copper
	lbs.	lbs.
Metals in Falconbridge matte received, less refining losses	10,421,850	4,768,704
Produced in marketable form during the year	10,753,756	5,029,525
Metals in process of refining at end of year	2,260,586	427,043
Metals in matte on hand at end of year	715,864	319,041

Marketing

This key factor in our business was favourable during the year and reached a peak in the third quarter. European exchange difficulties, of course, had their effect, as did the observance lately of "sanctions." At that, sales of nickel totalled 10,829,865 pounds and of copper 5,129,483 pounds, which closely parallels our year's production, and closed the year with little change in stocks. These continue to be lower than we would like to see, but should be reinforced by the steps now taken to increase production by the end of 1936. Forward bookings for 1936 deliveries are again higher than in prior years.

International Nickel Company of Canada, Limited

The authorized capital of the International Nickel Company of Canada, Limited, consists of $27,679,900 of preferred shares of $100 and $5 par value, and 15,000,000 shares of common stock of no par value.

The officers are: Charles Hayden, chairman of the board; Robert C. Stanley, president; John F. Thompson, vice-president; Paul D. Merica and John C. Nicholls, assistants to the president; James L. Ashley, secretary-treasurer.

The directors whose term expires in 1936 are: John P. Bickell, Hon. H. Cockshutt, Wm. N. Cromwell, D. Owen Evans, Sir Harry McGowan, R. H. McMaster, Wm. W. Mein, Rt. Hon. Lord Melchett, Paul D. Merica, Sir Robert Mond, Thomas Morrison, Seward Prosser, and Grant B. Shipley.

The directors whose term expires in 1937 are: James L. Ashley, John F. Dulles, Reg. Halladay, Charles Hayden, J. W. McConnell, R. S. McLaughlin, Britton Osler, J. A. Richardson, Robt. C. Stanley, Andrew V. Stout, John F. Thompson, and Rt. Hon. Lord Weir of Eastwood.

The executive office is at 67 Wall Street, New York, N.Y., and the general offices are at Copper Cliff, Ont.

This company and subsidiary companies operate hydro-electric power plants at High Falls, Big Eddy, Wabageshik, and Nairn Falls, Ont.; nickel-copper mines in Sudbury district, Ont.; smelters at Copper Cliff and Coniston, Ont.; refineries at Copper Cliff and Port Colborne, Ont., Acton, England, and Clydach, Wales; rolling mills at Birmingham, England, Huntington, W. Va., and Glasgow, Scotland; a colliery at Pontardawe, Wales; and a foundry at Bayonne, N.J.

The following information is extracted from the annual report of the company covering the year ending December 31, 1935:—

General

The progressive improvement in your company's business, which started in May, 1932, continued throughout 1935. Total sales of nickel were in excess of those recorded during 1929, which formerly was the peak year in the history of the nickel industry, and consumption was well diversified geographically and industrially. New sales records were achieved, not alone for nickel but for copper and the platinum metals as well.

During the year operations at mines and plants were conducted without interruption, and output was increased in order to meet the growing demand for your company's products. As a result of these activities pay-rolls increased in all plants, and unemployment was reduced in Sudbury district as well as in the town of Port Colborne, where your Canadian nickel refinery is located.

Attention is called to the redemption of outstanding debentures and to the acquisition of the minority interest in the Ontario Refining Company, Limited. The former transaction, by eliminating all funded debt, leaves your company and its subsidiaries in an entirely unencumbered financial position; and the latter gives your company full ownership in the copper-refining enterprise which was organized in 1929 primarily to refine your company's copper.

A net profit of $26,086,527.47 was realized after all charges, including provision for taxes, depreciation, mine depletion, and other purposes. After payment of preferred dividends of $1,933,898.75, there remained $24,152,628.72, or $1.65 per share of common stock. Cash on hand of $30,473,311.32 indicates a strong financial position, which is now more than ever necessary to assure at all times adequate production facilities and a continuation of aggressive market development to meet the exigencies of expanding business.

There follows a classified digest of essential facts concerning your company's varied activities during the year under review.

Sales

Your company's sales of nickel in all forms, including nickel in alloys, amounted to 129,850,207 pounds, comparable with 91,459,554 pounds in 1934, an increase of 42 per cent. Sales of nickel in products of the Port Colborne and Clydach refineries amounted to 105,620,318 pounds, comparable with 73,964,621 pounds in 1934, an increase of 43 per cent. Sales of nickel in products of the Copper Cliff smelter amounted to 4,085,570 pounds, comparable with 1,357,008 pounds. Sales of nickel in products of the rolling mills at Birmingham, Glasgow, and Huntington, and of the foundry at Bayonne, totalled 20,144,319 pounds, comparable with 16,137,925 pounds, an increase of 25 per cent.

Sales of Monel metal, a nickel alloy made direct from Creighton ore, totalled 13,411,624 pounds, comparable with 10,763,821 pounds in 1934, an increase of 25 per cent.; sales of pure rolled nickel were 9,339, 595 pounds, comparable with 7,469,914 pounds, an increase of 25 per cent., and sales of Inconel increased from 428,605 pounds to 609,632 pounds, or 42 per cent.

Sales of copper increased from 194,870,682 pounds in 1934 to 233,009,392 pounds, or 20 per cent.

Gold sales were 69,944 ounces, comparable with 74,375 ounces in 1934; silver sales were 3,160,222 ounces, comparable with 1,006,808 ounces; and sales of the platinum metals were 128,874 ounces, comparable with 124,424 ounces. Sales of selenium were 72,616 pounds, comparable with 73,516 pounds in 1934; and sales of tellurium increased from 1,110 pounds to 9,987 pounds.

Mines

During 1935 a total of 3,382,409 tons of ore was mined and shipped to the smelters at Copper Cliff and Coniston. All of this ore was extracted from the Frood and Creighton properties, which were operated continuously throughout the year. The Frood mine furnished 2,875,599 tons, and the Creighton mine 506,810 tons.

Development work in the Frood was carried on at a rate to conform to ore requirements. The advance of shafts, drifts, and crosscuts, raises, winzes, and box-holes for the year was 16,012 feet, bringing the total development footage in this mine to 183,211. There are now available for production 103 stopes and 16 pillar stopes, having respectively a daily capacity of 125 tons and 55 tons each.

In the Creighton mine development work was advanced 9,200 feet. Good progress was made in shaft-sinking and surface-plant construction. It is expected that this undertaking will be completed during the current year and that ore from this development will be available in 1937. The new shaft, 16 feet by 28 feet in cross-section, is being sunk to a depth of 4,200 feet and will be served by a hoist capable of handling 4,000 tons of ore per day.

By replacing mild steel skips with lighter skips made from nickel steel, the hoisting capacity at the Frood and Creighton mines has been increased approximately 15 per cent.

Smelters

The concentrator treated 2,584,666 tons of ore, the largest tonnage handled since this plant was built. Further improvements in metallurgy were effected, and from the standpoint of efficiencies and recoveries results were the most gratifying thus far attained. Milling was increased to 8,000 tons per day, and it is planned to expand capacity to 11,000 tons per day during the current year. Results have further shown the value of research experimentation, and work of this character will be intensified when the new research laboratory is completed.

At the Copper Cliff smelter there were produced 118,016 tons of bessemer matte and 121,574 tons of blister copper. All of the reverberatory furnaces, five in number, and all twelve converters, were in use from February until the end of the year. Operating results were satisfactory in respect to tonnage of ore smelted, fuel consumption, and slag losses. The Orford process department was operated throughout the year with improvement in costs, partly due to the increased tonnage of bessemer matte consumed.

The Coniston smelter, with the exception of the month of July, ran continuously with four blast furnaces and five converters in operation. Ore to the amount of 790,351 tons was processed, and 54,248 tons of bessemer matte produced. Plant practice was efficient as reflected in the higher percentage recovery of metal from ore smelted.

Hydro-Electric Plants

Your company's hydro-electric power plants are in good condition, and the capital expenditures thereon during the year were comparatively small. All of the plants are fully equipped and were operated throughout the year to the extent of the available water supply. Power purchases from the Hydro-Electric Power Commission of Ontario, including the requirements of the Port Colborne nickel refinery, totalled $759,906.07.

Refineries

Port Colborne Nickel Refinery.—Increased demand for nickel necessitated operating the electrolytic plant at capacity for the first time since additional units were installed in 1929. The year began with six circuits in service, to which were added during the year the three reserve circuits, this bringing the refinery to maximum output. There was produced 80,381,532 pounds

of nickel in all forms. Continuous research and experimentation have resulted in many minor process improvements through which improved quality of product and lower costs have been attained.

Ontario Refining Company, Limited.—There was a substantial increase in the tonnage of blister copper treated at this refinery, and plant output and copper shipments increased correspondingly. Refined copper production was 109,966 tons, comparable with 95,558 tons in 1934. Shipments of refined copper were 107,032 tons, comparable with 97,292 tons in 1934.

A new selenium plant was completed and put into operation in March, 1935, thus enabling your company to produce a substantially larger quantity of this metal. In order to eliminate silver losses and to further increase recovery of selenium a Cottrell electrical precipitator was installed and has shown satisfactory results. A plant to produce "single" and "double" nickel salts for the Canadian market was authorized in 1935 and is now completed and in operation.

An electric furnace installation for producing high-quality copper wire-bars and other shapes, authorized in 1935, will be put in operation during the current year. Research work was continued in all departments. Many improvements have resulted, and in consequence cost has been lowered and quality bettered.

Your company purchased for $1,175,000 the 10 per cent. minority capital stock of the Ontario Refining Company, Limited, and the latter is now a wholly owned subsidiary.

Ore Reserves

Proved ore reserves at December 31, 1935, were 205,590,592 tons. Additional ore proved during the year amounted to 4,573,538 tons.

Outlook

International use of nickel for industrial purposes is essentially dependent upon assured source of supply, prompt deliveries, and price schedules advantageous to consumer and producer alike. Furthermore, it is necessary at all times, while avoiding undue expansion, to maintain reserve productive capacity and adequate stocks of metal. In furtherance of this policy your plants in Canada and Great Britain are being enlarged with due regard to balanced operations from mine to market.

Sales and development activities, now world-wide in scope, have been augmented as new uses for your metals have been found. The potential field of application for nickel is extensive and in a large measure still unexplored.

The trend of consumption has been upward for nearly four years and more nickel is being used currently than ever before. It is not unreasonable to assume that with a continuation of your company's established methods this upward trend will continue as world trade improves.

Employees

The total number of employees at the year end was 12,452, distributed as follows: Canada 8,117, Great Britain 2,990, United States 1,293, other countries 52. Employees on December 31, 1934, numbered 9,154. The increase, amounting to 36 per cent., was due to the increased scale of operations and to the construction work in progress in Canada and Great Britain.

During 1935 an average of 1,894 men was employed at Copper Cliff, 456 at Coniston, 2,243 at Frood, and 883 at Creighton. Of these, an average of 1,835 was employed underground at Frood, and 552 at Creighton.

Donald MacAskill is general manager; R. D. Parker, general superintendent; H. J. Mutz, superintendent of mines; S. J. Kidder, superintendent of the Creighton mine; F. J. Eager, superintendent of the Frood mine.

Van Nickel Mines, Limited

In January, 1935, the name of Delta Metals, Limited, was changed to Van Nickel Mines, Limited. It has an authorized capitalization of 4,000,000 shares of $1 par value. Wm. Spears is president, and Dr. W. R. Naylor, vice-president. The head office is at 43 Victoria Street, Toronto.

In March work was started on the property of the Delta Mines Syndicate, located about 5 miles northwest of Worthington in Drury township, district of Sudbury.

In August a 2-compartment vertical shaft was started. Sinking was suspended at the end of September at a depth of 65 feet, and surface work done for the balance of the year.

The plant installed included a 55 h.p. boiler, an 8- by 10-inch steam hoist, and a 200-cubic-foot compressor, which was replaced by a 1,000-cubic-foot compressor after sinking was suspended. Buildings erected included a power-house, magazine, and cap-house. A bunk-house, cookery, office, blacksmith shop, and assay office had been erected in previous years.

An average of 12 men was employed during the year, under the direction of W. F. Taylor. The mine address is Worthington.

PEAT

Caledon Peat Company

A few miles south of Orangeville, in lot 27, concession I, Caledon township, Peel county, the Caledon Peat Company produced from 100 to 150 tons of peat fuel, which sold at approximately $10.00 per ton. The work was done under the direction of C. H. Burbridge and J. Pollock, Brampton.

The deposit is quite small, only 3 to 4 acres. The peat ranges from 4 to 5 feet in thickness with a few inches of humus and grass covering it. The actual operation consisted in cutting the peat out in blocks and spreading it on the ground to dry.

In quality the peat fuel is fairly good, having a low ash and good heating content. The operation ceased in the fall of 1935.

H. L. Hodgkins and Son

At a peat operation near the Forks Road, 5 miles from the village of Wainfleet, Wainfleet township, Welland county, 75 tons of peat fuel was produced and sold in the neighbouring towns. The fuel sold for $7.00 per ton at the bog, and $8.00 per ton delivered. The operators are H. L. Hodgkins and Son, R.R. 2., St. Ann's.

The peat is about 5½ feet thick. The upper 1½ feet is a mossy peat, which is sold to the nurseries for packing trees and shrubs; the lower 4 feet is a fair quality peat, rather high in ash.

The raw peat is processed in a manner similar to the Leasa operation near Stratford. The raw material is fed into a rebuilt clay pug mill, mixed, caught on drying racks, and placed in the open to dry. In all, about 7 men were employed for the greater part of the summer months.

Wm. Leasa

The largest peat operation in the province for the past year is located in lot 11, concession X, Ellice township, county of Perth, some seven miles north of Stratford. The operator is Wm. Leasa, Milverton.

The deposit is 1,200 acres in size. The area is wooded around the margin with small poplar, and in the centre, grasses and small shrubs are abundant. The thickness of peat utilized for peat fuel is only one foot.

The peat fuel is prepared by passing the raw peat through a clay pug mill, in which the peat is mixed to a soft plastic pulp. By means of a force feed the soft pulped peat is extruded from shaping mouthpieces on to drying racks. When only partially dry, the peat blocks are taken off the racks and placed in a drying shed.

During the summer of 1935 between 550 and 800 tons of peat fuel was produced and sold at $7.00 per ton, delivered. The quality of the fuel is fairly good, having a high heating content, but also high in ash.

Northern Peat Company

The Northern Peat Company, under the direction of W. B. Brewer, Timmins, produced and sold in Timmins 100 to 150 tons of machine-made peat fuel at approximately $9.75 per ton delivered, or 18 cents per bushel.

The deposit is located 5½ miles west of Timmins in lot 8, concession III, Mountjoy township, district of Cochrane, and is estimated to contain at least 100,000 tons of peat. The thickness varies from a few inches at the margins to over 20 feet in the central zone.

In much the same manner as the Leasa and Hodgkins peat operations, raw peat is cut and broken down by knives rotating in opposite directions. The pulped peat then passes through extruders on to racks and is dried.

During 1936 the operator will try out new methods of handling both the raw and pulped peat. Handling of the raw peat is a very important factor, since seven to nine tons of raw peat are required to make one ton of salable peat fuel.

G. Runke and Sons

G. Runke and Sons, 115 Cameron Street, Kitchener, produced and sold about 115 tons of peat fuel from a small bog, 20 acres in extent, situated in the upper part of the German tract, lot 55, Waterloo township, Waterloo county. The fuel sold readily in Kitchener, and according to the operators many times the quantity produced in 1935 can be sold in the area surrounding the deposit.

The thickness of peat that is used for peat fuel runs from 1½ feet to 2 feet. Approximately 8 inches of moss, covered by grass and small shrubs, overlies the peat. The quality is excellent, being low in ash and high in heating value.

The processing is carried on with a rebuilt brick press, which produces a very solid peat fuel, which sells at $7.00 per ton, delivered in Kitchener.

From 7 to 10 men were employed for the greater part of the summer.

RADIUM

Canada Radium Mines, Limited

Canada Radium Mines, Limited, has a capitalization of 2,500,000 shares of no par value, of which 1,561,037 shares have been issued. The property consists of 750 acres in Cardiff township, Haliburton county. The officers and directors are: K. W. Wright, president; I. L. Fletcher, secretary-treasurer; Frank Austin, managing director; A. Arthur, Geo. F. McCandless, E. W. Austin, and John G. Cole, directors. H. L. McClelland is consulting engineer. The head office is at 244 Bay Street, Toronto. The mine address is Cheddar.

The shaft has been sunk to a depth of 388 feet, with levels at 125, 250, and 365 feet. Approximately 1,200 feet of lateral work has been done.

About 15 men are employed at the mine.

SILVER AND COBALT

Bellorain Mines, Limited

Bellorain Mines, Limited, has an authorized capitalization of 1,000,000 shares of no par value. M. Lebovitz, Cobalt, is president; and Max Kaplan, Kirkland Lake, is secretary-treasurer. The address is Box 206, Cobalt.

The company acquired the old Bellellen property in South Lorrain township, district of Timiskaming. Previous operators had sunk a shaft to a depth of 400 feet and done considerable lateral work.

The present owners operated from July 15 to November 10, 1935, employing an average of 24 men. Some 77 feet of diamond-drilling was done; ore hoisted amounted to 39.5 tons; and shipments of ore, having a value of $1,687 in silver and $3,067 in cobalt, were made.

Cobalt Properties, Limited

Cobalt Properties, Limited, is capitalized at $25,000, in shares of $1 par value. The officers are: Ambrose Murphy, president; Arthur Brocklebank, managing director; T. Wainwright, vice-president; H. E. Tomney, secretary-treasurer; Agnes Reid, director. The head office is at Cobalt.

The company owns the following properties in the township of Coleman, district of Timiskaming: Coniagas, Mining Corporation, Right of Way, McKinley-Darragh-Savage, and Cobalt Townsite.

During the year 74 feet of drifting was done and 854 tons of ore were hoisted, from which 279,414 ounces of silver were produced. An average of 72 men was employed.

Cobnor Silver Mines, Limited

Cobnor Silver Mines, Limited, owns one claim of 40 acres in the township of Bucke, district of Timiskaming. The company is capitalized at 750,000 shares of no par value. The officers and directors are: M. King, president; Norman D. Johnston, vice-president; C. B. Munday, secretary-treasurer; Percy Luscombe, managing director; Edmund Eaves and Edward Smith, directors. H. F. Fancy is mine manager. An average of 20 men is employed.

The property was reopened on September 9, 1935, and the following work was done to the end of the year: drifting, 485 feet; crosscutting, 20 feet; ore hoisted, 900 tons; waste hoisted, 900 tons. About 20 tons of cobalt ore was shipped. The mine address is Cobalt.

Comet Leasing Company

Jas. H. Price and Bruce Williams, of Kirkland Lake, leased the Drummond mine in Coleman township, district of Timiskaming, under the name of the Comet Leasing Company.

Two men were employed throughout the year. Shipments totalling 23,010 ounces of silver, valued at $14,862, were made.

Dean and Downey

J. C. Dean and Ralph Downey, of Cobalt, leased the surface at the Wettlaufer mine in South Lorrain township, district of Timiskaming, and employed 3 men from April 24 to September 24 in picking over the dumps.

From 135 tons of ore shipped, a recovery of 6,538 ounces of silver, valued at $4,309.00, was obtained.

Hudson Bay Mines, Limited

The property owned by Hudson Bay Mines, Limited, in Coleman township, district of Timiskaming, was leased to several operators during 1935.

Shipments of ore yielded a total of 1,527 ounces of silver, valued at $774. The company's address is Box 700, New Liskeard.

George Martin

The Crown Reserve mine in Coleman township, district of Timiskaming, was leased to George Martin, of Cobalt.

Three men were employed from May 1 to December 31 sorting ore from the dumps, and 4 men were employed in the mill from June to October.

Shipments amounting to 10,551 ounces of silver, valued at $6,208, were made.

H. G. Miller

H. G. Miller, Silver Centre, leased the dumps on the Canadian Lorrain property, in South Lorrain township, district of Timiskaming, and employed three men during part of October and November picking over the rock in the dumps. A recovery of 812 ounces of silver, valued at $357, was obtained from 16 tons of ore shipped.

Mr. Miller also leased the Keeley mine in South Lorrain township and employed four men from May to November to pick over the dumps. Shipments from this property yielded 2,412 ounces of silver, having a value of $1,226.

A. G. Morgenthalor

A. G. Morgenthalor, 2108 South Second Street, Philadelphia, Pa., acquired the old Beaver mine in Coleman township, district of Timiskaming. The property was operated throughout the year, with an average force of 8 men.

Development work amounted to 112 feet of winze-sinking, 180 feet of drifting, and 30 feet of crosscutting. About 305 tons of ore were hoisted, which yielded 51,771 ounces of silver, valued at $31,770.

Morrison Mines, Limited

Morrison Mines, Limited, has a capitalization of $3,000,000, in shares of $1 par value. The officers and directors are: Horace F. Strong, president and manager; H. D. Fripp, vice-president; Jas. F. Cunningham, secretary-treasurer; W. W. Robinson and Jos. Montgomery, directors. The head office is at 165 Sparks Street, Ottawa.

The property consists of two claims, T.C. 204 and 205, in Nicol township, district of Timiskaming.

Operations at the mine were resumed in June, 1935, after a period of idleness since December, 1930. The shaft was sunk an additional 162 feet, and new levels were established at 500 and 575 feet. The following table shows the work done on these levels:—

	500-foot level	575-foot level
	feet	feet
Drifting	192	44
Crosscutting	120	86
Raising	66	.....

About 700 tons of ore and 3,800 tons of waste rock were hoisted. Production amounted to 28,526 ounces of silver.

An office and an addition to the shaft-house were built. Operations ceased at the end of the year, during which an average of 18 men was employed.

Mosher, Richardson, and Lafrange

I. E. Mosher and associates, of Cobalt, leased the Buffalo mine in Coleman township, district of Timiskaming, and made a clean-up of the mill from June 10 to October 12, 1935.

Some 46 tons of residues and precipitates, having a silver content of 5,597 ounces, valued at $3,582, were sold to Noranda Mines, Limited.

Nipissing Mining Company, Limited

Nipissing Mines Company, Limited, has a capital of 1,200,000 shares of $5 par value. The directors of the company are: E. P. Earle, president and treasurer; Alexander Fasken, vice-president and secretary; Richard T. Greene, Dr. F. R. Bennetto, C. W. Nichols, Halstead Lindsley, and Hugh Park, directors. The head office is at the Excelsior Life Building, Toronto, and the New York office is at 165 Broadway.

The operating company is the Nipissing Mining Company, Limited, with a capital of 2,500 shares of $100 par value. The officers and directors of the company are: Alexander Fasken, president and secretary; E. P. Earle, vice-president and treasurer; Richard T. Greene, C. W. Nichols, Dr. F. R. Bennetto, Halstead Lindsley, and Hugh Park, directors. Hugh Park, Cobalt, is general manager.

Mining operations at the property in Coleman township, district of Timiskaming, consisted principally of the extraction of cobalt ore at No. 81 shaft. An average of 38 men was employed, some in mining work and some on surface, in connection with shipping residue and general clean-up.

The following is an extract from the general manager's report for the year ending December 31, 1935:—

Operations at the Cobalt property were of the same nature as in the previous year, consisting largely of mining cobalt ore, shipping cobalt-nickel-arsenic residues, and recovering silver clean-up from various parts of the property, all operations showing a profit. Total shipments amounted to 4,380 tons, as against 1,692 tons in 1934. There was an increased demand and higher prices for cobalt, with the result that shipments of residue were 1,000 tons greater than in 1934.

The following shipments were made during the year:—

	Tons	Ounces silver
Fine bullion	39.75	1,158,985.50
Clean-up	552.32	57,800.22
Leasers' ore	1,884.39	90,883.58
Residue	1,615.13	112,673.43
Cobalt ore	288.49	.....
Total	4,380.08	1,420,342.73

There was considerable variation in the price of silver, the variations at times being extreme from day to day, with comparatively long periods of more or less constant quotations. The year opened at 55 cents; a low of 53½ cents was recorded on February 1; a high of 81 cents on April 26; the average for the year was 64.27 cents, closing at 49¾ cents. During most of February and March of 1936 the price has been fairly constant at 44¾ cents.

The stock of refined bullion held in storage at Cobalt was sold in December at varying prices, averaging 62 cents per ounce. This silver was held during the severe decreases during the past three or four years, including the low of 24¼ cents in 1932.

There still remains some indeterminate amounts of cobalt and silver in scattered surface workings and in dumps, which might be profitably concentrated if prices for both metals remain at their present levels.

Some ore was also obtained on the property by leasers. The recovery in given in the company's table of shipments above.

M. J. O'Brien, Limited

Cross Lake Mine

The Cross Lake mine in Coleman township, district of Timiskaming, is owned and operated by M. J. O'Brien, Limited. J. G. Dickenson is general manager, and W. A. O'Flynn is manager. About 105 men are employed. The mine address is Cobalt.

The following development work was done in 1935: drifting and crosscutting, 4,585 feet; raising, 446 feet; sinking, 10 feet.

The following table shows the ore hoisted and milled in 1934:—

	Tons
Total tons broken	44,597
Ore hoisted	25,860
Waste hoisted	16,553
Ore milled	25,863
Custom ore milled	4,649

The silver recovered amounted to 1,036,643 ounces, of which 138,783 ounces was from custom ore. There were shipped:—

Cobalt	lbs.	60,545
Copper	lbs.	35,969
Lead	lbs.	13,136
Gold	ounces	6.7

Miller Lake O'Brien Mine

The Miller Lake O'Brien mine, Nicol township, district of Timiskaming, is owned and operated by M. J. O'Brien, Limited. J. G. Dickenson is general manager and H. G. Kennedy is manager. The mine address is O'Brien. The average number of men employed was 95.

The 1934 report is as follows:—

	Feet
Drifting	1,871
Crosscutting	963
Raising	24
Sinking	56
	Tons
Ore stoped	18,918
Ore and waste broken	28,375
Ore hoisted	20,691
Waste hoisted	7,559

J. C. O'Donald

In 1935, J. C. O'Donald, Cobalt, leased the old Silver Queen mine in Coleman township, district of Timiskaming, for three years.

During the year a shaft was sunk 64 feet and a shaft-house, machine shop, and dry were built.

About 60 tons of low-grade ore was hoisted, and 500 tons of waste. The production for the year amounted to $1,269 in silver and cobalt. An average of 12 men was employed under Mr. O'Donald's supervision. The post office address is Box 286, Cobalt.

C. W. Price

The Foster mine in Coleman township, district of Timiskaming, was operated under lease by C. W. Price, Cobalt, who employed 2 men. Shipments of ore yielded 1,591 ounces of silver, having a value of $969, and cobalt to the value of $130.

Rowe and Stuckey

Alfred Rowe and Charles Stuckey, of Cobalt, leased the surface and dumps of the Frontier mine, in South Lorrain township, district of Timiskaming, during 1935. Shipments of silver ore and mill rock yielded 14,000 ounces of silver and 13,000 pounds of cobalt.

Sandoe and Moyle

The Temiskaming mine in Coleman township, district of Timiskaming, was leased to Richard Sandoe and H. Moyle, of Cobalt.

Production amounted to 10,246 ounces of silver, valued at $6,660, and 12,844 pounds of nickel-cobalt ore, valued at $534.

Silver Cliff Syndicate

R. H. Lyman leased the old Silver Cliff mine in Coleman township, district of Timiskaming, in April, 1935, and operated it as lessee until August. From then until November 26 he operated as manager for the Silver Cliff Syndicate. Mr. Lyman died on November 30.

During these operations there were sent to the O'Brien mill 694 tons of ore, which yielded 19,404 ounces of silver, valued at $11,836.

Silverado Gowganda Mines, Limited

Silverado Gowganda Mines, Limited, held under lease nine claims in the Gowganda area, Leith township, district of Timiskaming. F. E. Forster, 347 Bay Street, Toronto, is secretary of the company.

Work was started on May 15, 1935, and continued until December 1, an average force of 20 men being employed. About 387 feet of drifting and 78 feet of crosscutting were done.

Donald E. Sirola

Donald E. Sirola, Kirkland Lake, operated the Colonial mine in Coleman township, district of Timiskaming, under lease, from June to December 31, 1935. Production amounted to 11,860 fine ounces of silver and 669 pounds of cobalt.

An average of 7 men was employed.

Smith Cobalt Mines, Limited

Smith Cobalt Mines, Limited. has a capitalization of 4,000,000 shares of $1 par value. The officers and directors are: W. H. Smith, president; A. A. Amos and E. F. Armstrong, vice-presidents; A. Kelso Roberts, secretary-treasurer; R. D. Hoffman, director. The head office and mine office are at Cobalt. The secretary's office is at 320 Bay Street, Toronto.

The property is in Coleman township, district of Timiskaming, east of Cross lake. Operations were carried on from May to December 31, 1935, an average of 21 men being employed. The following work was done:—

Level	Winze-sinking	Station-cutting	Drifting and cross-cutting	Raising	Stoping
	feet	cu. ft.	feet	feet	cu. ft.
450-foot	17	3,259	931	19	1,508
500-foot	59	520	365	.....	.....

About 9,570 pounds of cobalt ore was shipped. The late G. S. Scott was manager until August, and was succeeded by D. G. Russell.

A. Wood

The old mill of the Dominion Reduction Company, at Cobalt, was leased to A. Wood. Two men were employed from July 5 to November 10 in making a clean-up of the plant. Screenings from the mill site yielded 10,694 ounces of silver, valued at $4,307, and 165 ounces of gold, valued at $5,198. This mill at one time treated high-grade gold ores from several Ontario properties.

TALC

Canada Talc Company, Limited

The mine and mill of the Canada Talc Company, Limited, at Madoc, Huntingdon township, Hastings county, were operated throughout the year with an average force of 18 men. The officers and directors of the company are: W. S. Morden, president; E. S. James, vice-president; Roy Taylor, Madoc, secretary and manager. The company owns 50 acres. The capitalization is $50,000.

During 1935, 250 feet of shaft-sinking and 850 feet of drifting were done. Ore hoisted and milled amounted to 6,379 tons.

Geo. H. Gillespie Company, Limited

The officers and directors of the Geo. H. Gillespie Company, Limited, are: Geo. H. Gillespie, president; M. H. Ludwig, secretary-treasurer; Alexander Longwell, director. The head office and mine office are at Madoc.

The property, which is called the Henderson mine, consists of 400 acres in Huntingdon township, Hastings county.

The production for 1935 was 7,330 tons mined and milled. L. Ashley is manager. About 12 men were employed in 1935.

METALLURGICAL WORKS

Algoma Steel Corporation, Limited

During 1935 only one blast furnace was operated by the Algoma Steel Corporation, Limited, located at Sault Ste. Marie. No. 4 furnace was in blast from February 8 to December 31, and produced a total of 119,394 gross tons of iron.

Jas. H. Bell was blast furnace superintendent.

Canadian Furnace Company, Limited

The Canadian Furnace Company, Limited, at Port Colborne, operated the furnace from January 1 to February 1, and from June 20 to December 31, in 1935. The production for the year was as follows:—

	Gross tons
Pig iron	64,484
Spiegeleisen	8,937
Total	73,421

The officers of the company are: Frank B. Baird, Buffalo, N.Y., president; Richard C. Yates, Port Colborne, vice-president and manager; Frederick C. Slee, Buffalo, N.Y., secretary. W. J. Higgins, Port Colborne, is superintendent.

The average number of men employed during 1935 was 102.

Canadian Industries, Limited

During 1935 the plant of Canadian Industries, Limited, located at Copper Cliff, was in continuous operation.

The three 50-ton-per-day sulphuric acid units were operated to capacity. These units manufacture the acid from converter gases produced at the smelter of the International Nickel Company. The oleum unit was also operated to capacity. The nitre-cake unit, in which sodium sulphate is treated with sulphuric acid to produce nitre cake, used in the Orford process of separating nickel from copper, was operated at about 70 per cent. of capacity.

An average of 46 men was employed. E. Jordon was plant manager.

Deloro Smelting and Refining Company, Limited

The blast furnace at the plant of the Deloro Smelting and Refining Company, Limited, operated for short periods during each quarter in 1935. Silver production amounted to 2,090,737 ounces. Arsenic and cobalt products, including stellite, were also produced.

The officers of the company are: M. J. O'Brien, chairman of the board; J. A. O'Brien, president; S. F. Kirkpatrick, vice-president and managing director; S. B. Wright, general manager; F. A. Bapty, secretary-treasurer; R. A. Elliott, works superintendent.

International Nickel Company of Canada, Limited

The refinery of the International Nickel Company of Canada, Limited, at Port Colborne was operated continuously throughout the year. An account of the operations appears on page 178 of this report.

Ontario Refining Company, Limited

The copper refinery of the Ontario Refining Company, Limited, situated at Copper Cliff, was operated continuously during 1935. Operations were increased from 85 per cent. of the rated capacity of the plant at the first of the year to about 95 per cent. at the end of 1935.

By-product departments were further expanded. A new selenium recovery plant was built and put in operation in March. A Cottrell unit was being installed at the end of the year to reduce the dust losses in the by-product departments.

The refinery operated chiefly on blister copper from the smelter of the International Nickel Company, although several lots of gold ores, gold-bearing slags, and mattes from various Canadian mines were treated during the year.

An average of 547 men was employed, in comparison with 462 in 1934. F. Benard was plant manager.

Steel Company of Canada, Limited

The Steel Company of Canada, Limited, operated "B" furnace for 365 days, with a production of 208,230 gross tons of pig iron. The average number of men employed was 87. R. A. Gillies is blast furnace superintendent.

The officers of the company are: Charles S. Wilcox, chairman of the board; R. H. McMaster, president; H. M. Jaquays and H. T. Diplock, vice-presidents; H. H. Champ, vice-president and treasurer; H. S. Alexander, secretary; S. E. Le Brocq, comptroller. The address is Hamilton.

MINING ACCIDENTS IN 1935

Chief Inspector of Mines, D. G. Sinclair, Toronto; Inspectors, E. B. Weir, Timmins; E. C. Keeley, Kirkland Lake; D. F. Cooper, Sudbury; A. R. Webster, Toronto.

Accidents during 1935

During the year 1935 at the mines, metallurgical works, quarries, and clay, sand, and gravel pits regulated by *The Mining Act*, there were 2,079 accidents to employees reported to the Department of Mines up to January 16, 1936. Thirty-five fatalities arising out of 31 separate accidents were reported.

These returns represent an increase of 134 in the total number of accidents and an increase of 1 in the number of fatalities recorded over the preceding year.

The report shows a fatality rate of 1.52 men killed per thousand men employed, which is a decrease of 0.13 from the rate for the preceding year and 1.09 per thousand lower than the average for the past twenty-five years.

There were 90 non-fatal accidents per thousand men employed, which is a decrease of 3 per thousand from the rate for 1934.

The percentage of non-fatal accidents followed by infection increased from 7.1 in 1934 to 7.4 in 1935.

Fatal Accidents

A comparison of fatal accidents for the past five years is given below:—

Distribution	1931	1932	1933	1934	1935
Mines, underground	21	17	20	23	25
Mines, surface	8	0	1	2	2
Metallurgical works	1	1	1	5	3
Quarries	2	1	0	1	0
Clay, sand, and gravel pits	4	4	2	2	1
Total	36	23	24	33	31

By months the fatal accidents occurred as follows:—

Month	No. accidents	No. men killed
January	4	4
February	1	1
March	1	2
April	1	1
May	0	0
June	3	5
July	4	4
August	5	5
September	5	5
October	4	5
November	2	2
December	1	1
Total	31	35

Classifying the fatalities according to industries gives the following:—

Gold mines	23
Nickel mines	8
Silver mines	0
Talc mines	0
Metallurgical works	3
Quarries	0
Sand, gravel, and clay pits	1
Total	35

ANALYSIS OF FATALITIES AT MINES, 1931–1935

Cause	1931	1932	1933	1934	1935
	per cent.	per cent.	per cent.	per cent.	per cent.
Fall of ground	31	21	23	31	45
Run of ore or rock	3.5	5.3	9	8	6.5
Shaft accidents	17.2	15.8	9	8	10
Explosives	6.9	31.6	9	18	16
Miscellaneous, underground	13.8	26.3	45	27	16
Surface	27.6	.....	5	8	6.5

TABLE OF FATAL ACCIDENTS IN MINES, METALLURGICAL WORKS, QUARRIES, AND GRAVEL, SAND, AND CLAY PITS, 1911–1935

Year	Persons killed at metallurgical works and mines	Persons employed at metallurgical works and producing mines	Persons employed at non-producing mines (estimated)	Total persons employed	Fatal accidents per 1,000 employed
1911	49	12,543	2,000	14,543	3.37
1912	43	13,108	2,000	15,108	2.84
1913	64	14,293	2,000	16,293	3.93
1914	58	14,361	1,500	15,861	3.6
1915	22	13,114	1,500	14,614	1.51
1916	51	14,624	2,000	16,624	3.07
1917	36	16,791	1,000	17,791	2.02
1918	32	14,726	500	15,226	2.1
1919	39	11,926	1,000	12,926	3
1920	29	10,486	1,000	11,486	2.61
1921	24	8,436	1,000	9,436	2.54
1922	30	9,500	1,500	11,000	2.72
1923	30	10,500	1,500	12,000	2.5
1924	40	11,000	1,500	12,500	3.2
1925	42	11,500	1,500	13,000	3.23
1926	32	11,500	1,500	13,000	2.46
1927	33	13,311	2,000	15,311	2.1
1928	85	15,787	2,000	17,787	4.76
1929	55	17,145	1,849	18,994	2.89
1930	56	18,217	317	18,534	3.02
1931	37	17,820	447	18,267	2.03
1932	25	14,378	431	14,809	1.69
1933	25	15,080	804	15,884	1.57
1934	34	19,302	1,254	20,556	1.65
1935	35	21,444	1,528	22,972	1.52

The comparative fatality rate per thousand men employed at mines, metallurgical works, quarries, and clay, sand, and gravel pits is as follows:—

	Men employed	No. killed	Rate per thousand
Mines	17,193	31	1.80
Metallurgical works	4,479	3	.63
Quarries	700	0	0
Clay, sand, and gravel pits	600	1	1.67
Total	22,972	35	1.52

The ages of the men killed were as follows:—

17–20	21–25	26–30	31–35	36–40	41–45	46–50	Over 50	Total
1	6	6	7	6	5	2	2	35

The occupation and nationality of the men killed at mines, metallurgical works, and clay, sand, and gravel pits are set out in the following table:—

Occupation	British	Czecho-Slovakian	Finn	Italian	Jugo-Slav	Norwegian	Pole	Ukrainian	Total
Chute-blaster	.....	.....	.....	.....	1	.....	.....	.....	1
Conductor	1	.....	.....	.....	.....	.....	.....	.....	1
Driller	5	1	.....	2	1	.....	1	.....	10
Hoistman	1	.....	.....	.....	.....	.....	.....	.....	1
Labourer	1	.....	.....	.....	.....	.....	.....	.....	1
Machine helper	1	1	.....	.....	.....	.....	.....	.....	2
Mucker	.....	.....	.....	2	2	.....	1	.....	5
Pumpman	1	.....	.....	.....	.....	.....	.....	.....	1
Scaler	.....	.....	.....	.....	1	.....	.....	.....	1
Shaft leader	1	.....	.....	.....	.....	.....	.....	.....	1
Shaftman	.....	.....	1	.....	.....	1	.....	.....	2
Shoveller	.....	.....	.....	.....	.....	.....	2	.....	2
Slusherman	1	.....	.....	.....	.....	.....	.....	.....	1
Stope boss	.....	.....	1	.....	.....	.....	.....	.....	1
Switchman	1	.....	.....	.....	.....	.....	.....	.....	1
Tableman	1	.....	.....	.....	.....	.....	.....	.....	1
Teamster	1	.....	.....	.....	.....	.....	.....	.....	1
Timberman	.....	.....	.....	.....	.....	.....	.....	1	1
Unitman	1	.....	.....	.....	.....	.....	.....	.....	1
Total	16	2	2	4	5	1	4	1	35

Non-fatal Accidents

The causes of non-fatal accidents at mines are shown in the following table:—

Cause	Surface	Under-ground	Total
Fall of persons	107	157	264
Falling objects	62	131	193
Rock or ore at chute	.....	138	138
Flying objects, sledging, etc.	28	105	133
Handling rock or ore	5	116	121
Fall of rock or ore, scaling, drilling, etc.	.....	120	120
Crushed between two objects	25	90	115
Hand tools	51	51	102
Tramming	7	92	99
Fall of rock or ore at face	.....	80	80
Strain while lifting	28	51	79
Nails or splinters	24	43	67
Drilling machines	.....	65	65
Machinery	45	9	54
Running into or striking objects	7	40	47
Cage, skip, or bucket	.....	27	27
Burns	20	4	24
Fall down shaft, winze, or stope	.....	16	16
Explosives	.....	11	11
Air or rock blast	.....	8	8
Poisoning from cyanide	4	.....	4
Electricity	3	.....	3
Gas	2	1	3
Explosions from carbide	1	1	2
Unclassified	14	.....	14
Total	433	1,356	1,789

The causes of non-fatal accidents at clay, sand, and gravel pits were:—

Fall of material	5	Strain while lifting	3
Fall of persons	4	Falling objects	1
Crushed between two objects	3	Hand tools	1
Machinery	3		
Transportation	3	Total	23

The causes of non-fatal accidents at metallurgical works were:—

Falling objects	32	Transportation	4
Fall of persons	21	Hand tools	4
Machinery	10	Strain while lifting	3
Flying objects, sledging, etc	10	Nails or splinters	2
Burns	7	Burns by acid	2
Burned by slag, matte, or scrap	5	Electricity	2
Cranes, ladles, hooks	5	Gas	1
Crushed between two objects	4		
		Total	112

The causes of non-fatal accidents at quarries were:—

Handling material	31	Machinery	5
Fall of rock	14	Crushed between two objects	5
Fall of persons	14	Derricks, cranes, etc	3
Flying objects, sledging, etc	12	Explosives	3
Hand tools	10	Nails or splinters	3
Falling objects	8	Electricity	1
Transportation	8		
Strain while lifting	7	Total	124

Infection

Location	No. of accidents	Accidents followed by infection	Per cent. infection
Mines, underground	1,356	103	7.6
Mines, surface	433	38	8.8
Metallurgical works	112	2	1.8
Quarries	124	9	7.2
Clay, sand, and gravel pits	23	.....	.....
Total	2,048	152	7.4

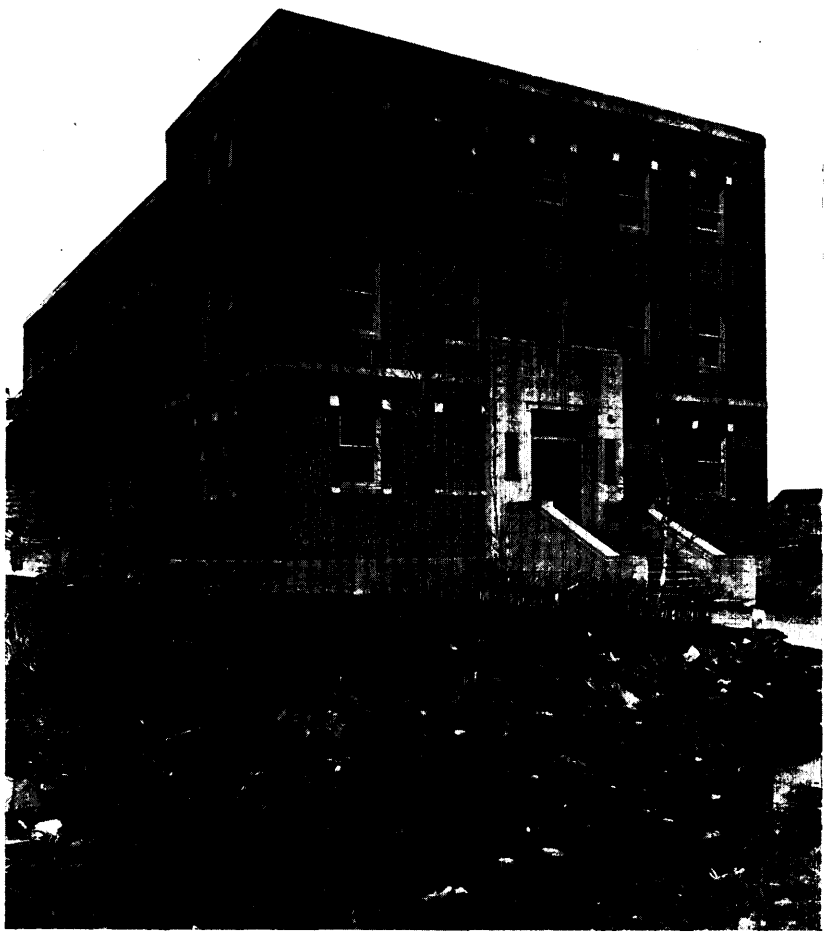
Accidents from Explosives

Cause	Non-fatal		Fatal		Total	
	No. of accidents	Men injured	No. of accidents	Men killed	No. of accidents	Men killed or injured
Delayed too long blasting	3	3	2	2	5	5
Drilled into explosive	2	3	.....	.....	2	3
Unexplained blast	2	2	.....	.....	2	2
Concussion from blast	2	2	.....	.....	2	2
Cap exploded while being tested	1	1	.....	.....	1	1
Hit by rock from blast	2	2	1	1	3	3
Walked into blast	1	1	.....	.....	1	1
Fumes from blasting	.....	.....	1	2	1	2
Total	13	14	4	5	17	19

Electric Accidents

The following table shows the fatal accidents due to the use of electricity at mines, metallurgical works, and quarries during the last ten years:—

1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	Total
.....	2	1	.....	6	.....	.....	.....	.....	.....	9



Kirkland Lake Hospital.

The following table shows the total number of non-fatal electric accidents during the last ten years:—

1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	Total
5	10	4	14	10	7	3	4	4	6	67

Classification of Non-fatal Accident Rates at Producing Mines

In the following table the producing mines are arranged in order, according to their rate of non-fatal accidents per thousand men employed:—

0–50	Canadian Gypsum Howey McIntyre-Porcupine
50–100	O'Brien (Cobalt) International Nickel (Frood and Creighton) Minto (Jubilee) Miller Lake O'Brien Nipissing Sylvanite Kirkland Lake Gold Naybob (Hayden) Hollinger Dome Darwin Tashota J-M Consolidated Lake Shore Young-Davidson Northern Empire
	Average producing mines—99.2 per M
50–100	Wright-Hargreaves
101–150	Coniaurum Parkhill Anglo-Huronian (Vipond) Falconbridge (mine) Teck-Hughes McKenzie Red Lake Ashley Gypsum, Lime and Alabastine Central Patricia St. Anthony Van Sickle (S. B. Smith)
151–200	Ardeen (Moss) Henderson Talc Little Long Lac Cobalt Properties Toburn Gillies Lake–Porcupine
Over 200	Matachewan Consolidated Bidgood Barry-Hollinger Macassa North Shores McMillan Pickle Crow Paymaster Consolidated Buffalo Ankerite Canada Talc Marbuan Kenora Prospectors (Cedar Island) Black Donald

Mine Fires

Hollinger Consolidated Gold Mines, Limited

About 5.30 A.M., January 27, a small fire was discovered in a by-pass chute at the 975-foot station off the Central shaft at the Hollinger mine.

The discovery was made by Joseph Bell, night-shift ore-pass operator on the 675-foot level. Bell had smelled wood smoke while at his work on the 675-foot

level and, being unable to locate the source of the smoke on that level, descended first to the 800-foot level and eventually to the 975-foot level, where he located the fire in the timbers of an unused by-pass chute behind the shaft. Two 12-foot 10- by 10-inch timbers, bolted together to form the end posts of this chute, were found to be smouldering. A section of these timbers extending from the floor of the level to a height of 8 feet was charred along the contact of the two timbers to a maximum depth of 5 inches. In the centre of the burned section the 20-inch face formed by the two timbers was charred across the full width.

The fire was easily extinguished and no material damage was done, but the consequences might have been serious indeed had it not been for the persistence of Bell in tracing the origin of the slight smoke he noticed on the 675-foot level.

During the afternoon of January 26 a crew of repair men had used an oxy-acetylene torch to cut out some plates and bolts at this chute and the original ignition of the timbers is presumed to have been due to this operation. The last cutting with the torch was completed about 2 P.M. and, although this crew worked at the location for nearly an hour and three-quarters after the last use of the torch, they noticed no indication of fire up to the time they stopped work and went to surface.

While it seems that from 2 P.M. to 5.30 A.M. was an almost incredible length of time for the fire to smoulder without spreading farther, this is partly accounted for by the nature of the wood in the posts—it was dry-rotted on the outer surface—and by the fact that until the waste-pass was drawn by the night shift there was little or no circulation of air through this by-pass.

It is thought that either the flame of the oxy-acetylene torch impinged on the joint between the two timbers while the cutting operations were under way or that a splash of molten metal became lodged in the joint and caused the fire.

International Nickel Company of Canada, Limited

On April 15, at 1.15 A.M., a smouldering timber was discovered by Motor Repairman F. Anderson at the 26th level crusher station, Creighton mine. It was thoroughly wetted and all signs of fire were easily extinguished.

An acetylene torch had been used in the vicinity on the previous shift to "burn" some crusher plates overlying this timber, and it is presumed that this operation was responsible for the ignition.

Lake Shore Mines, Limited

A small fire broke out in the hoist-room of No. 1 shaft, 2,000-foot level of the Lake Shore mine, on the afternoon of April 12.

This hoist-station contains the hoist-room proper and the adjoining grid-room, which is separated from the hoist-room, by a partition of metal lath and plaster, erected on 2- by 6-inch studding. Ventilation in the station is usually supplied by a fan. At the time of the fire, however, a repair job was being carried on and the fan was temporarily shut off.

The fire was confined to one stud and is presumed to have originated from the heat generated in the grids.

No damage was done, but, in order to guard against a repetition of the occurrence, the old partition was torn out and replaced by a concrete wall.

Porcupine Lake Gold Mining Company, Limited

Fire broke out in the shaft of the Porcupine Lake mine (formerly the Hunter) on the night of November 18, completely destroying three sets of shaft timbers,

including the collar set, and damaging the three sets immediately below. The sills of the shaft-house were also damaged, and approximately 170 square feet of shaft-house flooring was burned.

After the watchman discovered the fire, between 10.30 and 10.45 P.M., its progress was retarded by good work on the part of a quickly organized bucket brigade, who worked until the arrival of the chemical truck and firemen from South Porcupine. But for the prompt action of the watchman and his hastily summoned assistants, and the timely arrival of the fire department with chemical extinguishers, the entire shaft-house and boiler-compressor-hoist-house, which stands much too near the shaft-house, would undoubtedly have been destroyed.

Until early in October, when the buildings were repaired preparatory to dewatering the mine and examining the underground workings, no work had been done at this property for a number of years. Dewatering was completed early in November, after which the pumping crew on night shift was laid off and only a watchman-fireman retained on the shift.

The cause of the fire, at the time of writing, remains unknown.

Prosecution

A charge was laid against Norman S. Blue, chute blaster at the Frood mine of the International Nickel Company of Canada, Limited, in connection with a fatal accident to K. Karjula, for blasting in No. 1 north drift on the 2,600-foot level on September 9, without first causing all entrances to be effectively guarded, contrary to Subsection 61, Section 163, of *The Mining Act.*

Blue was convicted of the charge by Magistrate J. S. McKessock at Sudbury on October 9, and a fine of $10 and costs, or one month in jail, was imposed.

Summary of Rope Tests, 1935

The following is a summary of the tests made in the Wire Rope Testing Laboratories of the Department of Mines during 1935:—

Test for Ontario mines under Act	373
Special informative tests for mines	11
Tests for wire-rope manufacturers	19
Tests for mines outside Ontario	21
Other tests	5
Total	429

Classes for Prospectors, 1935-36

By E. M. Burwash

Introduction

Classes for the instruction of prospectors in mineralogy and geology were held during the past winter as usual, this being the ninth season during which the present instructor has had charge of the classes. The places visited were ten in number, including Hamilton, in which this work had not been done before, and Schreiber, where there had been no classes for a number of years. The numbers in attendance at these two places were fairly satisfactory.

Analysis of Class Attendance

The following table gives detailed information of the last season's work. The heading "Total registration" means enrollment for the daylight classes in mineralogy and petrography. The actual attendance at these classes is given under "Mineralogy." The heading "Geology" refers to attendance at illustrated lectures given in the evening. The column marked "Student hours" contains an estimate of the total hours of study done by the classes as a whole.

TABLE OF ATTENDANCE, 1935-36

Places	Dates	Total registration	Average attendance	Total attendance		Student hours
				Mineralogy	Geology	
	1935		per cent.			
Hamilton	Nov. 12	62	60.5	300	408	708
Ottawa	Nov. 21	38	67.4	205	126	419
Sudbury	Dec. 2	22	57.1	103	60	225
Sault Ste. Marie	Dec. 12	51	60.5	247	127	615
	1936					
Toronto	Jan. 2	227	70.3	1,277	820	3,135
Fort Frances	Jan. 14	13	54.8	57	37	151
Fort William	Jan. 23	62	64.7	321	123	696
Schreiber	Feb. 3	26	56.25	117	93	320
Kirkland Lake	Feb. 13	81	63.9	414	286	1,114
Kapuskasing	Feb. 24	22	64.8	114	154	365
Total		604		3,155	2,234	7,748
Averages		75.5	62.03	315.5	223.4	774.8

The total registration shows a considerable falling off as compared with the ten places visited a year ago, when the total was 1,084.

COMPARISON OF REGISTRATION BY YEARS

Year	No. of places	Total registration
1927-28	16	492
1928-29	14	353
1929-30	15	281
1930-31	15	345
1931-32	13	614
1932-33	13	1,667
1933-34	15	1,257
1934-35	10	1,084
1935-36	10	604

The conclusion drawn in previous reports that the attendance decreases as the prosperity of business in general advances and increases with depressed business conditions seems well sustained.

Acknowledgments

Acknowledgments are due to the following persons and public bodies who have aided in the promotion of the classes in the various centres where they were held, or who have provided rooms or otherwise assisted our work:—

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Sudbury—L. E. R. Stephens, Principal, and the Board of the Sudbury Mining and Technical School.

Sault Ste. Marie—A. D. Hone, Principal, and the Board of the Sault Ste. Marie Technical School; W. N. Miller, Mining Recorder.

Toronto—Chester S. Walters, Deputy Minister of Public Works, and the Governors of the University of Toronto for the use of a classroom in the Economics Building, 273 Bloor Street West.

Fort Frances—The Town Council and the Town Clerk, J. W. Walker.

Fort William—H. E. Johnston, Secretary, and the Thunder Bay Chamber of Mines; the Mayor and City Council for the use of their auditorium.

Schreiber—W. A. Spicer, Clerk, and the Mayor and Town Council for use of space in the Town Hall.

Kirkland Lake—H. G. Ginn, Mining Recorder, Swastika, for arrangements for the class at Kirkland Lake.

Kapuskasing—Herbert J. Swetman, Manager, and the Community Club.

The employment of a regular travelling assistant for the classes was abandoned in favour of the securing of local assistance as far as practicable. Jas. E. Thomson, geologist of the Department of Mines, did this work at Hamilton, Schreiber, Kirkland Lake, and Kapuskasing; and D. G. Sinclair, Chief Inspector of Mines, officiated very ably at Sudbury.

Local helpers were D. J. O'Brien at Sault Ste. Marie, J. McVey at Fort Frances, and Douglas Fraser at Fort William, who were employed for this work in whole or in part and performed their respective duties quite satisfactorily.

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KIRKLAND LAKE GOLD AREA

ANNUAL PRODUCTION STATISTICS BY MINES, 1911–1935

(Value includes gold and silver, and exchange premium and equalization have been added since 1920)

Year	Lake Shore		Teck-Hughes		Wright-Hargreaves		Sylvanite		Kirkland Lake Gold		Toburn (Tough-Oakes Burnside[1])		Macassa		Bidgood		Moffatt-Hall		Miscellaneous[2]		Total	
	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$
1911	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	675	4,650	675	4,650
1912	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1913	.....	.....	.....	.....	3	1,127	.....	.....	.....	.....	2,220	66,632	.....	.....	.....	.....	.....	.....	4,160	21,177	6,383	88,936
1914	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3,734	117,644	.....	.....	.....	.....	.....	.....	.....	.....	3,734	117,644
1915	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	26,196	555,539	.....	.....	.....	.....	.....	.....	.....	.....	26,196	555,539
1916	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39,865	711,626	.....	.....	.....	.....	.....	.....	.....	.....	39,865	711,626
1917	.....	.....	11,257	66,722	.....	.....	.....	.....	.....	.....	38,695	342,830	.....	.....	.....	.....	.....	.....	.....	.....	49,955	409,552
1918	16,749	416,414	14,774	80,570	.....	.....	.....	.....	.....	.....	22,000	139,683	.....	.....	.....	.....	.....	.....	.....	.....	53,523	636,667
1919	11,081	263,354	18,387	169,590	.....	.....	.....	.....	11,324	56,263	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	40,792	489,207
1920	19,779	545,311	30,646	277,878	.....	.....	.....	.....	40,812	322,533	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	91,237	1,145,722
1921	21,817	540,450	34,693	359,844	36,053	481,892	.....	.....	43,966	268,566	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	136,529	1,650,752
1922	24,279	476,461	41,194	604,006	66,181	767,445	.....	.....	37,489	226,527	16,108	107,617	.....	.....	.....	.....	.....	.....	6,496	10,082	191,747	2,192,138
1923	23,203	557,186	38,314	1,137,523	79,242	762,761	.....	.....	45,449	223,990	1,803	12,174	.....	.....	.....	.....	.....	.....	.....	.....	188,011	2,693,634
1924	56,168	1,104,550	44,209	1,035,338	84,487	1,094,462	.....	.....	8,091	46,513	8,438	47,548	.....	.....	.....	.....	.....	.....	.....	.....	201,393	3,328,411
1925	109,273	1,958,720	55,220	996,645	147,939	1,913,468	.....	.....	.....	.....	34,152	263,064	.....	.....	.....	.....	.....	.....	.....	1,526	346,584	5,133,423
1926	171,197	2,775,000	87,074	1,600,613	153,392	2,150,844	.....	.....	10,829	126,999	43,871	309,709	.....	.....	.....	.....	.....	.....	.....	.....	466,363	6,963,165
1927	236,818	3,375,053	153,881	2,781,962	209,164	2,151,916	40,479	429,424	52,648	473,673	38,999	153,215	.....	.....	.....	.....	.....	.....	.....	.....	731,989	9,365,243
1928	279,661	4,073,965	317,213	4,951,707	256,331	1,838,510	69,791	738,146	57,883	414,596	14,396	82,316	.....	.....	.....	.....	.....	.....	.....	.....	995,275	12,099,240
1929	430,170	6,126,688	330,340	5,081,078	188,238	1,734,728	74,523	689,465	53,595	353,915	.....	.....	.....	.....	.....	.....	.....	.....	.....	11,925	1,076,866	13,997,799
1930	550,501	7,847,508	338,555	5,403,030	220,430	2,432,888	81,213	794,459	52,106	534,154	.....	.....	.....	.....	.....	.....	.....	.....	.....	32,805	1,242,806	17,044,844
1931	816,580	11,650,281	444,410	6,286,668	266,352	3,078,754	91,621	921,216	52,628	615,882	.....	.....	.....	.....	.....	.....	.....	.....	1	1,662	1,671,591	22,554,423
1932	818,698	14,317,113	475,700	6,631,755	295,525	3,984,125	96,891	930,305	56,492	592,451	14,689	227,956	.....	.....	.....	.....	.....	.....	.....	.....	1,757,995	26,683,705
1933	808,917	14,377,716	474,700	6,166,619	285,465	4,955,960	96,937	1,072,977	49,487	400,622	36,913	666,894	8,101	110,172	.....	.....	.....	.....	35	6,411	1,760,555	27,757,371
1934	836,023	16,305,819	442,745	5,801,691	354,418	7,572,292	111,767	1,740,384	64,952	703,300	36,230	708,119	66,557	1,111,098	2,433	6,804	8,476	87,071	.....	13,150	1,923,601	34,049,728
1935	836,322	16,259,720	417,917	4,901,862	361,149	7,528,563	152,281	1,917,606	71,920	777,430	35,360	714,261	68,627	1,067,196	11,148	43,870	7,912	79,498	1	10	1,962,637	33,290,016
Total	6,067,236	102,971,309	3,771,229	54,335,101	3,004,369	42,449,735	815,503	9,233,982	709,671	6,137,414	413,669	5,226,827	143,285	2,288,466	13,581	50,674	16,388	166,569	11,368	103,398	14,966,301	222,963,435

[1]Acquired by Toburn Gold Mines, Limited, in 1931.

[2]See table of "Miscellaneous Production" to the right.

MISCELLANEOUS PRODUCTION, KIRKLAND LAKE AREA

Mine	Year	Quantity	Value
		tons	$
Gold Pyramid	1911	175	650
Lucky Cross (Kirkland Gateway[1])	1913, 1933, 1935	2,536	14,880
Ontario-Kirkland[2]	1922	6,496	10,082
Swastika	1911, 1913	12,60	11,172
Trout Creek	1931	1	1,662
Miscellaneous[3]	1925, 1929, 1933, 1934	.....	64,952
Total	.....	11,368	103,398

[1]Now owned by Golden Gate Mining Company, Limited.

[2]Now owned by Kirkland Gold Rand, Limited.

[3]This includes gold recovered from scrapped machinery, origin unknown, and high-grade.

PORCUPINE GOLD BELT

Annual Production Statistics by Mines, 1910–1935

(Value includes gold and silver, and exchange premium and equalization have been added since 1920)

Year	Hollinger		Schumacher[1]		McIntyre-Porcupine		Dome		Vipond[2]		Porcupine Crown (Northcrown)[3]		Coniaurum (Newray[4])		Buffalo Ankerite (Ankerite[5])		Marbuan (March[6])		Paymaster Consolidated[7]		Paymaster[8]		Dome Lake and West Dome Lake[9]		Night Hawk Peninsular[10]		Munro Croesus[11]		Gillies Lake–Porcupine (Porcupine United[12])		Naybob (Hayden[13])		McLaren-Porcupine		Miscellaneous[14]		Total	
	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$	tons	$
1910	.....	31,194	.....	.....	.....	.....	.....	4,355	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	35,549
1911	.....	6,000	.....	.....	.....	.....	.....	4,277	432	5,160	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	432	15,437	15,437
1912	45,195	909,181	.....	.....	14,500	77,657	75,088	737,499	5,168	16,259	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	139,951	1,740,596
1913	138,291	2,488,022	.....	.....	29,669	236,299	131,149	1,242,625	.....	.....	19,715	326,803	2,456	18,858	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	25	4,200	321,305	4,316,807
1914	208,936	2,719,355	.....	.....	62,284	549,166	221,390	1,059,238	9,700	73,628	40,857	685,135	11,607	125,255	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	20,212	554,774	5,231,989
1915	334,750	4,206,015	9,240	48,236	101,955	750,812	317,740	1,530,287	35,899	246,053	46,419	602,436	.....	36,925	.....	.....	.....	.....	.....	.....	.....	.....	11,727	102,880	.....	.....	100	73,215	.....	.....	.....	.....	139	9,134	857,969	7,605,993
1916	601,854	5,073,401	46,463	225,301	136,489	1,218,073	440,900	2,153,820	43,041	176,686	51,273	578,322	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6,542	16,814	.....	.....	477	51,722	.....	.....	.....	.....	.....	.....	1,327,039	9,494,139
1917	514,301	4,261,938	37,323	198,605	175,893	1,710,204	359,570	1,480,174	24,971	209,738	39,111	377,904	340	1,447	.....	.....	.....	.....	.....	.....	.....	.....	16,388	44,434	.....	.....	1,541	60,046	.....	.....	.....	.....	31	877	1,179,469	8,345,367
1918	578,755	5,752,371	19,098	92,842	176,976	1,578,444	.....	82,127	15,134	82,868	10,907	124,474	401	1,516	.....	.....	.....	.....	.....	.....	.....	.....	12,229	103,745	.....	.....	692	64,780	.....	.....	.....	.....	2,565	17,327	816,757	7,900,494
1919	711,882	6,722,266	.....	.....	185,018	1,978,014	187,580	1,290,301	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4,433	23,910	.....	.....	.....	.....	.....	.....	.....	.....	3,831	27,089	1,092,744	10,041,580
1920	650,205	6,939,629	.....	.....	191,032	2,515,861	295,220	2,243,926	.....	.....	17,898	190,713	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4,707	52,531	.....	.....	.....	.....	.....	.....	.....	.....	3,003	11,246	1,162,065	11,953,906
1921	1,072,493	10,015,712	.....	.....	172,287	1,985,803	335,680	2,386,357	.....	.....	.....	7,943	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,580,460	14,395,815
1922	1,491,381	12,436,393	.....	.....	217,208	2,042,931	368,400	4,178,936	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,800	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,664	2,076,989	18,662,724
1923	1,366,352	10,622,262	.....	.....	291,428	2,583,336	399,800	4,405,199	2,623	24,532	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8,114	60,765	38,326	268,518	518	27,375	.....	.....	.....	.....	.....	11,845	2,060,721	17,674,549
1924	1,659,776	13,574,776	.....	.....	390,459	3,625,493	493,400	4,307,624	52,427	603,234	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	35,235	[15]235,091	39,758	196,947	.....	.....	.....	.....	.....	.....	.....	5,270	2,642,502	22,445,680
1925	1,929,528	15,746,668	.....	.....	419,640	3,721,499	530,200	4,365,923	61,203	565,213	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	36,946	220,758	21,604	111,154	.....	.....	.....	.....	.....	.....	.....	3,453	3,015,607	24,834,794
1926	1,932,559	14,829,555	.....	.....	498,653	3,862,074	555,700	3,940,053	73,717	631,636	.....	.....	.....	.....	23,060	140,588	4,655	11,055	.....	.....	28,049	63,551	16,982	[16]87,919	.....	166	.....	.....	.....	.....	.....	.....	.....	780	3,180,943	23,811,304
1927	2,178,329	14,539,538	.....	.....	522,880	3,965,210	543,300	4,031,575	93,863	667,724	.....	.....	.....	.....	69,863	359,005	4,566	19,839	.....	.....	62,129	135,025	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	60	223,243	3,488,972	24,029,244
1928	1,778,470	10,706,235	.....	.....	524,695	4,201,808	548,000	3,915,051	88,896	694,426	.....	.....	52,005	220,534	66,606	289,960	32,627	133,879	.....	.....	94,050	183,271	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	255	39,739	3,185,604	20,384,903
1929	1,549,157	9,519,092	.....	.....	550,100	4,314,803	452,900	3,590,537	107,984	824,726	.....	.....	103,293	635,485	12,912	71,684	48,484	256,303	.....	.....	.....	.....	35,142	155,797	.....	.....	.....	.....	4,848	44,285	.....	.....	.....	.....	47,701	2,864,820	19,460,413
1930	1,625,868	10,276,546	.....	.....	565,510	4,700,726	67,600	774,943	111,667	910,581	.....	.....	122,972	738,941	.....	878	53,953	306,262	.....	.....	.....	.....	.....	15,662	.....	.....	.....	.....	7,815	56,913	.....	.....	.....	.....	61,940	2,558,385	17,843,392
1931	1,640,705	10,532,380	.....	.....	617,425	4,962,211	542,600	3,636,806	101,223	586,304	.....	.....	130,585	783,096	.....	.....	58,462	228,507	.....	.....	.....	.....	.....	.....	.....	.....	550	4,171	1,396	5,439	.....	.....	.....	.....	33,587	3,091,946	20,772,501
1932	1,754,863	11,685,512	.....	.....	723,285	6,155,757	536,450	4,581,131	107,197	513,504	.....	.....	144,654	977,007	55,267	247,536	26,812	89,566	.....	.....	.....	.....	.....	.....	.....	.....	.....	6,520	.....	.....	2,580	1,497	.....	.....	155	31,944	3,351,263	24,289,974
1933	1,727,102	13,831,174	.....	.....	754,360	7,589,845	546,500	6,103,340	107,562	700,354	.....	.....	145,657	945,765	111,402	650,591	2,800	5,288	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,593	3,188	[17]26	326	5,630	98,978	3,402,632	29,928,849
1934	1,900,490	15,108,883	.....	.....	851,345	8,289,262	547,600	7,177,087	101,806	539,243	.....	.....	138,114	979,156	131,720	712,898	26,030	113,422	13,824	69,522	.....	.....	.....	.....	.....	.....	205	10,467	.....	.....	.....	.....	50	339	530	2,491	3,711,714	33,002,770
1935	1,837,153	14,700,511	.....	.....	869,100	8,653,496	549,100	7,286,606	103,393	418,962	.....	.....	151,055	1,134,596	159,383	1,035,987	59,380	290,542	79,845	567,076	.....	.....	.....	.....	.....	.....	1,237	25,513	5,122	56,933	10,681	23,666	600	3,840	230	5,222	3,829,279	34,202,950
Total	29,228,395	227,234,709	112,124	564,984	9,042,191	81,268,784	9,045,867	76,509,797	1,265,906	8,490,831	226,180	2,893,730	1,003,139	6,598,581	630,213	3,509,127	317,769	1,454,663	93,669	636,598	184,228	384,647	188,488	1,120,306	99,688	576,785	5,320	323,809	19,181	163,570	14,854	28,351	676	4,505	16,454	657,942	51,494,342	412,421,719

[1]Purchased by the Hollinger in 1922.
[2]Acquired by Anglo-Huronian, Limited, in 1933.
[3]The Porcupine Crown was acquired by Northcrown Porcupine Mines, Limited, on May 15, 1920, and by Vipond Consolidated Mines, Limited (now Anglo-Huronian, Limited) in 1926.
[4]The Rea mine (production of which is shown in the figures for 1913, 1914, and 1915) was operated by Newray Mines, Limited, in 1917 and 1918. In 1924 the Newray was taken over by Coniaurum Mines, Limited.
[5]Renamed Buffalo Ankerite in 1932.
[6]The March was taken over by Marbuan Gold Mines, Limited, in 1933; the Buffalo Ankerite operated the Marbuan mill in 1933, treating 2,800 tons from the dump of the New York Porcupine Gold Mines, Limited. The Marbuan was taken over by Buffalo Ankerite Gold Mines, Limited, in 1935.
[7]Paymaster Consolidated Mines, Limited, incorporated in 1930, is a merger of West Dome Lake Gold Mines, Limited, and United Mineral Lands Corporation (which owned the Paymaster mine). The production for 1934 and 1935 came from the old Dome Lake and West Dome Lake shafts.
[8]Now owned by Paymaster Consolidated Mines, Limited.
[9]From 1915 to 1920, the production shown was from the Dome Lake mine, except 300 tons with a value of $2,462 from the West Dome Lake in 1918. In 1922 the properties were amalgamated as Consolidated West Dome Lake Mines, Limited, and in 1930 acquired by Paymaster Consolidated Mines, Limited.
[10]Acquired by Porcupine Peninsular Gold Mines, Limited, in 1933.
[11]Optioned to Tellaurum Gold Mines, Limited, January, 1936.
[12]Renamed Gillies Lake–Porcupine in 1933.
[13]The Hayden mine was acquired by Naybob Gold Mines, Limited, in 1934.
[14]See table of "Miscellaneous Production" to the right.
[15]In 1927 it was discovered that an erroneous return had been made for the year 1925 and that figure should have been $235,091 instead of $287,758, as shown in previous tables. The figure for 1927 was altered to make allowance for this discrepancy of $52,667. The present table now shows the correction applied to the year 1925.
[16]Shipped to Noranda smelter by J. M. McLaren.

Miscellaneous Production, Porcupine Belt

Mine	Year	Quantity	Value
		tons	$
Blue Quartz (Amal. Goldfields)	1923, 1926, 1928	.....	1,303
	1934	500	663
Bourkes	1918	3	1,113
Canusa (Scottish-Ontario)	1927, 1928	315	12,688
	1933, 1935	.....	2,152
Clifton (Preston)	1914, 1922, 1923, 1924	.....	30,575
Concordia (Jones-Porter)	1935	230	580
Davidson Consolidated	1918, 1919, 1920	9,371	53,914
De Santis	1926	.....	146
	1933	5,630	18,386
Gold Reef	1915, 1917	128	2,135
Hill Gold (Beatty tp.)	1918	25	635
J. Huddlestone and P. Clyne	1923, 1925	.....	3,257
Hughes	1926	.....	30
Northern Turnbull	1934	30	172
Porcupine Pet	1914, 1915	.....	10,551
Porphyry Hill	1913, 1915	46	6,236
J. Spence (Triple Lake)	1932	155	2,738
Tommy Burns	1917	21	289
Miscellaneous[1]	1925, 1927-1935	.....	510,379
Total		16,454	657,942

[1]This is all high-grading, with the exception of the year 1933, when $76,737 was recovered from scrapped machinery.





PROVINCE OF ONTARIO

DEPARTMENT OF MINES

HON. PAUL LEDUC, *Minister of Mines* T. F. SUTHERLAND, *Deputy Minister*

FORTY-FIFTH ANNUAL REPORT

OF THE

ONTARIO DEPARTMENT OF MINES

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New Developments in the Little Long Lac Area, by E. L. Bruce 118-140

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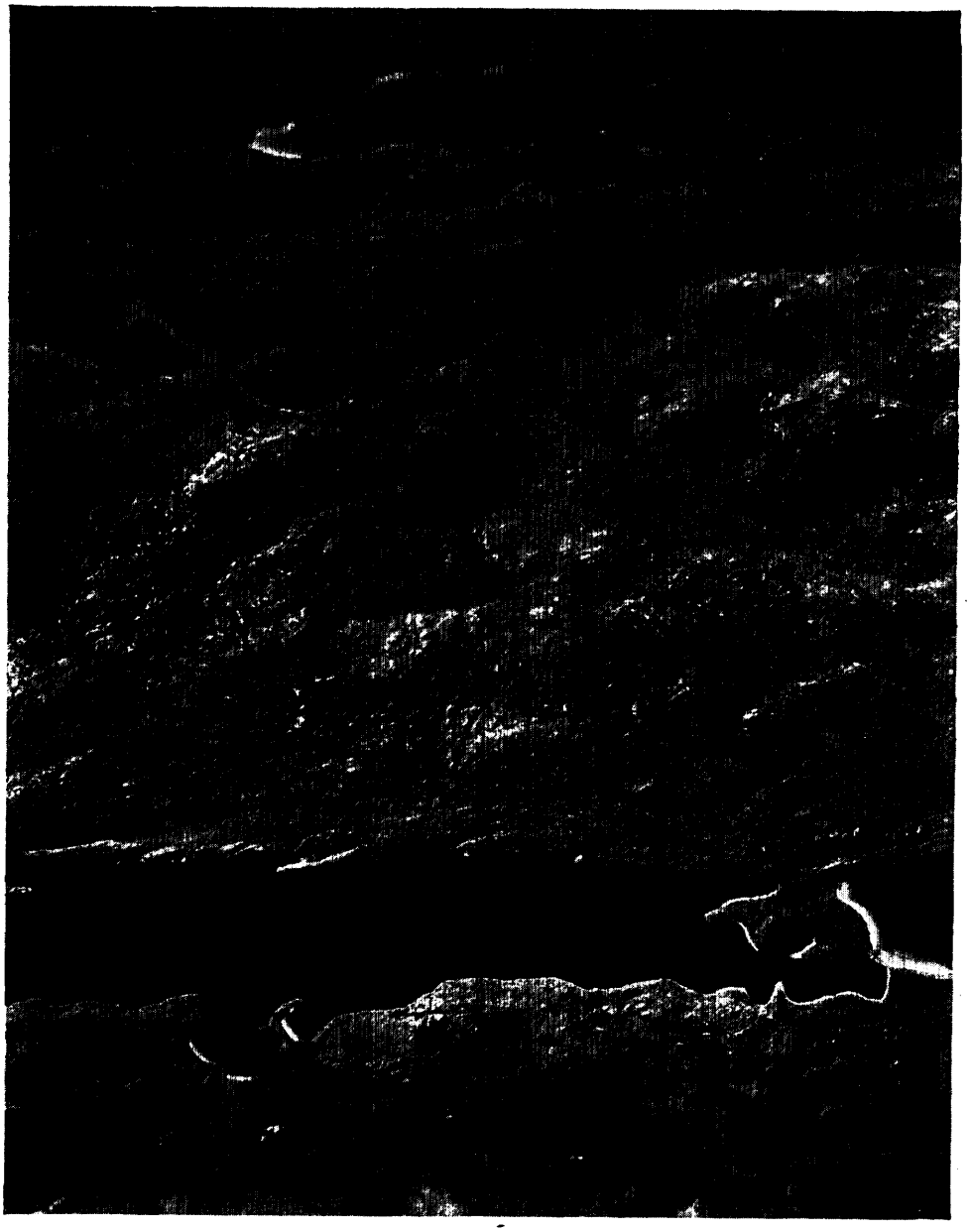
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COLOURED GEOLOGICAL MAP

(In pocket at back of report)

Map No. 45a—Sturgeon River Gold Area, District of Thunder Bay, Ontario. Scale, 1 mile to the inch.



Air photograph of the south side of Paint lake showing the Paint lake band of conglomerate. The trend of the ridges at a small angle to the elongation of the band is expressed in the shore line. Shearing parallel to the ridges occurs in some places.

The Eastern Part of the Sturgeon River Area
(Jellicoe-Sturgeon River Section)

By E. L. Bruce

INTRODUCTION

The discovery of gold in several veins in the area along the Sturgeon (Namewaminikan) river north of Jellicoe, Thunder Bay district, during the summer of 1934 led to the staking of a large number of claims in the latter part of that year. Development work has been carried on actively on some of the claims, but many have not been thoroughly prospected. Much geological information was available, since a large part of the area in which gold was discovered in 1934 had previously been prospected for iron, and geological reports were published in connection with the examinations of the iron formations. In addition, studies of the general geology of the country traversed by the railway were made both by the Geological Survey of Canada and by the Ontario Department of Mines. In view of the new interest, especially in the possibility of the discovery of workable gold deposits, a re-examination was undertaken as a continuation westward of the Little Long Lac map area. Some differences are noticeable in the successions in the two areas, but in general it seems possible to recognize in the western area the formations found at Little Long Lac.

During the present examination the lines of all surveyed claims were traversed. Where there were no surveys, pace and compass traverses were made at intervals of one-quarter of a mile. The information obtained was compiled on maps prepared from air surveys made by the Topographical and Air Survey Bureau, Department of the Interior, Canada.

Acknowledgments

Much assistance and many courtesies were received from those associated with prospecting and mining operations. Special thanks are due to C. M. Bowyer, of Sturgeon River Gold Mines; W. H. Graves and J. W. Webb, of Agaura Exploration; A. Rosenland, of Macjoe Sturgeon Gold Mines; H. M. Parrington, of Casey Contact Mines; D. MacKay, of Oremond Gold Mines; and W. G. Coughlan, of the J. Bruce McMartin (Orphan) mine. Permission to use information obtained during development of properties was kindly given by the officials of all the companies operating in the area.

Field assistants in 1935 were V. B. Meen, O. F. Carter, and C. K. Wilton; in 1936, W. W. Moorhouse, Malcolm Bews, and F. L. Casey. To all of them thanks are due for unfailing co-operation. V. B. Meen and O. F. Carter mapped large parts of the area independently during 1935. The mapping of the eastern part of Lapierre township and all of Hipel township is the work of W. W. Moorhouse.

General Description of the Area[1]

This report covers an area 12 miles wide along the Canadian National railways. It extend 6 miles west of the east boundary of the Nipigon Provincial

[1]Wherever the word "area" is used in this report without any descriptive qualification, it refers to the eastern part of the Sturgeon River map area (Jellicoe–Sturgeon River section), as described in the first paragraph of this section.

Forest and 18 miles east of it, and includes the townships of Elmhirst, Walters, Rickaby, Leduc, Lapierre, Legault, Hipel, and Colter.

Access to the northern part of the area is by airplane from Jellicoe or in summer by canoe down the Sturgeon river from the point where the railway crosses it 5 miles east of Jellicoe. The large number of lakes in the eastern part makes airplane service very convenient, but unfortunately in the western part there are no lakes of suitable size near the properties being actively developed. Goods are landed at Coyle lake, portaged a quarter of a mile north to the Sturgeon river, taken downstream past one rapid, and then again portaged to reach the camps of either Sturgeon River Gold Mines or Brengold Mines.[1]

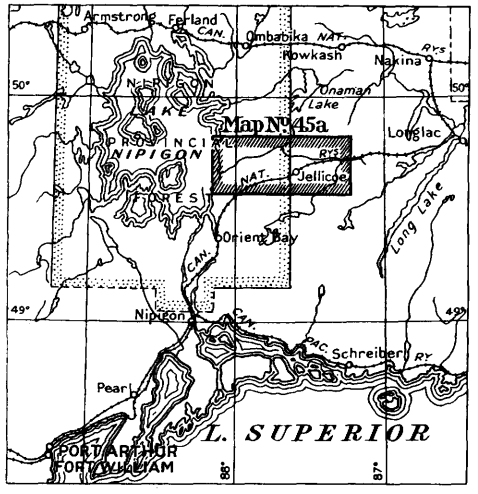


FIG. 1—Key map showing the location of the Sturgeon River area, district of Thunder Bay. Scale, 60 miles to the inch.

River transportation is rendered difficult by numerous rapids. Most of them are short and can be run by experienced canoemen who know the river, but only canoes can be used and hence the character of freight transported is limited and the cost fairly high. Furthermore, portaging from the river to the camps is necessary, as it is when airplanes are used.

A winter road leads from Nezah on the railway to the Sturgeon River and Brengold camps, but this is impassable in summer, chiefly on account of a broad muskeg a mile south of the Sturgeon river. A wagon road leads from Jellicoe to the Oremond property.

Previous Work

Lake Nipigon was the last of the large lakes of the Great Lakes system to be discovered. Its discovery is generally credited to Radisson and Grosseillers, who passed close to it in 1662. The first accurate maps of it were made in 1860 by J. W. Herrick, of the Crown Lands Department of Ontario. In 1869, Dr. Robert Bell,[2] assisted by Peter McKellar, began a geological reconnaissance that included part of the Nipigon basin, and this work was continued during part of the following year. In 1894, McInnes[3] continued the work begun by Bell, and the geo-

[1]Formerly Casey Contact Mines.
[2]Robt. Bell, Geol. Surv. Can., Rept. of Progress 1866-69, pp. 313-364.
[3]W. McInnes, Geol. Surv. Can., Vol. VII, 1894, pp. 48-51A.

logical examination of the country immediately adjacent to the lake was completed by Dowling[1] in 1898.

Iron formations were found on the Slate islands in Lake Nipigon by Peter McKellar during the season of 1870, but it was not until 1900 that there seems to have been any interest in the possibilities of bodies of iron ore occurring in them. Following the staking of claims, examinations of the areas in which iron formation was reported were made by J. W. Bain,[2] W. A. Parks,[3] A. P. Coleman,[4] and E. S. Moore.[5]

In 1905, part of the southwest shore of Lake Nipigon was examined by Collins,[6] and in 1910 a comprehensive report of the "Geology of the Nipigon Basin," including results of previous work as well as his own, was prepared by A. W. G. Wilson.[7]

In 1916, A. G. Burrows[8] examined the country adjacent to the Canadian National Railway line from Longlac to Orient Bay. His map extends northward to include the Sturgeon River valley. The following year T. L. Tanton[9] also examined the railway belt, and his map covers the lower part of the Sturgeon river. A more detailed study of the area west of Jellicoe was made by Langford[10] in 1927, following the discovery of gold at Beardmore in 1925.

Natural Resources

The area has little in the way of natural resources except whatever mineral deposits there may be. Much of it was formerly heavily forested, but forest fires have destroyed practically all of the timber between the railway and the Sturgeon river, and a broad band of brulé extends northward across the river at Martin rapids. Part of this area was cut over before the fire, but the fires came before lumbering operations were completed and large numbers of logs were never removed. At the present time this part of the country is a tangle of charred logs through which second growth jackpine has grown to heights of 10 to 15 feet. There is great danger of fire again starting in this. North of the Sturgeon river there are some areas of spruce of good size. Jackpine grows to a good size on the ridges and sand plains. A half dozen red pine trees, which escaped the fire, stand on the east shore of Expansion lake, but red pine seems never to have been abundant.

The country is not suitable for agriculture on any large scale. Here and there small areas of good soil occur, but much of the unconsolidated material is sandy and not suitable for farming. In addition, the season free from destructive frosts is short.

There are numerous falls and rapids on the Sturgeon river, but the minimum flow of the river is not large. The power development at Hydro on the Nipigon river is sufficient to supply the needs of mines that may be developed in the Sturgeon River area.

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[1]D. B. Dowling, Geol. Surv. Can., Vol. XI, 1898, pp. 94-99A.

[2]J. W. Bain, Ont. Bur. Mines, Vol. X, 1901, pp. 212-214.

[3]W. A. Parks, Geol. Surv. Can., Vol. XIV, 1901, pp. 105-109A.

[4]A. P. Coleman, Ont. Bur. Mines, Vol. XVI, pt. 1, 1907, pp. 105-135; Vol. XVII, 1908, pp. 136-169.

[5]E. S. Moore, Ont. Bur. Mines, Vol. XVI, pt. 1, 1907, pp. 136-148.

[6]W. H. Collins, Geol. Surv. Can., Sum. Rept., 1906, pp. 103-109.

[7]A. W. G. Wilson, Geol. Surv. Can., Mem. 1, 1910.

[8]A. G. Burrows, Ont. Bur. Mines, Vol. XXVI, 1917, pp. 227-247.

[9]T. L. Tanton, Geol. Surv. Can., Sum. Rept. 1917, pt. E, pp. 1-6; map No. 1836, "Explored Routes in a Belt Traversed by the Canadian National Railways (between Longlac and Nipigon)," Geol. Surv. Can., 1921.

[10]Geo. B. Langford, Ont. Dept. Mines, Vol. XXXVII, pt. 4, 1928, pp. 83-108.

There has been a small production of gold from the Orphan (formerly the Dikdik) mine, and it seems likely that other mines will be developed. So far as can be judged from present indications, they will produce small tonnages of high-grade ore. The iron formations are too low in iron content to be workable. There have been no discoveries of deposits of minerals of any other metals that give promise of commercial value.

Topography

The Jellicoe–Sturgeon River section of the Sturgeon River area has the general flat character of the Canadian shield. Considered in detail, however, its eastern and western parts have quite different topographic features. Owing to the thick mantle of glacial material that has filled up depressions in the rock floor, the extreme eastern part of the area has the very flat character of the neighbouring Little Long Lac area. The western part has a much less extensive covering and has the local ruggedness that is as characteristic of most parts of the Canadian shield as are the relatively small differences of relief when a whole region is considered in a large way. Broad tongues of glacial deposits extend westward, so that between the flat and the rugged portions there is a border zone consisting of narrow level valleys, which belong topographically to the eastern type, separated by rock ridges, which topographically are part of the rugged western part.

Where the surface is unmodified or but partially mantled with unconsolidated glacial or post-glacial material the topography reflects the structural control of the underlying rocks. The close folding of the heterogeneous lavas has caused narrow east-west valleys. The narrow and much elongated remnants of synclines of sediments are indicated by similar features. On the other hand the massive character of the granite is reflected in the development of broad, domed upland areas in which erosion has etched irregular hollows, now lake or swamp filled.

The granite batholiths, however, have undergone only a shallow incision, so that even where granite is exposed over considerable areas the land surface is not far below the original roof of the magma chamber. Hence there are remnants of the older rocks as roof pendants. Where these are softer than the granite, they have been eroded more deeply than the surrounding granite and valleys are formed, the immediate slopes of which are basic rocks, whereas the uplands are granite. On the other hand inclusion of rhyolite masses has in a few places resulted in resistance to erosion, so that prominent lava-capped ridges stand up above granitic or dioritic lower slopes. Diabase is the most resistant rock of the region, and where bodies of it are of some size it forms the most prominent elevations in the area.

In general the land surface prior to the glacial period was very similar to the present one where there is little or no glacial material. It seems likely that a river of some size had carved out a broad east-west valley, parts of which are now occupied by the Sturgeon river and parts by lakes or other streams.

The work of the continental glaciers was twofold. During their advance material was removed. Rocks were stripped of soil and fresh unoxidized surfaces exposed; only here and there in the lee of steep hills were pockets of weathered material left. During the ice retreat, on the contrary, till, sand, and gravel were deposited wherever the ice front remained stagnant for any length of time, and esker ridges were formed at or near the margins. The outflowing water from the melting ice supplied efficient transportation for some of the finer material

and spread it out into sand plains or flat fans. Topographically the constructive phase of glacial activity was extremely important, since hollows were filled and river valleys dammed, so that former drainage systems were largely disorganized. In places the deposits of glacial debris were sufficiently abundant to produce prominent ridges and hills, but for the most part they served to reduce the irregularity of the etched surface of the consolidated rocks.

Between Paint lake and the long string of lakes that lies south of it the topography has a strikingly linear character. The underlying rocks are mainly basic lavas with an east-west strike and nearly vertical dips. They form narrow elongated ridges separated by narrow valleys, most of which are occupied by cedar swamps or small lakes. It seems more than a coincidence that the rock forming the crests of many of the ridges shows well-marked ellipsoidal structure. On one of the highest parts of one of the ridges, which at this place rises to an elevation of 240 feet above Paint lake, there are many small dikes of feldspar porphyry. This high point does not seem to be due to the presence of the dikes, since a neighbouring elevation rises to 285 feet above the lake and on it only ellipsoidal-weathering greenstone occurs. In a section south from the narrows near the west end of Paint lake the gradient rises steeply to 100 feet at the top of the first ridge at a distance of only 6 chains from the lake. Thence steep-sided, east-west ridges rise successively higher to the most southerly one, from which the high land drops sharply to the sand plain in which lie Ida, Foxear, and Bush lakes.

A pronounced transverse valley leads south for over half a mile from the west bay of Paint lake between the ends of east-west ridges. The valley is wide with a drift-covered, flat bottom. There is no stream in it, but at the south end it is occupied by a lake, which is drained southward by a small stream with a valley much less well defined than the dry valley to the north. Another transverse valley is occupied by a stream of considerable size, which comes from the lakes south of the Sturgeon river and empties into the river opposite Kingston island.

On the north side of Paint lake ridges of greenstone rise steeply from the lake, but do not reach as great heights as do those on the south side. At the west end of Paint lake a valley with a broad, flat, sandy floor continues westward. North of Expansion lake the lavas form steep-sided ridges, but they are lower than those near Paint lake.

The sedimentary rocks do not form any pronounced elevations, but in many places along the south side of Paint lake the narrow band of conglomerate is a conspicuous feature because of the steep-sided ridge that it forms. A remarkable feature of this band is that though it forms the south shore of the lake for a considerable distance, yet the axes of the ridges are not parallel to the elongation of the lake. The subordinate ridges have a trend a few degrees to the north of the direction of the shore and they sink beneath the lake level as long narrow points, between which narrow bays extend westward. Thus the pattern is that of the edge of a rip saw with the slanting teeth pointing eastward (see frontispiece). Undoubtedly this is due to slicing of the band by faults at small angles to the general elongation of the band. Some of those that have considerable horizontal displacements are shown on the general map.

The granite area lying between Paint lake and the Sturgeon river rises steeply on the south side from the valleys separating it from the greenstone. On the north, east, and west sides, it sinks gradually beneath the cover of lavas. North of the Sturgeon river the country underlain by granodiorite and granite

rises gently from the river level to form the highest elevation in the eastern part of the Sturgeon river area. One and a half miles north of the river the elevation is 330 feet above the river. For much of the distance northward the rise is hardly noticeable, but the final slope to the top of the hill is very steep. The upper part is composed of rhyolite, which is interpreted as a remnant of the roof of the batholith. Beneath it the steep slope is underlain by granodiorite, which is thought to be a facies of the granite. Undoubtedly the hard and tough quartz porphyry capping has been the cause of the prominent hill.

The great granite area in the northern part of the township of Hipel reaches an elevation probably equal to if not greater than that of any other part of the area. The massive and uniform character of the rock, however, has not favoured differential erosion. Along the eastern boundary of Hipel township there is a gentle slope upward to the north as far as the 3-mile post. From that point north the granite forms ridges of considerable elevation. Along the north boundary of the township the elevation is also high, and half a mile south of the bench mark indicating the height of land, just west of the 3-mile post, a granite ridge forms a prominent landmark visible for several miles. Several inclusions of greenstone occur in the granite on the summit of the elevation. From the elevated area in the northeastern part of Hipel township the surface slopes downward to the basin-like depression in which Dumas lake lies.

The chief elevations of the eastern parts of Rickaby and Leduc townships are composed of glacial material. Ridges are not high, but most of them are steep-sided. Many of them are narrow but continuous for some distance. In places there are extensive sand plains, several feet below the general level of which the lakes and rivers lie in steep-sided valleys and hollows.

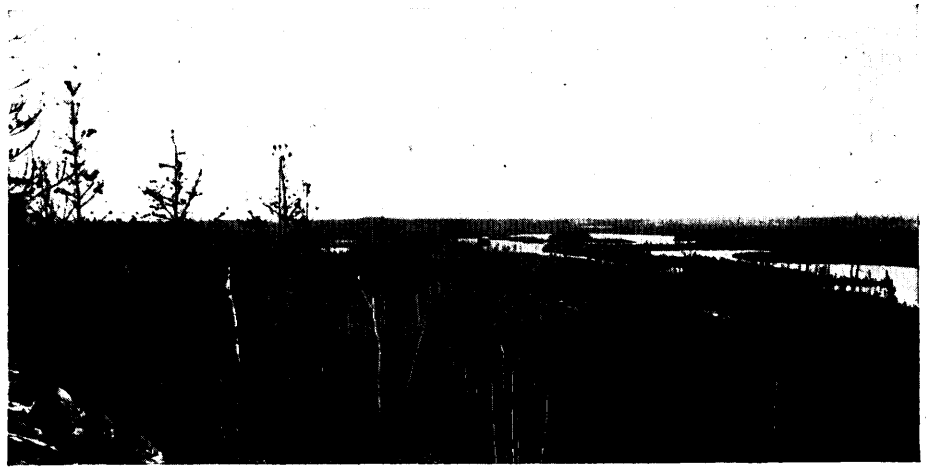
The Sturgeon is the chief river of the area. Into it Atigogama creek drains Atigogama lake and a large area of swampy country surrounding it. Three miles west of Atigogama creek a stream enters the Sturgeon river from the north, draining a group of lakes in the central part of Rickaby township. A mile and a half west of the Seven Foot falls a stream enters the river from the north. It drains lakes lying along the boundary line of the Nipigon Provincial Forest and is a canoe route to Onaman lake.

In parts the Sturgeon river has the character of a well-graded stream with meanders, oxbow lakes, and cutoffs. This part of the country is probably an old valley that was filled by glacial deposits in which the present stream has excavated its valley. In other parts, however, its course is interrupted by rapids and falls, at places where the stream has been forced out of the ancient valley and finds its way over rock ridges. From the rapids below Coral lake the river follows a straight course westward to the east end of Paint lake, dividing, however, into two channels around Kingston island. The westerly continuation of the valley is occupied by Paint lake for a distance of four and a half miles and the extension beyond the west end of the lake is broad, flat-bottomed, and floored with glacial sands. The Sturgeon river, however, does not enter Paint lake, but a short distance east of its east end turns sharply northeast and then north, flowing in a broad, shallow valley for a distance of 4 miles to Seven Foot falls. This northerly course is interrupted by only one short rapids where the river crosses a narrow ridge of rock. At Seven Foot falls the river again turns to the west, and a short distance farther down it curves to a southwesterly course. It seems possible that in pre-glacial times the river flowed through Paint lake and followed Foxear creek, at the mouth of which the present Sturgeon river again enters its old valley.

Dumas creek drains the lake of that name southward into the east end of Partridge lake. The creek carries a fair flow of water, and even in seasons as dry as the summer of 1936, it can be ascended by canoe as far as Dumas lake.

Blackwater river may be considered to have its source in Blackwater lake. There is, however, a stream of considerable size which rises in small lakes south of Colter township, flows northward across the south boundary of that township, turns sharply westward along the contact between the sediments and the lavas, and flows in a remarkably straight course, possibly along a fault zone, and empties into the southeast arm of Blackwater lake.

Below Blackwater lake the river is of fair size and although shallow in places can be used by canoes. The creek above Blackwater lake has been used as a canoe route for a distance of 4 or 5 miles, but is now impassable on account of logs.



Valley of Foxear and Ida lakes looking south from the ridge south of Paint lake.

Lakes are abundant, and some of them are of considerable size. Most of them are long and narrow, lying in rock basins between ridges of resistant rock. A few are in glacially dammed valleys or in shallow basins in glacial deposits. These are irregular in outline, since their shapes are not controlled by the structure of the consolidated rocks.

Oxaline lake is an excellent example of the first type, although less striking than some, since the south shore, underlain by sediments, is not nearly so precipitous as the north shore. Smaller lakes of this type on the canoe route from Oxaline lake to Beatty, Watson, and other lakes to the west are narrow, steep-sided troughs with somewhat gentler slopes at each end. Evidently they are merely rock trenches from which weathered material has been scooped out by the glaciers. Paint lake is long and narrow with steep shores on both sides, but it apparently forms the continuation of the Sturgeon River valley dammed at the western end of the lake by glacial deposits.

Lakes completely or entirely in areas of thick glacial deposits are of two types. Those that lie in the flat outwash deposits are irregular in outline. Thus Atigogama lake on the east boundary of Rickaby township is nearly equidimensional. Its shores are smooth and regular except where rock outcrops projecting through the glacial sands cause some diversity of shore line. Kaby

lake lying to the west of it is of similar character. Both these lakes are shallow. Where the glacial deposits are unmodified, the shapes of the lakes in them are controlled by the forms of the deposits. Thus Beatty lake is in part the type found in sand-plain areas, but the bays along the south shore are long and narrow since they lie behind esker ridges. In the same way, Blackwater, Ida, and Bush lakes are elongated parallel to the direction of the glacial ridges. The long peninsula in Ida lake is a narrow esker tied to the mainland to the south by a low outwash plain (see photograph on page 7).

In the granite areas some of the lakes have the roughly equidimensional form characteristic of lakes in massive rocks, but many are unusual in being somewhat elongated. In most areas elongated lakes can be assumed to lie in foliated rocks, but one such lake near the north side of the sheet, the rock around which was shown on previous maps as greenstone, apparently because of its shape, was found to lie entirely in granite. The elongation may be the result of weathering and subsequent gouging out of roof pendants of foliated or bedded rocks included in the granite. The map prepared from aerial photographs shows a striking drainage pattern in the area south of the map-sheet. The stream valleys have a marked net-like arrangement. It seems likely that jointing in a homogeneous rock, possibly granite, may be responsible for this pattern.

Swampy areas are extensive only in the northeastern part of the area, where the consolidated rocks are largely covered by flat glacial deposits of rather clayey character. In the rugged areas of the western part the valleys between the ridges are usually occupied by long, narrow cedar swamps or elongated lakes.

GENERAL GEOLOGY

All of the consolidated rocks in the Sturgeon River area are pre-Cambrian in age. Overlying them are sands and gravels of glacial origin, which are abundant in the eastern part of the map-sheet and mantle the consolidated rocks rather thickly in the basins of Beatty lake and the lakes forming the headwaters of Foxear creek and along the railway from Jellicoe to Jackpine. In other parts of the sheet they occur only as local sand plains and glacial ridges. Recent deposits of peat and river clays occur in some places.

The pre-Cambrian rocks consist of lavas both basic and acidic, tuffaceous rocks, and iron formation. On the basis of lithology and relation to other formations these are called Keewatin. Sediments consisting of conglomerate, greywacké, slate, and iron formation occur in synclinal troughs or as elongated, in-faulted bands in the Keewatin rocks. Later than the volcanics and probably later than the sediments are diorite, granite, which in places has a granodioritic facies, lamprophyre, feldspar porphyry, and diabase dikes. In this area the diabase occurs only as dikes, but large areas near Lake Nipigon are underlain by diabase, which probably occurs as sills.

Table of Formations

QUATERNARY	
RECENT:	Clay, peat.
PLEISTOCENE:	Gravel, sand, till.
	Unconformity
PRE-CAMBRIAN	
KEWEENAWAN:	Diabase dikes.
	Intrusive contact

POST-TIMISKAMING:	Green dikes (lamprophyre). *Intrusive contact* Granite; feldspar porphyry dikes. Granodiorite. *Intrusive contact* Diorite.
	Intrusive contact
TIMISKAMING(?) (Windigokan series):	Conglomerate, greywacke, slate, mica schists. Iron formation. Basic lavas.[1]
	Unconformity
KEEWATIN:	Iron formation. Lavas, mainly intermediate to acid in composition; agglomerate and tuff; schists derived from these. Lavas, mainly basic; ellipsoidal-weathering greenstones; derived schists.

Keewatin Series

The rocks assigned to the Keewatin series are mainly volcanic in origin. In the area south of Paint lake they are chiefly basic lavas with numerous bands of ellipsoidal-weathering greenstones. North of Paint lake the rocks of this series are much more heterogeneous. Flows of andesitic character are probably the most abundant type, but there are more acidic lavas and bands of agglomerate of considerable width. Bands of iron formation, some of which have widths of 50 feet, occur in the lavas of the Keewatin along the south margin of the map-sheet. In places all the rocks of this series have been rendered schistose, the schists varying from those high in chlorite to those made up chiefly of sericite and quartz.

The basic lavas lying south of Paint lake are similar both in the field and in thin section to the greenstones that have been described from other areas of Keewatin rocks. Here and there a band of white-weathering tuffaceous material is interbedded with dark-green lavas.

On account of the homogeneous character of these rocks only a few thin sections of them were examined. One taken from a point just south of Paint lake differs somewhat from the usual type of greenstone. It is a massive, dark-green rock, not ellipsoidal where the specimen was taken but showing well-developed ellipsoids 150 feet south. In thin section the rock is found to be made up chiefly of chlorite in larger than ordinary flakes and a considerable amount of pyroxene in large angular grains, which do not show crystal outlines. These have undergone no apparent alteration.

White, dense, tuffaceous rocks, which occur in places interbanded with the typical ellipsoidal-weathering greenstones, have commonly a faint, fine banding. In thin section they show a fragmental texture with angular grains of plagioclase and quartz in a matrix of calcite, sericite, and fine particles of plagioclase and quartz. These bands are apparently rhyolite tuff.

The Keewatin rocks north of Paint lake are of much greater variety than are those to the south. In the field an attempt was made to map separately rhyolites, andesites, and tuffs, but it was found difficult to outline the bands with certainty, and on the final map all have been grouped together. Probably the most widely distributed variety is well exposed along the high bare hills at

[1]Not differentiated on map from Keewatin lavas (see pages 15 and 16).

Martin rapids. The rock weathers light-grey and is dark-grey on fresh fractures. It has a porphyritic texture. The phenocrysts are dull-green in colour and look like well-formed feldspar crystals. Under the microscope the texture appears porphyritic with phenocrysts of feldspar, which, although the crystal outline is well formed, are skeletal in character with much more than half the area within the crystal boundaries consisting of material similar to that of the groundmass. Some hornblende phenocrysts are also present. The groundmass is made up of plagioclase with considerable secondary material, of which calcite, sericite, and epidote are the most abundant. The phenocrysts have the appearance of secondary crystals formed after the rock had consolidated. The fine-grained character and the composition of its alteration products indicate that the rock was originally a lava, possibly an andesite.

Most of the more acidic lavas are rhyolite, but certain bands are low in quartz and probably are trachytes. Others may be dacites. Those that are quite certainly rhyolites are porphyritic with conspicuous rounded phenocrysts of quartz visible in the hand specimens. Under the microscope a specimen from the southern part of the claims of the Sturgeon River Gold Mines, along the western boundary of T.B. 13,647, is a grey-weathering, fine-grained rock, which weathers to a hackly surface on which quartz grains stand in relief. Under the microscope the rock appears porphyritic, with phenocrysts of quartz and an untwinned feldspar. The former are large and rounded, evidently by resorption. The feldspars are much smaller and have skeletal outlines. Epidote is present in nests, which may be amygdules. The groundmass is fine grained. Minerals recognizable in it are quartz, feldspar in tiny elongated crystals, epidote, and sericite. A specimen taken 8 chains north of the No. 4 post of T.B. 13,402 (Agaura Exploration) was classed as quartz porphyry in the field. It is a greenish, siliceous-looking rock with conchoidal fracture. It weathers greenish-white. Microscopic examination shows that the phenocrysts are all lath-shaped feldspars. What looked like quartz phenocrysts in the hand specimen are mosaics of quartz grains, possibly the fillings of amygdules. The fine-grained groundmass seems to be mostly quartz and feldspar with some sericite. Some of the quartz, if not all of it, is secondary. Veinlets of quartz traverse the specimen. This rock may be either a trachyte or rhyolite. Other fine-grained grey rocks are equigranular. A specimen taken 14 chains northeast of No. 2 post of T.B. 16,734 is greenish-grey in colour weathering nearly white. It has a faint northeast-southwest foliation. Under the microscope it was found to consist mainly of a fine mosaic of light-coloured minerals, mostly quartz. Sericite is abundant, showing that feldspars were once present. Calcite makes up a considerable part of the whole and is in larger grains than the other minerals.

Northwest of the west end of Paint lake, the lavas are mainly andesitic in character, but certain bands appear somewhat lighter in colour. A specimen from one of these lighter-coloured bands was taken at a point 5 chains west of the No. 1 post of T.B. 13,146. Under the microscope it appears porphyritic with a large number of rather small, lath-shaped feldspar phenocrysts, many of which lie roughly parallel to each other, producing a trachytic texture. Many of the crystals show only Carlsbad twinning, but a few have albite twinning as well. The composition is near the boundary between oligoclase and andesine. Some of the larger crystals show a marked microperthitic intergrowth, in which lenses of a mineral of low birefringence is intergrown with the feldspar. These may also be feldspar with a particular orientation. Quartz is present, but only in small quantities. Sericite and calcite occur in the groundmass. The rock is considered to be a trachyte.

Certain light-coloured schists offer difficulty in identification. One such occurs on the Grierson claims east of the Sturgeon river in its northerly flowing part above Seven Foot falls. The rock in the pits on the south side of the lake expansion lying to the east of the river is very fissile; it weathers pale-yellow. Under the microscope it appears sparsely porphyritic with phenocrysts of an unidentifiable feldspar. Most of the rock is made up of secondary minerals, chiefly calcite, quartz, and sericite. The original of the schist was probably an acidic lava. A somewhat similar rock occurs with the greenstones on the south side of the great ridge of basic lavas south of Paint lake. It also is porphyritic with feldspar phenocrysts, which are not well developed and have a frayed appearance. Sericite is abundant.

Zones of fragmental rocks are rather common among the northern lavas. Commonly these do not seem to be continuous for long distances, which may be in part due to the difficulty in recognizing their fragmental character where not well exposed or where the surface is not free from vegetation. Many of these were recorded on the field maps, but the random character of their occurrence made it impossible to show them as separate units. The fragments in those seen in the area, are fine-grained, and many of them differ so little from the matrix in which they lie that they are difficult or impossible to recognize on fresh fractures. Most of the fragments are ellipsoidal in outline, but many are irregular in shape or subangular. In some outcrops the fragments are massive, and the slightly more schistose matrix curves around them. Less commonly the rock becomes a contorted chlorite schist, and the fragments drawn-out lenses.

The ridge in the centre of the Sturgeon river at the rapids half a mile below Seven Foot falls is fragmental rock. The "pebbles" are well rounded but differ little from the matrix in appearance. A thin section of the matrix shows a porphyritic texture with plagioclase of the composition of an acid andesine in a groundmass of chlorite, epidote, calcite, sericite, and feldspar. Quartz fringes occur at the ends of some of the phenocrysts, probably as the result of precipitation of quartz derived from the alteration of silicates. The amount of epidote present seems to indicate the introduction of considerable foreign material. Taken by itself the section would be considered to be an andesine porphyry. It is probable, therefore, that the rock is a volcanic fragmental of andesitic composition. This is considered to be the origin of all the fragmental lenses in the lavas of the eastern part of the Sturgeon River area.

Many other variations could be noted among the volcanic rocks, but only by mapping on a large scale in detail could they be differentiated.

The iron formation is similar in all respects to that described from other areas of Keewatin rocks. It occurs in contorted bands up to 50 feet in width. Most bands are thinly bedded with layers made up chiefly of magnetite alternating with layers composed of white sugary quartz or jasper. In other places chloritic bands alternate with quartz bands.

The attitude of the Keewatin rocks is difficult to determine with any accuracy. The directions in which the tops of some of the flows face are recorded on the map at many places south of Paint lake. The determinations were made on the shapes and relations of the ellipsoids, and no great accuracy is claimed for them, since the reliability of the method is doubtful in areas where there has been much disturbance. According to the same criteria the dips are steep. The strike of the flows is indicated in a general way by the mapping of various lava types. It is nearly east-west near Paint lake and swings to a direction approximately N. 60° E. at the east side of the sheet. Where there are tuffaceous

beds the dips and strikes can be determined with certainty. Some of these are shown on the map.

The major structure of the Keewatin rocks has not been determined. The occurrence of the basic, ellipsoidal-weathering greenstones on Paint lake and of a much more variable assemblage to the north seems clearly to indicate folds of great amplitude, but whether the basic types are above or below the less basic group is as yet not known. If the determination of the position of the lava tops is correct, then the northern beds near the north edge of the basic division face north. In that case the axis of a major syncline lies well north of the Sturgeon river. No ellipsoidal structures occur on the north side of Paint lake, and the northward-facing attitude of the greenstone immediately south of the lake is not due merely to a minor synclinal structure in which the Paint lake conglomerate band lies. The ellipsoidal structures indicate, however, a minor syncline, the axis of which is approximately half a mile south of the lake.

The lavas and sediments in the southern parts of Legault and Leduc townships are probably in fault contact. Schistosity is in most places nearly east-west in strike and vertical.

The similarity of the types of rocks in this assemblage to those of the original Keewatin series and to those that have customarily been so called and the position of the series at the base of the geological succession of this area seem to warrant the assigning to all the volcanic rocks the term Keewatin. It must be understood, however, that the use of the term does not imply strict contemporaneity with all other series of similar lithology that have been called Keewatin.

Timiskaming(?) Series

Three east-west belts of sediments occur in the southern part of the area. The narrow northern one extends along the south side of Paint lake eastward to the east edge of the map-sheet. It has also been traced eastward across the adjoining area, and the outcrop of conglomerate shown on the Little Long Lac map-sheet near the northwest corner of the township of Lindsley seems undoubtedly to belong to this band rather than to the larger band that lies south of Little Long Lac. The central band of sediments underlies the valley occupied by Beatty lake and the lakes lying east and west of it. This band does not extend eastward beyond the Sturgeon river. The southern band is the westward continuation of the Little Long Lac syncline. In the present map-sheet it underlies the area south of Partridge and Oxaline lakes, comprising nearly the whole southern part of the townships of Legault, Leduc, and Walters. The southern margin of the belt is marked by the great linear valley occupied by the creek that flows east to Blackwater lake.

The presence of an area of basic lavas southwest of Jellicoe is difficult to explain on any other assumption than that they belong to a period of volcanic activity in the Timiskaming.

Lithology

The rocks of the Timiskaming series vary considerably in character. Nearly all of them are clastic sediments ranging from coarse conglomerate to greywacké slate and mica schists. There are also bands of iron formation, probably formed by chemical precipitation. At Paint lake the sedimentary band is made up entirely of conglomerate. At Beatty lake, conglomerate with some bands of greywacké occurs along the north and south sides of the band; in the centre are outcrops of slate.

The southern band consists largely of greywacké. A small outcrop of conglomerate occurs on the north shore of Oxaline lake. Any continuation of it there may be to the east is concealed beneath the broad swampy valley through which the stream draining the lake flows. To the west it lies beneath the waters of the lake. A rather continuous band of iron formation extends eastward from Nissiamkikam lake and is exposed on a point projecting from the south shore of Oxaline lake. To the east it is covered by the waters of the lake. A small exposure, probably of the same band, occurs in the low land south of the stream draining the lake, at a point half a mile east of the lake. Iron formation has been located by magnetic disturbance south of Partridge lake and outcrops at one place along the south shore near the west end.

Sediments more highly crystalline than the normal greywacké occur in the southern parts of the townships of Legault and Colter. These are granular, glistening micaceous rocks, usually grey to nearly black in colour. In places there is well-developed schistosity. A thin section from a specimen taken half a mile east of the south end of Patsy lake contains quartz plagioclase, biotite, actinolite, calcite, and pyrite. Quartz makes up approximately 60 per cent. of the rock. Some of it is in relatively large grains, which range from 0.25 to 1 millimetre in diameter. Some grains consist of parts of two or more crystals, and a few are composed of quartz and feldspar. These larger particles are set in a mosaic made up of quartz and plagioclase with considerable biotite and some green amphibole, possibly actinolite, and a little chlorite. The plagioclase seems to be of two varieties. The more abundant one has narrow twinning *lamellae*, which give extinction angles corresponding to oligoclase. The other variety has broad twinning *lamellae*; extinction angles indicate that it is andesine. Biotite occurs both as tiny, well-formed foils lying between the grains of the quartz feldspar mosaic and as irregular flakes surrounding quartz or feldspar. A green amphibole, possibly actinolite, is in lath-shaped crystals with irregular terminations. Some of them are 0.6 millimetres long and 0.1 millimetres wide. They contain rounded grains of quartz and in places are interrupted by quartz, but probably the quartz that appears to cut across a lath is merely embedded in one side of the prism of amphibole. Pyrite and calcite are present but are not abundant.

A specimen rather similar in appearance to that just described was collected from a small outcrop on the bank of the Sturgeon river about 2 miles south of the south boundary of Colter township. Under the microscope it has the same textural character, but feldspar is almost entirely lacking. Biotite is in tiny and irregular flakes, and green amphibole in lath-shaped crystals. A fine-grained, black slaty rock 30 chains north of the 4-mile post on the south boundary of Colter township shows a well-marked foliation in thin section. It consists of quartz, biotite, chlorite, and sericite. Biotite is less abundant than in the previously described rocks and is in extremely intimate intergrowths with chlorite. In places alternate bands of chlorite and biotite form what appears to be a single flake. In other places chlorite almost completely surrounds biotite but without any clear indication of the direction in which alteration may have proceeded.

All of these micaceous rocks are without doubt metamorphosed clastic sediments.

Tanton mapped the micaceous rocks as a separate group. His map[1] shows a narrow band of them extending westward from the Sturgeon river to

[1]Map No. 1836, Geol. Surv. Can., 1921.

Patsy lake. The first specimen described above is from that band. There is a distinct lithological difference between the normal greywacké and the micaceous rock, but it seems possible that metamorphism could have produced the latter from the former. Chlorite, sericite, plagioclase, and limonite could have supplied the materials necessary for the formation of biotite and amphibole. Hence, as no positive evidence was found indicating a difference in age and as in places there seems to be a gradation between the two types, the micaceous rocks have been included in the Timiskaming series. Langford[1] suggested the derivation of biotite from the matrix of finer material in which the quartz and feldspar grains of the greywacké are embedded. He also states:—

> In travelling south . . . one is impressed by the gradual increase in the amount of biotite which occurs in the greywacké. This change is not entirely gradational, as highly micaceous bands are often interbedded with other bands which are relatively free from mica.



Squeezed conglomerate, south shore of Paint lake.

The conglomerate contains pebbles of jasper, quartz, chert, granite, quartz porphyry, and dark-coloured rocks that are similar to types found among the lavas of the Keewatin. One pebble of granite from the Beatty lake syncline was examined microscopically. It is typical granite, not very badly altered, with zonally grown feldspars of the composition of oligoclase. Ferromagnesian minerals are rare and almost completely chloritized. The remnants show that they were brown hornblende. For the most part the pebbles are of fairly large size. Where they are not distorted, granite fragments are ellipsoidal in shape with diameters up to a foot or more. Pebbles of other rock types are generally smaller. All are fairly well rounded. In many places, especially in the northern band, the original character of the rock is masked by the dynamic metamorphism it has undergone. Pebbles are so fractured or drawn out that the original shapes are entirely changed (see photograph above). Granite boulders, strangely enough, have suffered distortion to a remarkable degree but with striking variations in the effects produced on neighbouring pebbles. Thus one pebble

[1]Geo. B. Langford, "Geology of the Beardmore-Nezah Gold Area," Ont. Dept. Mines, Vol. XXXVII, pt. 4, 1928, p. 94.

of granite may be much elongated and even be squeezed into an hour-glass shape by granite pebbles lying against it which have not noticeably lost their normal ellipsoidal form. One such squeezed pebble was found with a length of 72 inches and a width of only 6 inches; another is 78 inches long and 12 inches wide. The matrix of the conglomerate has the composition of greywacké.

The greywacké of the series is a massive, somewhat foliated, grey, granular rock, weathering greenish-grey. Commonly, bedding is not noticeable except where there are lenses or bands of iron formation. A sample of massive character from the north shore of Beatty lake under the microscope shows a clearly fragmental character. Most of the fragments are irregular to subangular. The larger ones are quartz; plagioclase is also present. Many of the quartz fragments are made up of parts of two or more crystals. The matrix is composed of small grains of quartz and feldspar along with calcite and foils of sericite, which curve around the larger grains of quartz and plagioclase. Chlorite occurs in lenses and gives the dark colour to the rock.

In the vicinity of Beatty lake glacial deposits are extensive, and outcrops of the rocks of the syncline of Timiskaming sediments are neither abundant or extensive. Slates occur at only a few places. One of the best exposures is at the east end of Beatty lake at the beginning of the portage leading eastward. The rock is a fine-grained, soft, fissile, black slate in which no bedding can be detected. Slate outcrops between Ida and Bush lakes.

An area of massive, dark-greenish rocks occurs along the railway in the western part of the township of Legault. In general appearance they so much resemble greenstone that they were at first thought to be lavas. Certain dioritic schists north of the railway that look like the schists developed from basic volcanics were traced westward into well-banded slaty greywackés, and at one place along the railway the massive greenish rocks also show faint banding. Under the microscope thin sections from outcrops on the railway just west of mile 46 show that the rock has a typical clastic character with fragments of quartz and plagioclase in a groundmass of chlorite, sericite, and carbonate. The fragments are much smaller than those of the typical greywacké. It is likely that the original sediment was fine-grained and argillaceous.

The band of iron formation mentioned above as extending from Nissiamkikam lake eastward is well exposed by trenching for several hundred feet on the property of the Oremond Gold Mines near the west boundary of the township of Leduc. It consists of interbanded white and reddish quartz and dark bands made up of a mixture of hematite and magnetite. Shearing along the bands has produced lustrous cleavage or parting planes. The width depends upon the definition of iron formation. Even where the proportion of iron is highest there are narrow beds of greywacké intercalated, and the formation grades out through lean iron formation to greywacké with only a few thin bands of iron minerals. Near the west boundary of Leduc township, that part that may without doubt be classed as iron formation is about 50 feet in width. On the point extending northeastward from the south shore of Oxaline lake, claim T.B. 11,713, the width is approximately 30 feet, but the whole formation is lean. The exposure in the low ground east of Oxaline lake is only a few feet wide; the total width of the band at that point cannot be seen. A small outcrop occurs on the south shore of Partridge lake, and the band has been traced by magnetic surveys eastward to the Little Long Lac area.[1]

The Timiskaming iron formation is somewhat contorted but less so than

[1]A map showing the position of this band was kindly furnished by E. F. Creelman.

the Keewatin iron formation, possibly because the presence of hematite in the iron bands facilitated slipping within the beds.

Basic volcanics occupy an elliptical area within the sediments southwest of Jellicoe. Lithologically the rock is similar to the basic volcanics classed as Keewatin. Ellipsoidal structures are well developed south of Spring lake and between the railway at the western yard limit and Blackwater lake to the north. Strikingly amygdaloidal beds occur south of the railway not far west of Jellicoe. In places the bedding of the surrounding greywacké strikes in such a direction that the sedimentary beds appear to abut directly against the lavas. Since the beds are vertical or nearly so, it is impossible that the flows can be an underlying floor of Keewatin rocks. No system of faults has been observed that would explain the presence of an elliptical mass of older rocks completely surrounded by the sedimentary series. On the evidence at hand it must be concluded that these rocks belong to a volcanic series interbedded with the sediments and therefore of Timiskaming rather than Keewatin age. Were they not completely within the sediments they would undoubtedly be considered as part of the Keewatin series, and as no confusion can be created by using the same colour as that used to designate the older series, no separate designation is used for them.

Structure

The occurrence of slate in the central part of the Beatty Lake belt of sediments suggests a synclinal structure. The pitch must be to the west since the belt narrows to the east. However, in the vicinity of Beatty lake no internal structures were found to corroborate this hypothesis. The greywacké south of Oxaline lake is the continuation eastward of the belt studied by Langford.[1] He considered it to be synclinal but mentions that in places the contact is a fault.[2]

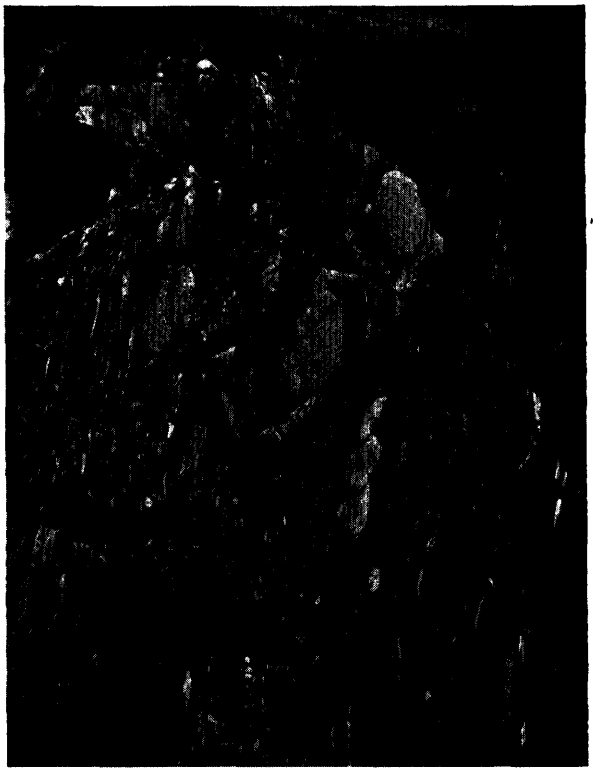
The Paint Lake belt consists entirely of conglomerate and shows no evidence of synclinal structure. Along the northern edge of the sediments it is difficult actually to determine the contact at many places, as massive greenstone grades into chlorite schist and this finally into schistose conglomerate. Apparently the contact is a zone along which movements have obliterated the normal relations of the younger to the older series. In places along the south side, the lavas and the conglomerate can be seen to be in fault contact. Furthermore, a band of conglomerate only a few chains in width persisting for several miles is difficult to explain as a synclinal remnant.

The lavas south of the conglomerate are ellipsoidal; those to the north of Paint lake are not. It seems likely that the band is an in-faulted remnant in the lavas. The greater width of the belt in certain parts is no doubt due to faulting. Evidence as to the direction of movement along the strike faults is contradictory, probably because the movements are not all of one period. Some of the pebbles are still ellipsoidal in shape, others are drawn out into thin lenticles; the elongation appears to be nearly east-west, parallel to the trend of the band. At an outcrop near the east end of Paint lake a pebble still ellipsoidal in shape, with its longest axis in an east-west direction, is fractured along approximately vertical planes, which strike northwest-southeast. Each section has been shifted southward with respect to the adjacent part to the west of it (see photograph on page 17). If the elongation is parallel to the sedimentary belt, then the fractures in the pebble represent one set of the shear planes developed during the deformation. It is likely, however, that the fracturing was a late event, occurring

[1]Geo. B. Langford, op. cit., p. 98.
[2]Ibid, p. 93.

as the containing pressures that made possible the elongation shown by many other pebbles became less and permitted fracturing to take place.

Near a prominent conical hill of conglomerate three-quarters of a mile north of the east bay of Beatty lake the conglomerate and greenstone are in contact along a vertical east-west fault. Axes of drag folds in the sediments strike S. 55° W. and plunge southwest at angles of 55 degrees. If the faulting is responsible for them, the shapes of the drag folds show that the rocks south of the fault must have moved westward and upward relatively to those to the north of it. On the other hand, along the north side of the conglomerate, a mile west of the



Fractured pebble from conglomerate south of Paint lake.
(Photograph by W. Sutton.)

narrows at the east end of Paint lake, drag folds in the conglomerate have nearly vertical axes and indicate that the rocks to the north also have a relative movement to the west. This seems difficult to understand unless there was more than a single period of displacement. There are faults the directions of which lie between N. 50° E. and N. 60° E., oblique to the general strike of the formations. These are commonly not single fractures but rather zones of schistosity along which there has been considerable movement. Topographically, they are indicated by the serrated character of the south shore of Paint lake. In a general way the shore is exceptionally straight, but in detail it consists of many narrow points, behind which are long narrow bays extending back westward behind the easterly projecting points. The general direction of the lake is

apparently controlled by the east-west elongation of the conglomerate belt; the serrated details of the shore line are the result of the shear zones inclined at a small angle to that direction (see frontispiece).

Diabase dikes indicate the existence of another set of fractures, which strike nearly north-south and are apparently vertical. In places there is a small offset of the formations along the dike, in other places there seems to be none. These fractures may be tensional, normal to the elongation of the deformed mass. The pattern of the fractures indicates a shortening in a north-south direction, with the intermediate axis of strain vertical. No doubt the stress was rotational; it seems certain that it acted horizontally.

Origin

The conglomerate contains pebbles of rocks similar to those that occur in the vicinity, but as this was an area of sedimentation, the area in which the pebbles originated must have been at some distance away. Wherever it was, it supplied debris similar in composition to the local Keewatin rocks and also large quantities of material from rocks of granitic character. Boulders of granite of some size are included in the conglomerate; a large part of the granitic debris is the finer-grained quartz and feldspar of the greywackés. Not all of this, of course, came from granite, since the rhyolites and rhyolitic tuffs were capable of supplying quartz and feldspar sands. The material of the Timiskaming slates probably was derived mainly from the weathering and disintegration of the basic Keewatin lavas. An important feature of the Timiskaming sediments of this area is the rather marked lateral gradation that must be assumed if the Beatty Lake band and that south of Oxaline lake are to be considered as parts of the same series. The Beatty Lake band has a thick conglomerate along the north side and one apparently somewhat thinner along the south side. Little conglomerate has been observed along the north side of the southern band. If there has been no extensive faulting, the conglomerate horizon thinned out completely before the locus of deposition of the Oxaline lake greywacké was reached by the transported sediments. Thus the source of the debris was to the north. It must be recognized, however, that the distance in which the conglomerate lens thins from a thickness of at least several hundred feet till it vanishes was originally much greater than the apparent distance on the present surface, since the sediments are folded into a great syncline, the depth of which is unknown.

From the largely clastic character of the Timiskaming rocks, the coarse and heterogeneous character of the conglomerate that makes up a great part of the northern exposures, the rapid thinning out and disappearance of it to the south, and the comparative freshness of the constituent minerals, even of the greywacké, it is concluded that the material from which the Timiskaming rocks was formed came from some area to the north of the Sturgeon river, that it was not transported far, and that it was carried in rapid streams flowing down from an elevated region being so rapidly dissected that the rocks were disintegrated without any deep weathering. Probably the sediments were deposited as a series of piedmont fans. Here and there, however, there must have been areas into which no clastic material was carried and in which the iron formations so prominent both east and west of this area were laid down in lenses interbedded with sandy sediments.

Age and Correlation

The Timiskaming series lies upon the lavas and associated rocks of the Keewatin series, from which it is separated by a great unconformity. The

unconformable relationship is not recognizable along any contacts observed. Here, as in the Beardmore-Nezah area, fault zones separate the two series where they have been seen together. Nor has there been found structural evidence to show even that the sediments lie above the lavas. The conglomerates did not lend themselves to the development of drag folds, and there is no regular grain gradation. The fact of an unconformity between the lavas and sediments must be inferred from the fact that pebbles of rocks similar to those of the Keewatin are found in the conglomerates of the sedimentary series. The most conclusive evidence of unconformity is the abundance of granite pebbles in the conglomerate and the quantity of quartz and feldspar that the greywacké contains. It is clear that there must have been a period of disturbance of mountain-making magnitude during which granites were intruded and that the erosion that followed was of sufficient depth to expose the granite, at some place near enough to the area in which the Timiskaming sediments are found, to supply the material for them. It is natural to assume that the rocks that were disturbed by this orogenic period, and into which granite was injected, were those that have been called Keewatin. To deny that hypothesis would require the assumption that there was a period of granite intrusion prior to the extrusion of the lavas and, by the same line of argument, the presence of some series into which the granite was intruded—a series older than any of the rocks that have been recognized. The observed facts fit the simpler hypothesis. No doubt the floor upon which the Timiskaming sediments were laid down was subjected to deep erosion before it became the site of deposition. All this implies the lapse of a long period after the formation of the Keewatin series before the Timiskaming sediments were laid down. It means a major unconformity between the two series. This interpretation differs from the impression of Langford[1] that there is no great unconformity between the two series.

Tanton in the table of formations in his report[2] states that the contact between the Windigokan series and the schist complex shows very slight structural discordance, and Langford[3] quotes Tanton as stating that the Timiskaming rocks truncate the Keewatin at angles less than 5 degrees. During the present work no contacts were observed where the Keewatin lavas were sufficiently well stratified to make possible accurate measurements of their attitude, and only rarely could dip and strike be determined in the basal members of the Timiskaming series. Even were beds of the Timiskaming locally found to be parallel to the bedding of the Keewatin lavas, it would not necessarily prove that there is not a profound unconformity between the two series, since it is possible that series between which there is in general marked structural discordance may locally lie in apparent perfect conformity.

The problem of the name to be applied to the post-Keewatin sediments was discussed in the report on the Little Long Lac area,[4] and the term Timiskaming was decided on, implying a tentative correlation with the Timiskaming series of the Lake Timiskaming area. Following Langford's use in the Beardmore-Nezah area this term is here used to include all of the sediments of the eastern part of the Sturgeon River area except the older iron formation and sediments associated with it. The term Lower Huronian was used by

[1]Geo. B. Langford, op. cit., p. 94.
[2]T. L. Tanton, Geol. Surv. Can., Sum. Rept. 1917, pt. E, p. 1.
[3]Geo. B. Langford, op. cit., p. 94.
[4]E. L. Bruce, Ont. Dept. Mines, Vol. XLIV, pt. 3, 1935, pp. 19, 20.

Coleman[1] and Moore[2] for the conglomerate and the closely associated iron formation and greywacké, but they placed large areas of greywacké in the pre-Huronian complex. Tanton[3] introduced the term "Windigokan," under which he included conglomerate, slaty iron formation, and greywacké. On his map,[4] however, large areas are shown as pre-Windigokan schist which actually are underlain by greywacké.[5]

In using the term Timiskaming for this series, it is realized that proof of equivalence in age of terrestrial sediments over a distance so great as that from Lake Timiskaming to Lake Nipigon is impossible. For that reason, the use of a local term, as adopted by Tanton, is undoubtedly preferable from a purely scientific point of view. As the series is, however, lithologically similar to the original Timiskaming and occupies a similar position in geological columns that appear comparable, it was decided to use the term Timiskaming, thereby conveying to those familiar with the rocks of the original Timiskaming area a notion of the kind of rocks which occur in the post-Keewatin series in the eastern part of the Sturgeon River area. The sediments of the southern part of the Little Long Lac sheet have now been traced westward with no interruptions through the townships of Colter, Legault, Leduc, and Walters.

Post-Timiskaming

Intrusive rocks of considerable variety and of different ages occur in the eastern part of the Sturgeon River area. Diorite similar to that in the Little Long Lac area forms irregular masses and dikes. Granite and granodiorite, apparently genetically related, occupy large areas of the northern parts of the map-sheet. Lamprophyre dikes, most of which are small, occur in the granite and in the rocks older than the granite; some of these a few feet in width have been observed cutting the diabase.

Diorite

Irregular masses and dikes of diorite cut the Keewatin volcanics and Timiskaming sediments. It is difficult to be certain of the character of some of the dioritic rocks and to determine whether certain occurrences are sills of diorite or the coarsely crystallized interior portions of thick flows. Thus it may be found that certain outcrops have been mapped as diorite that should have been included with the lavas; on the other hand, some coarsely crystallized lava may be shown as an intrusive. The determination of the character of the dioritic rocks north of Oxaline lake and of those between the lavas and sediments in the southern part of Legault township was especially difficult. The boundaries of the diorite at Oxaline lake were fixed largely on the lithological character of the rock; intrusive relationships were not established with certainty. A dike of dioritic character traverses the sediments in the southwestern part of Legault township and no difficulty arose in recognizing its character, but differentiation

[1]A. P. Coleman, Ont. Bur. Mines, Vol. XVI, pt. 1, 1907, pp. 112, 113; Vol. XVII, 1908, pp. 140-143.

[2]E. S. Moore, Ont. Bur. Mines, Vol. XVI, pt. 1, 1907, pp. 139, 146, 147; Vol. XVII, 1908, pp. 176, 183.

[3]T. L. Tanton, Geol. Surv. Can., Sum. Rept. 1917, pt. E, pp. 1, 2.

[4]Map No. 1836, Geol. Surv. Can., 1921.

[5]In the report dealing with the Little Long Lac area (page 19) the statement was made that "all the sediments of the Little Long Lac area" were placed by Tanton "in the schist complex." The statement should have read "most of the sediments", since on Tanton's map a small area of Windigokan rocks is shown on the claims of the Hard Rock Gold Mines.

from the greenstone is not easy, especially where the rocks are somewhat sheared.

The dike that cuts the sediments in the central part of Legault township is 150 feet in width. The rock is greenish in colour and weathers brown. The texture is granitoid. In thin section it is seen to be holocrystalline, with plagioclase, amphibole, quartz, and micrographic intergrowths of quartz and feldspar as the chief mineral constituents. Magnetite forms about 2 per cent. of the rock; chlorite and sericite are the alteration products. The rock is not severely altered. The plagioclase has the composition of andesine of intermediate type Ab_5An_5. As primary quartz forms approximately 10 per cent. of the rock, it is properly a quartz diorite.

Rocks of dioritic appearance outcrop as a rather continuous band in the remarkably straight and deep valley occupied by the creek flowing into Blackwater lake from the east. In few places can intrusive relationships be found. At a point a quarter of a mile east of the south end of Patsy lake in Legault township, a tongue of diorite appears to cut across the greywacké. Generally the diorite is not in contact with the sediments, and in appearance it is so similar to the massive greenstone to the south that the exact contact between the two is not easily located.

Outcrops southeast of Patsy lake consist of massive, greenish-white rock of a medium-grained, granitoid texture. In thin section these rocks appear holocrystalline, with plagioclase and amphibole as their chief constituents. The plagioclase is so badly altered that it is not possible to determine its variety. Some chlorite is present. The rock is considered to be diorite.

The prominent point projecting from the south shore of Blackwater lake southeast of the railway crossing consists of greyish-weathering, coarsely crystalline rock, which on fresh fractures shows a granitoid texture with greenish-black hornblende crystals and a greyish groundmass. Under the microscope specimens of this rock of medium grain appear porphyritic with blocky hornblende phenocrysts. The crystals are frayed along the edges, and apparently the mineral has been uralitized. The groundmass consists of plagioclase, which has the composition of acid andesine. Sericite and chlorite are present as alteration products. A coarse-grained variety consists of the same minerals. Hornblende phenocrysts make up about one-third of the whole. They are frayed along the edges, and needles of pale-green amphibole are scattered through the groundmass. The feldspars are lath-shaped and are not severely altered. The variety is andesine. Chlorite, calcite, and epidote are present. The microscopic character, as well as the appearance in the field, indicates that these rocks are probably intrusives of dioritic character. No contacts against other rocks, however, were found.

Coarse-grained basic rocks in the vicinity of Oxaline lake offered the greatest difficulty in satisfactory determination and mapping. The high ridge forming the south shore of the western arm of the lake, the prominent ridge rising from the north shore of the lake, and other ridges lying between Oxaline and Beatty lakes are of this kind.

At the eastern extremity of the ridge south of the lake, the rock exposed along the shore has a medium-grained, granitoid texture and a grey, pepper-and-salt appearance. Under the microscope it appears holocrystalline, with plagioclase, quartz, hornblende, and pyroxene as the chief constituents. The plagioclase has an obscure ophitic habit but is so badly altered that the variety is not determinable. Much of the pyroxene has gone over to hornblende, and

there is considerable chlorite present as a further alteration product. Quartz occurs fairly abundantly. A specimen taken from a ridge of coarse-grained, speckled, grey rock, 35 chains north of the west end of Oxaline lake, is much the same in mineral constituents, but quartz does not occur. Both of these rocks seem to be altered diabase.

Similar rocks occur on the south side of the ridge along the north shore of the lake. Between Oxaline lake and Beatty lake another area was found which extends westward into the township of Walters. Traverses from Oxaline lake northward failed to show satisfactory intrusive contacts, and in places it seemed that the whole might belong to the volcanics. The width of the zones of coarse-grained rocks seems, however, to be much too great, compared with that of the ellipsoidal and tuffaceous bands, to be explained as the thick parts of the flows. In places, coarse-grained rocks are in sharp contact with ellipsoidal greenstone. The areas shown as diorite on the map are outlined on lithological character only.

A considerable number of thin sections of the dioritic rocks of this part of the area were examined. All appeared under the microscope as holocrystalline, somewhat altered rocks, apparently originally of the composition of quartz diorite. A specimen from the shore where the lake bends westward is a fairly coarse grained rock with a pepper-and-salt appearance due to white feldspar and greenish amphibole in about equal proportions. Under the microscope it shows an ophitic texture. The feldspars, however, are so cloudy that the variety cannot be determined. Micrographic intergrowths of quartz and probably a feldspar are fairly abundant. No ferromagnesian mineral that can be considered primary is present. They are now represented by fibrous amphibole and chlorite. A little pyrite is present. Ten chains north of the place where the specimen was collected the rock has a somewhat similar speckled brownish surface. Where freshly broken it is greenish and is coarser in texture than the rock at the shore. Under the microscope only quartz and micrographic intergrowths can be recognized as primary constituents. All other original minerals have been altered to masses of amphibole, chlorite, epidote, and other unrecognizable secondary products.

Half a mile north of the lake a speckled, greyish rock of medium granitoid texture appears holocrystalline under the microscope, with the primary minerals plagioclase, hornblende, and quartz recognizable. The feldspars are so clouded, probably by kaolin, that the variety is not determinable. The ferromagnesian minerals are blocky hornblende crystals, which may be original, and abundant chlorite. This rock seems undoubtedly to have been a quartz diorite.

At some places along this band, shown as diorite on the map, the rocks are less altered. Thus at a point 65 chains north of the No. 2 post of claim T.B. 11,706, the rock is greyish in colour and medium to coarse in grain. Ophitic texture can be recognized in the hand specimen. The microscope shows that the ophitic texture is less well developed than would be expected from the appearance of the hand specimen. The feldspars are lath-shaped but not very well formed. The variety is basic andesine. Quartz and micrographic intergrowths are present as primary constituents. The basic minerals are completely chloritized.

The dioritic rocks north of Oxaline lake are in places in sharp contact with ellipsoidal-weathering lavas and with tuffaceous beds. Traverses were made across the complex at closely spaced intervals in an attempt to find out whether the coarse-grained rocks are intrusive or merely the thick portions of basic

flows. No intrusive contacts were found, but on the other hand the thickness of coarse rocks lying between bands of ellipsoidal material seems too great to be explained as part of a single thick flow, and no regular gradation in grain size was observed. It was concluded, therefore, that these rocks are intrusive, probably as sills into the lavas.

Burrows shows the rocks along the north shore of the western part of Oxaline lake as diabase.[1] Some varieties are diabasic in texture, but these rocks are much more severely altered than the diabase classed as Keweenawan. It seems likely that they belong to an earlier intrusive period and are of the same age as the diorite dikes that cut the Timiskaming and are cut by the Keweenawan diabase.

Granite and Granodiorite

Granite is the consolidated rock of most of the northern part of the township of Hipel. Another large area lies in the northern part of the township of Rickaby. Granite forms the divide between Paint lake and the Sturgeon river and is nearly continuous with a great mass of granitic and granodioritic rocks that outcrops north of the river in the township of Elmhirst. The distribution and extent of these and the location of other small bodies that may belong to the same period can best be grasped by referring to the general map.

Most of the granite in Hipel township is a porphyritic pinkish variety. Toward the northwestern part of the township, however, there are areas in which the granite is white but differs in no other way from the pink type. In places the feldspar phenocrysts are an inch and a half in length, but the average is about three-quarters of an inch. A specimen chosen for microscopic examination has pink feldspar crystals three-quarters of an inch in length. The groundmass is coarsely granitoid in texture with a considerable proportion of dark-coloured minerals. In thin section the porphyritic habit is not recognizable because of the coarse grain of the rock. The chief minerals present are orthoclase, plagioclase, microcline, and quartz. The plagioclase is basic oligoclase in composition. The accessory minerals are hornblende, biotite, titanite, and augite. Sericite and chlorite are present as alteration products of the primary minerals but are not abundant. The orthoclase is somewhat cloudy, probably with kaolin.

A specimen from the western extension of this batholith in Lapierre township is a finer-grained, pink granite, in which only augite occurs as a primary ferromagnesian mineral. The alteration products are more abundant, and epidote is present as well as chlorite and sericite.

In places this granite seems to have had considerable effect on the lavas with which it is in contact. A specimen of speckled rock from the northeastern part of Lapierre township under the microscope appears as a mosaic of quartz grains, in which there are rods and bundles of tremolite. The rock is not unlike a quartzite, but is thought to be a portion of the lava that has been thoroughly silicified. The inclusions of lavas in granite in the northwestern part of Hipel township show considerable alteration.

In the centre of the boss between Paint lake and the Sturgeon river the granite is a normal type. A specimen taken 20 chains north of the east end of Rita lake (which is half a mile south of Martin rapids on the Sturgeon river) shows no traces of contamination by inclusion of older rock and is considered

[1]A. G. Burrows, Ont. Bur. Mines, Vol. XXVI, 1917, map No. 26b.

to be representative of this southern area. Under the microscope it appears to be fairly fresh. Quartz is abundant. Plagioclase is the variety oligoclase, and there are micrographic and microperthitic intergrowths. Sericite is scattered throughout the rock, and there is some chlorite that shows brilliant blue interference colours.

A specimen from the mass north of the Sturgeon river, taken a mile and a quarter north of the river, is coarse-grained in texture and pink in colour. The microscope shows that it contains quartz, microcline, oligoclase, and hornblende as primary constituents, and kaolin as an alteration product of the feldspar. The rock is not severely altered.

A salient from the large mass of granite in Rickaby township extends eastward to Atigogama lake. In that part of the boss the granite is grey. Under the microscope it is found to contain quartz, oligoclase, biotite, and magnetite as primary minerals, and epidote, chlorite, sericite, and kaolin as alteration products. This rock is much more severely altered than either of the other two, and the plagioclase contains abundant sericite and kaolin. Biotite is segregated in groups of small crystals. This specimen is possibly not a fair sample of the normal rock of the boss, as it was taken not more than 300 feet from the vein of the Orphan mine.

Samples from some localities have been analysed and the results recast into the minerals recognized in thin sections cut from the respective specimens. The recast results may not represent exactly the mineral compositions of the rocks, but they are believed to be reasonably accurate. There seems to be a marked similarity.

Specimens Nos. 1, 2, and 4, Table I, are granites from three of the bosses. The plagioclases are practically identical. The minor constituents of all four rocks (No. 3 is the granodioritic facies) are the same.

TABLE No. I

	No. 1	No. 2	No. 3	No. 4
	per cent.	per cent.	per cent.	per cent.
SiO_2	69.98	68.06	61.30	66.68
Al_2O_3	15.12	14.64	16.78	16.33
FeO	1.75	2.42	3.78	2.57
Fe_2O_3	1.23	1.16	1.37	1.85
CaO	3.25	3.68	4.25	4.12
MgO	.98	1.57	2.98	1.48
K_2O	2.81	2.61	.80	1.51
Na_2O	2.80	3.07	3.52	2.95
H_2O	1.11	1.13	2.53	.89
CO_2	.18	.15	1.92	.71
TiO_2	.51	.51	.64	.62
P_2O_5	.13	.16	.11	.11
MnO	.40	.60	.11	.10
S	trace	trace	nil	nil
Total	100.25	99.76	100.09	99.92
Specific gravity	2.734	2.746	2.761	2.76

Sample No. 1—Granite north of Rita lake (which is half a mile south of Martin rapids on the Sturgeon river).
Sample No. 2—Granite 1¼ miles north of the Sturgeon river.
Sample No. 3—Granodiorite from the crosscut north of the shaft, Sturgeon River mine.
Sample No. 4—Granite, Orphan mine, north of Atigogama lake.
Analyst, W. K. McNeill.

TABLE No. II

	No. 1	No. 2	No. 3	No. 4
	per cent.	per cent.	per cent.	per cent.
Quartz	36.60	30.48	26.52	34.32
Albite	23.59	26.17	29.85	25.10
Anorthite	1.10 } 24.69	8.34 } 34.51	13.62 } 43.47	6.66 } 31.76
Orthoclase or microcline	9.45	12.78	.....	.....
Hornblende	.....	6.64	.....	.....
Apatite	.31	.27	.28	.26
Rutile	.51	.....	.64	.62
Titanite	.....	1.21	.....	.....
Biotite	.....	.....	.....	2.55
Pyrolusite	.40	.60	.11	.60
Magnetite	1.80	1.55	.93	2.32
Sericite	10.35	3.98	6.42	6.36
Chlorite	5.23	4.94	11.09	7.25
Kaolin	.....	1.03	2.58	.....
Epidote	.....	.....	2.74	.....
Zoisite	10.90	.96	.....	6.69
Calcite	} .30	.50	1.20	1.60
Magnesite			1.34 } 5.28	.....
Siderite			2.74	
Limonite	.....	.....	.37	.....
Total	100.10	99.45	100.48	101.67

The contact of the southern boss with the older rocks is fairly sharp. There are, however, in several places marginal zones of rocks of dark colour. On the north side the granite grades from the typical quartzose, pink granite to a grey rock with coarse texture and a considerable quantity of basic constituents. Immediately north of Coyle lake the width of the Keewatin band is narrow if, indeed, it is not quite lacking in places. Hence the intrusive mass south of the Sturgeon river is practically continuous with that to the north, the rocks along the river being granodioritic in composition. The northern boss shows more strikingly than does the southern one the granodioritic border. The whole western part of it is granodiorite, some of which is very dark in colour. The rock grades into typical granite towards the centre. The contact between the very dark coloured granodiorite and the lavas is difficult to determine with exactness, since the granodiorite becomes not only dark-coloured but very fine as the contact is approached. Thus the rock along the Sturgeon river, although so dark in colour that during reconnaissance of the area it was included as part of the volcanic series, still has a considerable proportion of lighter-coloured constituents and a granitoid texture.

A specimen taken immediately north of the river is a grey, granular rock, weathering pinkish-white. It shows a typical granitoid texture, as does the one just described, and in thin section is decidedly porphyritic, with feldspar phenocrysts of tabular shapes having average diameters of one-half to one millimetre. These are set in a groundmass of medium grain. The phenocrysts are plagioclase of the variety andesine. The groundmass consists of feldspars, chlorite, sericite, and calcite. Sericite occurs also within the phenocrysts. A little quartz is present. The rock is a granodiorite porphyry.

A mile north of the Sturgeon river a rock of granitoid texture contains about equal proportions of dark- and light-coloured minerals. Under the microscope it is found to be holocrystalline with feldspar, quartz, hornblende, apatite, and magnetite as original constituents. Chlorite, calcite, and kaolin have developed as alteration products. The quartz has a striking angular pattern, since it is interstitial between the well-formed feldspar crystals. Thus the rock may be said to have a porphyritic habit with an abundance of feldspar

phenocrysts. The feldspars are muddy with particles of kaolin and sericite and are not determinable. Hornblende was originally abundant. A considerable amount is still present, but much of it has been changed to a deep-green chlorite with deep-blue to purple interference colours. Small apatite crystals are abundant in the quartz. Evidently the rock is granodiorite.

Specimens from within a few feet of the lavas on the claims of the Sturgeon River Gold Mines were examined microscopically. The porphyritic habit is not noticeable in all specimens: Some appear equigranular. Quartz and plagioclase are present, and in some thin sections the plagioclase is determinable as andesine in composition. Chlorite and sericite are abundant in all; epidote and leucoxene are present in some. Alteration is commonly so intense that the original character of the rock is unrecognizable. Commonly quartz still shows the angular or micrographic texture mentioned previously in the description of less-altered specimens.

Heavy accessory minerals from the granites of three of the areas or from the granodiorite or from dioritic rocks thought to be marginal facies of one of them, were examined by M. L. Keith. Five composite samples were made up. Sample "A" consisted of material from three specimens of granodiorite, one of which is that described on page 25 from one mile north of the Sturgeon river. Sample "B" was composed of very dark coloured specimens, of which two were taken near the No. 3 vein of the Sturgeon River Gold Mines. Descriptions of them are given just above. Sample "C" was made up from four specimens of typical granite from the Coyle lake granite mass. Sample "E" was of granite from the batholith north of the Sturgeon river, and sample "F" consisted of three specimens from the Atigogama lake mass. Analysis No. 2, Table No. I, is from one of the specimens in sample "C"; No. 1 is from one of those in sample "E," and No. 4 from one of those in sample "F."

The heavy accessories were concentrated by panning material that had been crushed and screened into four portions: —40+60, —60+80, —80+100, and —100. Further concentration was accomplished by the use of a magnetic concentrator and heavy solutions. Finally grains were picked out by hand. These consisted of zircon, apatite, and titanite. The accessories of all samples appeared similar. Material from each of these final concentrates was photographed spectrographically, and the spectra compared and measured. All the lines appearing in any one of them appeared also in the others. Although this evidence is negative, it shows that there is at least no characteristic that would make it impossible that the basic rocks should be related to the granites.

There seems, therefore, to be a gradation from granite to granodiorite with varying proportions of basic minerals. Near the margins the granodiorite usually has undergone rather severe alteration.

In many places in the northwestern part of the township of Elmhirst there are remnants of lavas entirely surrounded by granodiorite; the latter is variable in character, as would be expected where an erosion plane intersects the irregular upper surface of a batholith. If the granodiorite is a marginal zone of a single intrusive mass, of which the granite is the central part, the area of it is much greater than marginal facies of that kind usually have. The batholith or boss evidently passes beneath its roof of older rocks at a very gentle angle.

The marginal zone is everywhere more basic than is the central part of the intrusive. If the intruded rocks were greenstone, the basic zone might be thought to be due to assimilation of the older rocks. The contact zones, however, are granodioritic no matter what the character of the rock invaded. This is well shown on the face of the high ridge crossed by the west boundary of the township

of Elmhirst, one and a quarter miles north of the Sturgeon river. The rock of the lava cap is fine-grained, dark-grey, and massive. Under the microscope it is found to be composed chiefly of feldspar, the variety of which is not determinable, considerable amounts of a pale variety of chlorite, and stringers of calcite. The rock was apparently originally an acid lava, possibly a trachyte, which has undergone considerable alteration. The rock of the lower slopes of the ridge is undoubtedly granodiorite, as it has a distinctly granitoid texture. Near the contact with the lava the granodiorite is a fine-grained, dark-green rock, which consists entirely of a mat of secondary minerals—amphibole, chlorite, epidote, quartz, and feldspar. So far as microscopic appearance goes, it might be either an altered, fine-grained intrusive or an altered basic lava. Since, however, it apparently grades into a rock with granitoid texture, it is considered to be the marginal facies of the granite-granodiorite batholith.

As the upper as well as the outer part of the intrusive is basic, it is impossible to explain the differentiation by a simple process of gravity separation. If the granite and granodiorite are facies of one mass, as they seem to be, then the basic upper part probably consolidated before any differentiation occurred and represents the composition of the magma at an early stage. Subsequent to the consolidation of the outer shell, differentiation, by settling out of basic material, could have resulted in the formation of the granite now exposed in the central part of the area of igneous rock as a residual portion of the original magma.

Two outcrops of acidic igneous rocks occur at Beatty lake. One (not shown on the map) is on the north shore of the east bay. It is a grey, granitic-looking rock, which under the microscope appears holocrystalline with a diabasic texture. It consists of oligoclase, hornblende, and quartz as original minerals, and chlorite as an alteration product of the hornblende. Thus the composition is that of a syenite. A coarsely porphyritic rock with pink feldspar phenocrysts outcrops on the point in Beatty lake crossed by the east boundary of the Nipigon Forest Reserve. Under the microscope the larger phenocrysts of feldspar appear to be untwinned; smaller ones have the composition of oligoclase. Hornblende is present as phenocrysts smaller than the large feldspars and not well formed. The groundmass consists of tiny laths of feldspar and of hornblende. This rock is a syenite porphyry, possibly related to the syenite just described.

Feldspar Porphyry Dikes

Dikes of a rather striking feldspar porphyry cut the greenstones. Several of these were seen south of Paint lake, but none is over 50 feet in width, and most of them are rather irregular. The phenocrysts are well-formed, tabular, white to pale-pink crystals of feldspar, which are set in a rather fine grained, reddish groundmass. Under the microscope the feldspar phenocrysts show marked zonal growth and well-defined albite twinning. The composition is oligoclase-andesine. Hornblende is present in smaller and less well formed crystals, which have marked pleochroism from green to yellowish-green. Phenocrysts of quartz are less abundant than either feldspar or hornblende. They are, however, as large as those of feldspar, but rounded and resorbed. The fine-grained groundmass consists of feldspar, hornblende, quartz, some calcite, and a little chlorite, formed by the alteration of the hornblende. The centres of some of the feldspar phenocrysts show some alteration products, chiefly sericite, and a cloudy material, probably kaolin.

Lamprophyre Dikes

Dikes of lamprophyric character occur in the lavas and the granite. Few of them are wider than 10 feet, and the maximum width of any seen is 50 feet. Most of them are fine-grained and equigranular, but porphyritic types occur.

One of the largest of these dikes cuts granodiorite northeast of the shaft of the Sturgeon River mine. The rock is equigranular in texture. The minerals present are pyroxene, magnetite, quartz, and an untwinned feldspar. Dark-coloured minerals are by far the most abundant. A dike 10 feet wide cutting granite three-quarters of a mile south of Martin rapids is green in colour with small pinkish spots. Under the microscope it appears porphyritic with poorly formed phenocrysts of hornblende, which make up most of the rock. The groundmass contains a little quartz and some feldspar of indeterminable composition. Chlorite is present in some quantity. No specimens from other green dikes were examined microscopically, but the marked difference in mineralogy of these two makes it seem likely that there is a wide range in composition among these dikes, although they are probably closely related in age and origin.

Age and Correlation

These intrusives have been grouped together in description, but there are evident differences in character and in age. The correlation of the most important of the group, the granite and its granodiorite facies, offers the most difficult problem. The granite is intrusive into the Keewatin rocks, but neither typical granite nor granodiorite has been found in contact with the Timiskaming sediments. The syenite and syenite porphyry outcropping along the shores of Beatty lake lie entirely within the Timiskaming sediments and no doubt are intrusive into them. Hence if they are related to the granite, the granite is later than the Timiskaming sediments. On the other hand pebbles of granite not unlike that of the three bosses shown on the map, and quite as fresh as that from any of them, occur in the conglomerate. On that evidence the granite might be considered to be pre-Timiskaming in age. Tanton[1] stated the belief that the gold, copper, and lead veins may be derived from post-sedimentary granites and on map No. 1836 has shown the granite as later than the sedimentary series. In this connection, however, it must be pointed out that the veins of the Sturgeon River mines not only cut through granodiorite but also cut and deform the green lamprophyre dikes, which in turn cut granite. In the absence of definite proof of its pre-Timiskaming age, the granite of this area is shown on the table of formations and on the map as post-Timiskaming. Evidence of this is by no means conclusive.

As just stated, the lamprophyre dikes cut the granite and are themselves cut by the gold-bearing veins. If the ore deposits are genetically related to the granite, then it must be assumed that the lamprophyre represents merely a stage in differentiation of the magma from which the granite formed and of which, as above outlined, the granodiorite is the undifferentiated representative. It seems much more logical to assign the veins to a later granite.

Keweenawan

Diabase

In this area there are many diabase dikes, few of which are more than a hundred feet in width. Most of them are nearly north-south in direction and all those seen are vertical. Some of them lie in fractures along which there have been minor horizontal displacements, but along others there is no evident offset of the rocks on opposite sides.

[1]T. L. Tanton, Geol. Surv. Can., Sum. Rept. 1917, pt. E, p. 2.

In the eastern part of the Sturgeon River area only the fresh-looking younger diabase is included in this group. The lithological character of this diabase has been so fully described in other reports that no further description of it seems necessary. It has been classed as Keweenawan in age.

Pleistocene and Recent

Glacial deposits are thick and extensive in the eastern part of the area, and become thinner towards the west. A long tongue of sand and gravel fills the great valley in which Beatty, Foxear, and Ida lakes lie (see photograph on page 7) and extends westward to the east end of Windigokan lake. Another great sand-covered area lies along the railway. In much of the western part of the area, however, the deposits are thin and local.

The glacial deposits are mainly sand and gravel in the form of narrow eskers or irregular drumlins and broad, flat sand plains, probably formed by outwash from the glacial front. Clays were not deposited, as this area was apparently on the divide between the post-glacial lakes. Some of the old valleys, such as that running westward from Paint lake and the valley of the Sturgeon river above Paint lake, were filled with glacial sands. Present streams are incising these and spreading them out to form flat areas of marsh and silt, such as that between the end of Paint lake and the Sturgeon river. In general, however, recent deposits are not abundant, except for the peat accumulating in marshy and swampy hollows inland from the main waterways.

HISTORICAL GEOLOGY

The geological history of this region may be interpreted from the foregoing description. The earliest record is that of a period of intense volcanic activity. A great series of flows ranging from those of very basic type, now greenstones, to trachytes and rhyolites were poured out on some surface not now exposed. At various places and times beds of volcanic *ejectamenta*, both coarse and fine, and possibly also some normal sediments were laid down. Locally there were bodies of water in which were deposited chemical precipitates of chert and iron oxides. After great thicknesses of these rocks had accumulated, there came a period of rather intense disturbance culminating in the formation of mountains, beneath which granites were intruded. If any of the area was formerly beneath sea-level it now became a land surface of considerable elevation. Erosion set in; the elevated region was cut down to a land surface of comparatively low relief and then at certain places sediments began to accumulate on the bevelled surface. A large part of the sediments were coarse. They consisted of boulders and pebbles of the lavas and of the then exposed granite that intruded the lavas at the time the mountains were formed. These areas of deposition may be pictured as the plains in front of a still rugged upland from which streams were bringing down gravel and sand to be spread out as coalescing river fans along the mountain front. After a long period, probably after these terrestrial deposits had been spread over a considerable area and consolidated, disturbances began once more. The lavas and the sediments deposited upon them were thrown into east-west folds. No doubt faults also were formed. Diorite both as dikes and as larger masses intruded the folded mass. Still later great masses of granite were intruded. Erosion may have intervened between the time of intrusion of the diorite and of the granite. Minor disturbances after the intrusion of the granite are shown by the occurrence of small lamprophyre dikes. The intrusion of the

granite no doubt accompanied an uplift of the region, and this inaugurated a period of erosion. In the neighbouring region to the west there is evidence of the deposition on the surface, produced by this post-Timiskaming erosion, of sediments belonging to the last period of the pre-Cambrian, the Keweenawan. These sediments were intruded by great sills of diabase, which are represented in the eastern part of the Sturgeon River area only by dikes, possibly feeders to sills that may once have lain above. The sills with whatever rocks they invaded were so completely removed by subsequent erosion that only the truncated dikes were left outcropping on a great plain of low relief very similar in appearance to the present surface.

There is no way of knowing what rocks may have been laid upon this surface during the Paleozoic and later periods, since if any were deposited they have since been completely removed. Erosion was the dominant process, and there is no evidence as to whether it was continuous or was interrupted by periods of deposition. No doubt a deep soil developed over the whole region, especially above the zones where lavas and sediments had been rendered schistose by the repeated disturbances they had undergone. Graded streams developed on this surface, flowing down to the seas, wherever they were at that period.

Then came the change of climate that initiated the Pleistocene glacial period. Ice formed on the mature land surface and moved southward, scraping off and carrying with it the deep soil formed by the long preceding erosion. Fresh surfaces of rock were uncovered, grooved, and polished by the overriding ice. Naturally the most deeply weathered zones were gouged out and became elongated depressions upon the abraded surface. Toward the end of glacial times the retreat of the ice, and the stagnation of the glaciers at various points, led to accumulation on the glaciated surface of irregular hummocky deposits and elongated ridges of sands and gravels and of sand plains where waters flowed out from the melting ice over this debris and redistributed it. Where the ice front remained stationary for a considerable time, deposits were thick and extensive. In other places they were confined largely to the river valleys that had been scoured out during the ice advance and were now filled by foreign material as the ice retreated. To the south and later to the north were formed great glacial lakes, into which the water from the melting ice was poured, but throughout the period this area was apparently above the highest level of either Lake Algonquin or Lake Ojibway, and no lake clays were laid over the glacial debris at any place within the present map area.

As the ice retreated drainage was re-established. Some parts of old valleys were again occupied by rivers, which began incising valleys in the gravels and sands. In other places the new rivers found new channels, and rapids and falls resulted as the rivers cut down to rock ridges. Each of these now forms a temporary base level for the part of the river above it. In poorly drained localities marsh deposits and peat have been developed.

ECONOMIC GEOLOGY

No mineral deposits in this region other than those of gold are of any importance at the present time. The history of the search for gold spreads over many years. Burrows[1] during his examination of the railway belt in 1916 sampled a vein in a railway cut one mile west of Jellicoe. It carried one-fifth of an ounce of gold per ton. Claims were staked near Beardmore by Powers and

[1]A. G. Burrows, op. cit., p. 244.

Silam in 1925; some of these claims now form the property of the Northern Empire Mines Company. Claims were staked near Twin falls on the Sturgeon river about 1929, and in 1931 T. W. Johnson discovered a vein on the north shore of Atigogama lake and staked the group of claims first known as the Dikdik mine, later the J. Bruce McMartin mine, and now rechristened the Orphan mine.

In 1933, C. W. Taylor and Rene Maloney prospected along the Sturgeon river, and in May, 1934, Taylor found the vein on the Taylor-Segsworth claims between the Sturgeon river and Paint lake. During the summer of 1934 groups of prospectors were active both north and south of the Sturgeon river, and several gold-bearing veins were discovered. R. H. Barnum and J. J. Green staked claims south of Barnum Green rapids; J. M. Wood and W. T. Brown, the adjacent claims that now form the property of Sturgeon River Gold Mines; and the Brennan-Kenty syndicate located veins still farther down the river. Somewhat later the McDonough brothers staked claims between the Wood-Brown group and the Brennan-Kenty group. South towards Windigokan, the Brookbank nd Knox claims were staked. Toward the end of the summer, news of these iscoveries spread, a rush followed, and a large area was staked. Many of the laims located then, had no prospecting whatever done on them, and during the summer of 1935 comparatively little work was done, except on the properties on which the original discoveries were made. Lack of funds contributed somewhat to this state of affairs, but reaction following the boom of the previous autumn was largely responsible.

The main band of Timiskaming sediments has now been traced continuously from Long lake to Lake Nipigon. In it several gold deposits of economic importance have been discovered during the last few years. They occur in various structural relations. Massive beds in folded parts of the sediments have been found to be favourable at some places; contacts between intrusive masses and sediments have localized deposition in others. In addition to the gold veins already found in the sediments, gold has been found in the lavas north of the Timiskaming belt at localities discussed in this report and also in the volcanics south of the sediments. Thus the area favourable for prospecting is not confined to the Timiskaming syncline.

Gold Deposits

Most of the veins in which there is sufficient gold to form ore are narrow, but some of them contain values sufficiently high to warrant mining on a small scale. No mineral of commercial value other than gold has been found.

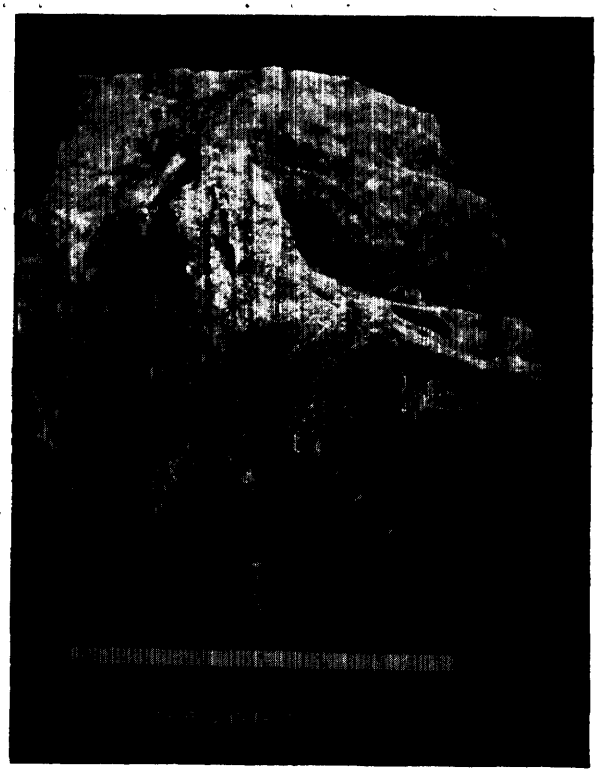
The gold veins occur in a variety of structural relations, which for purposes of description may be grouped as follows: (1) quartz veins, generally narrow, traversing volcanic rocks and granodiorite; (2) lenticular quartz bodies transverse to the contact between granite and lavas and cutting both formations; (3) quartz lenses in remnants of lavas included in either granite or granodiorite, the lenses persisting for short distances into the intrusive; (4) quartz veinlets and sulphide lenses in iron formation.

Quartz veins are fairly common in the area. They vary in width from mere cracks to veins 5 or 6 feet across. Some of the veins contain spectacular concentrations of gold; unfortunately the proportion of gold seems to vary inversely as the width of the vein. Some of the veins are remarkably continuous. One has been traced for 2,500 feet. In the vicinity of the original discoveries the veins seem to belong to several fracture sets: (1) veins striking a few

degrees east of north; (2) veins striking nearly northeast-southwest; (3) irregular veins that probably follow contorted bedding planes.

The first group may in reality be two sets, since there are veins that are parallel in strike but dipping in opposite directions. It is possible that two sets of fractures of the same age are present, one dipping west, the other east, and that deposition may have alternated between these two planes.

The relation of veins of the first group to those of the second has been observed at only a few places; the latter cut through the former. As the veins appear similar in all respects except strike, it does not seem likely that there is any great difference in age.

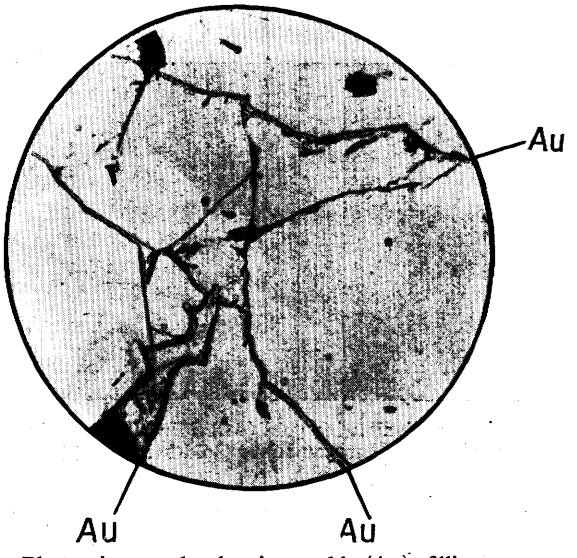


Specimen from No. 3 vein, Sturgeon River mine, showing streaked character

Only at the property of the Sturgeon River Gold Mines has sufficient detailed work been done to obtain information as to the attitude of the various sets of fractures. No. 1 vein on this property strikes northeast and dips at an angle of 75° N.W. No. 3 vein strikes N. 13° E., and in the upper part dips 70° W. Between the 375- and the 500-foot levels the vein dips to the east instead of to the west (see Fig. 3 on page 38). No. 1 and No. 3 veins, and similar veins on neighbouring claims, have the appearance of shear zones. The angle between the two veins is only slightly over 30 degrees and it seems impossible that the fractures could have been formed simultaneously by any simple stress. Probably the stresses were rotational, as a result of which the rock sheared along one zone and then no further definite break occurred until the direction of shear had rotated several degrees.

The mineralogy of the veins is comparatively simple. The main constituent in all of them is quartz, which is of two generations. The older is coarsely crystalline and has a streaked appearance; the younger is clear and glassy. The streaked character of the older quartz is due to the presence of zones of chlorite and sericite roughly parallel to the vein walls. These probably represent lenticles of sheared rock now so completely replaced that only chlorite- or sericite-coated planes are left (see photograph on page 32).

Metallic minerals form only a small part of the filling of the quartz veins, although on the Agaura claims the No. 2 vein has parallel to it and only a few feet distant a zone in which there is a large proportion of sphalerite. In the quartz veins pyrite is the most abundant metallic mineral. Sphalerite and galena occur very sparingly, and there is a little chalcopyrite. In some veins gold is relatively abundant. Much of it is in particles so fine that it is not readily



Photomicrograph showing gold (Au) filling fractures in grains of pyrite, Sturgeon River Gold Mines. (× 305.)

recognized without the aid of a lens. Some of it occurs along the chloritic and sericitic zones and, being a light-coloured variety, may be mistaken for tiny flakes of sericite. The gold is clearly later than the pyrite, as it coats crystals of it and fills fractures in broken grains (see photomicrograph above). In places, grains of gold lie within unfractured pyrite (see photomicrograph on page 34), but no doubt these are simply cross-sections of tiny tongues of gold cut across by the polished surface. Much of the gold occurs in fractures in quartz. Details of paragenesis will be given in descriptions of individual occurrences.

The wall rocks of the veins do not show marked alteration. Where they are lavas they had already been changed to secondary minerals, probably relatively stable under the action of the vein-forming solutions. In any case further alteration produced would be difficult to distinguish from that which had occurred at an earlier period. Tiny veinlets and lenses of quartz are present, and the amount of sericite and chlorite immediately adjacent to the veins seems to be greater than at some distance from it.

The veins of the second type also are narrow, and so far none has been traced very far from the contact between the granite and the lavas. They have a decidedly lenticular form, are less regular than are the veins of the first type, and in some places seem to feather out in both directions. They fill definite fractures in the granite, which seem to be the result of external stresses.

Mineralogically, there is more variety in these veins than in the veins of the first type. Quartz forms the greater part of the vein filling, but metallic minerals are much more abundant. Those recognized are pyrite, chalcopyrite, pyrrhotite, galena, sphalerite, gold, with so much silver that it may properly be called electrum and small quantities of arsenopyrite and tetrahedrite. The paragenesis of these minerals will be discussed later. The gold content has been found to decrease rapidly from the contact as the vein is followed into the granite. None of the veins has as yet been explored sufficiently to be certain how far they extend into the lavas, nor is it known what changes, if any, occur as veins are followed farther from the contact.



Photomicrograph showing gold (Au) filling fractures in grains of pyrite (P), Sturgeon River Gold Mines. (× 305.)

Wall rock alterations are noticeable in the granite. There are generally numerous veinlets of quartz traversing the wall rocks, and the feldspar of the granite has been completely sericitized. Gold values in the wall rocks are, however, usually low.

At two places lenticular masses of quartz have been found in inclusions of lavas in granite and granodiorite. The veins continue into the intrusive rock, but divide and taper out rather sharply. It is very likely that they behave in the same way vertically. Hence the lengths of ore bodies with this relation is directly dependent upon the size of the included block; ore will probably not extend downward as far as it does horizontally.

The fractures in these occurrences are roughly parallel to the schistosity of the included lava fragments, as that was naturally the direction of fracture under stresses subsequent to the inclusion of the xenolith, and a fracture formed in the schistose volcanics would be likely to continue downward for some distance into the surrounding intrusive.

The vein minerals are quartz and a rather large proportion of sulphides. Pyrite is generally the most abundant of these, but in places chalcopyrite is almost equal to it in amount. Gold is probably present with the sulphides. Assay results of ore grade have been reported from some bodies of this type:

The structural relations, however, are unfavourable for ore bodies of large size, since the xenoliths so far found are comparatively small. Probably none is large.

Some of the bands of iron formation, both in the Keewatin lavas and in the sediments, have been locally fractured. Some of the fractures are filled with quartz. In places pyrite, frequently accompanied by arsenopyrite, has filled fractures or replaced part of the iron formation. These later quartz veins and sulphide bodies contain some gold. The occurrence of gold is dependent on the late fracturing of the iron formation. Commonly fracturing occurs where the bands are much deformed. In most cases the distribution of gold is rather erratic, and the lengths of shoots of ore grade short.

The determination of the genesis and age of the ores depends upon determining the cause and age of the fracture systems, finding a possible source for the material for formation of the vein minerals, and deducing a method for its transportation and deposition.

For the first type of deposit it is necessary to explain sets of fractures continuous for considerable distances, traversing indiscriminately various kinds of rocks, and, in general, with no marked zone of schistose rock along them. The fracture pattern is not one that can be assigned to a single deformation. The veins have none of the characteristics of open-fissure fillings. Thus the depth at which fracturing occurred was great enough for rocks as different in character as andesite, rhyolite, and granodiorite to behave similarly under stress and yet shallow enough for all to be still brittle and to yield along narrow zones of shearing. From the pattern of the fractures it seems likely that they occurred at different times or at least under stresses the directions of which changed considerably during the period of fracturing. All the vein fractures so far found seem to have been the result of shearing rather than tension; tension fracturing must have developed with them, but none has yet been recognized.

The occurrence of the veins in the vicinity of bosses of granite or granodiorite is probably due to structural control of fracturing rather than genetic relationships. The veins cut granodiorite, which is believed to represent an early stage in the consolidation of the magma of which the granite is a later differentiated product. The vein fractures, however, cut lamprophyre dikes, which in turn cut the granite. Therefore, even if the lamprophyre is also part of the series of differentiates, the fractures came at a time when all the rocks that can possibly be assumed to belong to the intrusive series were already consolidated. It is likely, therefore, that bosses of igneous rocks during deformation acted as resistant units between which fracturing was localized and so prepared the way for the still later vein-forming solutions.

The character of the vein fillings in which quartz is the chief mineral and pyrite an early constituent shows that the solutions were highly siliceous and that the temperature was fairly high at the beginning of mineral deposition. Thus the solutions must have been derived from a magma containing abundant silica. The magma from which the granite formed was no doubt of a nature to produce such solutions following the differentiation that it is assumed to have undergone. But the facts stated above as to the relation of the fractures, not only to the granodiorite but to the lamprophyre dikes, which are post-granite in age, introduce uncertainty as to a genetic relationship between the granite exposed in the area and the ore solutions.

Thus there seem to be only two possible hypotheses, neither of which is entirely satisfactory:—

1. The granodiorite, granite, lamprophyre dikes, and quartz veins belong

to a single continuous differentiation sequence in which the vein solutions were the end phase of the original magma; or

2. The gold-bearing veins come from a younger granite, the only yet recognized evidence of which is the fracturing of the lavas, granodiorite, granite, and lamprophyre, and the formation of the ore bodies.

The first seems an attempt to make observed facts fit an hypothesis. The second furnishes no definitely recognizable source for the ore solutions.

DESCRIPTION OF PROPERTIES

The following descriptions of properties deal mainly with those upon which active development work was in progress during the summers of 1935 and 1936. Considerable assessment work was done previously on other groups of claims, but in many cases results obtained were not sufficiently encouraging to justify more than assessment requirements. Shortage of funds necessitated the minimum of work in others.

For convenience of description only, the properties will be grouped according to the classes of deposits previously discussed. The property of Sturgeon River Gold Mines and the Agaura group adjoining it on the east are of the first type. The Orphan mine, previously known as the J. Bruce McMartin mine and earlier still as the Dikdik, belongs to the second. In the third group are the deposit on the Oliver-Severn (Taylor-Segsworth) claims and that on the Miron claims situated between Coyle lake and the Sturgeon river. To the fourth belong the Oremond and Greenlee (Dalton) deposits.

Sturgeon River Gold Mines, Limited

Sturgeon River Gold Mines owns the group of claims, T.B. 13,641–13,647, on the south side of the Sturgeon river originally staked by J. M. Wood and W. T. Brown, and other claims on the north side of the river, in Irwin and Pifher townships. Work has been concentrated on claim T.B. 13,642, on which the original discovery was made, and has largely been confined to the examination of No. 3 vein.

The geological relations of the veins on that claim are shown in Fig. 2. The oldest rocks are volcanics consisting of lava of intermediate character, rhyolite, and possibly some tuffaceous beds. These are intruded by massive granodiorite and granodiorite porphyry. Lamprophyre dikes cut both lavas and granodiorite, and all rocks are cut by the gold-bearing veins.

The rock in the shaft is massive, fine-grained, and greenish-grey in colour; under the microscope it appears equigranular. It consists entirely of secondary minerals, approximately one-half of which is chlorite. Quartz and sericite are abundant and about equal in quantity. The quartz is apparently secondary, due to the breaking-down of original silicates. A few fresh-looking feldspars are no doubt secondary in origin. Leucoxene is the only other recognizable mineral. From the character of the secondary products, the rock is thought to have been originally an andesite. A specimen from the shaft at a depth of approximately 280 feet is greenish-grey in colour. Under the microscope it appears porphyritic with altered phenocrysts of oligoclase. The groundmass is made up of sericite, epidote, calcite, and chlorite. This rock is probably granodiorite porphyry. The contact between the intrusive rocks lying to the north is so close to the shaft that a dike may have been intersected. At the south end of the exposed part of No. 3 vein the rock is mapped as a flow of intermediate character. In the hand specimen the rock is grey in colour and fine-grained.

Under the microscope it shows foliation and a fine-grained texture. It consists of chlorite, sericite, and considerable quartz, some of which may be original. The section is traversed by veins containing quartz and calcite. The rock is a dacite or andesite.

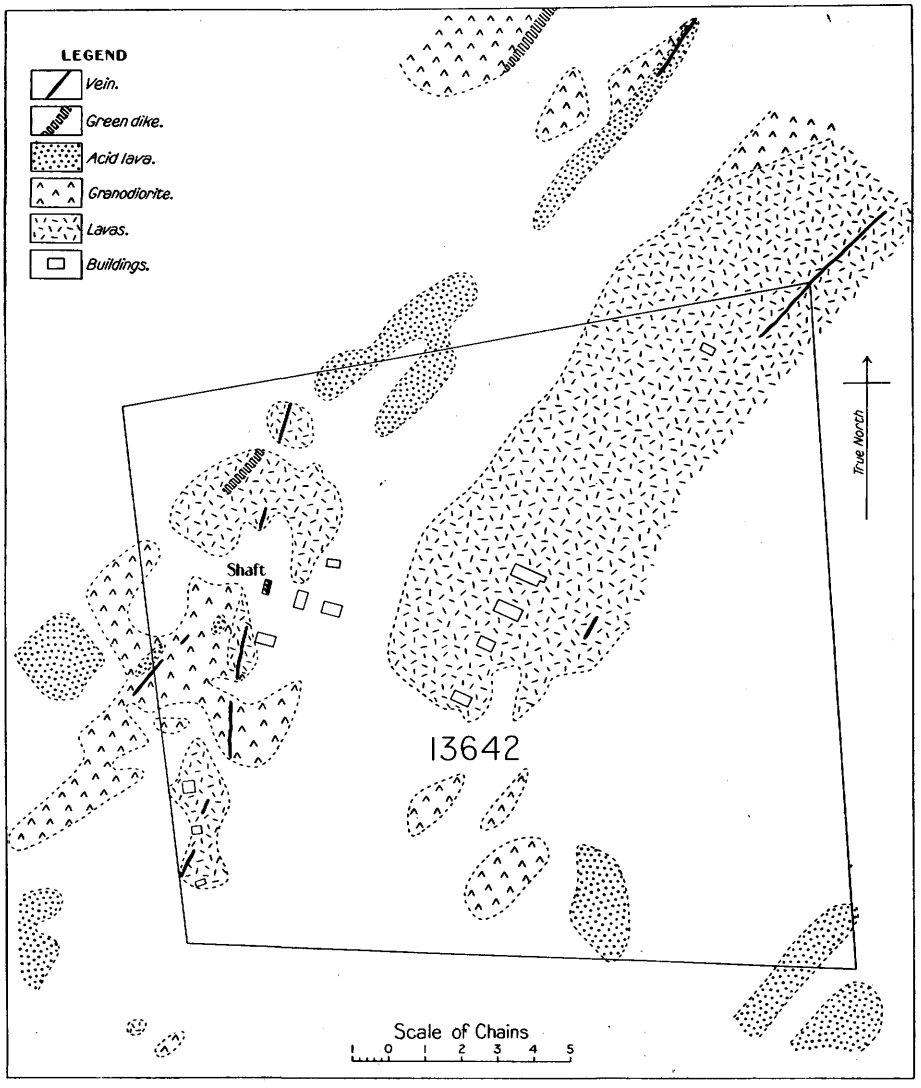


FIG. 2—Sketch map showing the geology in the vicinity of the shaft, Sturgeon River mine.

The ridge upon which the mine buildings stand consists of a greenish-grey, fine-grained rock, the origin of which is not evident. Microscopic examination of a specimen from the face of the hill shows a fine-grained mosaic of plagioclase, quartz, sericite, and chlorite. The plagioclase crystals are badly altered. Some of the quartz is in irregular, rounded grains with frayed edges. It may be original and the rock may be tuffaceous, but there is no banding or other evidence of fragmental origin. Veinlets of calcite and quartz traverse the section.

Acidic volcanic rocks of two different types outcrop on this claim. Northeast of the shaft the rock is greyish in colour. Under the microscope it is seen to consist of lath-shaped plagioclase feldspars of acidic composition arranged in a trachytoid texture. The other primary minerals are muscovite and quartz. Sericite, epidote, calcite, and chlorite are present. Quartz is in considerable quantity. Some of the epidote and calcite may be introduced, since granodiorite is not far distant. The rock is classed as rhyolite.

The other acidic type is grey on fresh fractures, weathers white, and is distinctly porphyritic with rounded phenocrysts of quartz recognizable in hand specimens. A small area of rock of this kind occurring near the south end of

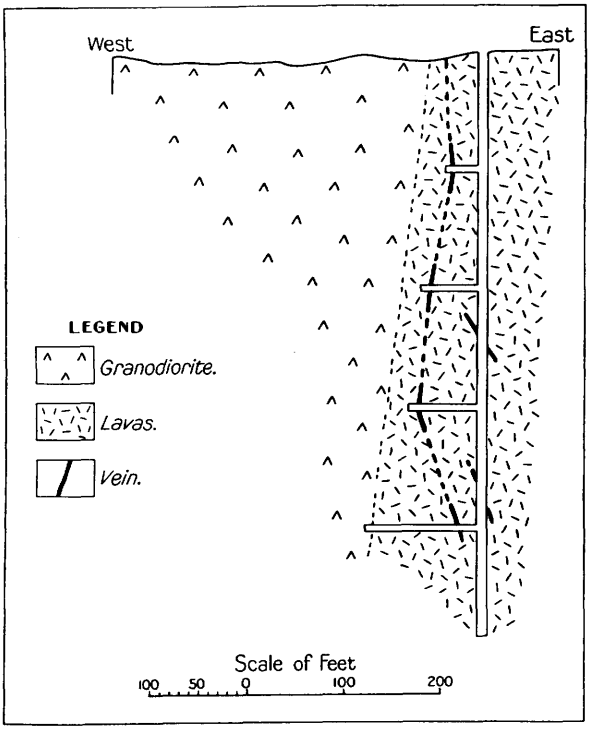


FIG. 3—Cross-section through the shaft of the Sturgeon River mine.

No. 3 vein consists of resorbed quartz phenocrysts in a fine-grained groundmass of quartz and sericite, the foils of which have a roughly parallel arrangement. Quartz veinlets and cubes of pyrite represent introduced material. A similar rock occurs along the edge of the ridge 200 feet west of the shaft.

The granodiorite has been described in some detail in the section on general geology (pages 25 and 26), and a further description will be found in the discussion of wall rock alteration (pages 42 and 43).

One large lamprophyre dike cuts granodiorite on claim T.B. 13,641; fragments of a smaller one are included in the vein zone 60 feet south of the shaft. A petrographic description of the rock from the larger dike is given on page 28.

Quartz veins cut lavas, granodiorite, and lamprophyre indiscriminately (see Fig. 4 on page 46). There are two or possibly three sets. Those of one set strike

nearly northeast-southwest. Those of the second set strike only a few degrees east of north. No. 3 vein, the most fully exposed of any on the property of the Sturgeon River Gold Mines, strikes N. 13° E. Drilling seemed to indicate a fairly regular dip of 70° W. Underground exploration has shown, however, that parts of it dip to the east (Fig. 3). This may mean that there is a third set of fractures. Also at 310 and 440 feet in the shaft, veins that have easterly dips were intersected. In the crosscut on the 500-foot level a vein was cut 20 feet west of the shaft, and no vein was found at the point where the intersections with the vein at 125, 250, and 375 feet would indicate that the vein should be found at 500 feet.



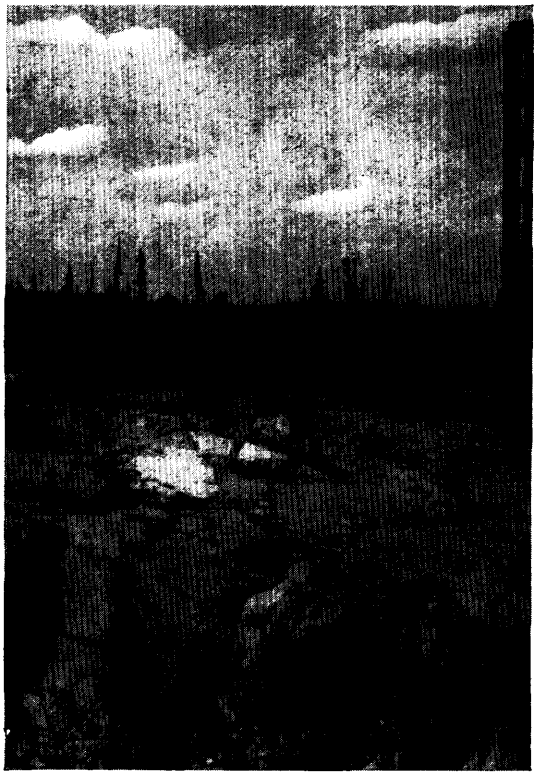
No. 3 vein, near the shaft, Sturgeon River mine.
The hammer handle is 13 inches long.

As the vein found near the shaft on that level is similar in appearance and mineral content to the typical No. 3 vein, it seems likely that at some places veins were formed in westward-dipping fractures and at others in eastward-dipping ones. No doubt veins may occur in both sets.

The course of No. 3 vein is remarkably straight and is unaffected by the kind of rock in which it lies; it cuts across contacts without any deviation whatever. The width varies considerably. At the widest part there is 3 feet of quartz. At other places the vein narrows to 2 or 3 inches (see photographs on pages 39 and 40). In the 700 feet it has been traced on the surface the average width is 9 inches. South of the shaft, No. 3 vein passes through a tongue of granodiorite, and the vein is narrower in that part than it is in the lavas. To the north of the shaft, the vein lies in places along the contact between grano-

diorite and lava; apparently the latter is included between salients of the intrusive. Underground the rocks are distinguishable by a blocky, polygonal jointing in the granodiorite, as contrasted with a more or less marked schistosity in the lavas. No doubt these structures are responsible for the different character of the vein where it crosses from one rock into the other.

Although in general remarkably straight, the vein is offset in a few places for distances of 2 to 4 feet. The offsets are not faults but merely the ending of the vein along one fracture and the beginning of another vein along a parallel fracture. In all cases observed the offsets are to the right hand. Commonly



Vein No. 3, near the shaft, Sturgeon River mine.
The hammer handle is 13 inches in length.

the end of the vein is rather blunt, but narrow veinlets of quartz stream off for a few inches along the direction of the vein zone. On the 625-foot level a fold offsetting the vein to the right has a short arm amplitude of several feet. The lenticular character is well shown in the drifts, the appearance of the faces of which changes with every round removed. Thus a single vein appears a few feet farther along as two, and these a little farther again unite (see photographs on pages 41 and 42). In addition to the gold-bearing quartz veins, there are lenses of barren quartz, most of which are only an inch or so in width and a few feet in length. Commonly these are parallel to the vein. Small veinlets of calcite intersected by the quartz veins form reticulating patterns in the wall rocks (see photograph on page 42).

The veins have a roughly banded structure (see photograph on page 39), due to the presence of zones, parallel to the walls, containing considerable chlorite and sericite. These are probably remnants of sheared wall rocks almost completely replaced. Quartz is the most abundant mineral in the vein. It is of two generations. The older is milky to faint pinkish in colour and appears fractured. The younger is in tiny, water-clear veinlets traversing the older quartz.

A thin section shows that the older quartz is rather coarsely crystalline and that the grains form a closely interlocking mosaic. In places there are areas of finer texture, possibly crush zones, since foils of sericite, in roughly parallel



Veins showing in the face of the drift on the 375-foot level, Sturgeon River mine, September 16, 1935. The handle of the hammer is 13 inches long.

arrangement, lie between the grains. Vein material from the 250-foot level has a streaked appearance. A section cut normal to the banding is found, under the microscope, to consist of alternate zones of quartz and calcite. The quartz appears to be younger than the calcite. There is as well a very marked difference in the grain size of the quartz, which may be due to brecciation. If so, there are two generations of quartz, and it is not certain that both are younger than the calcite. Sericite is apparently later than both the quartz and calcite. It occurs in narrow, irregular veinlets. Metallic minerals form a very small part of the vein filling. In order of abundance these are pyrite, chalcopyrite, sphalerite, gold, and gold telluride. Some of the pyrite shows fairly good crystal

outlines; some of it is in irregular grains. Chalcopyrite is found within apparently unfractured pyrite but generally occurs in fractures in it. Intergrowths of chalcopyrite and sphalerite are thought to be due to replacement of the former, since the rounded grains of it have a regular pattern (see photomicrograph on page 43) and have the same orientation as neighbouring grains when examined under polarized light. A telluride, probably petzite, occurs within apparently unfractured pyrite crystals (see photomicrograph on page 44). In nearly every polished section examined in which gold is present there is clear evidence that the pyrite had been fractured and the fractures filled with gold. Gold also occurs lying between pyrite and gangue. Much of the gold, however, is in fractures in the quartz (see photomicrograph on page 45), and a considerable amount lies in the zones of chlorite and sericite, probably because, subsequent to



Quartz veins and reticulating calcite veinlets, 125-foot level, Sturgeon River mine, September 16, 1935.

consolidation of the quartz, movements were localized along the chlorite-sericite zones.

Gold is relatively abundant in some parts of No. 3 vein. Most of it is in very fine particles and is very pale in colour. Hence, it is not always easily recognizable in hand specimens, especially where it is along highly sericitic slip planes. Very high assays have been obtained from some sections of the vein: The average gold content over a width of 9 inches for the total length exposed is said to be more than an ounce per ton. There is comparatively little in the wall rocks, even where they are somewhat altered. It will be necessary to mine as narrow widths as possible in order to avoid undue dilution.

A number of specimens were taken from the vein walls in order to study the alterations undergone during vein formation. Where the walls are andesite, the rock at some distance from the vein consists of secondary minerals: chlorite, quartz, sericite, and some altered feldspars. Chlorite makes up about 50 per cent. of the whole. A specimen of rock included in the vein consists of chlorite, sericite, quartz, and pyrite. Quartz, however, forms a much larger proportion than in the previously described section. It occurs as angular to subangular

grains, which look not unlike fragments. This characteristic is probably due to replacement of the somewhat schistose country rock. The pyrite is certainly introduced.

In one locality where the wall rocks are granodiorite, a specimen 2 feet from the vein consists of quartz, plagioclase, sericite, chlorite, and a considerable amount of pyrite. The greater part of the rock was originally imperfectly formed plagioclase crystals now altered to sericite, with which quartz forms a micrographic intergrowth. Two inches from the vein the rock is in most respects similar to that farther away except that there is a considerably larger proportion of sericite.



Photomicrograph showing sphalerite (grey) apparently replacing chalcopyrite (white), 250-foot level, Sturgeon River mine. (× 155.)

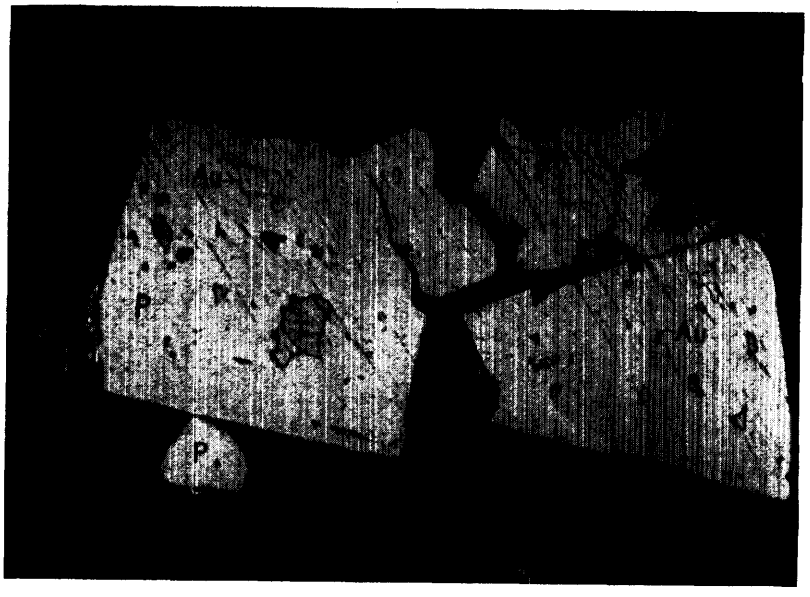
The wall rock alteration, therefore, is merely an addition of quartz and some sulphur and possibly some sericitization of the already altered andesite or granodiorite.

No. 1 vein belongs to the first fracture system mentioned above. It strikes nearly northeast-southwest and dips 70° to 75° N.W. Its intersection with No. 3 vein is concealed by drift, but it should be about 60 feet north of the shaft. On the 250-foot level at a point 300 feet north of the shaft, a shear zone containing quartz stringers cuts through No. 3 vein. On the 500-foot level a vein similar in appearance to No. 1 vein cuts through No. 3 vein. At that point the younger vein has a dip to the southeast, however, and the line of intersection of the two rakes downward to the south at an angle of approximately 5 degrees. On the

375-foot level what seems to be No. 1 vein intersects No. 3 at a point 433 feet north of the shaft.

Where exposed by trenches west of the shaft, No. 1 vein lies wholly in granodiorite. It should, however, cross the contact into the lavas in the low ground immediately north of the shaft, about 40 feet southwest of the junction with No. 3 vein. The northeasterly extension of No. 1 vein lies in low ground, but test pits show that the rock in that part is a narrow tongue of lava of rather acidic type but not a quartz porphyry. It appears to be a trachyte.

No. 1 vein is wider than No. 3. At the test pit 130 feet southwest of the shaft it has a width of 3 feet. The quartz is similar to that in No. 3 vein. There is some pyrite, but the content of gold is low; no sections of ore grade have been indicated by trenching and diamond-drilling.



Photomicrograph showing gold telluride (T) and gold (Au) lying inside an apparently unfractured cube of pyrite (P), Sturgeon River mine. (× 130.)

Several other veins are known, but on few of them has much work been done. A narrow vein parallel to No. 1 crosses the line between the claims of the Sturgeon River Gold Mines and those of Agaura Exploration at the No. 1 post of claim T.B. 13,642 and passes along the crest of the ridge behind the mine buildings. It has been traced for several hundred feet. It is narrow; the maximum width being one foot, and the average not more than 6 inches. So far no part of it has been found to contain more than small amounts of gold.

A few small faults have been found in the underground workings. One on the 625-foot level dips 45° N. Others have dips of 45 degrees or less. All are post-ore, but none offsets the vein more than a few inches. A considerable amount of water enters along these faults in the upper levels.

During the winter of 1934–35 a small mining plant was installed at the Sturgeon River mine; power was supplied by a Diesel engine. A vertical shaft was sunk to a depth of 500 feet, and by September crosscuts had reached the vein on four levels. On the 500-foot level the vein was intersected at a point

much nearer the shaft than expected, and the dip is in the opposite direction to that on the levels immediately above. Narrow veins containing spectacular amounts of gold were also encountered in the shaft at 300 and 440 feet.

A mill equipped with two twin Tremaine stamps was installed during the winter of 1935–36; milling began in June. Steam power was generated, with wood as fuel. Inside and plate amalgamation was used, and the sludge passed over blankets. The blanket concentrates were later amalgamated in a barrel. After a month's operation it was found that the tailings loss was high. This together with the cost of wood-generated steam power led to the suspension of operations until a more efficient mill could be installed and hydro-electric power obtained. Although the vein contains an unusual proportion of gold, its narrowness and the lack of any considerable amount of gold in the wall rocks will make



Photomicrograph showing gold (Au) in quartz (black) and apparently unfractured pyrite (P), Sturgeon River mine. (× 130.)

it necessary to mine narrow widths in order to avoid undue dilution. The total tonnage, therefore, will be small. All larger veins so far found in this area contain too little g d to make ore; hope of successful operation seems to rest upon the narrow high-grade veins.

Agaura Exploration, Limited

The claims of Agaura Exploration, Limited, T.B. 13,392–13,404 lie immediately east of the claims of the Sturgeon River Gold Mines. Staked early in the summer of 1934 by R. H. Barnum and J. J. Green, they have had a rather more thorough surface examination than most other groups in the area. Several veins have been discovered. One of these, No. 2, now almost completely uncovered for more than 2,500 feet, is one of the most persistent veins yet found in the area.

The northwestern part of the group is underlain by granodiorite; the southeastern third of the claim farthest southeast is underlain by granite. Between

the granite and granodiorite, volcanics, mainly andesite, extend across the claims in a diagonal belt 50 chains in width.

The veins on this group of claims belong to two sets similar to those just described on the adjoining claims (see Fig. 4 below). No. 2 vein outcropping on claims T.B. 13,395, 13,399, and 13,398, strikes N. 30° E. and appears to be vertical, or nearly so. The average width of quartz in the vein is about 2 feet. The maximum width is 7 feet, and the minimum 2 inches. Variations in the

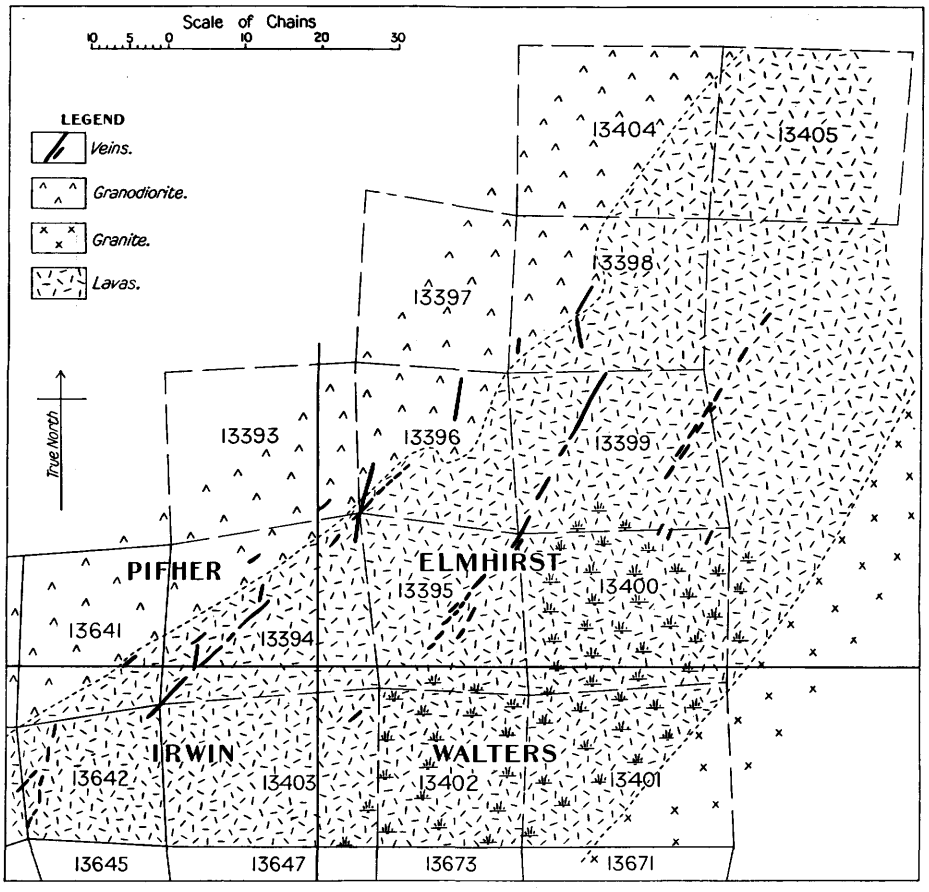


FIG. 4—Geological sketch map showing the vein systems on the Agaura and Sturgeon River properties.

size of the vein occur in short distances, so that any section through the vein has a marked lenticular form. Lenses of quartz a foot in width commonly taper in both directions to 2 or 3 inches in a distance of 5 feet.

Along the south end of No. 2 vein there is a silicified zone separated from the quartz-filled vein by a few feet of country rock. At the extreme south end, on claim T.B. 13,395, the quartz vein is on the northwest side, but a short distance to the north it cuts through the silicified zone, which, from that point north for several hundred feet is on the northwest side of the quartz vein. The wall rock of both is white-weathering, greenish-grey lava, which is slightly schistose immediately adjacent to the vein and has been eroded into grooves marginal to

the quartz. Under the microscope, quartz is the only original mineral in the rocks, which are composed mainly of chlorite and sericite. The thin sections are traversed by quartz veinlets. In view of the abundance of chlorite and the presence of quartz, the rock is considered to have been a dacite.

In addition to quartz, the vein contains calcite, pyrite, chalcopyrite, sphalerite, and galena. Most of the quartz is a massive, coarse-grained, milky to translucent variety, which in places has a ribboned appearance due to the presence of zones of chlorite and sericite. This type is cut by veinlets of glassy quartz one-half inch to three inches in width. Pyrite, chalcopyrite, and galena are present in small quantities, and there is a little gold. The silicified zone contains sericite, biotite, zoisite, calcite, leucoxene, hematite, limonite, apatite, and quartz. Some of these minerals are evidently derived from the alteration of original constituents of the lava. Later these secondary minerals were replaced by pyrite, chalcopyrite, sphalerite, and galena. A little gold is present. Thomson[1] examined a number of specimens of ore from this property. The vein from which they were obtained is not specified, but it is likely that most of them came from No. 2. He reports pyrite, sphalerite, chalcopyrite, galena, gold, and magnetite. The first three of these predominate; magnetite and gold are minor constituents.

Vein No. 6 on claim T.B. 13,398 differs from most of the others in that its outcrop is curved. At the south end it strikes north-south, curves gently to N. 30° E., and at the north end is N. 45° E. The total exposed length is 220 feet. The vein appears to be vertical. At the south end the wall rocks are lavas of intermediate character; at the north end the vein is in granodiorite. Rock trenches at the point where it begins to curve eastward show 40 to 50 inches of quartz, in which are included several fragments of chloritized wall rock. In the quartz, sphalerite, galena, and chalcopyrite are present. Pyrite occurs in the granodioritic wall rocks, and near the edge of the quartz the country rock is cut by calcite veins up to half an inch in width.

During the summer of 1935 much of the exploration work on this group was concentrated on the claims adjacent to those of the Sturgeon River Gold Mines. The contact between granodiorite and lava runs northeastward across claims T.B. 13,394 and 13,396; granodiorite lies to the northwest. On these claims several veins were discovered, trenched, and sampled. One of these (No. 11 on the Agaura property) continues southwestward on to claim T.B. 13,642, crossing the boundary between the two properties at the No. 1 post of claim T.B. 13,642 (No. 3 post of claim T.B. 13,394). At that point the vein has a width of 15 inches of quartz. In places it narrows to 2 inches, but is less variable in width than are most of the veins. The gold content so far as the vein has been sampled is low. At the No. 1 post of T.B. 13,394 two veins intersect. One strikes northeastward, the other nearly north. The former cuts through the latter and has the same northeasterly strike as the one just described; it may be the continuation of it. At this point it is narrow, but 50 feet to the north a vein parallel to it has a width of 8 inches of quartz, with which is some pyrite. Gold has been found at several places along rusty shear zones parallel to the walls of the vein, around grains of pyrite, and in quartz that shows no visible fracturing. Some of the north-south veins in this locality also contain gold in visible quantities. In physical character and mineralization they resemble the gold-bearing veins on the adjacent claims of the Sturgeon River Gold Mines.

[1]Ellis Thomson, "Mineralization of the Little Long Lac and Sturgeon River Areas," Univ. of Toronto Studies, Geol. Series No. 38, 1935. pp. 42, 43.

Development work on the Agaura claims consists of a large amount of stripping, trenching, and test-pitting. The long and continuous No. 2 vein has not been found to have any ore shoot in the part that has been exposed. Some of the veins found on the western claims have a considerable gold content, but they are so narrow that only small tonnages of ore can be expected from any one vein.

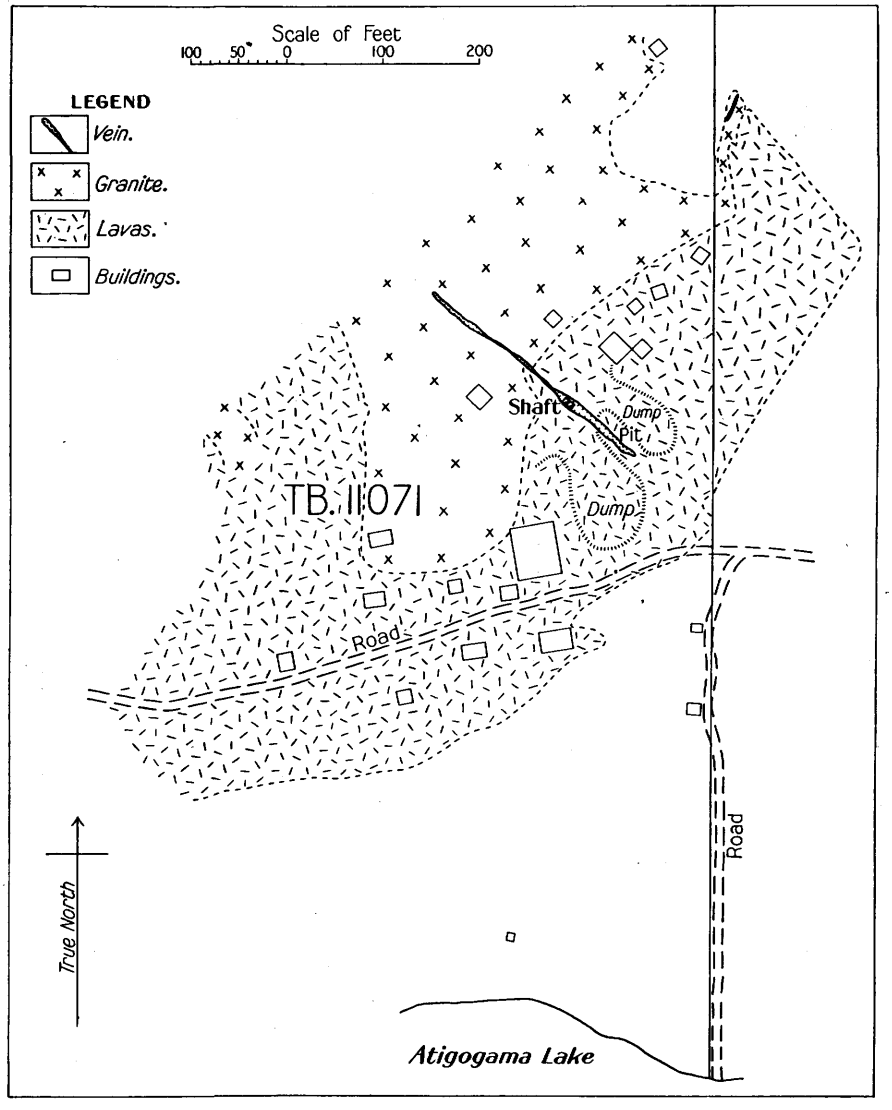


FIG. 5—Sketch map of the surface geology in the vicinity of the shaft, Orphan mine.

Orphan Mine

The Orphan mine, formerly known as the J. Bruce McMartin and earlier still as the Dikdik, is located on the north side of Atigogama lake in the northeast corner of the township of Rickaby. The claims held by the company are T.B. 11,070 to 11,078, extending from Atigogama lake northwest to Dilla lake. The

vein that is being worked was discovered by T. Johnson in 1931. At first ore was taken from an open cut, hand picked, and shipped to Flin Flon for treatment. During 1935 a small mill on the property produced a small amount of

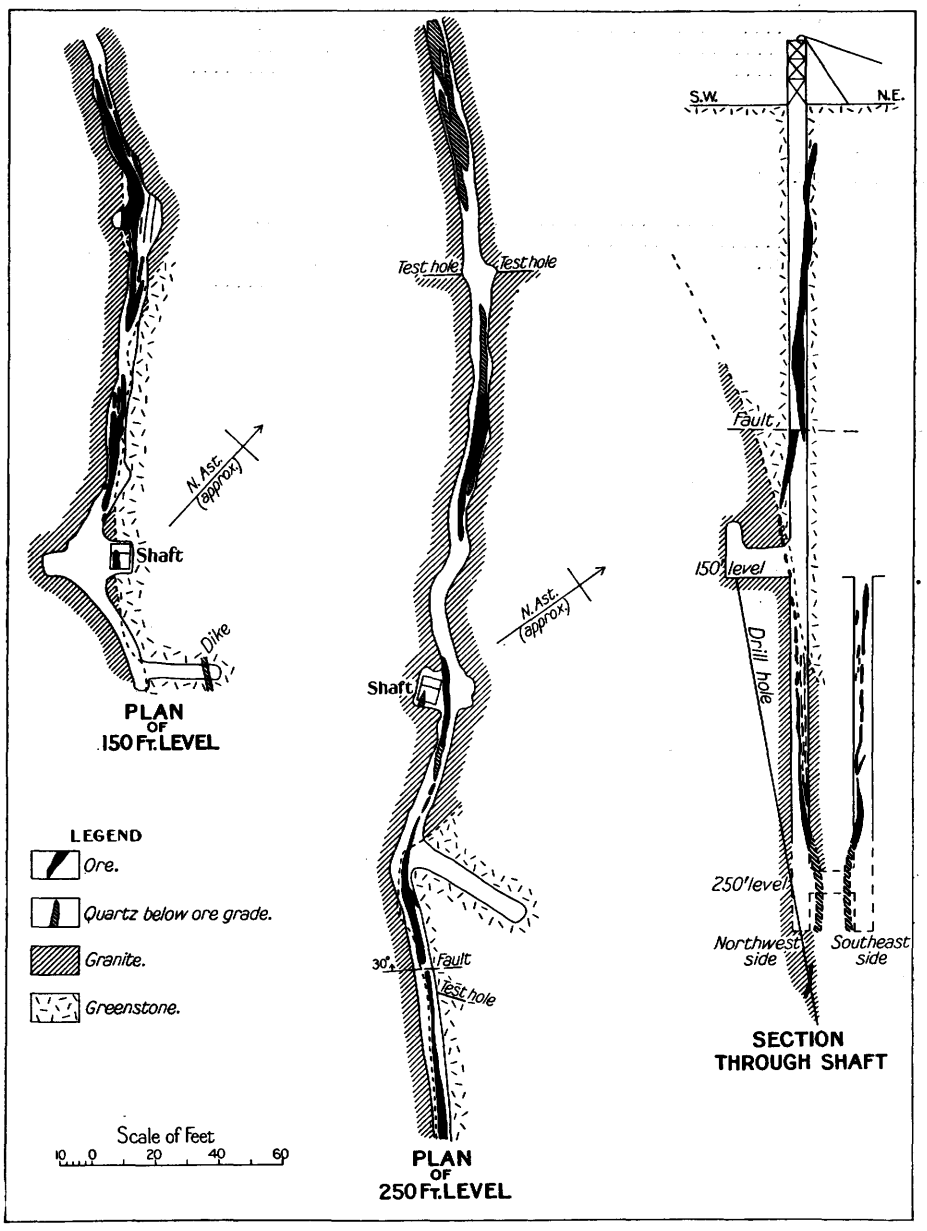


FIG. 6—Plan of the 150- and 250-foot levels and section through the shaft, Orphan mine. (After K. W. Fritzsche, published by permission of J. Bruce McMartin.)

gold. A Diesel plant supplies power both for mining and milling. As it is too small to permit much development work to be done while the mill is in operation, milling was discontinued in September, 1935, to allow development work to

proceed. In 1934 ore was taken from an open cut 80 feet long on the surface, 50 feet long at the bottom, and 50 feet deep. The production as reported to the Ontario Department of Mines was:—

Ore milled	tons	230
Gold	ounces	1,082
Silver	ounces	644
Value		$37,638

A vertical shaft has now been sunk to a depth of 250 feet and two levels have been opened. Ore during 1935 came entirely from the underground workings and production was as follows:—

Ore milled	tons	3,295
Gold	ounces	1,378.292
Silver	ounces	914
Total value		$49,118

A large part of the block of nine claims of the Orphan Gold Mines is heavily drift covered; the scattered outcrops show that much of the consolidated rock on them is granite. Apparently lavas occur only on the southeastern claims, T.B. 11,070 and 11,071. Tongues of granite extend southwestward from the main mass into the greenstone (Fig. 5).

The lavas to the west of Atigogama lake are fine-grained, dark-green, massive rocks, which under the microscope appear porphyritic with poorly formed phenocrysts of plagioclase. Chlorite, epidote, and calcite make up the fine-grained groundmass. Oval areas of quartz with a mosaic texture are probably amygdules. The phenocrysts have the appearance of being recrystallized rather than original in character, but in other parts of this area the feldspars are well formed. In any case the lavas were probably andesites.

The granite is a grey, fairly coarse grained type, made up of quartz, oligoclase, biotite, and magnetite, with epidote, chlorite, sericite, and kaolin as alteration products. The feldspars are rather badly altered. The biotite occurs in aggregates of small crystals. An analysis of this granite and a recast of the analysis into constituent minerals are given in Tables Nos. III and IV.

TABLE NO. III

	No. 1	No. 2
	per cent.	per cent.
SiO_2	66.68	68.00
Al_2O_3	16.33	10.95
FeO	2.57	1.54
Fe_2O_3	1.85	1.31
CaO	4.12	5.49
MgO	1.48	1.65
K_2O	1.51	2.74
Na_2O	2.95	.29
H_2O	.89	1.51
CO_2	.71	3.74
TiO_2	.62	.53
P_2O_5	.11	.17
MnO	.10	.60
Pyrite	.....	1.41
Total	99.92	99.93
Specific gravity	2.76	2.759

Sample No. 1—Granite 200 feet from the vein, Orphan mine.
Sample No. 2—Altered granite near the vein, Orphan mine.

TABLE No. IV

	No. 1	No. 2
	per cent.	per cent.
Quartz	34.32	54.48
Plagioclase (Albite	25.10	31.76
Plagioclase (Anorthite	6.66	.....
Microcline	2.22	.....
Apatite	.26	.39
Rutile	.62	.53
Biotite	2.55	.....
Pyrolusite	.10	.60
Magnetite	2.32	1.96
Sericite	6.36	20.00
Paragonite	.....	3.80
Chlorite	7.25	6.54
Kaolin	5.42	.....
Zoisite	6.69	2.15
Calcite	1.60	8.50
Pyrite	.....	1.41
Total	101.67	100.36

The contact between granite and andesite is remarkably sharp. There is no granodioritic contact phase such as that which borders the granite batholiths farther west. The attitude of the contact of the main mass is unknown. In the mine workings the granite tongue seems to plunge southward at a high angle. (See plan of 150-foot level, Fig. 6, page 49.)

The ore body of the Orphan mine is on claim T.B. 11,071. Quartz lenses occur in a shear zone crossing the contact between the granite and andesite. (See Fig. 5 and section through shaft, Fig. 6.) The strike is N. 40° W., and the dip nearly vertical. A parallel vein on the adjacent claim to the east is wholly in andesite, but the relation of this vein to the contact in depth is unknown. The shear zones are clearly later than the consolidation of the granite, since the contact seems to be slightly offset and the granite is somewhat gneissoid along the vein. The ore bodies are parts of irregular lenses of quartz (Fig. 6, plan of 150-foot level), which in places bulge to widths of 6 feet. A width of 9 feet is recorded in one place. From the contact in both directions the vein becomes narrower and finally seems to feather out.

The quartz of the vein is white and so fine grained that it is almost chalcedonic. In parts of the lenses metallic minerals make up a considerable part of the vein filling. The most abundant of these is pyrite. Chalcopyrite is common; pyrrhotite, sphalerite, and galena less so. Under the microscope a little arsenopyrite and tetrahedrite have been recognized. Gold in visible amounts occurs sparingly. It is very pale in colour on account of a large admixture of silver; the mineral can with propriety be called electrum. Under the microscope gold can be recognized as a late mineral. It usually occurs in pyrite and is commonly associated with galena.

The following mineralographic report on samples of the ore is by Dr. Maurice Haycock, of the Ore Dressing and Metallurgical Laboratories, Department of Mines, Ottawa:—

Samples.—The sample of gold ore from Atigogama lake, Thunder Bay district, Ontario, was received by the Ore Dressing and Metallurgical Laboratories from the Dikdik Exploration Company on January 5, 1934. Specimens were selected, and seven polished sections were prepared and examined microscopically for the purpose of determining the character of the ore.

Mineralogy.—The gangue is light-grey to white translucent quartz. The metallic minerals present in the polished sections are pyrite, sphalerite, arsenopyrite, chalcopyrite, galena, tetrahedrite, and native gold.

Pyrite is the only abundant mineral. It occurs in large irregular grains and imperfectly formed crystals, and in granular masses in the quartz. It is veined and somewhat replaced by sphalerite, galena, chalcopyrite, and native gold.

Arsenopyrite is rare, only occasional small crystals being present in the gangue and, more rarely, in the pyrite.

Sphalerite is common but, like the remaining sulphides, is present in only small amount. It occurs as small irregular patches and grains in the quartz.

Galena and chalcopyrite occur as irregular grains and veinlets in both the quartz and the pyrite. Galena shows a tendency to follow the crystallographic directions of the pyrite and to replace it to some extent. It is associated with some of the native gold [see photomicrograph on page 53].

Tetrahedrite, or tennantite, is very rare, and occurs as rounded grains in the galena.

Native gold is abundant in the sections examined. A large percentage of the metal is within pyrite, which it veins. The detailed occurrence of the gold is shown in the second table below.

Character of the Native Gold.—The large number of grains of finely divided native gold made it possible to carry out quantitative microscopic analyses, which are thought to represent rather closely the conditions obtaining in the ore. The grain size of the metal is shown in the first table below and the modes of occurrence in the second table.

GRAIN SIZE OF THE NATIVE GOLD

MESH	Au per cent.
—35 + 48	3.4
—48 + 65	5.0
—65 + 100	8.7
—100 + 150	10.7
—150 + 200	12.6
—200 + 325	17.3
—325 + 600	16.4
—600 + 900	12.2
—900 + 1,100	6.4
—1,100 + 1,600	4.2
—1,600 + 2,300	1.9
—2,300	1.2

MODES OF OCCURRENCE OF THE NATIVE GOLD

WITH PYRITE	Au per cent.
1. Alone	59.6
2. Associated with galena	4.5
3. Associated with sphalerite	1.9
4. Associated with chalcopyrite	.7
5. As veinlets in pyrite	7.0
6. On pyrite-sphalerite boundaries	.3
7. On pyrite-gangue boundaries	6.3
Total	80.3
WITH GANGUE	
1. Grains and veinlets in gangue	15.1
2. Associated with sphalerite	3.9
3. Associated with galena	.7
Total	19.7

Thomson[1] examined two specimens of ore from this property. He found that they contained pyrite as the chief metallic mineral, chalcopyrite and galena in considerable quantity, and smaller amounts of sphalerite, gold, and pyrrhotite.

During the present investigation several samples of the ore were examined. Some of these were collected at the property; some were supplied by K. W. Fritzsche, and a specimen containing considerable galena by P. E. Hopkins. No minerals other than those reported by Haycock were found. Pyrrhotite was observed forming a coating around pyrite and apparently younger than it

[1]Ellis Thomson, op. cit., p. 38.

(see photomicrograph on page 54). The galena and sphalerite are younger than the pyrite. Sphalerite is found containing remnants of pyrite. So far as seen, the boundaries between galena and sphalerite seemed to show contemporaneous formation (see photomicrograph on page 55). Gold is clearly quite late in the deposition sequence. Arsenopyrite was not recognized in any of the sections, and the relations of tetrahedrite to the other sulphides was not determined.

The gold content of the narrow lens that was removed in the open cut was exceptionally high. In general the values are higher and more consistent where the wall rock is lava. There are, however, lenses of good grade in the granite,



Photomicrograph of ore from the Orphan mine showing pyrite (light-grey), galena (dark-grey), and gold (white). The black spots are pits in the section. The gold and pyrite seem to follow the crystallographic directions of the pyrite. (× 140.) (Photomicrograph by M. Haycock, courtesy of the Department of Mines, Ottawa.)

but the gold seems to be much more erratically distributed in them than it is in lenses within the lavas. Apparently also the content diminishes rather rapidly as the lenses are followed into the granite. Fritzsche[1] states that the widest as well as the richest parts of the ore lenses occur where narrow fissures now filled with calcite intersect the quartz-filled fissure.

Lava forming the walls of the vein was apparently not much affected by the vein-forming solutions. Granite wall rocks show considerable alteration. Lava from the wall of the vein is dark-green in colour, massive, and fine-grained. Pyrite occurs commonly as disseminated grains. In a specimen examined under the microscope no original minerals are recognizable. Chlorite and epidote

[1]K. W. Fritzsche, private report for the J. Bruce McMartin mine.

make up most of the rock. Quartz and calcite occur in stringers and as areas apparently introduced. The mineral most distinctive of the alteration is biotite. Crystals of it are disseminated through the slide, but none of them are well formed and all of them contain a large quantity of foreign material. There has evidently been an introduction of potassium, but except for the presence of biotite the rock does not differ much from that at some distance from the vein.

Granite near the vein is a grey, granular rock with abundant quartz. Under the microscope it is found to be thoroughly altered. It contains quartz, sericite, calcite, pyrite, and chlorite. Feldspars have been changed to a mat of sericite. Some quartz occurs as mosaics, probably formed by the breaking-down of silicates. Pyrite is evidently an introduced mineral, and veinlets of calcite and quartz traverse the section.



Photomicrograph of ore from the Orphan mine showing quartz (black); pyrite (white), surrounded by a rim of pyrrhotite, and the whole surrounded by sphalerite (grey). Within the sphalerite are rounded remnants left as the sphalerite replaced pyrite. (× 130.)

Table No. III (page 50) shows analyses of the granite at a point 200 feet from the vein and of the altered granite near the vein, and the latter analysis recalculated as free from pyrite.

The composition of the two specimens is shown for comparison in the straight-line diagram (Fig. 7). As the specific gravities of the two rocks are so nearly the same, line 100 of the diagram may be taken to represent conditions under no change of volume. In that case the total silica and TiO_2 have apparently not changed very much during the alteration. Alumina, soda, and iron oxides have decreased; lime and magnesia show some gain; and potash, water, and CO_2 large gains.

If this represents a true picture of the changes that have occurred, it is evident that there are at least two stages in which quite different conditions existed; for although the total silica has not changed much on the assumption of constant volume, yet recalculation of the oxides into the constituent minerals

shows that there has been a large increase in quartz (Table No. V). This fact is evident under the microscope, as the thin sections show many quartz veinlets. It appears, therefore, that as the feldspars were destroyed there was a considerable loss of silica, but that later this was compensated by the introduction of quartz into fractures. The table shows also how intense has been the sericitization. The presence of paragonite is assumed to account for the soda; no plagioclase is recognizable in the section examined. Part of the calcite may represent the breaking-down of the feldspar, but a considerable part has been introduced as veinlets. Zoisite and kaolin seem to have been unstable under the action of the vein-forming solutions. They have probably gone into calcite and sericite. The absence of biotite in this rock is in contrast to its presence in the lava.



Photomicrograph of ore from the Orphan mine, showing pyrite (P), galena (G), and sphalerite (S). The sphalerite evidently replaces the pyrite. The galena and sphalerite are apparently of the same age. (× 130.)

The minerals of the vein and the alteration of the wall rock could have resulted from vein-forming solutions derived from a magma of granitic composition. The proximity of the veins to a salient from a granite mass suggests a genetic relationship of the veins to the magma from which the granite was formed. But clearly the fracturing occurred after the granite had solidified sufficiently to be sheared. The relationship between the veins and the granite may be purely a structural one, due to a difference in competency of the granite and lava under stress. The fracturing would thus be localized near the contact between the two rocks. If this is so, the source of the vein-forming solutions must be some magma younger than that from which the granite crystallized. Either hypothesis offers difficulties.

If the fractures were caused by external stresses acting on the granite, and are localized at the contact between the two rocks of differing competency, they probably die out in both directions from the contact. Thus the ore shoots will be limited to short lenses lying across the contact between the granite and

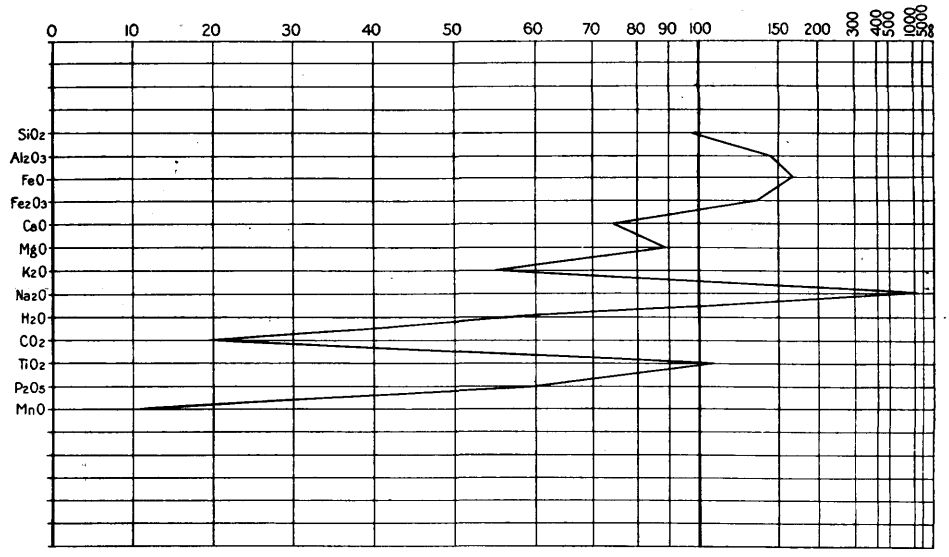


FIG. 7—Straight-line diagram showing alteration of the granite wall rocks, Orphan mine.

greenstone. The tonnage will not be large, but from past experience it seems likely that material of exceptionally high grade can be produced by sorting to eliminate barren wall rock.

TABLE NO. V—MODE OF FRESH GRANITE AND ALTERED GRANITE

	No. 1	No. 2
	per cent.	per cent.
Quartz	33.24	53.82
Oligoclase {Albite	25.12	30.96
Oligoclase {Anorthite	5.84	.....
Orthoclase	4.45	.....
Hornblende	6.75	.....
Apatite	.22	.22
Titanite	1.55	1.21
Biotite	2.55	.....
Pyrolusite	.10	.60
Magnetite	2.32	1.96
Sericite	3.18	20.95
Chlorite	3.22	7.52
Kaolin	5.89	.....
Paragonite	.....	3.80
Zoisite	4.41	.....
Calcite	1.59	9.00
Pyrite	.....	1.41
Total	100.43	100.49

Sample No. 1—Granite 200 feet from the vein, Orphan mine.
Sample No. 2—Altered granite near the vein, Orphan mine.

Oliver-Severn Gold Mines, Limited

The claims of Oliver-Severn Gold Mines (Taylor-Segsworth group), T.B. 13,654–13,659 and 14,175–14,177, lie almost midway between Paint lake and the Sturgeon river. They are reached by a trail from the camp buildings near the

mouth of a small stream entering the Sturgeon river from the south above Martin rapids.

All the consolidated rock on the claims is granite except a small lenticular remnant of older rocks in which the veins occur. Apparently the roof of the batholith was not far above the present surface. Dark-coloured and gneissic areas in the granite at several other places in the vicinity are probably the lower parts of other roof pendants now almost completely assimilated.

The main lava inclusion on the Oliver-Severn claims is now chlorite schist. It is 225 feet in length and 35 feet in width at the widest part. The strike is N. 65° E. In the schist there are large and irregular quartz veins roughly parallel to the schistosity. Individual quartz veins in the wide part of the lens have widths up to 5 feet, and at the point where the schist inclusion has a total width of 30 feet, approximately one-half of it is quartz. At the southwest end where the schist tapers out, a quartz vein continues into the granite beyond the end of the schist but narrows sharply and fingers out.

The quartz is a white, vitreous variety. Metallic minerals form 5 to 10 per cent. of the vein material. Pyrite and chalcopyrite are in approximately equal proportions, and in places quite large masses of mixed sulphides occur in the quartz. Sampling of trenches indicated an average gold content of 0.17 ounces per ton over a width of 4 feet 8 inches for a length of 200 feet.[1]

The chlorite schist in which the quartz veins occur contains only small quantities of sulphides. Thomson[2] reports the examination of two specimens, one of which consisted mainly of sulphides, the other mainly of gangue. In the former, pyrite and galena were the predominant metallic minerals with subordinate quantities of sphalerite, chalcopyrite, hematite, and gold; the latter specimen showed chalcopyrite as the common metallic mineral, with pyrite and hematite in minor amounts.

Trenches were put down to the consolidated rock for a length of 340 feet. Some diamond-drilling was done in the winter of 1934–35, and the schist was found to narrow and finger out in depth as it does on the surface. In most of the holes little schist was found at vertical depths of 100 feet. The veins apparently do not continue far into the granite beneath, and work was discontinued.

Miron Claims

Work done on claim T.B. 13,892 north of Coyle lake has disclosed conditions somewhat similar to those just described. A lens of lava is included in granodiorite. The vein zone lies along the contact between the lava inclusion and the granodiorite and continues for some distance into the latter. Near the southwest tip of the inclusion a zone 7 feet in width contains irregular quartz veins, which make up approximately three-quarters of the whole. In a pit in this part of the stripping, white, vitreous quartz contains massive aggregates of chalcopyrite as much as 2 inches in diameter. Gold is reported from assays. The total length of the zone exposed when the claims were visited was 55 feet. At the ends it tapers into irregular veins, which feather out in short distances. Conditions seem similar to those at the Oliver-Severn property, and the possibility of the continuation of the zone at depth seems doubtful, even if a much greater extension of it could be found on the surface than is at present indicated.

Oremond Gold Mines

Oremond Gold Mines now have under exploration a group of fourteen

[1]Information from the company's records.
[2]Ellis Thomson, op. cit., p. 43.

claims, T.B. 11,799 to 11,807, inclusive, and T.B. 15,197 to 15,201, inclusive, held by the Dumond Mining and Exploration Company. The claims lie between Nissiamkikam and Oxaline lakes. Some of them are in Leduc township, the others in Walters township.

The rocks in which the gold deposits lie are all sedimentary. The contact between the sediments and lavas is a short distance to the north. The sediments consist of interbanded greywacké and iron formation. The latter is actually a greywacké in which alternate beds contain abundant hematite. The iron formation fades out into greywacké with only an occasional thin lens of hematitic material, and there are, within the iron formation, beds of greywacké a foot or more in thickness. About fifty feet of the sediments contains a large enough proportion of iron minerals to be considered iron formation.

The strike of the formation is nearly east-west. The band of iron formation is fractured and sheared in places, and in the fractures quartz with some carbonate has been deposited. There has also been a considerable introduction, possibly at a somewhat later date, of pyrite with some arsenopyrite. The sulphide minerals have not only occupied fractures, but have replaced the iron formation more or less completely. Polished sections of the ore show that both arsenopyrite and pyrite have been fractured. Although no gold was seen in the specimens examined microscopically, it is probable that the gold present in the ore is associated with fractured sulphides. The more complete the replacement of iron formation by sulphides, the higher seems to be the gold content.

Trenching along the iron formation has shown the existence of a zone 154 feet in length, averaging 7¼ feet in width, in which ore of medium grade is reported to occur. To the east of this section, material of lower grade continues, but the zone is narrow. The south margin of the ore of the 150-foot section is marked by a bedding-plane shear zone. At the northern side the gold content diminishes gradually. Other fracture zones containing gold occur in the iron formation, and one lies entirely in greywacké near the iron formation.

Some diamond-drilling was done to test the character of the zone at depth, and during the summer of 1936 a shaft was sunk to the 150-foot level, a crosscut was made to the iron formation, and drifting done in each direction along the zone of fracturing.

Greenlee Gold Mines, Limited

Greenlee Gold Mines, Limited, took over the Dalton claims 1½ miles south-east of Nezah in Vincent township and carried on active development work during the summer of 1936.

The rocks in this part of the area are basic lavas, some showing ellipsoidal structures, and iron formation. A feldspar porphyry dike 6 feet wide cuts both lavas and iron formation. Two bands of iron formation are well exposed on claims T.B. 5,669, 5,670, and 5,671. One is 35 feet in width, the other about 20 feet. They are separated by 350 feet of lava. Both are much contorted and in places are fractured. The typical iron formation consists of black bands a quarter of an inch wide containing much magnetite, alternating with white bands of sugary quartz of the same width. In places the black bands consist mainly of chlorite rather than magnetite. Parts of the bands, usually where they are flexed, are fractured. The fractures are filled with quartz, with which there is pyrrhotite, pyrite, chalcopyrite, and a little arsenopyrite. The quartz veins are narrow, commonly not more than a quarter to half an inch in width, but locally they form approximately a fourth of the rock. Usually the sulphides are sparingly disseminated, but in places pyrrhotite is present in masses a foot in

diameter. In most places it occurs as narrow lenses along the bedding of the iron formation. Gold has been found by assay. It is confined to the areas of secondary minerals. The feldspar porphyry dike cuts the quartz veins. The gold content is rather low and the distribution is erratic.

In addition to the gold-bearing zones in the iron formation, a north-south quartz vein has been uncovered. It lies entirely in greenstone. For 200 feet its width averages 30 inches, and in places it is over 40 inches wide. Toward the south it becomes irregular in strike and narrower where it cuts through a feldspar porphyry dike 2 feet in width. Evidently it is younger than the fracture zones in the iron formation, since the dikes appear to be of the same kind.

The quartz in this vein has an indistinct banded structure parallel to the walls. A little galena is present, and gold is reported to occur in those parts where there is galena.

Other Properties

Veins or mineralized zones have been found on several other groups of claims, but either development has failed to reveal sufficient gold to warrant further exploration or for other reasons work was not continued.

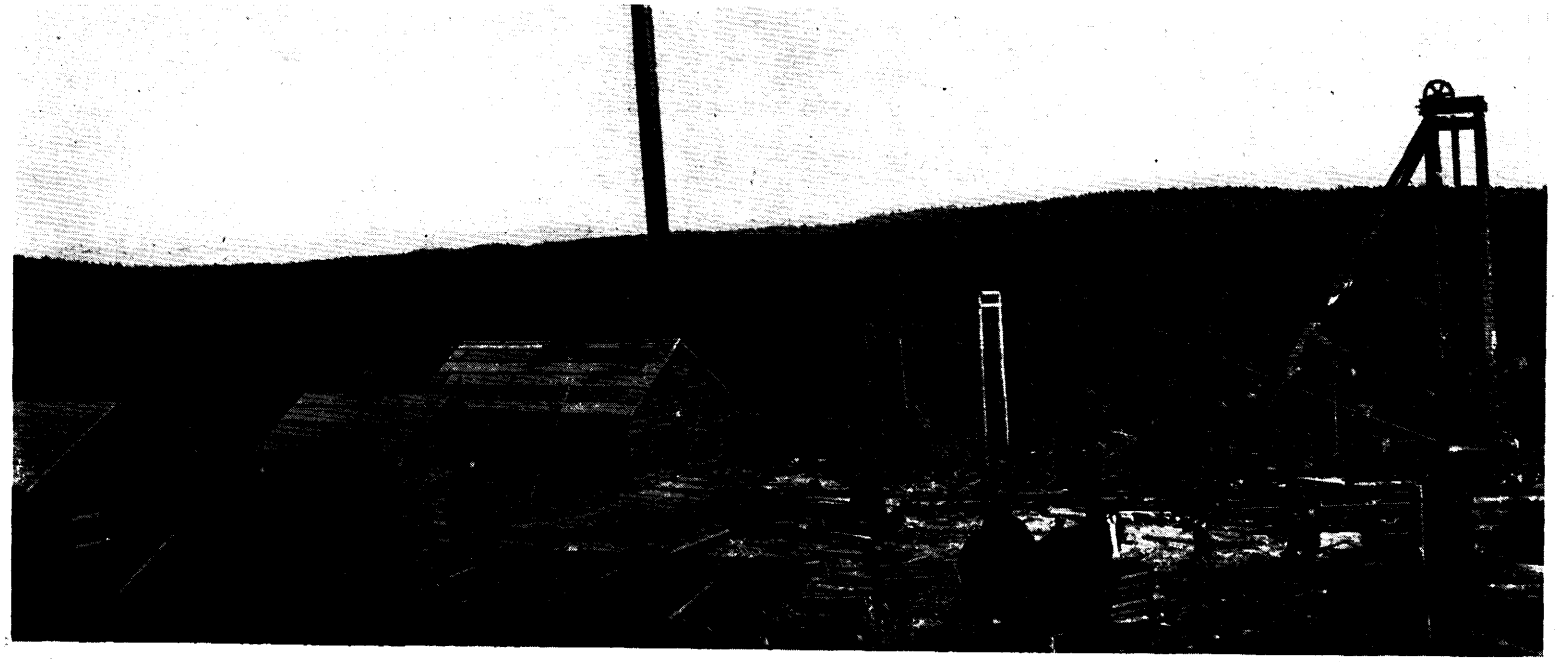
On the claim adjoining T.B. 11,071 of the Orphan mine to the east, a large quartz vein has been uncovered. It is entirely in lavas but is not far from the edge of the granite. It contains only small quantities of metallic minerals, and the gold content is reported to be low.

Considerable work was done during the winter of 1934–35 on claims east of Coyle lake, adjoining the Agaura claims. A silicified zone between granite and lava contains considerable fine-grained pyrite. The gold content was found to be low.

On the group of claims, T.B. 11,310–11,318, 11,467, 11,468, 11,858, and 11,859, held by Minefinders, Limited, there was considerable trenching done, and zones containing pyrite were located. No body of ore grade has been reported.

East of the Sturgeon river above Seven Foot falls on the Grierson claims, pits were opened up on a strongly sheared zone in rhyolite. No information as to the gold content of the material was obtained.

A number of claims were staked in the southern part of the township of Walters and the northern part of Vincent during the summer of 1936. On one of these, claim T.B. 22,073, southwest of Nezah, a contorted quartz vein occurs in schistose greenstone. The vein varies in width, with a maximum of 3 feet. It is transverse to the regional east-west schistosity, but along the margin of the vein the schistosity bends to a position parallel to it. Only a small amount of pyrite occurs with the quartz, but gold has been recognized in visible quantities. Sufficient work has not yet been done to determine the extent of the gold-bearing section and its gold content.



PANORAMIC VIEW OF SHAFT-HEAD AND POWER PLANT, LOOKING SOUTH, CASEY CONTACT PROPERTY, JUNE, 1935

The Western Part of the Sturgeon River Area
(Sturgeon River-Beardmore Section)

By H. C. Laird

INTRODUCTION

The western part of the Sturgeon (Namewaminikan) River area (Sturgeon River–Beardmore section) is located in the Nipigon Provincial Forest, district of Thunder Bay, about 60 miles north of Lake Superior. It borders the east side of Lake Nipigon and embraces the townships of Pifher, Irwin, and Sandra, as well as parts of the townships of McComber, Summers, Meader, Eva, and Dorothea.

In the summer of 1934 gold was discovered by Rene Maloney north of Twin falls on the Sturgeon river, on what is now the Maloney Sturgeon property. As a result of this and subsequent discoveries farther east a staking rush developed in the late fall and carried on well into the following year. The region was staked solidly, but only a small proportion of the claims received more than a cursory examination. Although many of the claims were allowed to lapse, sufficient interest was maintained during the summer of 1935 to cause the immediate restaking of any open ground.

Gold in this area[1] was first reported in 1925 on what is now the property of the Northern Empire Mines Company, Limited, near Empire station on the Port Arthur–Longlac Branch of the Canadian National Railways. At that time many claims were staked, mainly along the railway between Warneford and Jellicoe, but no development of any consequence took place.

The period between 1900 and 1922 witnessed considerable intermittent development of certain iron ranges, especially those in the region between Beardmore and the Sturgeon river. These efforts were not attended by any great measure of success, no iron ore deposit of economic grade having been disclosed.

There are no producing gold mines in the area covered by this report, but underground development has commenced on two properties, Casey Contact Gold Mines, Limited, and Leitch Gold Mines, Limited. During the summer of 1935 diamond-drilling and intensive surface development were carried on at four properties: Macjoe Sturgeon Gold Mines, Limited; Amorada Gold Mines, Limited; Sand River Gold Mining Company, Limited; and Leitch Gold Mines, Limited. The property of the Northern Empire Mines Company, Limited, which is located just outside the surveyed area, commenced production in April, 1934, and is now established as a successful producer with a milling capacity of 200 tons per day.

Access and Communication

No part of the area is more than 10 miles from the railway, yet the canoe routes leading to the main operating properties involve travelling more than twice this distance. Any point on the Sturgeon river above Twin falls may be reached in one day by powered canoes from Sturgeon Bridge on the C.N.R. five miles east of Jellicoe, the main outfitting station for this part of the area. A daily freighting service was maintained over this route during the summer of 1935, and airplane service from Jellicoe to all parts of the area was provided.

[1]Wherever the word "area" is used in this report without any descriptive qualification, it refers to the western part of the Sturgeon River map area (Sturgeon River–Beardmore section).

To reach the Casey Contact and Macjoe properties by airplane, one must land on Coyle lake, make a quarter of a mile portage north to the Sturgeon river, and thence travel by freighter canoe to Macjoe Landing, a distance of about 4 miles downstream. A number of buildings have been erected at Macjoe Landing, including the Macjoe camps, and a general store, barber shop, and restaurant.

The lower reaches of the Sturgeon river, that is below Twin falls, may be more conveniently approached from Lake Nipigon than from eastern points. A small canoe of the prospector type, however, cannot be used with safety on Lake Nipigon on account of the rough water and unprotected shoreline. If the western route is chosen it is advisable to outfit at Macdiarmid, a fishing village on Pijitawabik bay, at the southeast corner of Lake Nipigon. From this point seaworthy boats may be engaged to make the trip to the mouth of the Sturgeon river, and some of the smaller boats will even navigate the river as far as the first rapids, about 3 miles from Lake Nipigon.

Old lumber roads, still in fair condition, lead north from Nezah and Beardmore on the railway to central parts of the area. Wagons may be used on the Nezah road in the summer only as far as Windikogan lake. The newer section of the road, extending northward from this point to the main camps on the Sturgeon river, is only fit for winter use. The total distance is about 14 miles. What is locally known as Sinclair's road leads north from Beardmore to a set of abandoned lumber camps at the south end of Long rapids on the Sturgeon river, a total distance of about 10 miles. Although this road has not been travelled much since the suspension of lumbering operations, it is still in fair condition and could be used as a summer road. A new winter road, branching off from Sinclair's road at a point 1½ miles south of Long rapids, leads west to both the east and west camps of the Amorada Gold Mines, Limited, a distance of 3 and 5 miles, respectively. This road crosses the Sturgeon river just above the 35-foot falls, a floating bridge being used at this point. The main properties in the Standingstone river section, the Sand River Gold Mining Company and Leitch Gold Mines, may be readily reached from Beardmore station by what is known as the Poplar Lodge road, the total distance being about 6 miles. This road was constructed in 1918 by interests associated with the development of the iron deposits in this section. Further improvements have been made by the present operators, and this road is now in fair condition for summer use.

Within the area canoe travel is confined largely to the Sturgeon river, the lakes in the Windigokan lake section, and Crooked Green creek. The Sturgeon river is a broad, deep stream, broken at intervals by long stretches of shallow rapids and steep waterfalls. With the exception of that at Long rapids, the portages are short, and all are well travelled, but the river should be traversed only by experienced canoemen. Crooked Green creek is one of the few routes leading north toward the Onaman River area. At present, however, this stream is only navigable as far as a small lake about 6 miles from its junction with the Sturgeon river. Beyond this lake the stream is choked by log jams but still carries a considerable volume of water. Standingstone river is navigable only to a point about half a mile from Lake Nipigon, where a trail leads east through the Sand River property to join the Poplar Lodge road.

Acknowledgments

The writer takes this opportunity of tendering grateful thanks to all those whose thoughtful assistance and hearty co-operation has added materially to the information contained in this report. While in the field, and even since that

time, many maps, plans, and other detailed information of a confidential nature were placed freely at his disposal. In this connection special thanks are due the following and the principals whom they represent: A. Rosenland, of Macjoe Sturgeon Gold Mines, Limited; H. M. Parrington, of Casey Contact Gold Mines, Limited; Russell Cryderman and B. Tribble of the Sand River Gold Mining Company, Limited; and Karl Springer and W. J. Hacker, of Leitch Gold Mines, Limited.

Grateful acknowledgment is made to A. M. Narraway, Chief Aerial Surveys Engineer, Ottawa, who kindly loaned a complete set of vertical aerial photographs covering the whole area. With the aid of a stereoscope these photographs proved to be of great value in outlining the topography and in the location of rock outcrops, as well as making for greater accuracy in the accompanying geological map.

J. Ellis Thomson, of the Department of Mineralogy, University of Toronto, kindly examined by polished-section methods certain ore minerals from quartz veins in the Standingstone river section.

During the field season, able assistance was rendered by W. C. Güssow, W. W. Moorhouse, and F. L. Casey. The writer appreciates the loyalty and high degree of efficiency demonstrated by these men at all times.

Previous Work

The earliest record of geological investigation in the area is that of Robert Bell and his assistant Peter McKellar in 1869. This work, which had to do largely with micrometer surveys of the shore line of Lake Nipigon and its tributary streams, was continued in 1894 by W. McInnes, and further supplemented in 1898 by D. B. Dowling. The first important contribution to the geology of this area, however, was that of W. A. Parks, who traversed portions of the region lying both north and south of the Sturgeon river in 1901. In the same year several mining companies began an investigation of the iron ranges in the Standingstone river section. This widespread interest in iron led to a detailed geological study of these deposits by A. P. Coleman and E. S. Moore for the Ontario Bureau of Mines in the years 1906 and 1907. In 1908, A. W. G. Wilson completed the field work in the Nipigon basin region initiated by the Geological Survey of Canada in 1869, and in 1910, the results of all these previous investigations, together with Wilson's further detailed studies, were published in Memoir 1, of the Geological Survey of Canada.

No further geological work seems to have been done until 1916, when A. G. Burrows examined and reported on a section lying along the railway between Beardmore and Nezah. In 1917 T. L. Tanton mapped the Windigokan lake section, as well as a section lying on either side of the railway between Beardmore and Jellicoe. In 1927, this latter section was mapped in somewhat greater detail by Geo. B. Langford.

The following bibliography contains pertinent information on this area.

Bibliography

ROBT. BELL, "Report on the Geology of the Northwest Side of Lake Superior and of the Nipigon Nipigon District," Geol. Surv. Can., Rept. of Progress, 1866-69, pp. 339, 340, 342, 343, 351, 356, 358, 360, 363, and accompanying map No. 78.

REPORT OF THE ROYAL COMMISSION, "Mineral Resources of Ontario and Measures for Their Development," 1890, p. 22.

W. MCINNES, Geol. Surv. Can., Sum. Rept. 1894, p. 51A.

D. B. DOWLING, Geol. Surv. Can., Sum. Rept. 1898, pp. 95A, 97A, 98A.

W. A. PARKS, "The Country East of Nipigon Lake and River," Geol. Surv. Can., Sum. Rept. 1901, pp. 105A-107A.

W. A. PARKS, "Region Lying North-east of Lake Nipigon," Geol. Surv. Can., Sum. Rept. 1902, pp. 214A, 216A, 218A, 220A, 221A.

J. W. BAIN, "The Iron Belt on Lake Nipigon," Ont. Bur. Mines, Vol. X, 1901, pp. 212-214.

W. G. MILLER, "Iron Ranges of Northern Ontario," Ont. Bur. Mines, Vol. XII, 1903, pp. 310, 311.

A. P. COLEMAN, "Iron Ranges East of Lake Nipigon," Ont. Bur. Mines, Vol. XVI, pt. 1, 1907, pp. 105-135.

E. S. MOORE, "Iron Ranges East of Lake Nipigon—The Ranges around Lake Windigokan," Ont. Bur. Mines, Vol. XVI, pt. 1, 1907, pp. 136-148.

W. J. WILSON and W. H. COLLINS, "Geological Map of Portions of the Districts of Algoma and Thunder Bay, Ontario," 1907, Geol. Surv. Can., Map No. 964 (accompanies Repts. Nos. 980 and 1081).

A. P. COLEMAN, "Iron Ranges East of Lake Nipigon," Ont. Bur. Mines, Vol. XVII, 1908, pp. 136-169, and accompanying coloured geological map.

A. W. G. WILSON, "The Region in the Vicinity of Lake Nipigon, Thunder Bay District, Ontario," Geol. Surv. Can., Sum. Rept. 1908, pp. 95, 96.

A. W. G. WILSON, "Trap Sheets of the Lake Nipigon Basin," Bull. Geol. Soc. Amer., Vol. 20, 1909, pp. 197-222.

A. W. G. WILSON, "Geology of the Nipigon Basin, Ontario," Geol. Surv. Can., Mem. 1, 1910, and accompanying map No. 1090.

A. G. BURROWS, "Longuelac to Jellicoe and Orient Bay," Ont. Bur. Mines, Vol. XXVI, 1917, p. 247.

T. L. TANTON, "Canadian Northern Railway between Nipigon and Longuelac, Northern Ontario," Geol. Surv. Can., Sum. Rept. 1917, pt. E.

E. LINDEMAN and L. L. BOLTON, "Iron Ore Occurrences in Canada," Mines Branch, Can. Dept. Mines, 1917, Vol. II, pp. 67-70.

MAP 1836, "Explored Routes in a Belt Traversed by the Canadian National Railways (between Longlac and Nipigon)," Geol. Surv. Can., 1921.

REPORT OF THE IRON ORE COMMITTEE, 1923, Ont. Dept. Mines, pp. 134-136.

A. G. BURROWS, "Occurrence of Gold near Beardmore, Ontario," Can. Min. Jour., Vol. 46, 1925, pp. 839, 840.

GEO. B. LANGFORD, "Geology of the Beardmore-Nezah Gold Area," Ont. Dept. Mines, Vol. XXXVII, pt. 4, 1928, pp. 83-108.

E. S. MOORE, "Keewatin-Timiskaming Boundary," Bull. Geol. Soc. Amer., Vol. 40, 1929, pp. 553, 554, 556.

L. V. RORKE, "List of Water Powers in the Province of Ontario," Ont. Dept. Surveys, 1931, p. 56.

T. L. TANTON, "Geology of Sturgeon River Area," Trans. Can. Inst. Min. & Met., August, 1935, pp. 341-347.

MAP 312A, "Sturgeon River Area," Geol. Surv. Can., 1934.

MAP 308A, "Lake Nipigon Sheet," Geol. Surv. Can., 1935.

Topography and Drainage

Parts of the area are decidedly rugged, and outcrops are abundant everywhere. In this respect the area as a whole stands in marked contrast to the more or less flat, drift-covered region extending east toward the Little Long Lac area. For the most part the ridges trend in an east-west direction, following the general regional rock structure. A notable exception is the broad diabase mass that traverses the central part of the area from north to south.

Apart from the diabase, greenstone is the main ridge-forming element. Two east-west greenstone ridges are found in Irwin township. The northern one is located just south of Foxear (Clear) creek and may be followed from a point near the east end of Knox lake westward to the north end of Long rapids on the Sturgeon river. The southern one extends from the vicinity of Doris lake west toward Standingstone lake. This ridge is especially prominent along the north side of Watson lake, where it rises more than 200 feet above the surrounding country. There is definite evidence that both these ridges are related to strong fault lines, along which erosional processes have deeply etched the old

peneplaned surface. Most of the less conspicuous east-west ridges in this section of the area may be similarly explained.

In the high ground immediately south of Foxear creek, just west of the Irwin township boundary, a rather unusual type of topography was observed. It consists of a series of parallel, trough-like depressions striking in a general east-west direction and following the trend of the main ridge. These troughs have vertical rock walls up to 30 feet in height and fairly flat but steeply tilted floors up to 30 or 40 feet in width. A similar topography was observed in other parts of the area where there is evidence of strong east-west faulting. The origin of these trough-like structures may be attributed to minor block faulting of the graben type, definite evidence of vertical movement being indicated along the walls. In places, the gouging and plucking of glacial ice has further deepened these depressions.

Probably the most outstanding topographic feature is the high north-south ridge of diabase mentioned above. It has been referred to as an erosion remnant of a flow or sill which at one time is believed to have capped the entire Nipigon Basin region. It stands high above the surrounding country and, on account of the abrupt slopes and general precipitous nature of the east side, forms an effective barrier between the eastern and western parts of the area. In a few places strong east-west faults, post-diabase in age, have broken through the barrier, and, as a result of erosion at these vulnerable points, deep gaps have developed, notably the one between Watson lake and Standingstone lake. The west slope, on the contrary, is more or less gentle and inclined to be hummocky. Outliers of this diabase mass occur north of Twin falls on the Sturgeon river in the form of high conical hills rising 200 feet or more above the general level. The best example is the high symmetrical hill, known as Peddle's peak, in the southwest corner of Pifher township.

Other prominent elevations are the high hills west of Crooked Green creek in the central part of Pifher township; the high east-west ridge just north of McCambly lake in the northern half of Irwin township; the high hills immediately southwest of Windigokan lake in the southeastern part of Irwin township; the high east-west ridge west of Twin falls on the Sturgeon river, which extends to a point south of Musca lake in Sandra township; the high hills lying west of the 35-foot falls on the Sturgeon river in the southwest corner of Sandra township; the elongated ridges in the High Hill river section, Eva township. On either side of the Sturgeon river between the 35-foot falls and Long rapids are high esker ridges parallel to and in some places rising as much as 150 feet above the level of the river.

In marked contrast to the ridge-forming characteristics of the greenstone and diabase are the sedimentary types, which with few exceptions underlie more or less flat or gently rolling areas.

Narrow muskeg areas are found between rocky ridges, and broad muskegs occur just south of the Casey Contact[1] and Macjoe Sturgeon properties, southwest of Twin falls on the Sturgeon river, and north of the Amorada property.

This area lies on the Great Lakes watershed, the immediate drainage being toward Lake Nipigon mainly by three streams, the Sturgeon, Standingstone, and Blackwater rivers. From the point of view of size, volume of water, and drainage basin the first-named is, of course, by far the most important.

For the most part, the Sturgeon river is a rather deep stream, with an average

[1]The name of this company was changed to Brengold Mines, Limited, in 1936, and is so designated in the "List of Properties" on the map.

width of about 150 feet and an appreciable current and volume of water at all times of the year. Between Macjoe Landing and Twin falls the gradient is about normal, but below this point the descent to the level of Lake Nipigon is very rapid, being estimated at approximately 200 feet in a distance of 11 miles. This descent is taken up largely by rapids and waterfalls, the most important of which are Twin falls and Long rapids. Twin falls consists of two waterfalls about 10 chains apart, the upper one being a beautiful rolling cascade with an 8-foot drop, and the lower one consisting of a chute and waterfall with a total drop of 20 feet.

Crooked Green creek and Foxear creek are the main tributaries of the Sturgeon river. The former drains a large part of Pifher township; and the latter, Windigokan lake and the string of clearwater lakes lying to the east.



Twin falls, Sturgeon river.

Watson and Angle lakes drain south into the Blackwater river, which empties into Lake Nipigon at a point 10 miles south of Poplar point.

The Standingstone river drains the northern part of Summers township. It is a narrow, shallow stream, although it carries a considerable volume of water.

Natural Resources

Forests

The area is heavily wooded with the common evergreen and hardwood types, with the exception of white pine, which is conspicuously absent in this section of Ontario. There are no lumbering operations being carried on at the present time, but a considerable amount of cutting took place several years ago in the section just east of Windigokan lake and along the railway near Jackpine. The most recent operations were conducted in the section between Corrigan lake and Long rapids, Sandra township, in the winter of 1929–30 by A. Sinclair in the interests of the Thunder Bay Paper Company.

Timber for use in the early stages of mining development is plentiful. The forest in this area has escaped the fires that have swept the region immediately to the east, only three small areas of brulé being observed. These consist of

a narrow strip north of Foxear creek, burned in 1923; a narrow section on the east side of the narrows on Tyrol lake, Meader township, burned recently; and the region near Tallon and Bearskin lakes, burned early in 1935. The nearest fire rangers' headquarters for this area is at Macdiarmid.

Fish and Game

Pike and pickerel are the common types in the larger inland streams and lakes. Windigokan and Tallon lakes are especially good pickerel waters. Brook trout appear to be confined largely to the Standingstone river and Littlelake river, which enters Lake Nipigon at Devil's Walk, about 5 miles north of Poplar point. Grey trout and whitefish are the common types taken in Lake Nipigon, where commercial fishing is done on a large scale, the fishing fleet making its headquarters at Macdiarmid.

The common fur-bearing animals are gradually being trapped out. Skunks seemed to be more abundant than usual. Rabbits were rarely seen. Big game, such as moose and deer, is still plentiful. Black bears were annoying marauders around most of the mining camps. Partridges were rather scarce.

Water Power

Possible power sites are located on the Sturgeon river at Twin falls, Long rapids, and the 35-foot falls. Their head and estimated capacity as reported by the Ontario Department of Surveys[1] is indicated below:—

Power site	Head in feet	Estimated capacity in horse-power at 80 per cent. efficiency	
		At ordinary minimum flow	At ordinary 6 months flow
Twin falls	20	265	666
Long rapids	78	1,100	2,744
35-foot falls	35	496	1,240

The immediate needs of the mining operators, however, will be adequately served by the Hydro-Electric transmission line running along the railway between Hydro and Geraldton.

Inhabitants

With the exception of two Indian families living at Poplar Lodge, Lake Nipigon, the permanent residents are all located in small communities along the railway. At present, the main centres, Beardmore and Empire, are experiencing prosperous days, due both to operations at the Northern Empire mine and to mining development in the Standingstone river section.

Three decades ago the Hudson's Bay Company maintained a trading post on the Sturgeon river, about a mile from Lake Nipigon. This trading centre has long since been abandoned, its location being marked only by the ruins of many buildings. The company, however, still holds under patent its original plot of 5 square miles.

[1]L. V. Rorke, "List of Water Powers in the Province of Ontario," Ont. Dept. Surveys, 1931, p. 56.

Mapping Methods

The area was traversed across the strike of the formations by standard pace-and-compass methods, the space interval ranging from 20 to 30 chains, depending on the nature of the country being examined. Much unnecessary work was eliminated by the use of a map showing the location of the high and low ground, as well as probable outcrops, all of which were clearly indicated in vertical aerial photographs. This map was prepared by W. C. Güssow in the offices of the Topographical and Air Survey Bureau, Department of the Interior, Ottawa, before leaving for the field.

The base for the accompanying map was prepared by the Topographical and Air Survey Bureau of the Department of Interior, Ottawa. Since leaving the field, however, township surveys have been completed. With the assistance of the original plans as compiled from the surveyor's notes, these townships have been placed on the aerial survey base. Certain minor adjustments have been necessary in order to make the topography conform with the new township surveys, and, as a result, small errors may have been introduced elsewhere.

For 1935, the magnetic declination in this area was approximately 3 degrees west of true north.

GENERAL GEOLOGY

The area is underlain by Keewatin rocks, with which have been infolded sedimentary types, believed to be of Timiskaming age. This assemblage was invaded by dikes and small irregularly-shaped masses of quartz diorite, diorite, granodiorite, granite, and various types of porphyry, all of which have been assigned to the Algoman period of intrusion. A still later period of igneous activity is marked by the intrusion of diabase dikes and the occurrence of what appears to be the remnant of a widespread diabase flow or sill of Keweenawan age. The above types are all pre-Cambrian in age. Unconsolidated sand, gravel, and peat of the Pleistocene and Recent have been deposited on the glaciated surface of the consolidated pre-Cambrian rocks.

The area is the western end of a long belt of volcanic and sedimentary rocks, which is known to extend from Lake Nipigon eastward beyond the Little Long Lac area, a total distance of about 75 miles. What would appear to be the westward continuation of this same belt occurs 60 miles to the southwest in the Black Creek area, the intervening region being concealed by a thick capping of Keweenawan diabase. These geological features are indicated on the Lake Nipigon Sheet, map 308A, published by the Geological Survey of Canada, 1935.

Table of Formations

QUATERNARY	
RECENT:	Sand and gravel beaches, peat.
PLEISTOCENE:	Lacustrine: Stratified silt; sand and gravel. Glacial: Boulder clay, sand, gravel.
	Unconformity
PRE-CAMBRIAN	
KEWEENAWAN:	Olivine diabase, aplitic dikes.
PRE-KEWEENAWAN(?):	Quartz diabase dikes.
	Intrusive contact
ALGOMAN(?):	"Chlorite" or "green" dikes. Quartz veins. Feldspar and granite porphyry. Gneissic biotite granite, with hybrid and porphyritic phases. Granodiorite. Diorite, quartz diorite.
	Intrusive contact

TIMISKAMING(?) (Windigokan series):	Conglomerate, greywacké, arkose, slate. Iron formation.
	Unconformity
KEEWATIN:	Tuffs and agglomerates. Rhyolite, dacite, andesite flows and their associated pillowed, amygdaloidal and porphyritic varieties; flow breccias; carbonate, sericite, and chlorite schists derived from the various flows.

Keewatin

Rocks that have been assigned to the Keewatin series underlie approximately three-quarters of this area. They consist mainly of highly metamorphosed lavas, to which the term greenstone is usually applied, but volcanic sediments, such as tuffs and agglomerates, are locally prominent. In places excellent flow breccias have been developed, and schists have resulted from the folding and shearing processes to which the various rocks have been subjected.

The Keewatin rocks have their greatest distribution in the northern half of the area, that is between Foxear creek and Tyrol lake. In the southern half they occur in two subparallel bands striking slightly north of east and separated by a band of Timiskaming sediments. This separation into bands is undoubtedly due to close folding and subsequent erosion of the Keewatin and Timiskaming rocks, the former being exposed in the anticlines and the latter in the synclines of the same folds.

Lavas

The lavas vary greatly in general appearance, texture, and composition, but in the main they are typically Keewatin and could be duplicated in most of the greenstone belts of Northern Ontario.

In the vicinity of Crooked Green creek, the lavas are dense, massive, greyish-green types, displaying little or no evidence of their extrusive origin. In places they have a characteristic tuffaceous appearance due to the scattering of hornblende flecks throughout the matrix. They range in composition from rhyolite to hornblende dacite. A thin section of the latter from the workings on the Jackpine Sturgeon property showed a fine-grained matrix of quartz and feldspar, with abundant phenocrysts of pale-green fibrous hornblende and plagioclase feldspar, the main alteration product being epidote.

Between the Jackpine Sturgeon workings and Macjoe Landing, on the Sturgeon river, the lavas show a gradual transition from dacite to typical rhyolite. Outcrops of the latter about a mile north of Macjoe Landing show it to be a dense, yellowish-green, white-weathering rock, breaking with an excellent conchoidal fracture and clearly exhibiting flow lines and porphyritic texture. A highly porphyritic and fragmental variety of this same rhyolite occurs in the central part of the Macjoe Sturgeon group of claims.

West of Crooked Green creek, in the central and western parts of Pifher township, the transition mentioned above carries over from dacite into typical dark-green, highly altered andesite. Andesite exhibiting excellent pillows was observed in a subtriangular area bounded by Tyrol lake, Forge lake, and Peddle lake, this being one of the few sections in the whole area in which pillow structures were abundantly developed in the lavas. The lavas in this part of the area strike N. 80° E. and dip at high angles from the vertical. In one place, however, a dip of 45° N. was recorded.

Coarse-textured phases of the andesite, believed to represent the central portions of thick flows, were encountered southeast of Forge lake. These rocks

have the general appearance and texture of diorite or diabase, with which they are easily confused. Indeed, some of them included with the greenstones may really be intrusives. On the other hand, certain fine-grained, dark-green rocks extending in a belt from the southwest corner of Pifher township northeast to Forge lake and beyond, have, on account of their characteristic diabasic texture, been assigned to the Keweenawan diabase group. They are believed to be extremely thin erosion remnants of the Keweenawan diabase overlying the Keewatin greenstones, as is the case farther west. Although there are valid



Polished specimen (natural size) of amygdaloidal lava, Lac-Teck property.

reasons in support of this belief, it is still debatable whether this diabase is really Keweenawan in age or a development peculiar to the Keewatin lavas.

In many places the dark lavas display a distinct porphyritic texture, light-coloured feldspar phenocrysts having been developed under conditions prevailing subsequent to the extrusive period. Furthermore, quartz and feldspar phenocrysts are commonly observed in the light-coloured rhyolite flows, to which the term rhyolite porphyry may be applied. Thick flows of rhyolite porphyry occur on the Macjoe Sturgeon property and thin flows of the same material have a widespread distribution in the area lying between Windigokan and Tyrol lakes. The thin flows range from 1 to 20 feet in thickness and are interbedded with the more basic lavas. That these rocks represent flow types and not intrusive quartz porphyry, which they resemble, is indicated by the interbedded relation-

ship just noted and the fact that they have in places been subjected to the same shearing processes as the enclosing lavas.

The southern greenstone belt consists largely of dark-greenish andesitic lavas, mostly massive, but in places showing the development of excellent pillow structures. On one of the small islands in Lake Nipigon, just off Poplar Lodge, enormous pillows were observed. They are more or less flat-lying, irregularly elongated structures, ranging up to 10 feet in length and 4 feet in width, and with selvages of extraordinary thickness. Especially characteristic of this southern belt, however, are the amygdaloidal lavas extending in a broad band, a mile or more in width, more or less continuously from Poplar Lodge eastward to Tallon lake. These lavas are greyish to greenish in colour, rather massive, and highly carbonatized and chloritized in places, but essentially andesitic in composition. The most striking feature is the widespread occurrence of amygdules, which are developed to a degree not commonly observed in the Keewatin lavas of Northern Ontario, and, in the writer's experience, only surpassed by the development of the Keweenawan amygdaloids of the Lake Superior region. The amygdules are elongated, suboval structures ranging up to 3 inches in length, the common fillings being quartz, calcite, a chlorite mineral, chalcedony, and pyrite, in the same order of decreasing abundance. Quartz invariably fills the openings greater than half an inch in diameter. The deposition of chalcedonic quartz in small openings gives rise to bluish agate, and in places pink rather than white calcite was observed. Chlorite fillings are commonly replaced wholly or in part by pyrite. Seldom were more than two of the above-named amygdaloidal types seen in any one outcrop, a notable exception being on the Lac-Teck property, southwest of Windigokan lake, where amygdules filled with quartz, calcite, chlorite, and pyrite occur together in the same outcrop. These amygdaloidal lavas are especially well-developed between Gooseneck lake and Windigokan lake, on the road to the Amorada property near its junction with Sinclair's road, between Lake Eva and the 35-foot falls on the Sturgeon river, and on some of the small islands in Lake Nipigon just off Poplar Lodge.

Tuffs and Agglomerates

Intercalated with the lava flows in many places are narrow bands of volcanic tuff and agglomerate. These fragmental types vary greatly in general appearance and composition, but, in the main, correspond closely to the contemporaneous flows with which they are associated. The tuffs are usually fine-grained but show all gradations into coarse agglomerates, with fragments up to 8 inches in length. For the most part they appear to have been subaerial accumulations, with the result that bedding is not a common feature. Locally, however, they are finely banded and were evidently laid down and sorted under water. Excellent examples of banded tuff were observed on the Amorada property about one mile west of the 35-foot falls on the Sturgeon river and elsewhere in this section of the area.

In mapping, only one of these fragmental bands was of sufficient size and importance to separate from the lavas. This band is of more than ordinary interest since many of the gold showings occur within its boundaries. It is a broad, more or less schistose band of chloritic tuffs and agglomerates extending unbroken from the vicinity of Musca lake eastward across the northern part of Irwin township, a total distance of about 9 miles. It attains a maximum width of about 2 miles midway between Macjoe Landing and Twin falls. It narrows toward the west, where it is covered in part by Keweenawan diabase; toward the

east boundary of Irwin township it becomes highly sheared and less fragmental in character and gradually passes into rocks that can scarcely be separated from the schistose lavas. The north and south boundaries between the lavas and the volcanic sediments are not sharply defined but rather marked by an alternation of these types.

In places, unmistakable flows have been observed within the volcanic fragmental band but always close to the border. In other places, the rocks have been so closely sheared that their relationships are somewhat obscure. For these reasons the boundaries of the fragmental band, as designated on the accompanying map, must be regarded in part at least as arbitrary.



Photomicrograph of tourmalinized tuff, Macjoe property. The radiating clusters consist of tourmaline crystals. (× 114.)

Good exposures of agglomerate were observed on the north half of the Casey Contact property, on the trail between the Sturgeon river and the Jackpine Sturgeon camp on Crooked Green creek, at Twin falls, and on the Hopkins group of surveyed claims lying to the north.

Between the Hopkins group and Crooked Green creek light-weathering arkose-like tuffs were encountered. Elsewhere, however, the tuffs are highly altered, dark-greenish, chloritic types, usually closely sheared parallel to the strike of the band and exhibiting a characteristic weathered appearance due to a rough surface and the bleaching of the materials to a faded green colour. In places the tuffs are distinctly porphyritic due to the development of blocky feldspar.

Associated with the tuffs near the boundary between the Macjoe Sturgeon and Casey Contact properties is an outcrop of a very unusual and interesting

type of rock. It is part of a narrow band extending westward through the northern part of the Casey Contact property for a distance of at least three-quarters of a mile. The rock is greyish to black in colour and contains rounded and angular fragments of black, lustreless material, such as one might expect to find in the vicinity of a volcanic vent. In places the rock is distinctly scoriaceous in appearance, but under the microscope, the black material is seen to be a bluish variety of tourmaline and the remainder a finely granular quartz. These minerals are the main constituents of the rock and are present in about equal proportions. The tourmaline occurs in two habits, as individual needles, microscopic in size, and as characteristic radiate clusters of needles, all embedded in a very fine grained matrix of quartz fragments. The rock is believed to be a tourmalinized tuff. Both tourmaline and quartz have completely replaced original feldspar phenocrysts, evidence of which are pseudomorphs of former feldspar crystals. Although no tourmaline has been recognized either in the granodiorite mass lying close to the northeast or in any of the nearby quartz veins, the original granitic magma is believed to have carried boron-bearing solutions, emanations of which resulted in tourmalinization of the tuff.

Two kinds of breccia commonly associated with the Keewatin lavas are volcanic breccia and flow breccia.

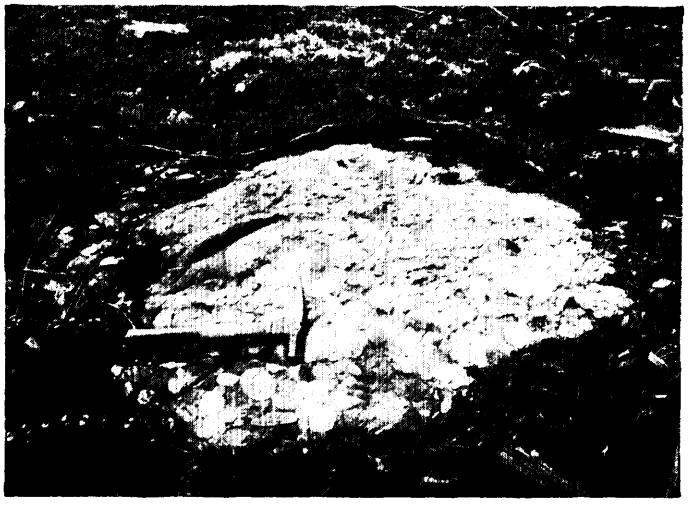
The volcanic breccia is a pyroclastic type differing from the agglomerate mentioned above mainly in the angular nature of the fragments. Particularly interesting outcrops of this material occur on the shore of Lake Nipigon half a mile north of Poplar Lodge and north of the mouth of the Sturgeon river. It consists of numerous angular and blocky fragments of greenish materials showing considerable variety and ranging in size from mere particles to four-sided blocks 2 feet or more in width. The fragments are generally crowded together and show no special orientation. The interstitial material is a dark chloritic substance. In places near the water's edge, surfaces polished by glaciation and wave-action exhibit a very pleasing mosaic of velvety-green fragments, this rock being almost in the ornamental class. Another interesting occurrence of volcanic breccia was noted on the Amorada property just north of the road and a short distance east of the east camp. It is a light-coloured rhyolite breccia containing an abundance of light-brownish, angular quartz fragments, with a maximum length of one inch, and scattered fragments of black cherty material.

Flow breccias are less common, but excellent outcrops of this material were observed in the southern part of Irwin township on the north side of Gooseneck lake toward the east end and on the trail leading west from Tallon lake. They resemble the volcanic breccias on account of their fragmental character but may be distinguished by the more uniform nature of the matrix.

Timiskaming(?)

Three more or less parallel bands of sedimentary rocks, believed to be of Timiskaming age and collectively known as the Windigokan series of Tanton traverse the southern portion of the area in a general east-west direction. For descriptive purposes these bands, starting with the most southerly, have been designated the Watson Lake band, the Windigokan Lake band, and the Corrigan-Paint Lakes band. Except where they are capped by the later Keweenawan diabase the two southern bands are more or less continuous through to Lake Nipigon. The Watson Lake band is 2 miles in width and consists almost entirely of greywacké, but thin localized lenses of pebble conglomerate were noted along the north contact. The Windigokan Lake band has an average width of about

1 mile and consists mainly of consolidated grit, greywacké, arkose, a little slate, and elongated lenses of pebble conglomerate along the north and south contacts. The Corrigan-Paint Lakes band is less than half a mile in average width and, except for a little greywacké near the middle, consists entirely of coarse boulder conglomerate. A fourth band, less prominent because of its lack of continuity along the strike, occurs between the Watson Lake band and the Windigokan Lake band. It is well exposed on Tallon lake and east of Eva lake. The south shore of Tallon lake is greywacké and slate, and pebble conglomerate outcrops on the portages leading to the west and south. East of Eva lake the rock is a highly altered ferruginous greywacké. Banded iron formation was observed at different horizons in both the Watson Lake band and the Windigokan Lake band and in the greywacké just east of Eva lake, but not in the Corrigan-Paint Lakes band.



Timiskaming conglomerate west of the 35-foot falls, Sturgeon river.

Greywacké is the predominant sedimentary type, but all gradations from arkose to greywacké were observed. In places, the rock might be properly called an arkosic greywacké on account of the high percentage of feldspar fragments. In other places, notably south of Windigokan lake, it resembles a coarse consolidated grit. All these varieties have a pronounced clastic appearance. They are greyish-green, siliceous-looking rocks, especially characterized by the presence of tiny eyes of crystal-clear quartz, which on freshly broken surfaces reflect little points of light. They are fine to medium in grain and in places show excellent bedding. On the south side of Watson lake, the greywacké is well-bedded and shows good grain gradation, the coarse material being at the bottom and the fine-grained material at the top. In the coarse arkosic varieties tiny fragments of red jasper are common. In thin section under the microscope the fragmental character of both the greywacké and arkose is quite evident. The fragments, which consist mainly of quartz and feldspar, are for the most part angular and show little evidence of wear. Quartz is always abundantly represented, but feldspar is a variable constituent. Both orthoclase and plagioclase feldspar occur, but the latter is usually predominant. Minor quantities of

chlorite, carbonate, and magnetite are present, especially in the somewhat schistose greywacké.

All four sedimentary bands contain conglomerate lenses. The Corrigan-Paint Lakes band consists almost entirely of conglomerate with boulders up to a foot or more in diameter. Going south across the bands, however, one is impressed by the apparent tendency toward gradual diminution in both the size and quantity of boulders present as well as the thinning out of the lenses themselves. To some extent the same is true of the greywacké, where the fragmental material is seen to be coarser in the northern bands than in those lying to the south. The Watson Lake band contains a pebble conglomerate horizon at or near its north contact, but the lenses are thin and discontinuous. They were observed at only



Timiskaming slate, north shore of Schnob lake. Note the fracture cleavage.

a few places, namely, on a trail just east of Watson lake, at the Leitch Gold Mines camp, on the Poplar Lodge road where it traverses the northeast part of claim A.L. 414, and on claim H.F. 5. The only exposures of conglomerate noted on Windigokan lake are at the narrows near the east end, on a point on the south shore about three-quarters of a mile from the entrance of Foxear creek, and on the north shore close to the portage leading west to Corrigan lake. Many excellent exposures of coarse boulder conglomerate were observed on Knox and Patter lakes, on a high hill near the middle of the north side of Corrigan lake, and on the portage between Corrigan lake and the Sturgeon river. Another area with prominent outcrops of boulder conglomerate is that along and north of the winter road leading to the Amorada Gold Mines camp from the 35-foot falls on the Sturgeon river.

The conglomerate contains a wide variety of pebbles and boulders, including granite, schistose greenstone, diorite, gneiss, porphyry, felsite, red jasper, black chert, and quartz, in about the same order of decreasing abundance. The matrix consists of dark-greenish, coarse- to fine-grained material, mainly quartz and chlorite. The pebbles and boulders have been waterworn, as shown by their

well-rounded and polished surfaces. In places, they are closely packed together and show very little interstitial material. In other places, the pebbles are few and scattered. A notable feature is the relatively massive character of the conglomerate beds as compared with the other sedimentary horizons. Only in a few places have the pebbles and boulders been drawn out or in any way distorted by shearing movements, as is commonly the case in closely folded sediments; the best example is seen in the occurrence on Knox lake, Irwin township.

Slate was observed in all but the Corrigan-Paint Lakes band of sediments. It is a fine-grained, dark-grey to black rock, usually well-bedded and in places showing excellent slaty cleavage. It has every appearance of being a consolidated mud deposit. It occurs in narrow bands, usually not more than a few feet in width, and its characteristic association with banded iron formation led Coleman[1] to the conclusion that these slaty bands are lean phases of the iron formation. Good exposures of slate apparently not associated with banded iron formation were observed on the north shore of Schnob lake near the east end, at the west end of Tallon lake where a portage leads south to Watson lake, and just north of the road midway between the Sturgeon river and the east camp of the Amorada Gold Mines.

The southern part of the area is traversed by three prominent bands of iron formation all striking in a general northeasterly direction and exhibiting a certain degree of parallelism. They have been designated as the Northern, Central, and Southern ranges by A. P. Coleman and E. S. Moore, who made a special study of them in 1906 and 1907. For a detailed description reference should be made to their reports.[2]

The Northern range is in Dorothea township north of the Sturgeon river about 2 miles from Lake Nipigon. It has been traced for about a mile, and strikes in a general northeast direction, with an average dip of 45° N.W. The iron formation is well-banded and consists of thin alternating layers of magnetite and grey silica; in places red jasper layers also occur. In very few places did the total thickness exceed 40 feet.

The Central range is located south and east of Eva lake. It is rather discontinuous but has been traced from claim A.L. 414 to H.F. 5, a distance of about 3 miles. The beds have been crumpled and intricately folded, with the result that they have the appearance of great thickness in places. The formation is well-banded and consists of thin layers of red jasper alternating with steel-grey hematite, the whole being irregularly interbedded with dark slaty bands. The jasper-hematite bands are not commonly more than a few feet in width and in places they occur as mere streaks in the slaty material. Magnetite is not a prominent constituent of this band, but in places it is present in quantities sufficient to cause considerable magnetic disturbance.

The Southern range lies about a mile south of the Central range and has been traced by Coleman and Moore from a point 2 miles east of Lake Nipigon east toward Standingstone lake, Watson lake, and beyond. It resembles the Northern range rather than the Central range in that the banding consists of jasper and magnetite with very little hematite. It further resembles the Northern band in being a single more or less compact unit. Furthermore, it shows no evidence of folding or crumpling of the beds such as characterizes the Central range. Toward the west end a width of 550 feet is recorded, but the average width is probably about 60 feet. It has an average strike of N. 70° E.

[1]A. P. Coleman, "Iron Ranges East of Lake Nipigon," Ont. Bur. Mines, Vol. XVII, 1908, pp. 143, 144.

[2]Ont. Bur. Mines, Vol. XVI, pt. 1, 1907, pp. 105-148; Vol. XVII, 1908, pp. 136-169.

and is nearly vertical. The character of the formation varies considerably from place to place. Along the north shore of Watson lake it is a black, finely laminated rock consisting of thin layers of magnetite and hematite, almost microscopic in size and strongly magnetic. South of Standingstone lake it is mainly a dark, thin-bedded slate containing only enough magnetite to feebly affect the compass. Toward the west end of the band dull red jasper layers commonly alternate with the magnetite bands.

In addition to the above-mentioned ranges are the outcrops of banded iron formation immediately west of Windigokan lake on the old surveyed claims H.F. 10, 12, 13, and 14. They consist mainly of finely banded slate, jasper, and hematite. A narrow band of the jasper-magnetite type occurs on H.F. 10 and 15. Farther east between Still lake and Spawn lake is a lens-shaped mass of banded silica and hematite. Elsewhere in this section thin streaks of hematite or jasper are common, especially where the sediments are slaty in character.

Age and Relationships

From their early investigations in this area Coleman and Moore[1] were led to regard the conglomerate bands as Lower Huronian in age, whereas the remaining sediments including the banded iron formation were placed in the Keewatin group. Burrows first suggested[2] the possibility that certain conglomerates in the area might be the equivalent of the Timiskaming series of other areas. T. L. Tanton[3] applied the term "Windegokan series" to the Corrigan-Paint Lakes band, the Windigokan Lake band, and scattered conglomerate members near the north contact of the Watson Lake band, all of which he regarded as pre-Huronian in age. More recently G. B. Langford[4] has adopted Tanton's term but goes further in stressing the point that the Windigokan series may be properly correlated with the belts of Timiskaming sediments as defined in the eastern section of the province, a correlation based entirely on lithological and structural resemblances. Langford made a further contribution when he separated the greywacké in the Watson Lake band from the Keewatin lavas, including it in the Windigokan series.

The sedimentary bands occur as synclinal remnants, structurally overlying the Keewatin series but showing little or no evidence of a structural unconformity. In places, the folds have been overturned, in which case the sediments appear to dip beneath the greenstones. The exact contact between the two great series is seldom observed although it may often be located within a hundred feet, the interval being marked by a drift-filled depression or muskeg. So constant is this feature that it can scarcely be regarded as fortuitous. The explanation lies in the fact that this contact has been the locus of strong differential movements during the folding process, and as a result much shearing and faulting has taken place. Wherever observed the contact is marked by rusty schist in a zone ranging from 20 to 50 feet in width. The more or less soft, highly disintegrated material in these shear zones has been gouged out into trough-like depressions into which drift has subsequently been dumped. On the Springer Sturgeon group, just south of Patter lake, Irwin township, a considerable amount of work was done along one of these rusty contact zones, but gold was found only in negligible quantities. At one point a long trench running across the contact

[1]Ont. Bur. Mines, Vol. XVI, pt. 1, 1907, pp. 111-114, 139, 140, 146; Vol. XVII, 1908, pp. 140-144.
[2]A. G. Burrows, Ont. Bur. Mines, Vol. XXVI, 1917, p. 241.
[3]T. L. Tanton, Geol. Surv. Can., Sum. Rept. 1917, pt. E, pp. 1, 2.
[4]G. B. Langford, Ont. Dept. Mines, Vol. XXXVII, pt. 4, 1928, p. 101.

exposes a complete section from conglomerate through rusty schist to massive greenstone, all within about 60 feet.

Algoman(?)

The Algoman period is marked by the intrusion of diorite, porphyry, and relatively small granitic bosses, all of which occur widely throughout the older lavas and sediments, although they are not especially abundant in any one section. North and northeast of the map boundaries widespread areas of Algoman granite and granodiorite occur.

In only one section of this area are the lavas in contact with the regional batholithic granite just mentioned. The axis of Tyrol lake, Meader township, lies on this contact. On the north shore the rock is a fine- to coarse-textured, light-greyish biotite granite with distinct gneissic tendencies. At the narrows toward the west end of the lake the contact, as observed on a point on the south shore, is fairly sharp, and the same is true of the contact west toward the Tyrol river. The greenstone close to the contact has been cut by narrow granitic dikes and converted into amphibolite. In marked contrast are certain rhyolite flows which under the same contact conditions have suffered no appreciable alteration.

North of a line roughly joining the north end of Tyrol lake, Forge lake, and Little Crooked Green lake is a broad contact zone, consisting of hybrid granite, porphyritic granite, garnet-bearing schist, and dioritic facies of the greenstone. These rocks represent border phases of a large mass of granite underlying this section at shallow depth and exposed at the surface just beyond the northern limit of the map-sheet.

A further example of the contact effects of large intrusive masses is that observed in the section lying between Crooked Green creek and the east boundary of Pifher township, about 2 miles north of the Sturgeon river. Here, the rocks in the contact zone, which attains a width of half a mile or more, have been recrystallized and show all gradations from granite to greenstone, the intermediate type being granodiorite. So gradual is the change that mapping is difficult, and the contacts have been more or less arbitrarily delimited. As the granite side of the contact is approached, there is a progressive decrease in the femic constituents, a condition that persists far out into the granite mass. On the opposite side of the contact the greenstone assumes a porphyritic appearance on account of the development of light-coloured feldspar metacrysts usually not more than an eighth of an inch in length. The metacrysts become fewer and fewer as one retreats from the intrusive mass, until they finally disappear. The intermediate granodiorite is undoubtedly a metamorphic rock, but whether it should be considered a border phase of the Algoman batholithic intrusive or merely recrystallized Keewatin lavas is a matter of controversy. The writer holds to the opinion that the granodiorite is a border phase of the granite intrusive, made basic by the digestion, in part, of basic lavas and rendered dioritic in texture and composition by chemical rearrangements of the new constituents.

A salient from the granite batholith in Elmhirst township crosses the Sturgeon river in the vicinity of Macjoe Landing. It extends about 30 chains south of the river and underlies the north half of the Macjoe Sturgeon group of claims. It is a light-weathering, greenish-grey rock with a good granitic texture. Thin sections show an abundance of quartz and chloritic hornblende, as well as decomposed orthoclase and plagioclase feldspar, the latter dominating. The rock is essentially an altered granodiorite.

Small more or less isolated masses of granite and granodiorite were observed in Dorothea township intruding the Keewatin lavas north of the Sturgeon river about a mile and a half from Lake Nipigon. The rocks are greyish to reddish in colour and fairly coarse in texture. In thin section they are seen to consist mainly of quartz, feldspar, and a little green hornblende. The feldspars, mainly oligoclase and orthoclase, are strongly clouded with kaolin and other alteration products.

Among the most characteristic rocks invading both the lavas and the sediments are the diorites and quartz diorites occurring as rounded bosses and broad dikes mainly in the section lying between Tallon lake and Lake Nipigon. In places, the dikes attain a width of 10 chains or more, and have been traced for a mile and farther. They are massive, dark-coloured rocks, showing considerable variation in texture and general appearance from place to place. They weather to a greyish-green earthy material with a pitted appearance. Fresh surfaces characteristically exhibit greenish and pale reddish materials, the latter in fine-grained specimens and not discernible without the aid of a lens. In addition, tiny laths of plagioclase feldspar stand out prominently in an otherwise dull matrix, and yellowish flecks of leucoxene are common. Indeed, so characteristic is the latter mineral that its presence in any of the basic rocks in this area points to their affinity with the intrusive diorite group. Under the microscope thin sections show little variation in the mineral constituents except in the amount of quartz, which is abundant in some specimens but absent in others. The main constituents are plagioclase feldspar, green hornblende, and ilmenite. These materials are all strongly altered, the feldspars reverting to kaolin and other alteration products, the hornblende to chlorite, and the ilmenite to leucoxene. Pyrite occurs in varying quantities, and chalcopyrite and molybdenite were observed in the diorite near the mouth of the Sturgeon river. Whether or not these diorite intrusives have any genetic relationship with the auriferous quartz veins in the southern part of the area has not been definitely established, but nevertheless in this regard they assume no small measure of importance, since many of the gold showings have been uncovered near them.

Dikes of feldspar porphyry, with a maximum width of 1 chain, striking in various directions, were observed in the following localities: between Crooked Green creek and Forge lake, Pifher township; in the area bounded by Windigokan lake, Watson lake, and Tallon lake, Irwin township; in the area between Standingstone lake and Long rapids; and in the section between the Amorada property and the mouth of the Sturgeon river. Among the most striking of these porphyries are two parallel dikes exposed along a high ridge of greenstone near the south shore of Tallon lake. It is a light-weathering rock exhibiting huge, light-coloured phenocrysts of feldspar, as large as 3 inches in length and half an inch in width, and commonly twinned. Almost as striking are the reddish porphyry dikes exposed at the showings on the Lac-Teck property south of the west end of Windigokan lake. Here, feldspar phenocrysts an inch in length are common.

A fairly large intrusive mass of feldspar porphyry and granite porphyry occurs northwest of Twin falls. The showings on the Brennan-Kenty and Spooner groups are associated with rocks of this type. They weather almost white, and their porphyritic character is often masked by shearing and strong alteration of the phenocrysts to kaolin, sericite, and carbonate. In both types femic constituents are almost negligible and quartz is dominant in the granite porphyry.

A few narrow aplitic dikes were observed cutting the greenstones between Standingstone lake and the 35-foot falls on the Sturgeon river, and also north of Gooseneck lake. They are very fine grained, dense, white-weathering, pinkish rocks with porphyritic tendencies and in some places carrying much pyrite. In this connection it should be noted that dikes of this nature, representing acid differentiates of the diabase magma, have been observed cutting the Keweenawan diabase. It may be possible, therefore, that these aplite dikes are late Keweenawan rather than Algoman in age.

Throughout the area and especially in the vicinity of the various showings in the northern half are many narrow basic dikes, which on account of their singular appearance have been called "chlorite" or "green" dikes. They range from 1 to 25 feet in width and are rather sinuous along the strike. They weather to a soft, earthy green, chloritic material, and thin sections of the fresh rock show that it likewise is composed of little other than chloritic substances. Dikes of this character are prominent in the vicinity of No. 1 vein on the Casey Contact property and toward the south end of No. 25 vein on the Macjoe Sturgeon property. Although the age of these dikes has not been definitely fixed, they are known to be post-porphyry, this relationship being established on the west side of the little lake extending north from the north boundary of Irwin township a quarter of a mile east of the 5-mile post. Here a small boss of feldspar porphyry intruding agglomerate is itself intruded by a 25-inch "chlorite" dike.

The quartz veins in this area are doubtless related to the various Algoman intrusives including both the porphyry and diorite. In the central part of Pifher township several large pegmatitic quartz veins were observed cutting the lavas. In places they contain considerable reddish feldspathic material, but for the most part they consist of barren quartz only. Thus far veins of this type have disclosed no important mineralization.

Generally speaking, the intrusive relationships of the widely varying Algoman types, one to the other, are somewhat obscure. With the exception of the "chlorite" dikes, it seems quite probable that the various intrusives described above are contemporaneous or nearly so, in which case it must be assumed that the parent granitic magma underwent considerable differentiation prior to its injection into the older rocks.

Pre-Keweenawan(?)

A few dikes of quartz diabase ranging from a few inches up to 100 feet in width were encountered in this area. They invariably strike in a north-south direction and are remarkably persistent along the strike. In places they are coarsely porphyritic, exhibiting many yellowish-green phenocrysts of altered feldspar with a maximum diameter of 2 inches and similar in every respect to those that characterize the Matachewan diabase in the eastern sections of the province.

These dikes are definitely post-Algoman in age, since they are found sharply cutting off quartz veins. Their relationship to the Keweenawan diabase flows, however, has not been observed anywhere in the area. Some have suggested that these dikes represent the fracture vents through which the Keweenawan diabase flowed from below. Langford,[1] however, in his work near Beardmore, proves that these dikes are pre-Keweenawan in age, since "the Keweenawan diabase flow was found lying on the eroded top of a porphyritic diabase dike."

[1]Geo. B. Langford, Ont. Dept. Mines, Vol. XXXVII, pt. 4, 1928, p. 102.

In places, magnetite is sufficiently concentrated in these dikes to cause strong magnetic attraction.

Keweenawan

One of the most outstanding geological features in this area is the high ridge of diabase extending in a southerly direction from Lake Nipigon toward the Beardmore section. It is an erosion remnant of the Keweenawan diabase which occurs as a capping rock overlying much of the Nipigon Basin region lying to the west. Whether this capping is a sill or a flow is a point that has given rise to much controversy on the part of previous workers in this region. The various arguments are presented in some detail by Wilson,[1] and further discussion has been presented in reports by Coleman and Moore,[2] and Tanton.[3] More recently Langford,[4] who has paid special attention to this problem, concluded that the diabase is a flow rather than a sill. This conclusion is based largely on the presence of foreign boulders in the diabase near the contact with the underlying rocks, a fact which suggests that they have been picked up and carried along by molten lava flowing over an old erosion surface. This feature was observed by the writer in the diabase 2 miles south of Poplar Lodge. Along the north side of a high east-west ridge the contact between the diabase and the underlying greenstone may be clearly observed. In places the diabase contains numerous well-rounded pebbles of greenstone, diorite, and various granitic types, which could only have become so embedded by some such process as that just related. On the other hand the development of excellent columnar jointing at various places, notably on the east side of the gorge in the Sturgeon river near the north end of Long rapids, is one of the main features suggesting sill structure of the diabase. It is conceivable, however, that columnar parting, which is a cooling phenomenon, might readily develop in the lower portions of thick diabase flows such as obtain here.

Outliers of Keweenawan diabase north of the Sturgeon river have been mentioned above in connection with the topographical features.

The Keweenawan diabase as exposed in this area is a massive, medium- to coarse-grained rock, weathering to a pale-brownish colour, but generally exhibiting a characteristic fresh appearance. The lower portions of the flow become fine-grained near the contact with the underlying rocks and, in places, show porphyritic tendencies. The rock commonly has good ophitic texture, a feature that may often be observed even in the outcrop. In places, however, the texture is definitely non-ophitic, in which case the rock may be more properly called a gabbro; no doubt transitions from diabase to gabbro are common.

A specimen of the diabase taken from the north end of the portage at Long rapids, showed the following constituents when examined in thin section under the microscope: plagioclase feldspar (labradorite), brown augite, abundant olivine and magnetite, and a little apatite. No alteration of these minerals has taken place, and the rock is remarkably fresh.

Pleistocene and Recent

The consolidated rocks are covered in part by a relatively thin mantle of Pleistocene drift consisting of both glacial and lacustrine deposits. In spite of

[1]A. W. G. Wilson, "Geology of the Nipigon Basin, Ontario," Geol. Surv. Can., Mem. 1, 1910, pp. 72-100.

[2]Ont. Bur. Mines, Vol. XVI, pt. 1, 1907, pp. 115, 147; Vol. XVII, 1908, pp. 141, 142, 157-159.

[3]T. L. Tanton, Geol. Surv. Can., Sum. Rept. 1917, pt. E, p. 3; Bull. Can. Inst. Min. & Met., August, 1935, p. 345.

[4]Geo. B. Langford, op. cit., pp. 96, 97.

this handicap, prospectors find themselves at no great disadvantage, since rock outcrops are fairly abundant everywhere except in the valleys of the Sturgeon and Blackwater rivers.

Most typical of the glacial deposits is a low hummocky ground moraine in the depressions between rocky ridges, which is composed of unclassified clay loam, sand, gravel, and boulders. Low esker ridges and kame-like hills of sand and gravel were observed in the Bearskin lake section and along the Sturgeon river at the south end of Long rapids. East of Still lake the Nezah road follows a section of sand plain that is more or less pitted and contains several clearwater lakes.

The rock outcrops show much evidence of glaciation by ice movement. They have been rounded, polished, fluted, and scratched, particularly the harder rocks, of which the iron bands are good examples. Typical *roches moutonnées* characterize many of the small islands just off Poplar Lodge. In the same locality glacial striae are well preserved, two sets being observed together, the older striking N. 10°-25° E., and the younger striking N. 70° E.-N. 80° W. The ice movement was therefore southward at first but westward later on.

The lacustrine deposits, consisting of stratified silt, sand, and gravel, are confined mainly to the Sturgeon river valley between Long rapids and Lake Nipigon, the section south of Poplar Lodge bordering on Lake Nipigon; and along the railway in the vicinity of Beardmore and Jackpine. These deposits are definitely younger than the morainic materials, as evidenced in several places along the Sturgeon river, where the stratified materials near the water's edge overlie boulder clays. Coleman[1] observes that these materials were probably laid down as beach deposits in embayments of glacial Lake Warren, a predecessor of the present Lake Nipigon. High sand flats separated by 30-foot terraces are commonplace on either side of the Sturgeon river, being particularly well preserved in the vicinity of the 35-foot falls. These flats and terraces indicate the various stages in the retreat of Lake Warren to the present confines of Lake Nipigon. In most places, the stratified sands are not visible on account of the slumping of the steep banks, but good exposures were observed on the Standingstone river not far from Poplar Lodge, on the south side of the Sturgeon river at the first rapids, and again near the 35-foot falls. One section on the Sturgeon river, measured by Coleman, showed 98 feet of silt followed by 14 feet of sand and gravel.

The Recent has to do with shore-line phenomena and the various changes in the river courses and upland lakes. The deposits are mainly sand, gravel, peat, and organic debris. At present a considerable amount of sand is being discharged into Lake Nipigon by the Standingstone, Sturgeon, and Littlelake rivers. This material under the influence of winds and shore currents is building up prominent sand beaches in certain protected embayments south of the points of discharge. Two of the outstanding beaches that add to the scenic beauty of the Lake Nipigon shore line, have been given the names Kiwatish Walk and Devil's Walk; the former is a mile and a half long.

That the Sturgeon river above Twin falls has changed its course many times in the Recent is indicated by ox-bows and their remains near the mouth of Crooked Green creek and just east of Macjoe Landing.

Small lakes and ponds showing various stages in the accumulation of peaty and other organic deposits were observed in the upland areas. On the whole,

[1]Ont. Bur. Mines, Vol. XVI, pt. 1, 1907, p. 135.

however, the drainage is good and takes place at a relatively rapid rate, with the result that the water table is always low and organic deposits do not accumulate to any great extent.

STRUCTURAL GEOLOGY

The rocks in this area, with few exceptions, have been subjected to various structural deformations, which may be conveniently discussed under the headings of folding, faulting, and shearing.

Folding

The earliest deformation of which there is any record took place at the close of the Timiskaming epoch, when both the sediments and the underlying Keewatin rocks were thrown, as one unit, into a series of subparallel folds of varying magnitude, striking a little north of east. That the Keewatin series had not been previously folded is indicated by the absence of a structural unconformity between the lavas and the sediments. The lower truncated portions of these folds are now visible in the form of alternating belts of sediments and lavas. The sediments occur in synclines, whereas the greenstones occur in the anticlinal parts of the same folds. Evidence of this is based mainly on the attitude of the sedimentary beds as obtained from a study of grain gradation in the greywacké and fracture cleavage in the slaty bands. The folding was very close as shown by the steep dip of the beds, which in places have been completely overturned. On the whole, the folds appear to be relatively simple in structure, but in places there is evidence that minor flexures have been superimposed on the major ones. Minor drag-folds on the limbs of the major folds indicate that the whole structure plunges steeply to the west at angles up to 40 degrees. In places, however, minor cross-folds have resulted in gentle plunges toward the east, a fine example being the Tallon lake syncline. An outcrop on the south shore of Tallon lake, about 20 chains from its west end, exposes well-bedded greywacké, in which the bedding can be followed around the very nose of a syncline plunging east at 15 degrees.

The sediments in the Standingstone river section have been more severely folded than in most parts of the area. The iron formation especially has been crumpled in a most intricate fashion, even the smallest plications being perfectly recorded.

Faulting

The southern half of the area is much broken by faults, the more prominent of which trend in an east-west direction, more or less parallel to the strike of the rock formations. In some measure these faults are expressed topographically by the trend of the various watercourses and, in specific cases, by the presence of prominent scarps. Two of these faults, and perhaps more, are distinctly regional in their extent. The first one extends from Devil's Walk on Lake Nipigon eastward along a creek and through two lakes to Foxear creek and thence toward Paint lake. The second one passes through Watson lake, extending east toward Oxaline lake and west through Angle lake, Standingstone lake, and a part of the Standingstone river. Viewed from the air both of these fault lines are particularly impressive, giving one the concept of a deep, wedge-like incision traversing the area from side to side. Another fault only slightly less prominent than the regional ones just noted was observed midway between Windigokan and Knox lakes. It has been traced from a point just east of Corrigan lake eastward to the east end of Windigokan lake. The north side of the fault is represented by a scarp which, toward the west, rises more than 100 feet above the

adjacent country to the south. Similarly, the rocks on the north side of the Watson lake fault have been vertically displaced upward, resulting in a scarp which rises as much as 150 feet above the lake in several places. Other faults of less magnitude but belonging to the same east-west system of faulting were observed in the northern half of Irwin township.

Movement along the major fault lines involved considerable horizontal as well as vertical displacement as indicated by the derangement of a north-south dike of pre-Keweenawan diabase in the section lying between Corrigan lake and the mouth of Crooked Green creek. A maximum horizontal throw of half a mile is indicated where the dike crosses Foxear creek. This dike is of further interest since it indicates that much of the major faulting was of the block-fault type, whole segments of the area being displaced in step fashion. Furthermore, the derangement of this dike shows that at least some of the movement is post-diabase in age.

Major adjustment faults such as undoubtedly attend the folding of the Keewatin and Timiskaming rocks are commonly observed. Prominent among these are the various strike faults at or near the contact between the Keewatin lavas and the Timiskaming sediments. In places where faults of this type are not clearly marked, their presence may be inferred from the schistose nature of the contact. The quartz veins on most of the properties are broken here and there by minor faults with horizontal displacements of seldom more than a few feet.

Shearing

Localized shear zones of varying intensity and magnitude are frequently encountered in both the greenstones and the sediments. They generally strike slightly north or south of east. Some of this shearing may be attributed to the strong north-south compressional forces attending the folding of these rocks, but much of it seems to have resulted from subsequent east-west movements, which may have taken place during the intrusion of the granite batholiths in surrounding areas. Generally speaking, the sediments have been subjected to more widespread shearing than the greenstones, but the most intense shearing occurs in the latter. Among the sedimentary types, the greywacké is especially prone to shearing processes, the schistosity being superimposed on the original bedding, which may be completely obliterated. In places, however, where bedding and schistosity occur together the difference in strike was observed to vary as much as 60 degrees. In this connection it should be noted that, in many places, schistosity resembles bedding, and care should be exercised in distinguishing between them.

Zones of intense shearing were observed in the northern half of Irwin township and the adjacent section to the west. One of these zones crosses the Sturgeon river midway between Twin falls and the mouth of Foxear creek and has been traced in an easterly direction through McCambley lake. It is exposed over a width of about a quarter of a mile on the Sturgeon river, where it consists mainly of a closely sheared, rusty, carbonate material, striking east and with a dip close to the vertical. It is again well exposed on either side of McCambley lake toward the east end. Here, several pits have been sunk in the rusty schistose material. In places along the north side of this lake there is a notable development of a pale-greenish sericitic material along the shear planes.

Other strong shear zones were observed along the north side of Knox lake, at the narrows, and along the north and south shores of Patter lake. They consist of a rusty-weathering, carbonated, arkosic conglomerate. The zones tend

toward parallelism and have a strike parallel to that of the whole sedimentary belt. The main showings on the Brookbank property (Connell Mining and Exploration Company, Limited), just east of Knox lake, occur along a zone of rusty schist, which has been exposed for over a quarter of a mile.

Another section in which shearing has been rather intense is the triangular area bounded roughly by a line joining Eva lake, Standingstone lake, and Long rapids.

ECONOMIC GEOLOGY

Gold is the only mineral of immediate economic importance occurring within this area. Iron and molybdenite are known, but in neither case have deposits of ore grade thus far been disclosed. The search for valuable minerals commenced long before the beginning of the present century. In 1898, Dowling[1] wrote:—

> A number of mining claims were staked out at the mouth of the river [Sturgeon] some years ago, but no paying ores appear to have been found. Ore from a band containing disseminated pyrites was shipped out, but appears to have been of little value. The stream has been prospected but without very much success.

Wilson[2] states that "some attempts at gold mining were made on some similar quartz veins in the Poplar Lodge area in 1884, by C. S. Morris, but they appear to have been unsuccessful." Two surveyed claims, T. 243 and T. 244, just north of the mouth of the Sturgeon river are reported to have been staked for copper. Although disseminated chalcopyrite occurs in this vicinity, especially in the quartz veins near the granitic bosses, no concentrations of economic interest were observed.

As far as known the Keweenawan diabase flow contains no minerals of economic value.

Gold

Up to the time of the recent gold rush in 1934, this area had been somewhat neglected by gold prospectors, a fact that may seem strange when one considers the broad expanse of favourable geological formations as well as its easy accessibility. The discovery of gold in 1925 on what is now the site of the Northern Empire mine led to a staking rush, which was confined largely to the section along the railway between Jellicoe and Warneford. In 1931, J. J. Green and G. Brennan found gold north of Twin falls on the Sturgeon river and staked a large group of claims, none of which, however, were recorded. Four of these non-recorded claims, now the Hopkins group, were restaked a year later by J. J. Green. In June, 1934, Rene Maloney made a spectacular gold discovery on what is now the Maloney Sturgeon property about 2 miles north of Twin falls and a mile north of the showings already uncovered by Green and Brennan. News of Maloney's discovery led to an influx of prospectors from the Little Long Lac field. Not many days passed before other finds were made farther up the Sturgeon river by J. J. Green, R. H. Barnum, and G. Miller. These discoveries precipitated the staking rush that developed in the summer of 1934. In a short time the whole area was staked almost solidly regardless of the rock formation. Apart from those groups close to the major discoveries, only a small number of these claims received more than a cursory surface examination, and many not even that. By the summer of 1935 only a few scattered prospecting parties remained in the area, the main interest being centred largely on the results of

[1]D. B. Dowling, Geol. Surv. Can., Sum. Rept. 1898, p. 98A.
[2]A. W. G. Wilson, op. cit., p. 137.

development on the Macjoe Sturgeon and Casey Contact and on the properties in the Standingstone river section.

Gold is widely distributed throughout this area, being confined largely to narrow quartz veins. Some shear zones, such as that on the Brookbank property, contain gold, but thus far deposits of this type have not responded favourably to development, mainly on account of the low and inconsistent gold values. Quartz veins and stockworks up to 30 or 40 feet in width are not uncommon, but almost invariably veins wider than 5 feet are barren of mineralization. Indeed, the most promising veins are those ranging from 8 to 18 inches in width. They are found in most of the various rock types, including greenstone, tuff, greywacké, porphyry, and granodiorite. On the Macjoe Sturgeon property, the main vein, No. 25, passes from granodiorite into rhyolite, the gold content increasing appreciably in the latter. It is true that thus far the more important auriferous quartz veins have been located in bedded greywacké, greenstone, or tuff, but any generalization in this regard might be very misleading at this stage, since well-mineralized quartz veins have been observed in all types, including intrusive porphyry masses such as those obtaining on the Brennan-Kenty property west of Twin falls.

Even the narrowest of the quartz veins are unusually persistent in length. In some cases, a vein not more than 8 inches in width has been traced for more than 1,000 feet. The veins pinch and swell every few feet in characteristic manner, and frequently follow a rather sinuous course. For the most part, they occupy a system of fissures which developed roughly parallel to the east-west regional schistosity, but near intrusive bodies this regional orientation has been modified to some extent. For example, on the Macjoe Sturgeon property the veins have a definite northeast-southwest alignment parallel to the long axis of the granodiorite intrusive.

Veins in the lavas generally have rather massive wall rocks, whereas those in the tuffs and greywacké are usually more or less schistose. As a rule no perceptible alteration of the wall rocks is observed, but in places there has been some introduction of carbonate, silica, reddish feldspathic material, and pyrite. Even when sheared and carrying considerable pyrite the wall rocks seldom yield appreciable gold values, the gold being confined almost entirely to the vein quartz. The walls are usually sharply defined, and little vein matter occurs outside the main quartz leader.

One of the most striking features of the quartz veins everywhere in this area is their banded or ribboned appearance due to the presence of thin layers of dark chlorite or sericitic material along fairly persistent fractures parallel to the strike. In places, a moderate concentration of sulphides and native gold occurs along these fractures and in the attendant slip planes. Where these subsequent movements have been more intense, vein breccia develops, as is the case in vein No. 1A on the Amorada property. The quartz is commonly a white milky variety showing varying degrees of lustre. Apart from the parallel fracturing just noted, it is strongly shattered and has the appearance of what the prospector would call "good-looking quartz." Two generations of quartz characterize the veins in the greywacké in the Standingstone river section. The older generation of milky quartz which forms the bulk of the vein matter has been intersected by a younger generation of relatively clear quartz in tiny veinlets, commonly at right angles to the strike of the vein. This later quartz introduced no mineralization.

The mineralization of the quartz veins in widely separated portions of the area differ in no important detail. Generally speaking, sulphides are not

abundant. In places spectacular quantities of native gold were observed in quartz that otherwise was barren of mineralization. That the occurrence of certain sulphides, such as galena and zinc blende, is indicative of high-grade vein matter is one generalization, however, that seems to hold true of all the veins here. Gold occurs only in the native state. In some veins it is finely disseminated throughout the quartz and along the various slip planes and tiny fractures; in others it is coarse and darker in colour. Pyrite, galena, and zinc blende occur sparingly in certain veins on the Macjoe Sturgeon, Casey Contact, Maloney Sturgeon, and Amorada properties. Arsenopyrite was observed in only three places; the Watson Lake Shore group, Sand River property, and the Lawrence-McKirdy property just south of the Amorada group. Chalcopyrite and pyrrhotite are not commonly associated with the gold-bearing veins, but these sulphides are sparsely represented in certain veins carrying only negligible gold values. On both the Leitch and Sand River properties native gold is intimately associated with a dark-grey mineral identified as tetrahedrite (grey copper, $Cu_8Sb_2S_7$). On oxidization this mineral yields thin flakes of copper stain or malachite green, the presence of which is always indicative of a high gold content. This mineral has not been observed outside the Standingstone river section.

Since the quartz veins intersect all the Algoman intrusive types and are intersected by the pre-Keweenawan diabase dikes, their age is fairly well established as late Algoman. After consolidation the vein quartz was fractured by longitudinal movements and the various minerals were introduced into these fractures. The origin of the mineralizing solutions is somewhat obscure but their genetic relationship with the various intrusive granitic and dioritic bodies which must underlie this area at no great depth, geologically speaking, can scarcely be doubted.

Iron

The iron ranges in this area have been thoroughly investigated by commercial interests associated with the steel industry in their search for further sources of iron ore. Although known for many years, development of the ranges did not begin until about 1900, when several claims along the Central range near the present Sand River and Leitch properties were staked and surveyed. In 1901, R. H. Flaherty optioned certain claims for the U.S. Steel Corporation, and one diamond-drill hole was put down. In 1902, the Algoma Commercial Company of Sault Ste. Marie drilled two holes, after which they allowed their option to lapse. There was no further interest until 1910, when the Nipigon Hematite Ore Company was organized to develop a large number of surveyed claims on the North, Central, and Southern ranges. This company, at present controlled by the Leitch estate, is reported as holding all the surveyed claims of the "A.L." series, and those of the "X" series along the Southern range are wholly owned by the Leitch estate. The various properties were idle until 1919, when the Lake Superior Iron Ore Company was formed to option and drill a portion of the Central range. At this time the Kokoko camps on claim A.L. 413 were built, and the road to Beardmore was constructed. The drilling campaign carried over into the spring of 1920, when the option was dropped. In 1922, the Bethleham Steel Corporation became interested to the extent of putting down 5 drill-holes on claim H.F. 5. Since that time no further development of the ranges has taken place.

While exploration of the iron ranges in the Poplar Lodge section was proceeding, other interests were engaged in probing similar bands of iron formation

along the north side of Watson lake and in the Windigokan-Still lakes section. The results of these investigations were likewise disappointing.

The results obtained by the various operators are not available, but it may be assumed that iron deposits of ore grade have not as yet been proved. In this connection Coleman[1] states that the Central range in the aggregate contains a considerable amount of lean ore with only negligible quantities of the common deleterious constituents, sulphur and phosphorus. He states further that an average iron content ranging from 40 to 50 per cent. was disclosed in the early drilling on claims H.F. 5 and A.L. 414.

DESCRIPTION OF PROPERTIES

Amorada Gold Mines, Limited

Amorada Gold Mines, Limited, was incorporated early in 1935 to develop two adjacent groups consisting of 20 unsurveyed claims and 4 surveyed claims, in Sandra and Dorothea townships, about a mile north of the Sturgeon river and two miles east of Lake Nipigon. The west group, known as the Sellars group, was formerly held by Springer Sturgeon Gold Mines, Limited. The east group, known as the Brennan-Kenty group, was originally staked for the Brennan and Kenty Bros. Prospecting Company, Limited, later optioned by the Mid-Canada Exploration Company, Limited, and still later incorporated as Kenbro Sturgeon Gold Mines, Limited.

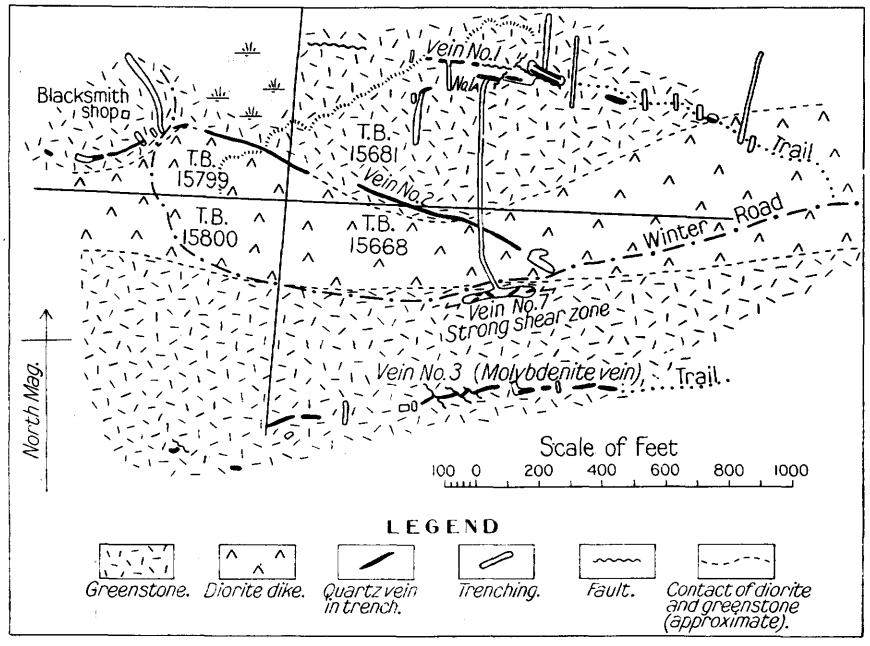
The claims are underlain mainly by grey Keewatin lavas, interbedded with which are various banded tuffs, rhyolitic breccias, and cherty agglomerates. Intruding the lavas are dike-like bodies of a dull-reddish, medium- to fine-grained, greyish-weathering quartz diorite, which under the microscope is seen to consist of quartz, orthoclase, and plagioclase remnants as well as much carbonate, sericite, chlorite, and kaolin. The veins thus far uncovered appear to be associated with this type of intrusive, and there is reason to believe that genetic relationships exist. Rusty shear zones, banded iron formation, and other interesting mineralization has been encountered at widely separated points, but most of the work has been done on four quartz veins on a high hill centred about No. 1 post of claim T.B. 15,800, this point being on the north-south boundary between the original Sellars and Brennan-Kenty groups. These veins, known as Nos. 1, 2, 7, and 3, strike in a general easterly direction, and are roughly parallel, ranging from 200 to 800 feet apart. They have all been well exposed by stripping, test-pitting, and cross-trenching.

No. 1 vein has been traced along the north side of a high east-west ridge for about 1,200 feet, showing widths ranging from 7 to 31 inches. It strikes N. 80° W. and dips vertically to steeply south. The vein appears to follow a fault along which a somewhat rusty shear zone has developed. The country rock is coarse- to fine-grained andesite. The vein pinches and swells and in places seems to be more or less scattered into a number of parallel stringers. Visible gold was observed here and there, but the results of channel assaying are said to indicate only erratic gold values. About 300 feet from the west end the vein is faulted south. At this point a parallel vein lying a few feet to the south has likewise been intersected by the same fault. This vein, known as No. 1A, has been exposed for 60 feet west of the fault, has an average width of 15 inches, and is reported to have yielded channel assays ranging from 0.05 to 1.60 ounces gold per ton. A grab sample taken by the writer from a 10-foot pit yielded

[1]A. P. Coleman, Ont. Bur. Mines, Vol. XVI, pt. 1, 1907, pp. 127, 128.

3.18 ounces gold per ton. The quartz here is much brecciated and carries considerable galena and shattered pyrite cubes.

No. 2 vein has been traced about 1,600 feet. It is 475 feet south of No. 1 vein and parallel to it. In low ground toward the west end it consists of a rusty shear zone up to 40 inches in width and carrying numerous quartz stringers. Farther east the shear zone persists, but the quartz becomes more or less concentrated into a single vein with a maximum width of 13 inches. Visible gold occurs in several places along this vein, but no ore sections have been delimited. A grab sample of well-pyritized quartz from a pit near the west end yielded 2.32 ounces gold per ton.



Geological sketch map showing the veins in the vicinity of the main workings, Amorada Gold Mines, Limited.

No. 7 vein is located about 250 feet south of No. 2 and just south of the winter road. It consists of an irregular network of quartz stringers in a strongly carbonated shear zone, which strikes east and has a maximum width of 12 feet. The schist contains a little pyrite and negligible quantities of gold. The immediate country rock is altered andesite, but a parallel dike of quartz diorite occurs a few feet to the north.

No. 3 vein, known as the "molybdenite vein" on account of the unusual concentration of molybdenite in the quartz, is located on the south side of the same east-west greenstone ridge along which the other veins have been traced. It has been exposed by trenching and in test-pits for 1,400 feet. It strikes N. 80° E. and stands vertical. It is broken into many short sections by a series of parallel cross-faults, which result in horizontal displacements up to 25 feet. The vein attains a maximum width of 34 inches near the east end of the exposure, and in few places is it less than 6 inches in width. In places the main leader splits into a number of smaller parallel veins extending over a width of 6 feet. The molybdenite occurs as thin films in the fractured quartz and as massive

concentrations. In addition, the quartz carries a little pyrite and molybdite, but the gold content is negligible. The following table gives the results of sampling by the operators. The samples were taken in the more promising sections numbering from west to east.



Polished specimen (natural size) of gold-bearing quartz, No. 2 vein, Amorada property.

AVERAGE PERCENTAGE OF MOLYBDENITE IN SAMPLES OF VEIN NO. 3

Vein section	Length	Average width (sampled every 5 feet)	Per cent. MoS_2
	feet	inches	
No. 1	70	21.4	1.65
No. 2	35	20.5	.44
No. 3	35	8.7	.99
No. 4	30	22	.55
No. 5	50	24.2	.58
No. 6	65	16	1.01
No. 7	35	22.8	.27
No. 9	40	33	1.22
No. 10	50	18.8	1.22

From the above table it may be observed that only in No. 1 section is there a MoS_2 content approaching ore grade. This vein, therefore, would seem to have no immediate economic importance, but from the scientific viewpoint the occurrence is interesting.

A few feet south of vein No. 3 and parallel to it is another quartz vein carrying molybdenite. It has been exposed for only about 200 feet and like No. 3 has no economic importance.

During the summer of 1935 an average of 12 men was engaged in surface exploration of the various showings. Two sets of camps, about a mile and a

half apart, were built by the original vendors of the property. Operations ceased in mid-August, the working crew being moved to the property of Leitch Gold Mines.



"Molybdenite" vein, No. 3, Amorada property.

Brennan and Kenty Bros. Prospecting Company, Limited

The Brennan and Kenty Bros. Prospecting Company was one of the first to stake in this area. It was the vendor of the Casey Contact property as well as the east group of claims that now belongs to the Amorada Gold Mines. Early in 1935 this company was mainly interested in a group of 8 unsurveyed claims (T.B. 13,570 to 13,577), in Sandra and Meader townships, bordering Musca lake on the north and reached by a 2½-mile trail leading west from Twin falls on the Sturgeon river. The camp is located at the west end of Musca lake.

The southern part of the group is underlain mainly by Keewatin tuffs and rather acid lavas. Farther north these rocks have been intruded by dikes and bosses of white-weathering intrusive types consisting of granodiorite, granite porphyry, and feldspar porphyry. Five showings, consisting of well-mineralized shear zones in porphyry, have been located about a quarter of a mile northeast of the camp. A considerable amount of trenching and test-pitting had been done early in the season, but when the property was visited in July operations had ceased pending the results of sampling.

No. 1 vein, which has been exposed over a length of 110 feet, consists of a strongly mineralized shear zone striking east and dipping steeply north. Toward the middle of the exposed section of the shear zone a maximum width of 6 feet is attained. The mineralization consists of pyrite and chalcopyrite; little or no quartz is present. The country rock is a highly altered feldspar porphyry.

No. 2 vein is about 4 chains northeast of No. 1 vein. It consists of narrow mineralized quartz stringers, which follow an irregular fracture pattern in altered feldspar or granite porphyry. The vein matter consists of silicified and pyritized porphyry with a few narrow quartz stringers carrying abundant pyrite. Although the "break" is 4 feet wide in one place, it can be traced for only a few feet.

A few chains east of No. 2 is vein No. 3. It consists of a strong shear zone up to 6 feet in width in a light-weathering, highly altered feldspar porphyry. The shearing strikes N. 65° E., dips steeply north, and is exposed for 40 feet. In places the schist is strongly silicified and impregnated with pyrite, but no vein quartz occurs.

No. 4 vein is about 3 chains south of No. 3 and is exposed for 200 feet. It consists of a rusty-weathering shear zone, which strikes N. 55° E. and dips steeply to the north. Unlike the other veins, the schist here carries many mineralized quartz veinlets, and toward the east end of the exposure an 8-inch quartz vein carrying appreciable quantities of pyrite, chalcopyrite, and pyrrhotite was observed. The country rock is like that at No. 3 vein but is characterized by hornblende veinlets up to an inch in width. A well-mineralized grab sample from this vein yielded 0.06 ounces of gold per ton.

The results of the preliminary sampling of the above showings are reported by the manager, Jay Kenty, to have been only mildly encouraging. It is felt, however, that the geological conditions here are such that further exploration of the property is warranted.

Calhet Exploration Syndicate

The Calhet Exploration Syndicate holds a group of 9 unsurveyed claims (T.B. 16,999 to 17,007) in Summers township, located about a mile north of Standingstone lake and just east of Sinclair's road. The property is underlain by Keewatin lavas. As a result of surface exploration carried on late in the summer of 1935, several quartz leads were uncovered and encouraging gold values are reported in places.

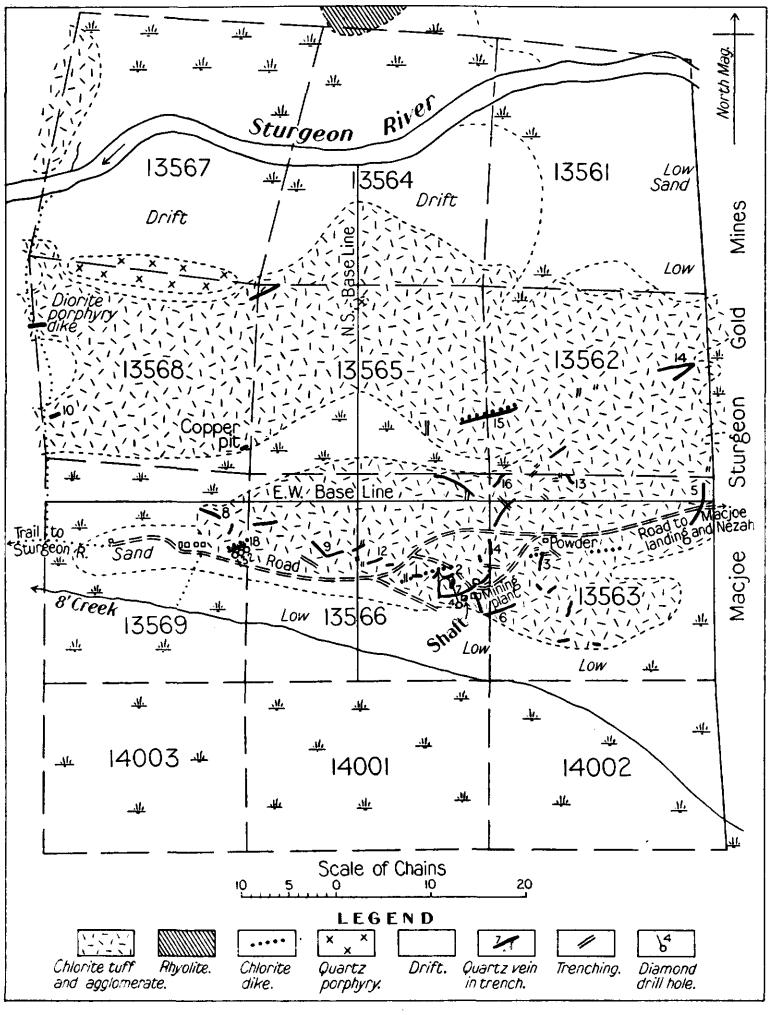
Casey Contact Gold Mines, Limited[1]

The property of Casey Contact Gold Mines consists of 12 unsurveyed claims (T.B. 13,561 to 13,569, 14,001 to 14,003) in Irwin township, adjoining the Macjoe Sturgeon property on the west. Nine of these claims were purchased from the Brennan and Kenty Bros. Prospecting Company, and three additional claims along the south side of the original group were later purchased from independent parties. The original discoveries were made by prospectors of the vending company in the summer of 1934. When the Casey Contact company assumed control it extended the programme of surface exploration and initiated a campaign of underground development near the original discovery. In all, close to 5,700 feet of stripping and trenching has been completed and 15 quartz veins of varying importance have been systematically examined. In the spring of 1935, the main showings were probed to shallow depths by diamond-drilling, 16 holes being drilled for a total of 2,604 feet.

The property is underlain by Keewatin rocks, mainly schistose tuff and agglomerate but with some interbedded lava flows of intermediate composition.

[1]In February, 1936, this company was reorganized under the name of Brengold Mines, Limited, and is so designated in the "List of Properties" on map No. 45a, which accompanies this report.

An elongated mass of reddish to greyish quartz porphyry outcrops along the boundary between claims T.B. 13,567 and 13,568, and two outcrops of rhyolite porphyry were observed along the north boundary of the group. "Green" dikes ranging from 1 to 20 feet in width intrude all the other rocks. Tiny veinlets of tourmaline are common near the main showing and in a band crossing claims T.B. 13,562, 13,565, and 13,568. Much of that part of the group north of the



Geological sketch map of the property of Casey Contact Gold Mines, Limited.

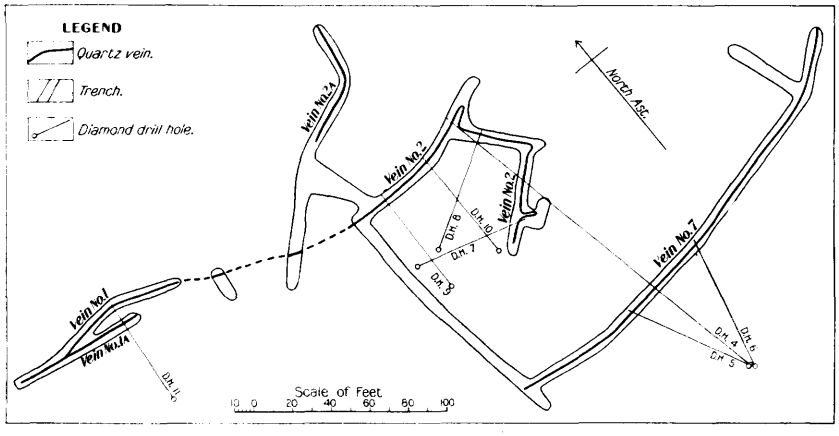
Sturgeon river is covered with muskeg, and the same is true of the south tier of claims.

The more important showings are located along an east-west ridge that extends over parts of three claims, T.B. 13,563, 13,566, and 13,569. They occur in a highly chloritic tuff, which has been strongly sheared at N. 80° E. In places the rock becomes quite agglomeratic, but shearing commonly tends to destroy the usual fragmental appearance. The fine-grained tuff in places shows faint bedding parallel to the schistosity, and in one outcrop near the west

boundary of claim T.B. 13,568, excellent bedding was observed. The veins are more or less parallel to the schisting, but in some cases they cut across it.

The discovery vein, No. 2, is located near the east boundary of claim T.B. 13,566 and is exposed for a length of 200 feet along the contact between a "green" dike and highly altered tuff. It is lens-like in character, ranging from 12 to 50 inches in width. It strikes in an easterly direction, but toward the east end it turns sharply southward, more or less folding back on itself. Rather severe faulting further complicates the vein system. The quartz is rusty and much fractured, and it contains moderate quantities of pyrite, chalcopyrite, and visible gold, and a little carbonate.

About 60 feet southeast of the discovery vein is No. 7 vein, which is exposed in a cribbed trench and on surface for about 65 feet. It strikes N. 75° E. and dips 80° S. It has a maximum width of 30 inches, but the average width is probably not more than 10 inches. The quartz is moderately mineralized with



Surface plan of the vein system and diamond-drilling in the vicinity of the shaft, Casey Contact mine.

pyrite, chalcopyrite, galena, zinc blende, and visible gold, and contains appreciable quantities of carbonate (ankerite) and sericite. The immediate wall rock is a rusty, bleached sericite schist carrying no gold values. As a result of the diamond-drilling of this vein, it was decided to proceed with underground development and a shaft was sunk 20 feet to the south.

Next in importance is No. 5 vein, which is located in the extreme northeast corner of claim T.B. 13,563 and is exposed over a length of 275 feet. It strikes N. 25° E. and dips steeply to the west. It has a maximum width of 33 inches, but narrows down in places to a mere stringer. The quartz is milky and well-fractured, and carries moderate quantities of pyrite, chalcopyrite, and visible gold. In one place near the road, where the vein narrows to not more than an inch in width, specks of visible gold are plentiful. The country rock is a tuffaceous greenstone.

No. 6 vein, a little more than 200 feet southeast of the shaft, occurs in a highly sheared sericitic tuff, arkose-like in appearance. It strikes N. 75° E., dips 80° S., and pinches and swells over an exposed distance of 225 feet. Its maximum width is 18 inches, but the average width is probably less than 6 inches. The quartz carries a little pyrite and visible gold.

No. 8 vein, 200 feet north of the cookery, has been uncovered for 200 feet. It strikes N. 60° W. and stands vertical. It pinches and swells in characteristic fashion, the width of quartz ranging from 2 to 24 inches. The mineralization consists of pyrite, ankerite, and visible gold. Visible gold was also observed in a similar vein, No. 17, about 100 feet east of the cookery.

Vein No. 15, on the boundary between claims T.B. 13,562 and 13,565 has been traced for 300 feet. It strikes N. 80° E. and stands vertical. In places it widens to 45 inches, but the average width is 12 inches. The quartz is milky and contains pyrite and sphalerite, but no gold was observed. Vein No. 14, on the same claim but east of No. 15, has been uncovered for nearly 500 feet. It has an average width of 12 inches and carries pyrite, chalcopyrite, and visible gold, as well as ankerite and sericite.

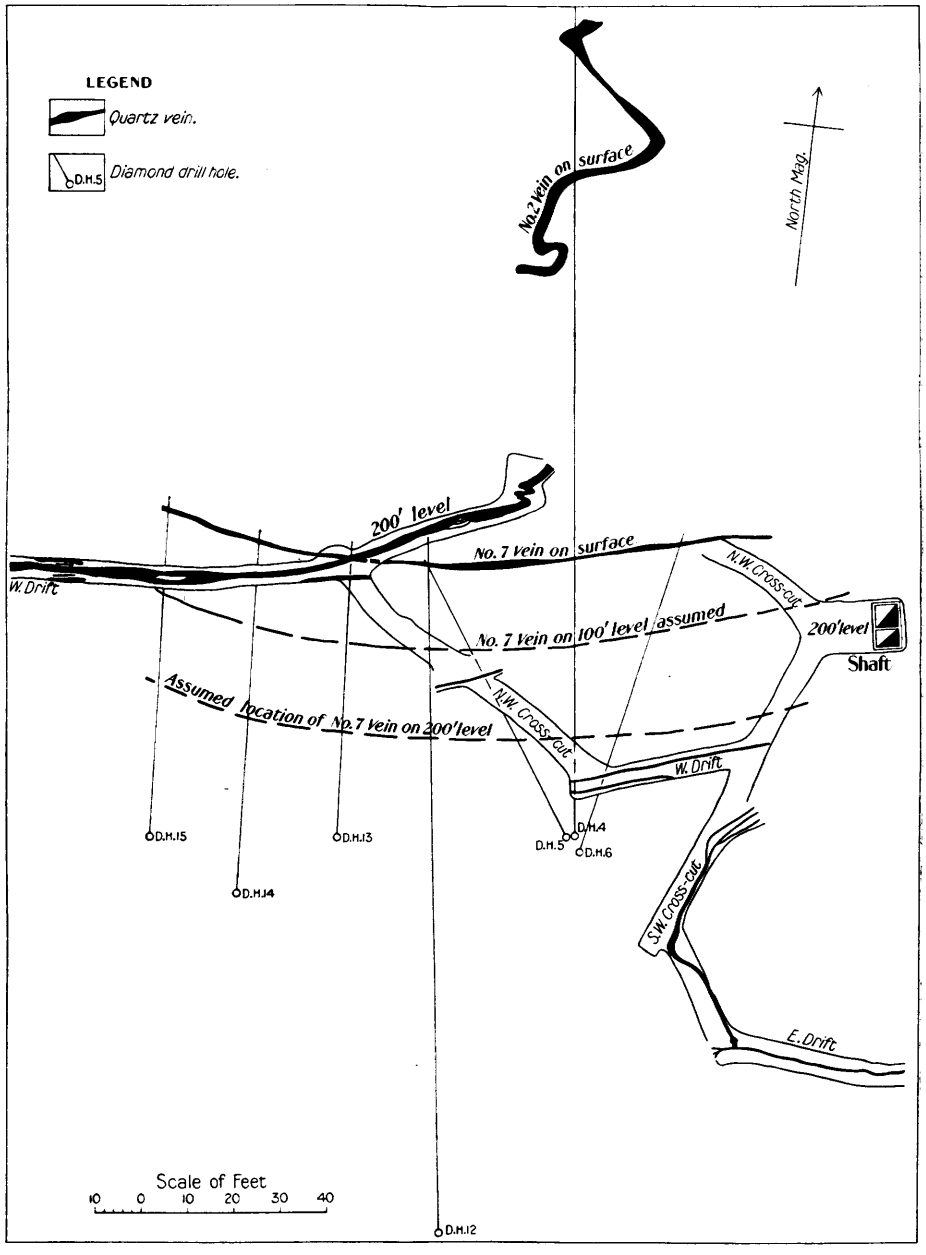


Auriferous quartz vein, face in the northwest drift, 200-foot level, Casey Contact mine, September 17, 1935.

A type of vein matter entirely different from that commonly observed on this property was encountered on the east line of claim T.B. 13,568 about 3 chains north of No. 2 post. It consists of a strongly mineralized shear zone in a volcanic tuff. The shear zone is 4 feet wide, strikes east, and dips 85° S. The mineralization consists of abundant chalcopyrite and a little azurite; there is no vein quartz.

All but three of the veins thus far uncovered have a general easterly trend and seem to follow a definite fracture system, which continues on to the Macjoe Sturgeon and Sturgeon River properties lying to the east. Veins No. 3, 4, and 5 strike north, a fact suggesting that there may be two sets of vertical fractures in the pattern. There is some evidence, however, of folding, and it may be assumed that these northerly veins occur in drag folds. If this is true, there may not be as many veins as at first supposed. What are known as veins Nos. 1, 2, 7, and 4 may be one and the same vein; and veins Nos. 6 and 3 may likewise be a single vein. Further work may establish similar relationships between other widely separated veins on this property.

Most of the veins have features in common. They are narrow and lens-like in habit, follow curved fractures, and pinch and swell in characteristic manner



Plan of the vein system and underground workings, 200-foot level, shown in relationship to veins Nos. 2 and 7 as exposed on surface, Casey Contact mine.

along both the strike and dip. They usually develop a characteristic banded or ribboned appearance due to the presence of chlorite or sericite along fractures and slip planes parallel to the walls. Alteration of the wall rocks is not strong

but results mainly in the addition of silica, carbonate, pyrite, and sericite. The quartz is rather milky, well-fractured, and finely granular. The mineralization is rather sparse and confined largely to the quartz. It consists of pyrite, galena, sphalerite, native gold, and a little chalcopyrite. The gold is a pale variety occurring as tiny specks, almost invisible without a lens, and also in coarse blobs of a spectacular nature. The gold is found in several associations. Galena and sphalerite appear to be favoured, since the presence of either of these minerals commonly indicates gold in greater quantities than ordinary. It has also been observed in tiny fractures in grains and cubes of pyrite, in association with chlorite and sericite in the fractures and various slip planes in the quartz, and far out into what appears to be otherwise barren and unfractured quartz.

During the summer of 1935 the northern half of the group was further prospected, but the main interest was centred largely on underground development in the vicinity of veins No. 2 and 7. A crew of 21 men under the management of H. M. Parrington was engaged in this work. On July 13 a pilot shaft was completed to a depth of 223 feet and a 200-foot level established. Crosscuts on the 125-foot level failed to locate important vein matter, although the shaft had been located to intersect the southward-dipping No. 7 vein above this level. At first, success did not attend lateral work on the lower level, but early in September a drive to the west encountered a vein on the 200-foot level at a point 115 feet almost directly west of the shaft and directly below No. 7 vein as exposed on surface. When the property was visited in September the relationship between this vein and those on surface had not been established. It had been drifted on for 60 feet. The face in the west drift showed a 42-inch width of excellent-looking vein matter, consisting of well-fractured quartz carrying considerable pyrite, chalcopyrite, galena, and visible gold. The face in the east drift showed a 28-inch width of similar vein matter. The average width of quartz over drift length is estimated to be about 19 inches.

The company suspended operations at the property on September 25, reportedly on account of financial difficulties. The property has since been idle pending reorganization of the company.

The property is equipped with a steam plant and an excellent group of mine buildings. It is connected by winter road with MacJoe Landing and Nezah.

Connell Mining and Exploration Company, Limited

The Connell Mining and Exploration Company, Limited, holds a group of 24 unsurveyed claims, known as the Brookbank group, located just east of Knox lake, in Irwin township. Late in 1934 an extensive programme of surface exploration and diamond-drilling was carried out on showings located a few feet south of the north line of claim T.B. 13,525.

The claims are underlain mainly by Keewatin lavas, in some places much schisted, in other places decidedly granitoid in texture. Extending diagonally across the northern part of the group, however, is a narrow belt of sedimentary rocks including conglomerate and greywacké belonging to the Corrigan-Paint Lakes band of the Timiskaming series.

The showing has been traced across the north side of claim T.B. 13,525 in a series of 17 cross-trenches and many test pits, over a total length of nearly 1,300 feet. It is a replacement deposit in a rusty shear zone in Keewatin pillow lava. The shear zone ranges from 20 to 40 feet in width, has an average strike of N. 70° E., and dips from 50° S. to 70° N. Both the schist and adjacent wall rocks have been replaced by feldspar and iron carbonate, the presence of which

imparts a characteristic pinkish to brownish colour. The whole zone is cut by an intricate stockwork of narrow quartz veinlets, usually not more than an inch in width but widening to 6 inches toward the east end of the exposure. The pinkish material occurs in vague streaks throughout the rock, and it is especially noticeable near quartz veinlets. In addition to feldspathization, there seems to have been widespread silicification and development of cubical pyrite throughout the zone. Apart from the pyrite and a little specular hematite, no other metallic minerals were observed. Gold accompanies the pyrite in the pinkish altered rock and may be panned in most places in the rusty schist. The milky-white quartz veinlets are, however, devoid of mineralization and contain no gold values. A grab sample of highly altered and pyritized material taken by the writer from a point near the east end of the workings yielded 0.05 ounces of gold per ton. Systematic sampling of the deposit by the company is reported to have shown only a low and erratic gold content. All development work was suspended early in 1935, and no one was at the property when it was visited in midsummer.

The property is equipped with two camp buildings on the south side of Foxear creek. It may be reached either by a wagon road leading from Nezah or by a trail from Windigokan lake leading from a shallow bay near the east end.

Cyril Knight Prospecting Company, Limited

The Cyril Knight Prospecting Company, Limited, carried on surface exploration on two groups of unsurveyed claims late in 1934 and early in 1935. The "East group," consisting of 6 claims (T.B. 14,861 to 14,866), is located between the mouth of Crooked Green creek and the 4-mile post on the north boundary of Irwin township. The "West group," consisting of 14 claims (T.B. 14,852 to 14,860, 15,693 to 15,696, and 15,760), lies half a mile south of Musca lake in Sandra township and adjoins the Brennan and Kenty Bros. property on the south.

The "East group" is underlain mainly by schistose tuffs and agglomerates resembling arkose, but Keewatin in age. The schisting of these rocks is east-west, and their attitude more or less vertical. A massive outcrop of rhyolite or quartz porphyry occurs near the northeast corner of claim T.B. 14,866, and a porphyritic diabase dike, about 150 feet in width, strikes north across claim T.B. 14,861 only a few feet west of the main showing. Several small quartz veins have been uncovered near the middle of claim T.B. 14,861, but the only one containing gold is No. 1 vein. This vein has been stripped for 70 feet. It strikes east, dips 70° S., and has an average width of 5 inches. The quartz is well-fractured and milky-white and carries a little pyrite in addition to the gold. Channel-sampling disclosed no commercial gold values; the best sample is said to have yielded 0.64 ounces gold over a channel width of 9 inches. The showing is reached by a trail leading from the middle of the ox-bow stream just west of the mouth of Crooked Green creek.

The "West group" is underlain mainly by volcanic tuffs and agglomerates, which have been intruded by a few small dikes and bosses of granite. A portion of the western part is occupied by the Keweenawan diabase flow. The main showings occur on claim T.B. 14,853. Near the middle of this claim a quartz vein or series of lenses has been traced for 657 feet. Near the trail this vein attains a maximum width of 17 feet but narrows considerably in either direction. It strikes N. 45° W. and dips from the vertical to 55° N. The quartz is well-fractured and milky white, and on the whole is rather sparsely mineralized with

pyrite, chalcopyrite, and gold; in one pit near the west end rather massive chalcopyrite was encountered. The gold is confined largely to the main quartz lens, which is crossed by the trail leading from Musca lake. This lens is 45 feet long and has a maximum width of 17 feet. In channel-sampling, it was found that the highest gold content occurs where the lens is widest. One small "pay streak" is said to have yielded 1.90 ounces of gold over a width of 7 inches, but the streak is only 2 feet long.

On the north boundary of claim T.B. 14,853, just west of the trail, a rusty carbonate shear zone carrying a few quartz stringers was stripped. Neither the schist nor the quartz carries any important mineralization.

P. E. Hopkins Group

P. E. Hopkins holds a group of 4 surveyed claims (T.B. 10,501, 10,502, 10,504, 10,505) located just north of Twin falls on the Sturgeon river, in Irwin and Pifher townships. J. J. Green and G. Brennan found gold on these claims as early as 1931. Their continued interest in this section is said to have induced other prospectors to visit the area, resulting in the gold discoveries along the Sturgeon river three years later.

The claims are underlain by arkosic tuffs and agglomerate of the Keewatin series. The main showings are located in the northwest quadrant of claim T.B. 10,502 and may be reached by a good trail branching off from the Maloney Sturgeon trail at a point 20 chains north of Twin falls. Most of the work has been done on the east slope of a steep north-south ridge. Here a few quartz stringers, well-mineralized with pyrite, intersect a somewhat indefinite east-west shear zone in light-weathering, arkose-like tuff, which is interbedded with agglomerate. Farther along the trail in the southern part of claim T.B. 10,505 are large, irregular, lens-like masses of quartz in schistose arkosic tuff. This quartz is rusty in places but appears to carry no mineralization other than a little pyrite. In the central part of the same claim an east-west vein of white milky quartz, 3 feet wide, has been traced up the east side of a steep hill and exposed for about 80 feet. No important mineralization was observed.

No further surface exploration was carried out on this group of claims during the summer of 1935.

K. L. Exploration Company, Limited

In 1935, the K. L. Exploration Company, Limited, held 80 unsurveyed claims distributed in 5 groups in the Windigokan lake section, Irwin township. Early in the summer a small crew of men was engaged in prospecting the Tallon Lake group (T.B. 15,270 to 15,296). Although interesting geological conditions were noted, no important mineralization was disclosed. Later in the summer exploration was centred on the Knox Lake group of 16 claims (T.B. 13,542 to 13,550 and 19,711 to 19,717) adjoining the Brookbank (Connell) property on the west and including the "Knox West group" of 9 claims, formerly under option to the Connell Mining and Exploration Company.

The northern half of the Knox Lake group is underlain by arkosic conglomerate and schist belonging to the Corrigan-Paint Lakes belt of Timiskaming sediments. The southern half is underlain by massive to schistose Keewatin greenstone and a few small intrusive masses of quartz diorite. Along both the north and south shores of Knox lake, toward the west end, the sediments have been strongly schisted and carbonated, but no important mineralization has yet been disclosed.

What is known as the "Galena vein" is located on claim T.B. 13,549 a few chains inland from the deep bay in the middle of the south side of Knox lake. It strikes N. 33° E., dips 70° W., and is exposed for 200 feet. It pinches and swells in characteristic manner, attaining a maximum width of 30 inches but in places narrowing to less than an inch. The enclosing rock is a soft-weathering, highly chloritized greenstone, slightly sheared at N. 60° W. The quartz is well-mineralized with pyrite and galena, and pink calcite is plentiful. Two character samples taken by the writer from the north and south ends of the exposed vein yielded 0.20 and 0.16 ounces of gold per ton.

In the central part of claim T.B. 13,546, on the south side of Knox lake, less than a quarter of a mile from the east end, is another vein believed by some to be the westward continuation of the "break" on the Brookbank property. This vein was opened up by the Connell interests under an option agreement. It has been exposed in a series of 6 cross-trenches over a length of 200 feet. A quartz vein in the most easterly pit is 28 inches wide, strikes east, and dips slightly south. The mineralization consists of pyrite and carbonate. The country rock is a rusty, pyritized greenstone, and a small body of coarse quartz diorite is exposed near by. At the west end of the workings the vein matter is spread over a width of 32 feet and consists of a sort of stockwork of quartz veins ranging from a quarter of an inch to 3 inches in width. The wall rock is altered to a reddish and greenish material, being strongly silicified and feldspathized, similar to that at the Brookbank showing. The mineralization consists of fine-grained pyrite and specular hematite, both of which occur mainly in the altered wall rock. Channel assays are reported to have yielded no gold values.

In the summer of 1935 surface development under the direction of John Knox was being carried on, largely on newly acquired ground along the south side of the group. Interest was centred mainly on a quartz vein along the boundary between claims T.B. 19,714 and 13,547. This vein strikes N. 50°-75° E., dips slightly south, and has been exposed by trenching and test-pitting over a length of a quarter of a mile or more. The quartz itself is usually not more than 12 inches in width, but the accompanying shear zone carrying quartz stringers widens to 5 feet in places. Both the quartz and schist are well mineralized with pyrite, and chalcopyrite and galena occur sparingly in the quartz; carbonate is a common constituent of the vein matter. A well-mineralized character sample taken by the writer from the best-looking section near the east end yielded 0.03 ounces gold per ton.

As yet no ore bodies of commercial grade have been indicated on this property, although several of the quartz leads show interesting mineralization and low values in gold.

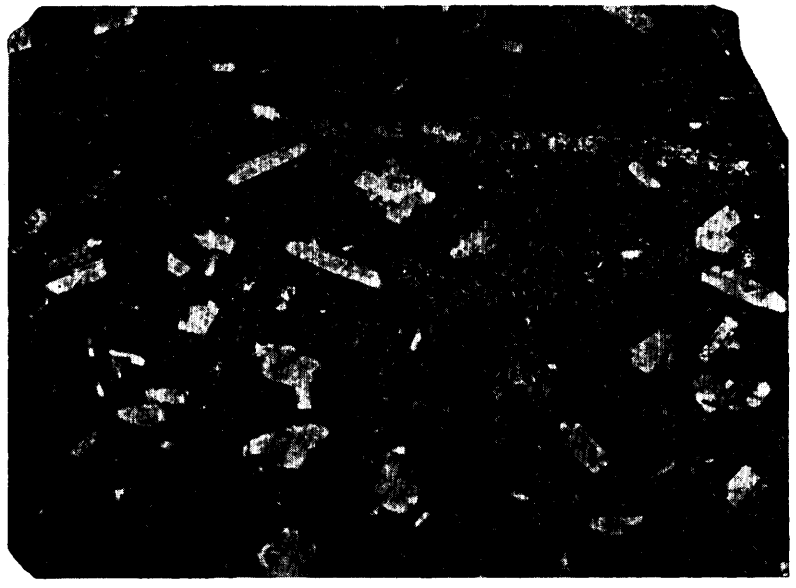
The property is equipped with a good camp located at the east end of Knox lake. The Nezah road has been cut to within a quarter of a mile of the camp.

Lac-Teck Gold Mines, Limited

The property of Lac-Teck Gold Mines, Limited, consists of a group of 18 unsurveyed claims (T.B. 15,500 to 15,505, 15,484 to 15,492, and 15,497 to 15,499) centred about Schnob lake south of the west end of Windigokan lake, Irwin township, and the old surveyed iron claims H.F. 16 and H.F. 17.

Interesting mineralization was uncovered on the east slope and top of a high hill just south of Schnob lake. The main showing, near the northeast corner of claim T.B. 15,502, is exposed in a trench 100 feet long. It consists of a heavy gossan zone, which appears to be a replacement of an amygdaloidal flow

by silica, pyrite, and carbonate; specular hematite is abundant in places. Two well-mineralized character samples yielded no gold values. Samples taken by company officials likewise indicate that the deposit is not auriferous.



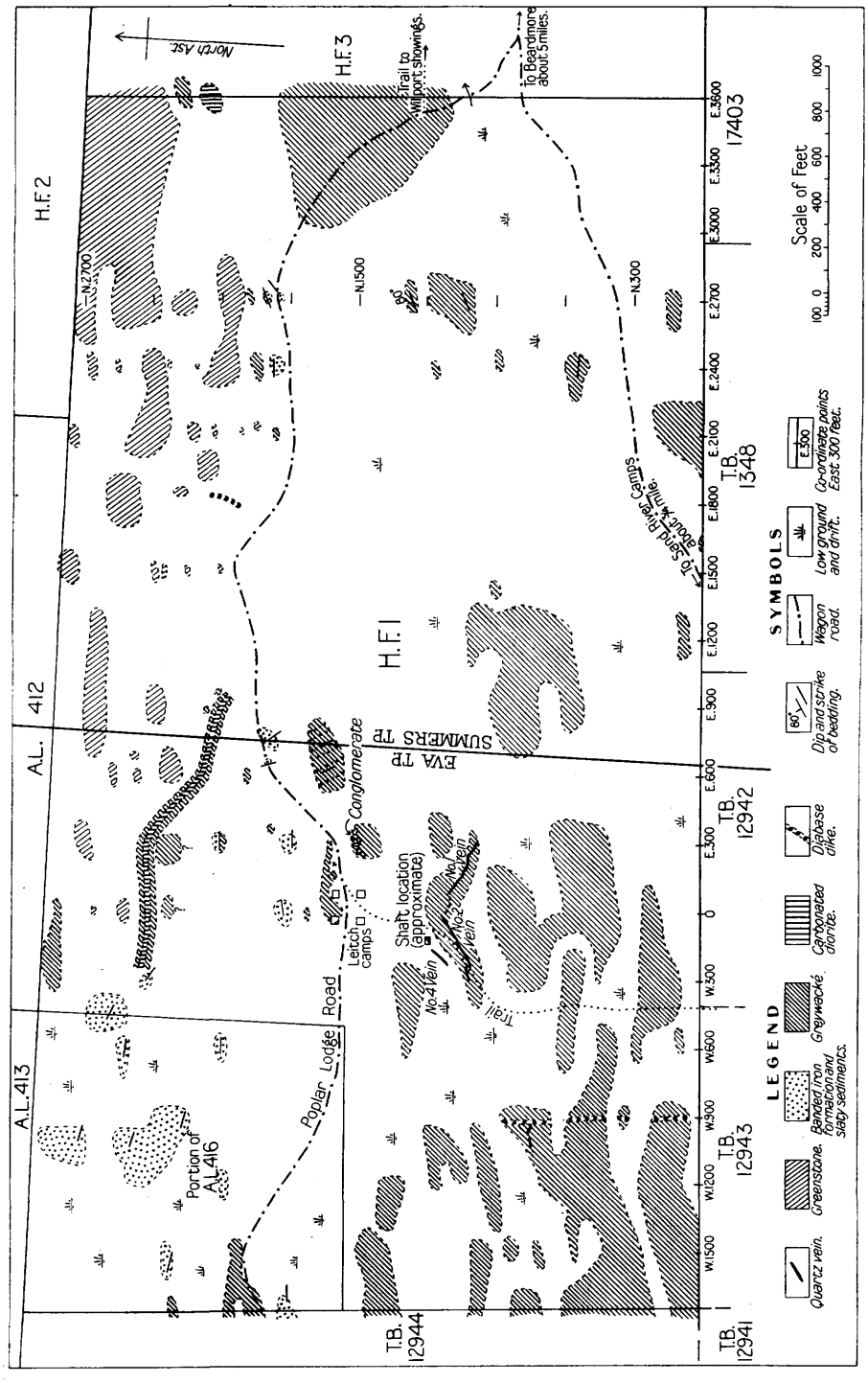
Polished specimen (natural size) of feldspar porphyry, Lac-Teck property, south of Schnob lake.

Leitch Gold Mines, Limited

Leitch Gold Mines, Limited, was incorporated early in the summer of 1935 for the purpose of developing a parcel of patented ground on which a spectacular gold discovery had been made. The property, which lies southeast of Lake Eva in Eva and Summers townships, consists of claim H.F. 1, the eastern half of claim A.L. 416, and the western half of claim H.F. 3, all old surveyed claims which had been staked for iron and which for several years have been vested in the estate of the late P. A. Leitch, of Port Arthur. The claims lie between the Sand River property on the west and the Wilport property on the east.

Although a little greenstone occurs in the northern part, the group is underlain mainly by Timiskaming sediments, consisting of greywacké, interbedded iron formation, and at least one narrow lens of pebble conglomerate. Locally, the original bedding of the greywacké is preserved, but for the most part it has been completely obliterated by later shearing. The iron formation is a well-banded, jasper-hematite variety, which, however, in places contains sufficient magnetite to cause considerable magnetic attraction. Four distinct bands of iron formation, all within a width of a few hundred feet, have been located and traced by dip-needle methods. These bands are strongly crumpled and folded, a condition which will doubtless provide a key to the general structure of the rocks and the relationship to vein structure, if any. The only intrusive observed on the property is a quartz diorite or granodiorite dike near the north boundary.

Credit for the discovery, which was made in June, 1935, goes to Messrs. Russell and James Cryderman as a result of their having run a picket line eastward along the strike of No. 1 vein on the Sand River property. The discovery



Geological sketch map of the western part of the property of Leitch Gold Mines, Limited.

vein, known as No. 1, is located on claim H.F. 1, about 800 feet southeast of the southeast corner of claim A.L. 416. Three other veins, known as Nos. 2, 3, and 4, have been uncovered west of the discovery vein, all within a distance of 600 feet. They all occur in bedded greywacké.

No. 1 vein is unusually sinuous, but has an average strike of N. 60° W. For the most part it stands vertical but in places has a tendency to dip steeply to the north. It has been traced and exposed for a length of approximately 350 feet and shows widths ranging from a few inches to 21 inches, the average being about 15 inches. In places the vein completely doubles back on itself, at which points the quartz widens to about 31 inches. After careful calculation, Wm. Hacker, who was in charge of the early development, has estimated that this vein on account of its convolutions has been shortened at least 15 per cent.



No. 1 vein, Leitch property, October, 1935.

This condition, however, makes for greater widths of vein matter and may be construed as a favourable factor in mining operations. The wall rocks are closely sheared outward for about 4 inches on either side of the vein, but this schist carries little or no gold. The country rock is a slightly schisted greywacké, bedded at N. 82° W. and dipping 78° N. Wall rock alteration is slight and consists mainly of the addition of a little carbonate and pyrite. A shear zone of varying intensity has been superimposed on the original bedding; it strikes N. 63° E. and dips 74° N. Grain gradation in the greywacké beds and fracture cleavage in narrow slaty bands indicate that the veins lie on the north limb of a syncline overturned to the north and plunging steeply west.

The quartz in No. 1 vein is strongly fractured both parallel and at right angles to the strike. The parallel fractures are the stronger and are commonly marked by thin films of a yellowish-green sericitic material and flakes of malachite and azurite. Associated with these minerals in the fractures and in quartz immediately adjacent are irregular patches of a dark-grey to black metallic aggregate, in which Professor Ellis Thomson has identified pyrite, tetrahedrite,

sphalerite, and native gold in the same order of decreasing abundance. In addition he observes that, according to etching figures with HNO_3, minute quantities of a dark mineral surrounding the tetrahedrite may be either galena or chalcocite, more probably the latter. The green copper stain or malachite is doubtless derived from the alteration of tetrahedrite. Almost invariably fine specks of visible gold may be observed in these longitudinal fractures, especially when they are lined with sericitic films and contain the dark metallic aggregates just mentioned. Furthermore, it should be noted that the mineralization is concentrated largely along these fractures, the intervening quartz for the most part having a characteristic barren appearance. The fractures, at right angles to the strike, cut across the vein from wall to wall and stand out prominently on account of their being filled with a characteristic milky-white quartz, lighter in colour than the common vein matter and of a later generation. This later quartz is not auriferous. Carbonate in the form of rusty ankerite occurs sparingly in some sections of this vein.

What may be the westward continuation of No. 1 vein was picked up 25 feet west along the strike. This vein, known as No. 2, strikes N. 64° E., dips 75° N., and has been opened up for a total length of 220 feet. It ranges from 6 to 17 inches in width, the average being about 11 inches. It is not contorted like No. 1 vein but rather occupies a fairly straight fissure. The quartz differs from that in No. 1 vein only in being more strongly fractured parallel to the strike and in the occurrence of thin flakes of reddish hematitic material. The schistose wall rock also contains reddish hematite for several inches outward from the vein. For the most part the mineralization is scanty and consists of little other than pyrite and visible gold, the latter being observed in many places over the full length of the exposure.

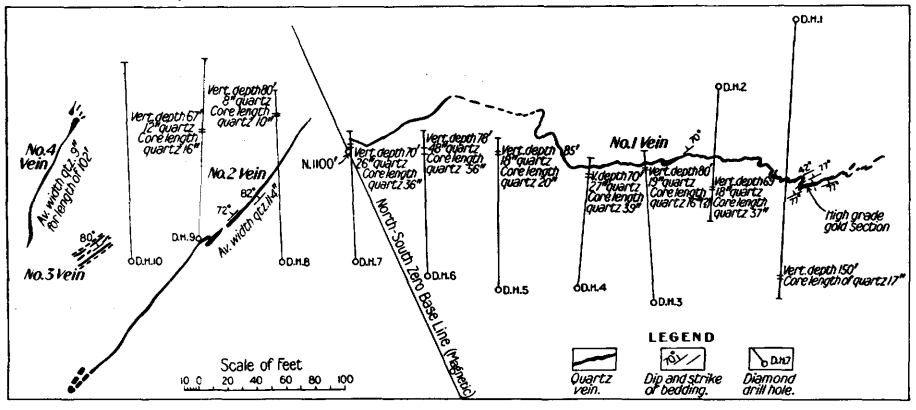
Veins Nos. 3 and 4 are located northwest and within 110 feet of No. 2 vein. They strike in a general northeast direction, more or less parallel to No. 2 vein. Vein No. 3, as exposed in one deep pit, consists of a series of 5 subparallel quartz veins ranging from 1 to 7 inches in width. These veins occur in a schistose "break" in greywacké, the total width being 15 feet. No important mineralization was observed. Vein No. 4, lying to the north of No. 3, has been stripped for 102 feet and has an average width of 9 inches. The mineralization is scanty, but visible gold was observed in the quartz near the east end. When the property was visited in October very little work had been done on either of these veins.

Two months after the discovery, preliminary diamond-drilling commenced on veins Nos. 1 and 2. By the latter part of August No. 1 vein had been proved to a depth of 160 feet, visible gold being observed in many of the drill intersections. The results of diamond-drilling and surface sampling are officially reported as follows:—

RESULTS OF SAMPLING AND DIAMOND-DRILLING NOS. 1 AND 2 VEINS, LEITCH GOLD MINES DECEMBER, 1935

Vein		Length	Deepest intersection	Average width of quartz	Average gold content
		feet	feet	inches	ounces
No. 1	Surface sampling, 5-ft. intervals.....	226	.....	15.25	1.04
	8 diamond-drill holes.....	.....	310	15.25	1.29
No. 2	Surface sampling, 5-ft. intervals.....	210	.....	10.9	.85
	3 diamond-drill holes.....	.....	70	10	1.09 (approx.)

It may be observed that two high-grade ore shoots have thus far been indicated. Furthermore, diamond-drilling has established that the ore shoot in No. 1 vein rakes west at 45 degrees. Shaft-sinking commenced in November, 1935, the location being about 100 feet northwest of No. 2 vein. The present objective is 350 feet, with three levels being established at depths of 125, 225, and 325 feet. Early in March, 1936, the station at the 2nd level had been cut. Concurrent with the sinking programme, the low-lying area eastward along the ore zone was diamond-drilled in the hope of picking up further ore shoots. Officials report that this drilling has indicated another ore shoot 200 feet east of No. 1, vein intersections being encountered over a length of 240 feet.



Surface plan of the vein system and diamond-drill intersections, Leitch Gold Mines, Limited, October, 1935.

Of considerable interest at the present stage of development is the fact that a gold brick containing 65.5 ounces of gold has already been produced on this property. The brick was obtained from 770 pounds of selected high-grade ore taken from a pocket on surface 40 feet from the east end of No. 1 vein. This pocket, which was the site of the original discovery, exhibits visible gold in spectacular quantities.

The property is now equipped with an excellent set of mine buildings and a Diesel power plant. Whether or not further success will attend this operation depends largely on what is encountered in underground development. The veins are admittedly narrow, but this handicap is overcome somewhat by their high-grade gold content. In the matter of production costs, three factors of prime importance favour this operation: (1) The ore is a free-milling type resulting in reasonable milling costs; (2) relatively cheap power is available from the Hydro-Electric transmission line passing through Beardmore; and (3) comparatively cheap transportation is available, since the property is already connected with Beardmore, only 5 miles distant, by a wagon road in fair condition. At a comparatively low cost this road could be sufficiently improved to serve motor traffic.

Long Lac Superior Syndicate

The Long Lac Superior Syndicate holds 2 groups of unsurveyed claims in the Standingstone river section, Summers township. The Standingstone group, consisting of 12 claims, is located between Standingstone lake and Empire. It is underlain by Timiskaming greywacké, and a 30-foot band of black, slaty iron

formation traverses the northern part in a general easterly direction. In addition a broad dike of diabase 150 feet wide crosses the central part of the group in a north-south direction.

Considerable stripping and trenching in the central part of claim T.B. 19,834 exposes a shear zone, which is 6 feet in width and contains a little quartz. No important mineralization was observed.

The second group, consisting of 4 claims (T.B. 19,912 to 19,915), formerly surveyed as A.L. 390 and 391, adjoins the Wilport property on the south. A few quartz veins have been uncovered near the east boundary of claim T.B. 19,913 just south of the trail to Sinclair's road. Sufficient work has not as yet been done to estimate their importance.

Macjoe Sturgeon Gold Mines, Limited

Macjoe Sturgeon Gold Mines, Limited, holds a group of 12 surveyed (1935) claims (T.B. 13,931 to 13,933, and 16,726 to 16,734) in Pifher and Irwin townships, located at Macjoe Landing on the Sturgeon river and surrounding the Sturgeon River property on the north, west, and south. The property was staked originally for the Jomac Gold Syndicate, Limited, just as the Sturgeon River gold rush was getting under way early in the summer of 1934. Late in the same year the present company, representing the same interests, acquired the group and commenced systematic development.

The northern half of the group is underlain by medium-grained, light-weathering granodiorite, this being a salient from a large area of granite lying to the northeast in Elmhirst township. The southern half of the group is underlain largely by massive, light-weathering rhyolite flows, rhyolite fragmental types, and greenish schistose lavas and tuffs. The occurrence of tourmalinized tuff in the west central part of claim T.B. 16,730 has already been mentioned above in the general description of the rock types. Outwardly this rock has the appearance of volcanic *ejectamenta* with dense, black, rounded and angular fragments scattered throughout a greyish siliceous matrix, such as one might expect near the site of a volcanic cone. Under the microscope, however, the black material is seen to be tourmaline, and the rock probably owes its origin to a replacement phenomenon, as suggested earlier in this report. Both the Algoman and Keewatin types are intruded by narrow "chlorite" or "green dikes," porphyry dikes, and a few narrow diabase dikes.

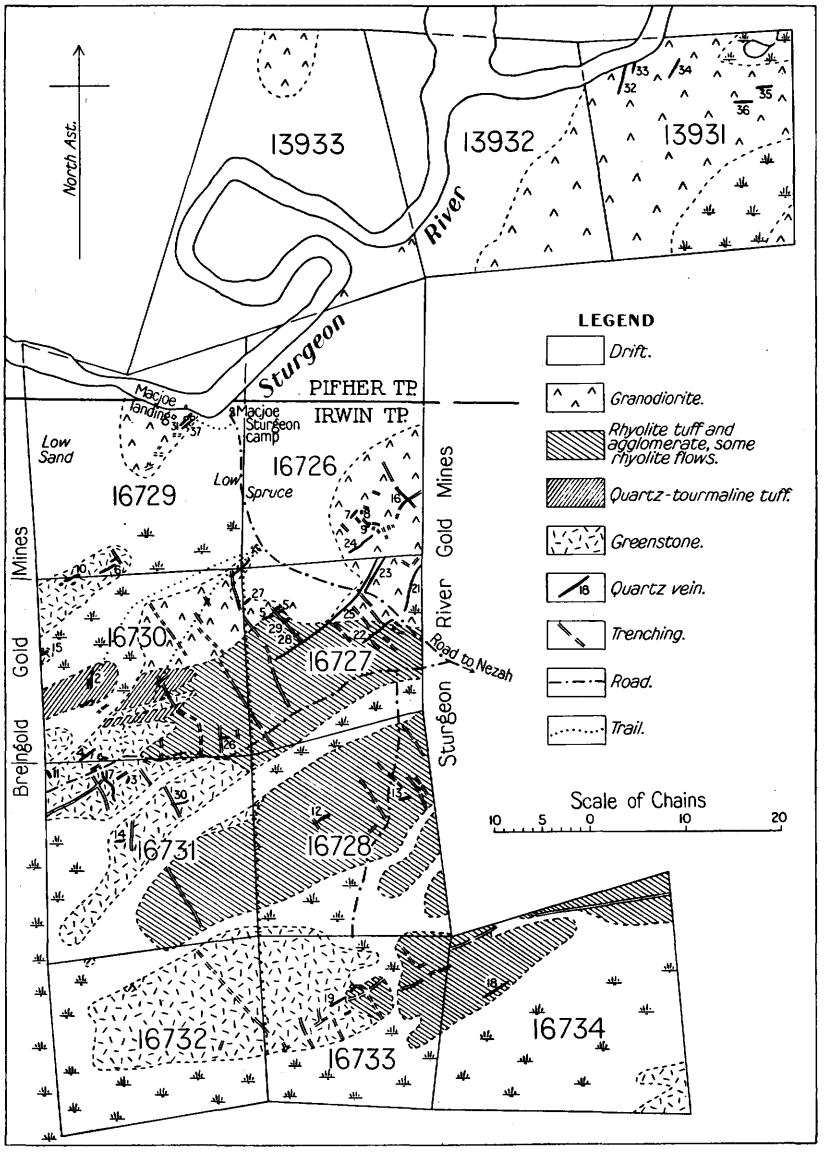
Quartz leads were uncovered on nine of the claims, their occurrence being noted in both the granodiorite and Keewatin types. In all, 38 quartz veins were found, but only 4 of these, Nos. 21, 23, 24, and 25 demanded further attention. These veins, closely grouped near the boundary between claims T.B. 16,726 and 16,727, strike in a general northeast direction and are approximately parallel. Veins No. 21, 23, and 24 occur entirely within the granodiorite; vein No. 25 passes from granodiorite into rhyolite flows and agglomerate.

On surface, vein No. 21 has a maximum width of 6 inches and has been exposed for 250 feet. Diamond-drill holes in low ground to the south, however, have indicated the extension of the vein in this direction for another 150 feet. It has been traced in the opposite direction to the east boundary of the property, where it passes into the property of Sturgeon River Gold Mines. The quartz is strongly fractured parallel to the strike and contains varying quantities of pyrite, chalcopyrite, and galena, and a little visible gold.

Vein No. 23 has a maximum width of 12 inches and an average width of 6 inches; it has been exposed for about 300 feet. The quartz is strongly fractured

parallel to the strike and carries moderate quantities of pyrite and galena. Thin flakes of visible gold occur in tiny fractures near the margins of the vein.

Vein No. 24 is a lens-like mass of quartz with a maximum width of 6 feet but narrowing down to a few inches in places. The quartz is rusty in spots and carries



Geological sketch map of the property of Macjoe Sturgeon Gold Mines, Limited.

moderate quantities of pyrite concentrated mainly in longitudinal, sericite-filled fractures parallel to the strike. The gold values here are said to be low.

Vein No. 25 is the most important thus far exposed on the property both as regards magnitude and mineralization. Like most of the veins in this area it is narrow but remarkably persistent as to length, being exposed in a long trench

for more than 1,000 feet. It pinches and swells in characteristic manner, ranging from 6 to 18 inches in width over much of its length, but widening to 3 feet in places. The average sampling width is probably about 10 inches. Where the vein passes from the granodiorite into the rhyolite fragmental, the wall rock for 2 feet on either side of the vein is perceptibly altered to a reddish, cherty, well-pyritized type, which, however, is said to yield no gold values. In places, fairly heavy concentrations of pyrite, chalcopyrite, galena, and sphalerite were observed. Specks of visible gold are commonly seen, especially where galena and sphalerite are prominent constituents of the vein matter. A systematic sampling of this vein by officials is reported to have shown very few blanks over its entire length. In a few places channel assays, according to the company assay sheet, indicated gold values of an ounce or more per ton over vein width.

During the summer of 1935 a crew of 22 men under the management of A. Rosenland was engaged in a well-planned programme of surface exploration and diamond-drilling. In all, 5,000 feet of diamond-drilling in 30 short holes and 20,000 feet of stripping and trenching was completed. Having finished its programme early in October, 1935, the company suspended operations pending the compilation of results. Apart from a few short ore shoots in vein No. 25, nothing outstanding was found on the property. As late as March, 1936, no decision had yet been reported regarding further development.

The property is equipped with good camp buildings and connected by winter road with Nezah.

Maloney Sturgeon Gold Mines, Limited

Maloney Sturgeon Gold Mines, Limited, incorporated in October, 1934, holds 2 groups of 22 unsurveyed claims (T.B. 12,913 to 12,930, 13,360 to 13,362, and 13,997) in Pifher township, which were acquired from the Karl Springer Exploration Company, Limited. The main group is located about 1½ miles north of Twin falls and is reached by a good trail from that point. It is underlain mainly by pillowed Keewatin lavas and tuffaceous types. In places the lavas have been intruded by irregular masses and dikes of altered feldspar or granite porphyry.

The only showing of any importance is that which is credited with precipitating the gold rush into the Sturgeon River area early in the summer of 1934. This discovery was made by Rene Maloney. It occurs in rather massive andesitic greenstone at the northwest corner of claim T.B. 12,914. A shallow test pit exposes a lens-shaped mass of quartz 7 feet in maximum width, which strikes N. 50° W. and dips 70° S. The quartz is rather glassy but well-fractured and fairly heavily mineralized with pyrite and lesser quantities of chalcopyrite, galena, and malachite. Two cross-trenches to the northwest failed to disclose any further vein matter, although the "break" was traced for some distance in this direction. About 50 feet east of the pit the vein narrows down to 20 inches and takes a sharp turn southward. Several deep pits in this direction expose a strong rusty shear zone dipping 45° W. Although a little quartz was picked up in one of these pits, no important mineralization was disclosed. The "break," however, has been indicated for a distance of nearly 1,000 feet. Stockworks of quartz in an irregularly shaped mass of feldspar porphyry lying a few feet south of the discovery pit likewise showed little or no mineralization.

In the summer of 1935 the groups were further prospected with no important results. The original discovery pit was further opened up by blasting, and much spectacular gold ore was revealed. From one short ore shoot or pocket, not

more than 20 feet in length, vein matter estimated at 40 tons was removed. A shipment of cobbed material weighing 364 pounds is reported to have yielded a small gold brick weighing 21.4 ounces. Even though a sizeable ore shoot is not yet indicated, the officers plan to remove the extremely rich high-grade ore and follow the shoot by sinking a shallow shaft if it extends to depth.

The property is equipped with three excellent camp buildings.



Discovery pit, Maloney Sturgeon property, July, 1935.

Milroy-Taylor Group

The partnership of A. Milroy and R. S. Taylor holds a group of 9 unsurveyed claims (T.B. 13,042 to 13,050) north of Twin falls on the Sturgeon river and adjoining the Hopkins group of surveyed claims on the east. The claims are underlain mainly by Keewatin volcanic sediments, arkosic tuff and agglomerate, and a few small intrusive masses of feldspar porphyry.

The main showing, discovered in August, 1934, is located on the west shore of the lake near the east boundary of claim T.B. 13,045. It consists of a quartz vein, 9 inches in width, exposed in a prospect pit on the side of a steep ridge near the water's edge. It strikes N. 60° W. and dips steeply south. It pinches out within a few feet but reappears in the same "break" a little farther up the hill. In one place specks of visible gold were observed.

In July, 1935, a small crew was engaged in surface exploration at the main showing as well as elsewhere on the property. This work resulted in the finding of several interesting mineralized "breaks" with quartz stringers, from which gold pannings were obtained. Although no important discoveries were made, the results indicated that the group should be intensively prospected.

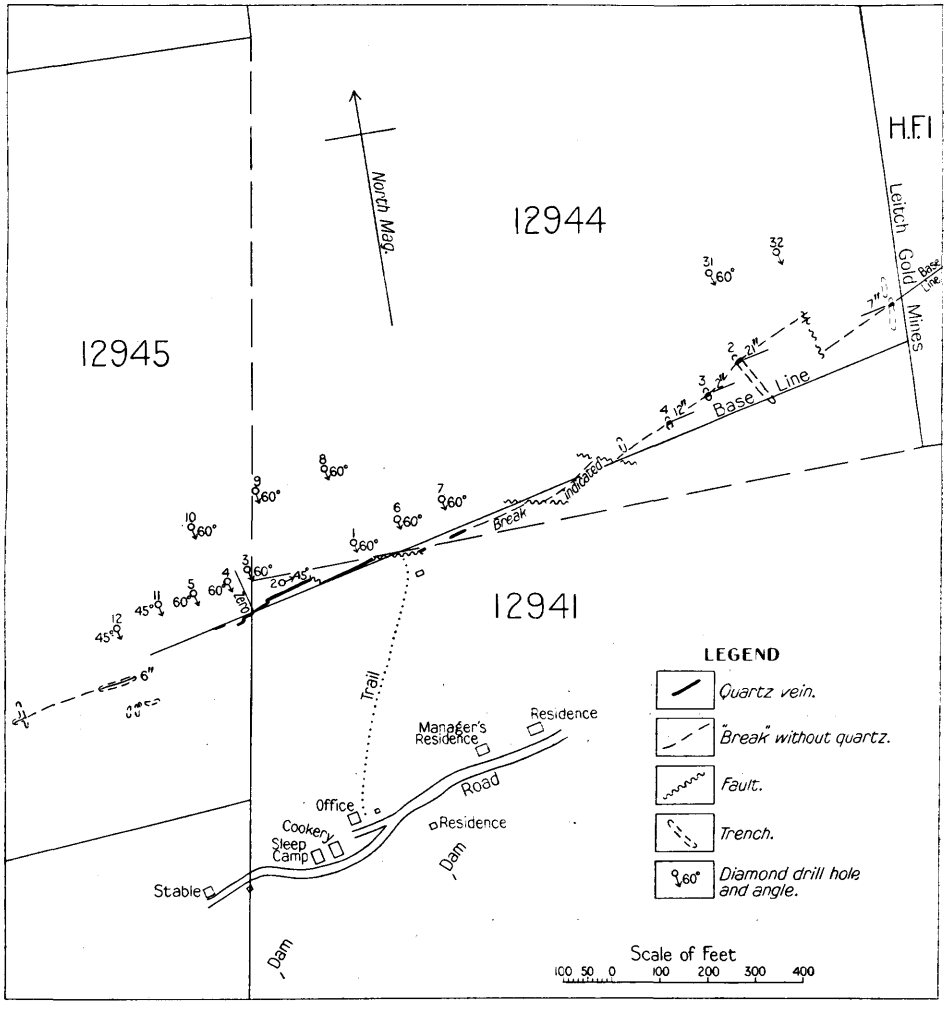
For a time this property was under option to Tellaurum Gold Mines, Limited.

Sand River Gold Mining Company, Limited

The Sand River Gold Mining Company, Limited, holds a group of 22 unsurveyed claims (T.B. 12,941 to 12,948, 13,040, 13,041, 13,060, 13,061,

13,757 to 13,764, 14,416, and 18,545) in Eva township, located south of the Standingstone river between the Leitch property and Lake Nipigon, the most westerly claim being only a few hundred feet from the lake.

The group is underlain by Timiskaming greywacké belonging to the Watson Lake belt. Apart from a few dikes of coarse diorite and diabase in the western part of the group no other intrusives were observed. In the southwest corner the sediments are capped by a high ridge of Nipigon diabase.

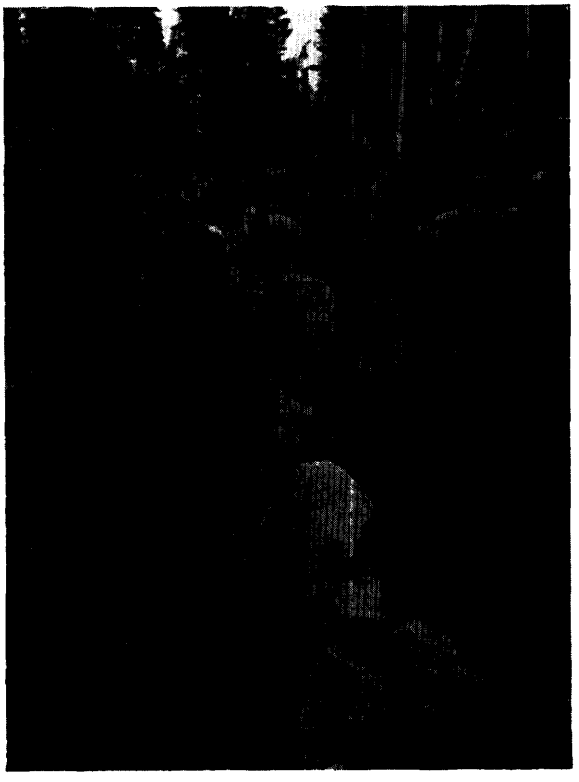


Surface plan of No. 1 vein, Sand River Gold Mines, Limited, October, 1935.

The first gold discovery in the Standingstone river section was made on this property by Russell Cryderman early in June, 1934. It is located near the northwest corner of claim T.B. 12,941. Most of the work has been done on the discovery vein, known as No. 1 vein. On claim T.B. 13,759 toward the west side of the group, another vein known as the "Creek vein" has received some attention.

Vein No. 1 occurs in a narrow shear zone in well-bedded greywacké with thin slaty interbeds. The vein follows the shear zone, which strikes N. 60°-70° E.

The greywacké beds strike N. 85° W. and dip 80° N. The vein is rather sinuous and broken in several places by eastward-dipping thrust faults, which results in minor horizontal displacements. Its sinuosity at first suggests folding, but on further examination it seems clear that this has not been a dominant process, since the enclosing bedded greywacké has not been subjected to a similar derangement. It would appear rather that the vein matter occupies an original sinuous fracture cutting across the bedded sediments, as it is quite independent of any structural folding in them. Although the average width is only about 13 inches, it is remarkably persistent along the strike, having been exposed in cross-trenches and test pits for a length of 2,100 feet, and exposed continuously for 550 feet.



No. 1 vein, Sand River property, September, 1935.

Like other veins in the area it shows a strong tendency to pinch and swell, both along the strike and on the dip. The quartz is milky in colour and well fractured parallel to the strike. Narrow veinlets of a later generation of lighter-coloured quartz up to half an inch in width intersect the main vein at right angles. Some of the stronger of these veinlets cut across the main vein and penetrate the schistose wall rocks on either side for several feet. This late generation of quartz carries no mineralization. Generally speaking, the quartz is rather sparsely mineralized with pyrite, flakes of malachite and azurite, and tetrahedrite; specks of visible gold are common, especially in test pits near the west end of the exposure. Carbonate, greenish sericite, and chlorite are rather common constituents of the vein matter and occur mainly in the longitudinal fractures and in tiny slip planes.

The "Creek vein" is not well exposed on surface. One section 25 feet in length outcrops in the creek bed, and 200 feet west of this point another section 20 feet in length is exposed. It strikes N. 74° E. and has an apparent dip of 50° N.; it has an average width on surface of 24 inches. It occurs mostly in a broad dike of quartz diorite, dipping 50°-60° N., but toward the east it passes into greywacké; the dike ranges from 60 to 130 feet in width. The vein matter consists of a highly altered, greenish, silicified material cut by numerous quartz stringers, which constitute about 25 per cent. of the whole. In places arsenopyrite is abundant, and a little pyrite occurs. No visible gold was observed, but a character sample carrying arsenopyrite yielded 0.14 ounces gold per ton. The quartz is milky in colour and much fractured and carries some carbonate in the form of ankerite. Just below a waterfall about 20 feet east of the main vein is another subparallel quartz vein striking N. 74° E. The quartz is well fractured, but no important mineralization was observed. Early in May, 1935, over 2,450 feet of diamond-drilling was done on the main vein, a total vein length of 400 feet being indicated. According to official plans the average of channel assays taken on surface indicates a gold content of 0.218 ounces per ton over a width of 18 inches.

Late in May, 1935, surface exploration of No. 1 vein was further supplemented by diamond-drilling. In all, 16 shallow holes with a total footage of 2,531 feet were drilled. The results of surface sampling and drilling are officially reported as indicating an ore section 550 feet long with an average gold content of 0.67 ounces per ton over an average width of 13 inches and to a depth of 250 feet.

Early in 1936 plans were being made to sink a shaft at No. 1 vein to a depth of 500 feet, with 4 levels to be established at 125-foot intervals.

As in the case of the Leitch Gold Mines, operation power and transportation costs will be relatively low. Hydro-electric power is available at Beardmore, 4 miles distant by pole line. A good wagon road connects the property with the Poplar Lodge road, which leads to Beardmore, 6 miles away.

The property is further equipped with an excellent set of camp buildings.

Karl Springer Exploration Company, Limited

The Karl Springer Exploration Company, Limited, holds a group of 18 unsurveyed claims (T.B. 13,765 to 13,782) lying between Knox lake and Corrigan lake, Irwin township. The group is underlain mainly by Keewatin greenstones, but the Corrigan-Paint Lakes band of conglomerate traverses the northern half of the group.

Considerable surface work has been done just east of a small lake lying midway between Patter lake and Foxear creek. A rusty shear zone has been exposed in a series of 9 north-south trenches over a distance of 600 feet. The zone strikes in an easterly direction and has a maximum width of 40 feet. The immediate country rock is a coarse, massive, dioritic greenstone. Quartz is not abundant, but in places the schist carries considerable pyrite and arsenopyrite. A grab sample of this material yielded 0.07 ounces gold per ton.

The main showings are located south of Knox lake. Starting from a point a few chains south of the narrows a mineralized zone, which trends in a southwesterly direction, has been explored in a series of 21 cross-trenches and rock cuts over a distance of more than a mile. The zone lies in the greenstone close to or at the contact with the conglomerate, in this respect resembling conditions on the Brookbank property a mile to the east. In places the showings consist of

rusty shear zones ranging from a fraction of an inch to 20 feet or more in width and carrying quartz stringers. In other places the mineralization is associated mainly with narrow quartz lenses as much as 30 inches in width and 150 feet in length. The average strike of the break is N. 80° E. The schist is commonly silicified and heavily pyritized but contains no gold. In places the quartz is mineralized with pyrite and galena, and calcite and ankerite are common constituents of the vein matter. On the whole the gold content is low and the values erratic.

Two excellent camp buildings have been built at the west end of Knox lake.

Wilport Gold Mines, Limited

Wilport Gold Mines, Limited, was incorporated in November, 1935, to develop a patented property of about 455 acres in Summers township adjoining the Leitch Gold Mines property on the east. Roughly it consists of the eastern half of claim H.F. 3, the southern halves of claims H.F. 4 and H.F. 5, and the southwest quarter of claim H.F. 6, all of which were originally vested in the estate of the late P. A. Leitch, of Port Arthur. The southern half of the property is underlain by Timiskaming greywacké and the northern half by Keewatin greenstone.

No. 1 vein is located about 5 chains south of the northeast corner of claim H.F. 3 and just a few feet west of the claim line. It is an irregular quartz vein ranging from 12 inches to 6 feet in width, striking N. 65° E., and dipping steeply south. It has been traced in a series of trenches and test pits for a length of 260 feet. The quartz is milky and strongly fractured, and like that on the Leitch property exhibits a late generation of very light coloured quartz. Generally speaking the mineralization is sparsely represented by a little pyrite; no gold values have been indicated. In September, 1935, this vein was diamond-drilled to a depth of 210 feet, the results being inconclusive. The country rock is greywacké.

Another vein, known as No. 2, is located about 12 chains west of No. 1 vein. It occurs in a schistose greywacké just south of a band of rusty-weathering iron formation. By cross-trenching it has been exposed for a length of about 300 feet; it strikes N. 65° E. and dips slightly north. In one trench it is 20 inches in width, and toward the west end of the workings it appears to break up into numerous veinlets, some of which intersect the iron formation in stockwork fashion over a width of 6 feet; the total width of the iron formation band at this point is 20 feet. The quartz in the vein is strongly fractured and carbonated and carries a little pyrite; low values in gold are reported.

A new discovery, known as No. 3 vein, was made late in October, 1935, just after this section had been visited. It is located near the northeast corner of claim H.F. 3 and has been traced 600 feet west of this point. It is reported[1] to consist of quartz and schist ranging from 3 to 10 feet in width and showing visible gold near the west end of the exposure.

Early in February, 1936, a programme of diamond-drilling commenced. In addition to drilling veins Nos. 2 and 3 it is planned to probe the low ground in the central part of claim H.F. 3 in the hope of picking up the eastward extension of No. 1 vein on the property of Leitch Gold Mines.

Other Properties

Development of an exploratory nature was carried out on many other

[1]Personal communication with Russell Cryderman, director of exploration for the company.

properties late in 1934 and during the summer of 1935. No important discoveries were made, but in some instances mildly encouraging results were obtained.

Boylen Group

The Boylen group consists of 6 claims surveyed in 1935 (T.B. 15,259 to 15,264) and located between Windigokan and Gooseneck lakes, Irwin township. Near the north boundary of claim T.B. 15,259 a prospect pit was sunk on a rusty shear zone in a rather acid lava. A narrow quartz-carbonate veinlet traversing the schist is reported to carry gold.

Devanney-Smith Group

The workings of the Devanney-Smith group are on the north shore of McCambley lake, near the east end, Irwin township. A series of 6 cross-trenches exposes a rusty shear zone, 40 to 50 feet in width and striking N. 55-70° E.; it is sparsely mineralized by pyrite. A trail leads north half a mile to other shear zones with a few rusty quartz stringers.

Dumond Mining and Exploration Company, Limited

The Dumond Mining and Exploration Company, Limited, holds several groups of claims in the area. Early in 1935, the Tyrol lake group of 15 claims was examined. At one point just east of Tyrol lake some diamond-drilling was done, but no important results ensued.

Empire Contact Gold Syndicate

The Empire Contact Gold Syndicate holds several claims in 2 groups lying just north and west of Beardmore in Summers township. A considerable amount of surface development was carried on in 1934. The main showing occurs on the west group. It consists of a strong shear zone along the north side of a steep hill of greenstone, which has been stripped continuously for 800 feet and indicated by trenching over a length of 2,700 feet. It strikes N. 70° E. and dips vertically or steeply south. The schisted zone is 4 to 5 feet wide and carries quartz veins ranging from mere stringers up to 30-inch veins, the average width being about 6 inches. The schist is not mineralized and carries no gold values. The quartz is a rather vitreous, sugary type, sparsely mineralized with pyrite, arsenopyrite, and galena, and is reported to carry low values in gold.

In 1935, the Mining Corporation of Canada, Limited, obtained a prospecting option on this property for a period of one year.

The property is reached by a trail that leaves the Poplar Lodge road half a mile northwest of the Blackwater river bridge. The camp is 1¼ miles west of the road.

Jackpine Sturgeon Gold Syndicate, Limited

The Jackpine Sturgeon Gold Syndicate, Limited, acquired a group of 8 unsurveyed claims (T.B. 16,010 to 16,017) in Pifher township from the Dikdik Extension Gold Syndicate early in 1935. The claims are located east of Crooked Green creek about a mile north of the Casey Contact property. Previous to being taken over by the present syndicate, considerable stripping and trenching has been done on claim T.B. 16,010 and near the north boundary of claim T.B. 16,011. The showings consist of several narrow quartz veins traversing massive greenstone. The quartz is rather glassy and carries little or no mineralization. No further work was done in 1935. An excellent camp building is located at the 8-chain portage on Crooked Green creek.

Kirkland-Hudson Bay Gold Mines, Limited

Kirkland–Hudson Bay Gold Mines, Limited, holds a group of 6 unsurveyed claims (T.B. 13,802 to 13,807) in Pifher township, on the west side of Crooked Green creek 2½ miles upstream from its point of entrance into the Sturgeon river. The showings are located on claims T.B. 13,803 and 13,805 just north of the camp at the rapids on Crooked Green creek. A north-south "break" in a feldspar porphyry dike has been trenched for several hundred feet. The "break" carries numerous stringers of bluish quartz. In a few places pyrite, coarse chalcopyrite, and galena are abundant, but no gold is reported. The property was further prospected in the summer of 1935 with no important results.

Lawrence-McKirdy Syndicate

The Lawrence-McKirdy Syndicate holds a group of 9 unsurveyed claims (T.B. 19,670 to 19,678) in Dorothea township, adjoining the Amorada property on the south. A considerable amount of trenching and test-pitting has been done at the main showing on claim T.B. 19,672 just south of the Amorada boundary. The most easterly test pit on the south slope of a high east-west ridge exposes a rusty shear zone in greenstone over a length of 25 feet and a width of 6 feet. The schist strikes N. 55° E. and dips 80° N. The zone is cut by an intricate network of ankerite stringers, and calcite segregations are common. Along the hanging-wall side of the "break" are irregular masses of quartz up to 6 inches in width. In the middle of the "break" is a lens of siliceous vein matter, 6 to 12 inches in width and 20 feet in length, which carries much arsenopyrite, as well as pyrite and galena. A grab sample of this material yielded 0.08 ounces of gold per ton.

Minefinders, Limited

Minefinders, Limited, holds a group of 9 unsurveyed claims (T.B. 13,733 to 13,741) just west of the third rapids upstream on Crooked Green creek. A trail leads north from the rapids to the workings, less than half a mile distant. A quartz vein, 3 feet wide, is exposed on the east side of a hill and in the bed of a stream; it strikes N. 10° W. and dips 45° W. The quartz contains a little pyrite and ankerite, and is reported to have yielded spectacular gold specimens.

Further work was done on a group of claims just east of the Sturgeon river about a mile south of Long rapids. Considerable mineralization was encountered, but the gold values were negligible.

Minerals Development, Limited

Minerals Development, Limited, holds a group of 7 unsurveyed claims (T.B. 14,800 to 14,806), formerly held by the Jaroba Syndicate, in Irwin township. The claims border the Sturgeon river on the south side, about 1 mile east of Twin falls. They are underlain by volcanic tuffs, which have been intruded by dikes and small bosses of quartz diorite and granodiorite. During the summer of 1935 further surface exploration was carried on, mainly on claims T.B. 14,801 and 14,802. The showings consist of rusty carbonate shear zones with irregular quartz veinlets. Although interesting mineralization was encountered, the gold values are said to have been low.

H. A. Montgomery Group

H. A. Montgomery holds a group of 12 unsurveyed claims (T.B. 16,863 to 16,874, 17,241, 17,242) north of the Sturgeon river less than a mile east of Lake Nipigon, Dorothea township. As a result of prospecting late in 1935 several quartz veins of varying importance had been located. One narrow vein near

the extreme northeast corner of the property carries appreciable quantities of pyrite and chalcopyrite; this material is reported to carry low values in gold

Nordic Sturgeon Gold Mines, Limited

Nordic Sturgeon Gold Mines, Limited, holds a group of 9 unsurveyed claims (T.B. 16,091 to 16,099) located about half a mile west of Tallon lake, Irwin township. The main showings are located near the middle of the east side of Nordic lake. Test pits and 6 cross-trenches expose a strong shear zone in greenstone, 6 feet wide and about 200 feet long. It strikes N. 15° W. and dips 70° S. In places the schist carries abundant pyrite and is intersected by quartz veins up to 18 inches in width. In one trench there is much massive pink calcite in vugs and unusual quantities of massive graphite developed along shear planes. A short quartz lens in the most easterly pit carries considerable pyrite, chalcopyrite, and carbonate. No gold was obtained in two representative specimens taken by the writer.

Ontario-Quebec Prospectors (Trust)

Ontario-Quebec Prospectors holds a group of 6 surveyed claims (T.B. 15,238 to 15,243) lying between Windigokan lake and Bearskin lake in Irwin township. A considerable amount of stripping and trenching has been done along a high east-west ridge, just north of Foxear creek on claim T.B. 15,240. The showings occur along the contact between highly schistose amygdaloidal lavas, conglomerate, and iron formation. The schists along this contact are rusty and impregnated with pyrite. Very little quartz occurs. No important mineralization is indicated.

Rayner-Tyson Syndicate

In the fall of 1935 the Rayner-Tyson Syndicate was engaged in prospecting a group of 12 unsurveyed claims (T.B. 17,017 to 17,025 and 16,007 to 16,009) located north of Watson lake, Irwin township. On claim T.B. 17,025 a prospect pit has been sunk on a band of what appears to be a brecciated cherty iron formation. The band at this point is 5½ feet wide and exposed over a length of 60 feet. Both the fragments and matrix are heavily impregnated with very fine pyrite. No gold is reported. Further work has been done farther west along the north line of claim T.B. 17,021 on what may be the same or a similar band of rusty breccia.

Reed-Coyne Partnership

The Reed-Coyne partnership holds a group of 20 unsurveyed claims centred about Little Crooked Green lake in the northeastern part of Pifher township. A trail leads north to the showings from the camp at the west end of the lake. Stripping and trenching have exposed a mineralized "break" in a narrow tongue of granite. No gold is reported.

Spooner Sturgeon River Syndicate

The Spooner Sturgeon River Syndicate, representing Port Arthur interests, holds a group of 10 unsurveyed claims (T.B. 13,211 to 13,217 and 13,230 to 13,232) centred about Spooner lake, which is on the boundary between Meader and Sandra townships three-quarters of a mile west of Pirum lake. The showing is located 1 mile northwest of the lake near the northwest corner of claim T.B. 13,214.

The showing consists of a broad shear zone in granite porphyry, the maximum width being 28 feet. The schist carries a system of quartz stringers, more or less parallel and much drag-folded over its entire width. The zone

strikes N. 10° E. and dips 60° E. It is exposed over a length of 200 feet. In places, the quartz is heavily mineralized with massive pyrite and chalcopyrite. A grab sample of the best-looking material yielded no gold. What appears to be the northward extension of the same "break" is exposed about 100 feet to the north. Here the shear zone is 12 feet wide and exposed over a length of 275 feet; no important mineralization was observed.

Taylor-Segsworth

A considerable amount of stripping and trenching has been done near the centre of the unsurveyed Taylor-Segsworth claim, T.B. 12,937, about 1 mile north of Twin falls, in Pifher township. The showings consist of rusty quartz veins and mineralized shear zones in a broad dike of granite porphyry, which trends in a general easterly direction. Gold is reported to have been found in some of the pits, but on the whole the mineralization is not impressive.

Tom Johnson Nipigon Mines, Limited

Late in 1934 the Tom Johnson Nipigon Mines, Limited, optioned a group of six unsurveyed claims (T.B. 17,316 to 17,319, 17,430, and 17,431) bordering Lake Nipigon about a mile north of the mouth of the Sturgeon river, in Dorothea township. Early in 1935 a considerable amount of work was done on a showing on claim T.B. 17,430 about 4 chains from the shore of the lake. A quartz vein ranging from 4 to 12 inches in width has been exposed in a trench over a length of 340 feet; it strikes N. 70° E. The vein appears to follow a shear zone in greyish amygdaloidal lava and at one point intersects a 30-foot granitic dike. The quartz carries pyrite and specular hematite, but no gold is reported.

Watson Lake Shore Syndicate

The Watson Lake Shore Syndicate holds a group of 10 unsurveyed claims (T.B. 17,412 to 17,417 and 16,055 to 16,058) bordering the south side of Watson lake. A considerable amount of stripping and trenching has been done just south of the south boundary of Irwin township.

In a pit just west of an old tote road near the north boundary of claim T.B. 17,417 an intricate stockwork of quartz veins and stringers intersects a 12-foot shear zone in greywacké. The schist is light-greenish in colour and carries abundant pyrite and arsenopyrite. The quartz carries some carbonate but very little sulphides. Gold is reported to occur in the rusty material. Farther west in four other test pits extending over a quarter of a mile other rusty shear zones with quartz veins have been exposed. In none of them, however, has any important mineralization been disclosed.

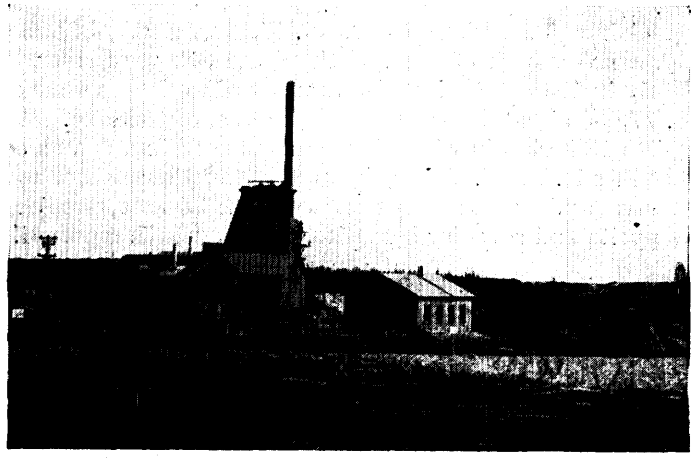
New Developments in the Little Long Lac Area

By E. L. Bruce

MacLeod-Cockshutt and Hard Rock Mines

Introduction

New developments at the MacLeod-Cockshutt and Hard Rock mines are related largely to the discovery of mineralized zones in the vicinity of the porphyry bodies that outcrop on the border claims of the two properties. Brief visits to this area were made in the fall of 1936. The extensive surface work and diamond-drilling accomplished since the original mapping have made it possible to fill in many details of the geology. Mining operations have since added still further information concerning the relations of the porphyry bodies to the sediments.



New shaft of the MacLeod-Cockshutt mine with the new shaft of the Hard Rock mine in the distance, September, 1936.

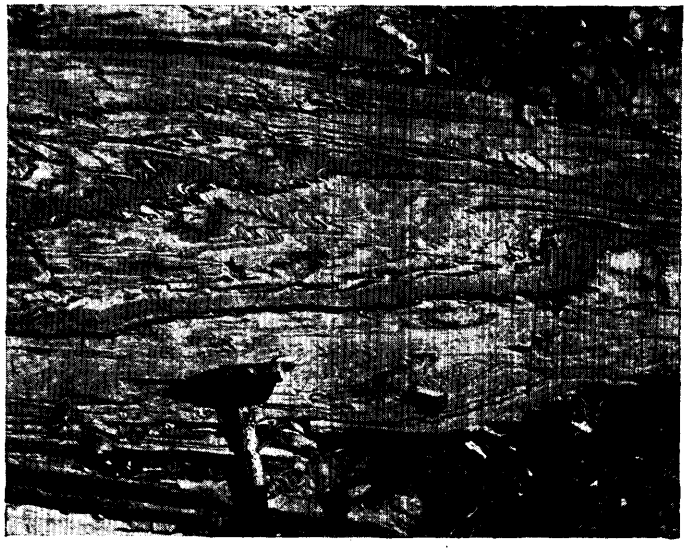
Thanks are due to those in charge of MacLeod-Cockshutt Gold Mines, Limited, and Hard Rock Gold Mines, Limited, for use of information from mine plans and records. W. Samuel, geologist of the MacLeod-Cockshutt mine, has supplied much personal information about new developments on that property, and E. J. Bolger gave much assistance both during visits to the Hard Rock mine and during the preparation of this report.

Developments on the MacLeod-Cockshutt claims during 1934 were mainly in the central part of claim T.B. 10,040, where a lens of ore of rather low grade was uncovered in trenches in low ground. A shaft was sunk, but underground work did not show a sufficient amount of ore to make mining profitable.

On the claims of Hard Rock Mines, early trenching of the area of porphyry on claim T.B. 9,991 by the Homestake Mining Company failed to show any zones of ore grade; and low values seemed to be erratically distributed. Hard Rock Gold Mines, on acquisition of the ground, began thorough diamond-drilling of the section beneath the marsh and the bay, claims T.B. 9,989 and 9,986 south and east of the point on claim T.B. 9,985, where gold was originally discovered by W. Smith in 1931. A shaft was begun in the early part of 1935. Four levels

at 200, 325, 450, and 575 feet have been opened up, and a considerable amount of development work has been accomplished on each. The vein system has been found to be much more continuous than the drilling results seemed to indicate, and some ore shoots have been found in the vein zones. The veins are rather contorted, following as they do in places the folds of the sediments. This characteristic no doubt explains the difficulty encountered in interpretations of the results in drilling.

The existence of this series of veins on the Hard Rock claims and of low values in the porphyry to the west of them, suggested the possibility that the ground west of the porphyry might be worth underground examination. Drilling was resumed on the MacLeod-Cockshutt claim directly west of the porphyry outcrop. The surface consolidated rocks are greywacké and iron formation,



Contorted iron formation showing thickening of beds and intricate folding, MacLeod-Cockshutt mine.

except for a small area where the porphyry extends westward from the main mass. Porphyry was intersected by the drills beneath the greywacké. Concentrations of sulphides with a considerable gold content were found along some of the tongues of porphyry. Guided by these discoveries the sections adjacent to the porphyry both on the MacLeod-Cockshutt and the Hard Rock claims were extensively drilled. In addition, the latter company has thoroughly re-examined the porphyry mass, stripping all the high ground and sampling the surface systematically. As a result some zones in the porphyry have been found in which narrow quartz veins contain gold in visible quantities, and it now seems that there is sufficient gold in some of them to form shoots of ore.

New shafts are being sunk on the MacLeod-Cockshutt claims immediately west of the porphyry hill and on the Hard Rock claim, T.B. 9,991, on the top of the porphyry outcrops.

General Geology

The rocks on the MacLeod-Cockshutt and Hard Rock claims in the vicinity of the ore deposits are sediments, dikes and bosses of feldspar porphyry, and a few

small diabase dikes. The sediments are mainly greywacké with some prominent bands of iron formation. They lie considerably south of the horizon in which the Little Long Lac veins occur and thus are stratigraphically higher.

The greywackés are dark-grey and rather fine grained; some of them show distinct bedding. Here and there a narrow band high in hematite is present, and by increase in the number and size of these the rock passes over into the finely stratified iron formation made up of alternate bands of quartz or greywacké and material high in magnetite or hematite. There are also in places in the sedimentary series considerable thicknesses of conglomerate. Apparently the conglomerate is even more lenticular than usual, as some drill-holes intersected thicknesses of a hundred feet or more of conglomerate, whereas cores from holes at no great distance along the strike of the beds show only greywacké.

All of the sediments are much contorted. The iron formations especially are intricately plicated. Thickening and thinning of beds is a characteristic feature; it can be seen on all scales (see photograph on page 119) and may in some cases explain why certain beds are not found along the strike. The plunge of the folds measured directly on minor synclines is to the west at about 30 degrees. As noted in the previous report,[1] the shapes of the contortions indicate a syncline to the north and thus, probably, a fold somewhat similar to that near the north side of the major sedimentary syncline.

A large irregular mass of feldspar porphyry intrudes the sediments. It outcropped originally as low rounded knolls rising above the swamp in the western part of claim T.B. 9,991. A large area of it has now been uncovered, leaving a hill of bare rock. The porphyry weathers white. The fresh rock is pale-grey, in places with a faint yellowish-green shade. It is fairly massive but contains irregular veinlets of quartz. Toward the margins it has a banding that seems to be undoubtedly due to remnants of greywacké retained as the porphyry made room for itself by *lit par lit* injection of the sediments. It was this apparent bedding that at first led to the inclusion of this rock as part of the sedimentary series. Its true character is evident in thin section, and chemical analyses show its undoubted similarity to the porphyry that occurs as dikes at the Bankfield mine.[2]

Structural Relations

Originally swamp and drift cover prevented outlining, even approximately, the extent of the mass of porphyry. The western part of the surface exposure extends on to claim T.B. 10,038 of the MacLeod-Cockshutt Gold Mines, but 500 feet west of the boundary the surface rocks are greywacké and iron formation and no porphyry outcrops farther west. The southern side of the main porphyry body was uncovered during early trenching.

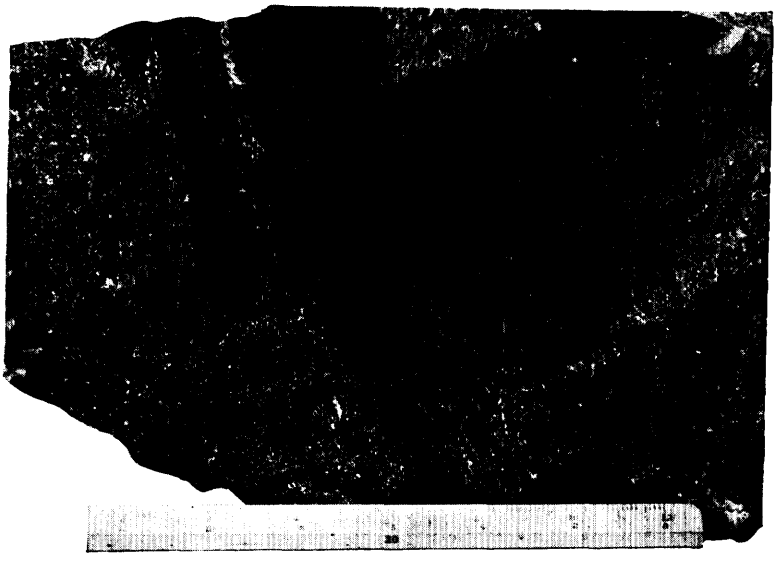
West of the main porphyry mass, drilling has shown the presence of tongues of porphyry, which do not outcrop. They are undoubtedly fin-like offshoots of the main body which pinch out both laterally and vertically. Thus to the west the serrated surface of the intrusive passes beneath the sediments at an angle that seems to be approximately that of the plunge of the folds in the sediments (Fig. 1). The shape of the eastern end of the porphyry has not yet been thoroughly determined.

So far, therefore, as the structure has been worked out, the porphyry occurs as a mass, the outcrop of which is elliptical in outline but very irregular, due to tongues that project both east and west from the main body along bedding planes

[1] E. L. Bruce, "Little Long Lac Gold Area," Ont. Dept. Mines, Vol. XLIV, pt. 3, 1935.
[2] Ibid, pp. 22, 23.

or shear planes in the sediments. In the area now being developed there seems to be two masses of porphyry, which at their thickest parts are very close together, if not actually coalescent. They diverge both east and west. To the west they contain between them a steep-sided trough of sediments plunging westward (Fig. 1). To the east the wedge of sediments is of undetermined shape. Other porphyry bodies are known to occur south of those that are being intensively examined.

As mentioned above, the tongues of porphyry appear to have followed the shearing and bedding of the sediments. Iron formation seems to have been more resistant to stoping action or assimilation by the porphyry than was the greywacké. Thus bands of it are found which show little disturbance by the



Block of ore from the dump of the new shaft of the MacLeod-Cockshutt mine, showing sulphides (left side) penetrating along the bedding of the greywacké.

intrusive, even though no other beds of the sedimentary series remain. Evidently the porphyry has made way for itself by removal of the invaded rock rather than by shoving aside of the beds. On the other hand the constancy of composition of the porphyry, even at its margins and in small tongues, is difficult to explain on the hypothesis that much material has been assimilated.

The Ore Bodies

The gold deposits first investigated, both at the MacLeod-Cockshutt and Hard Rock properties, are entirely in the sediments. Deposits recently discovered are along the contacts of porphyry and sediments and entirely in porphyry.

MacLEOD-COCKSHUTT GOLD MINES, LIMITED

The original discovery on the MacLeod-Cockshutt claims was made near a band of iron formation that crosses claim T.B. 10,040 in an east-west direction.[1]

[1]E. L. Bruce, op. cit., p. 44 (Fig. 7).

The ore consists of portions of the iron formation that have been fractured; the fractures have been filled, and probably part of the original rock has been replaced, by quartz and pyrite carrying some gold. Only rarely is gold present in visible quantities. Some small irregular veinlets containing gold in visible quantities were found in greywacké.

The new discoveries on the MacLeod-Cockshutt property are associated with the tongues of porphyry projecting westward and upward from the westward-plunging upper surface of the boss. None of these have been found on the surface. So far as they can be pictured from available information, the



Photomicrograph of a fragment from the block shown in the photograph on page 121, showing a bleb of gold occurring along a fracture in pyrite. (×360.)

ore bodies lie along the contact between porphyry tongues and greywacké or iron formation. Where a tongue is narrow, gold values occur not only at the contact between porphyry and greywacké, but in the igneous rock as well. Hence in places wide zones have been found to be of ore grade and, in some of these, portions, apparently along the actual contact between porphyry and sediments, have high gold contents.

The ore material consists of massive, rather coarse grained sulphides. The replacement of greywacké by sulphides is clearly shown by the penetration of tongues of sulphides along the bedding planes (see photograph on page 121). In the porphyry the sulphides appear to be less massive, and at short distances from

the greywacké the ore consists of porphyry containing disseminated sulphides. A considerable amount of quartz has been introduced into both the porphyry and the greywacké; tiny quartz veinlets can be observed, especially in the porphyry.

Polished specimens from ore intersected in the shaft show that pyrite is the chief sulphide. A few tiny grains of arsenopyrite were found completely enclosed in pyrite, and a bleb of gold was found in a tiny fracture in pyrite (see photomicrograph on page 122).

It seems likely that the ore zones follow downward along the pitch of the porphyry tongues. The distance to which they penetrate the porphyry, below



Specimen of ore from the zone north of the main porphyry mass, Hard Rock mine, showing pyrite replacing alternate layers of sediments and cut by transverse veins of white quartz.

the contact shell where porphyry and sediments interfinger, and to which they continue into the greywacké upward from the contact, is yet unknown.

There is probably no genetic relationship between the ores and the porphyry. The marginal zone between the boss and the sediments is favourable for ore deposition, either because of fracturing produced during the introduction of the porphyry or because the ore solutions followed the same zones of weakness that localized the intrusion.

HARD ROCK GOLD MINES, LIMITED

The vein in which the original discovery of gold on the property of Hard Rock Gold Mines was made is entirely in conglomerate and greywacké. Bands

of iron formation occur in the series, and the bedding of the sediments is much contorted. Commonly the veins follow the bedding planes for considerable distances, and thus they also are contorted. In places, however, they follow zones of shearing and cut across the beds.

The ore consists of quartz containing a small amount of pyrite. Gold is present as the metal and in places is visible in the hand specimen. So far as development work has been carried, ore shoots appear to be of medium grade. The contorted character of the veins makes exploration difficult, but on the other hand the veins, which are 18 inches to 2 feet in width where straight, bulge to considerably greater widths along the axes of some of the folds.

Recent explorations on the Hard Rock property have been influenced by the discoveries on the neighbouring claims to the west. Diamond-drilling has indicated a wedge of greywacké and iron formation between the main porphyry mass and another of unknown size concealed beneath the swampy area to the north or possibly not extending upward even to the rock surface. A zone in the wedge, showing values in gold, has now been opened up underground. The ore is of a banded character, consisting of pyrite, which has replaced alternate layers of the closely folded sediments (probably originally lean iron formation). Later than the pyrite are transverse veinlets of white quartz (see photograph on page 123). The relation of the gold to these minerals is not yet known.

The porphyry exposed on the hill contains a large number of small quartz veins, and much of it has pyrite disseminated through it. The first examination of the mass was apparently made in the hope of finding the whole body of porphyry workable as low-grade ore. It now seems, both from careful surface sampling and from drilling, that the gold content of some of the small veins is sufficiently high to make possible selective mining of certain portions of the intrusive. The small gold-bearing veins vary in width from a fraction of an inch to a few inches. Most of them contain no visible metallic mineral except pyrite, which in most cases is along the vein margins or entirely in the wall rocks. In some places, however, in white quartz so fine as to be almost cryptocrystalline, gold occurs in visible quantities, usually as aggregates of tiny particles.

The ore bodies of the Hard Rock mine are, therefore, varied in type. Some are entirely in sediments; others are concentrations of material high in sulphides in iron formation adjacent to porphyry tongues; and others are small auriferous quartz veins which occur in the porphyry.

Little Long Lac Mine

Introduction

Gold was discovered at the Little Long Lac mine in July, 1932. A geological examination of the area in which it lies and of the ore bodies as then developed was made during the summer of 1934. By the end of the field season the mine had been prepared for gold production, which began during the winter of 1935. Extension of underground workings, additional diamond-drilling, and detailed mapping of the geology have added so much new information to that available at the time the first report was published that it seems necessary to record some of the new data now available.

The writer is indebted to the management of the Little Long Lac mine for access to mine plans and records. W. Samuel, geologist for the company, supplied much of the information that is here included and has offered many valuable suggestions concerning the geology of the deposit.

General Geology

The rocks in the vicinity of the mine are basic lavas which have been assigned to the Keewatin, a series of sediments (Timiskaming?) of rather heterogeneous character, overlying the lavas uncomformably, a few small masses of diorite intrusive into the sediments, and a few small dikes of lamprophyric character. Dikes and masses of porphyry in which the phenocrysts are an acid albite in composition intrude the sediments at various places in the area. None is known to occur near the Little Long Lac ore bodies. At the MacLeod-Cockshutt mine a mile and three-quarters southeast of the Little Long Lac mine, a large irregular mass of porphyry outcrops. The western end of it plunges westward beneath the greywacké and iron formation. Recently diamond-drilling beneath the marshy bay that extends southwestward from Barton bay has revealed the existence of a mass of porphyry on claim T.B. 10,611 of Elmos Gold Mines, a mile and three-quarters S. 65° W. from Little Long Lac mine. It has now been traced for a length of 3,400 feet. The maximum width is 660 feet.

Natural outcrops are not numerous in the Little Long Lac area, but on the somewhat scanty evidence available at the time of the first examination the structure of the sediments was interpreted as a westward-pitching drag fold imposed on the north limb of a great syncline, the axis of which is an unknown distance to the south of the Little Long Lac mine. The ore body was considered to be a lode composed of quartz veins filling shear planes occurring near the crest of the anticlinal part of the drag fold. The shearing is well developed in a series of beds of massive arkose, to which the ore bodies seemed likely to be confined. In general these conclusions have been found to be correct. Minor changes, however, are necessary in the original conceptions.

All the rocks in the vicinity of the ore body are sediments except a few small lamprophyre dikes that have been encountered underground. A small mass of diorite outcrops 600 feet south of the ore zone. The surface contact between greenstone and sediments is 2,800 feet north of the outcrop of the vein.

The sedimentary series here consists of greywackés of various compositions and beds of iron formation. No conglomeratic beds outcrop in the series near the mine, but they occur to the south on the claims of Mosher Long Lac Gold Mines and northwest at the portage near the mouth of Magnet creek. Some conglomeratic beds have been found underground. In the first report only the iron formation was mapped as individual beds in the series. It offered easily recognized and easily traced horizons for determination of the structure. In the detailed mapping of the series, W. Samuel, geologist for the Little Long Lac mine has differentiated certain other sedimentary types as well and has delimited the massive arkosic bed to which the ore bodies are confined.

The sediments are variable in character along the strike. Hence any particular type is lenticular in cross-section. In large part, no doubt, the change in thickness of individual beds is a primary feature due to slightly different conditions of sedimentation along the strike. In part, however, some of the variability may be due to thickening and thinning of the beds during folding. Apparently the iron formation has suffered more in this way than other beds; magnetic determinations indicate that in places at the noses of the folds portions of beds have been actually squeezed away from the rest. The apparent tremendous thickening of the beds at the axes of folds, as shown in magnetic maps, is probably in part due to the wide zone of magnetic attraction resulting from the westward plunge of the folds. On the limbs of the folds the steeply dipping beds would affect the needle over a much narrower zone.

The lithological succession and thicknesses of various rock types penetrated in drilling are shown in the following table:—

No. 1 section, S. 20° W. through No. 2 post T.B. 10,564, approximately 5,000 feet east of the shaft. (Older beds at top of column)	Feet	No. 2 section S. 20° W. through No. 1 post T.B. 10,565, approximately 600 feet west of shaft. (Older beds at top of column)	Feet
Flows	0– 120		
Iron formation	120– 700	Iron formation	0– 220
Arkose	700–1,000		
Greywacké	1,000–4,000	Unknown	200– 400
Arkose—probably that in which the veins occur	1,400–2,050	Arkose—probably that in which the veins occur	400–1,000
Greywacké	2,050–2,300	Greywacké	1,000– ?
Interbedded greywacké and coarser fragmentals	2,300–2,900	?	
Iron formation	2,900–4,000	Iron formation	1,300–1,450

(Estimates of thicknesses and correlation by W. Samuel)

Thus in areas not involved in the drag fold, the arkosic band in which the ore bodies lie ranges from 600 to 650 feet in thickness. Other beds are apparently still less regular.

Most of the sediments contain the same minerals. The distinctions in the table above are made on the proportions of the various constituents in the rocks. The iron formation is made up either of reddish jaspery material alternating with black *laminae* which contain considerable magnetite and hematite, or of bands of grey or greenish-grey greywacké interlayered with the iron-rich beds. The hematite is of the specular variety, and where there has been shearing along the bedding planes the surfaces are crinkled, lustrous, and a bluish-black colour. The iron formation grades from bands in which beds high in iron minerals form half the thickness to material in which the sediment is mainly greywacké with a few narrow lenses containing hematite and magnetite. Thus the part of the series that may properly be called iron formation depends upon the definition given to the term; magnetic effects may result from greywacké with comparatively little magnetite. In dip-needle mapping an arbitrary value for the dip must be chosen. Where the attraction is greater than this, the underlying rocks are classified as iron formation. The thicknesses given for various members of the series must therefore not be considered as absolute; they depend upon the standards chosen.

The arkose bed at the Little Long Lac mine is fairly easily distinguished. On fresh fractures it is grey. The lustre is vitreous due to the abundance of tiny fragments of quartz. In thin sections the rock has a clastic appearance, with angular to subangular fragments of quartz and plagioclase set in a matrix of sericite and chlorite. The plagioclase is fresh; most of it is the variety albite ($Ab_{90}An_{10}$). Chlorite is the chief ferromagnesian constituent and is responsible for the grey colour of the rock. The analyses below are of two specimens: No. 1 from the wall of a quartz vein, 2½ inches in width; No. 2 from the wall of the drift 275 feet west of the shaft on the 2nd level, at a distance of two feet from any quartz veinlets.

TABLE NO. I

	No. 1	No. 2
	per cent.	per cent.
SiO_2	68.22	68.73
Al_2O_3	12.76	12.92
FeO	2.52	2.34
Fe_2O_3	1.57	1.80
TiO_2	.45	.41
P_2O_5	.18	.20
CaO	2.22	1.81
MgO	2.06	1.72
Na_2O	3.14	2.92
K_2O	1.58	1.76
H_2O	1.51	1.60
CO_2	3.23	2.50
FeS_2	.66	1.43
Total	100.10	100.14
Specific gravity	2.750	2.746

TABLE NO. II

	No. 1		No. 2	
	per cent.		per cent.	
Quartz	40.68		41.28	
Plagioclase Albite	26.24	29.02	25.56	28.90
Plagioclase Anorthite	2.78		3.34	
Sericite	13.51		14.40	
Apatite	.40		.46	
Rutile	.45		.41	
Magnetite	.46		1.85	
Carbonates $CaCO_3$	2.57	6.72	1.70	4.40
Carbonates $MgCO_3$	2.18		1.43	
Carbonates $FeCO_3$	1.97		1.27	
Chlorite	5.32		5.43	
Kaolin	1.29		1.03	
Limonite	1.50		.53	
Pyrite	.66		1.43	
Total	100.01		100.12	

Analyst, W. K. McNeill.

In both specimens the rock contains a considerable quantity of feldspar and so may be classed as arkose under the somewhat inexact definition given for that rock. Evidently the alteration produced by the vein-forming solutions is slight, and either analysis can be considered as indicating approximately the composition of the original rock. Undoubtedly, as in all detrital formations, there is likely to be some variation in constituents and composition within short distances either along the strike or transverse to it.

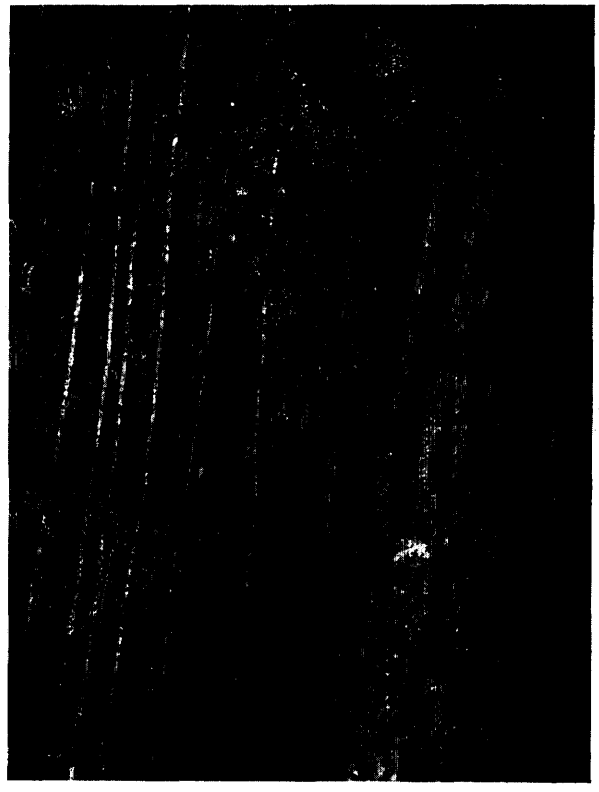
The dynamic metamorphism that the rock has undergone is shown by the lenticular shape of many of the larger fragments. Well-rounded forms are not common, and granulation can be recognized along the margins of many grains. Recrystallization is clearly shown by the fresh character and high albitic composition of the feldspars. No potash-feldspar is recognizable. Doubtless it was originally present but has been entirely altered to sericite.

The beds below the arkose are massive greywacké, which is darker in colour and finer grained than the arkose and contains less quartz and more chlorite.

At the upper surface of the arkose there is a thin but apparently rather continuous bed of coarser grain than the arkose beneath. It is not sufficiently

coarse to be classed as conglomerate, but some of the quartz fragments are as much as an eighth of an inch in diameter and they give the rock a speckled grey and white appearance. Above this coarse layer, which is only 8 inches to 4 feet thick, there is a bed of massive to slaty greywacké similar in character to the one that lies below the arkose.

The evidence of the drag fold in the vicinity of the Little Long Lac mine is now well established by the tracing of the bands of iron formation and by diamond-drilling. Any particular bed followed from the east is found to be



Back of the 2nd level, Little Long Lac mine, 30 feet west of the shaft, showing parallelism of the quartz veinlets. The area shown in the photograph is 4½ by 6 feet.

bent back on itself and carried northward about three thousand feet before resuming its regular east-west strike. On the claims of the Mosher Long Lac Gold Mines south of the Little Long Lac mine, the plunge of minor folds was found to be 30° W. On the large island west of the mine the plunge is 45 to 55 degrees. Measurements of the intersection of the fragmental bed intersected by the drifts west of the shaft, with the shear planes along which the veins occur, show a plunge to the west of approximately 50 degrees. The axial plane of the anticlinal part of the drag fold appears to be curved. To the east of the mine it strikes about east-west. Farther west it strikes N. 80° E. In the greywacké there is a nearly east-west schistosity, and in the arkose there are well-defined shear zones, approximately parallel to the axial plane of the folds. In addition

the arkoses have conspicuous joint planes, the major ones nearly horizontal, and an intersecting set of vertical planes at approximately 45 degrees to the east-west shearing.

The Ore Bodies

The ore bodies of Little Long Lac mine are lodes made up of relatively narrow, closely spaced quartz veins lying in the shear planes in the arkose. The main lode lies about 80 feet south of the axial plane of the anticlinal part of the drag fold. Its strike is nearly east-west, but in parts it varies from that strike. It dips steeply to the south. Even very narrow veins in this lode are continuous for remarkably long distances. "Veinlets of quartz only an eighth of an inch in thickness can be traced for 12 to 15 feet along the shear

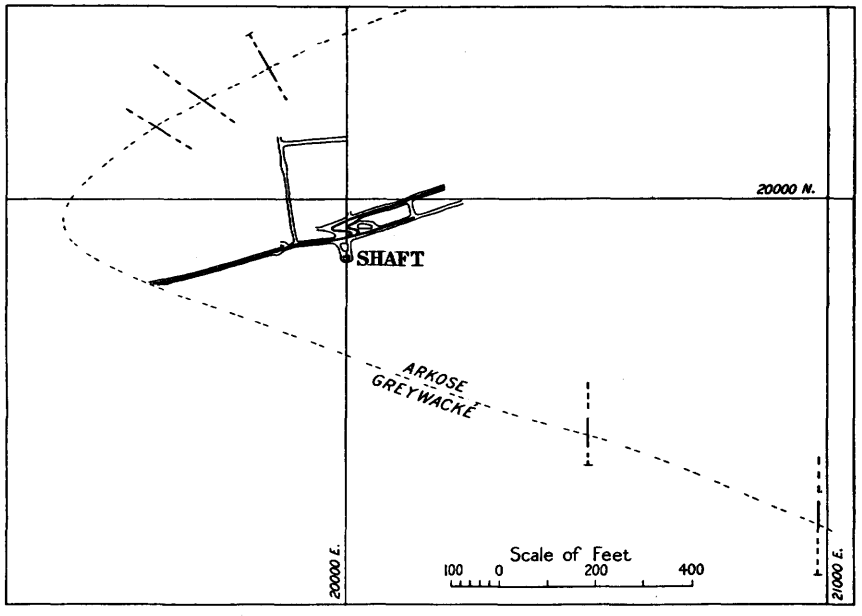


FIG. 6—Plan of the 2nd level, Little Long Lac mine.

planes without any interruption whatever and with little variation in thickness."[1] (See photograph on page 128.) The gold is chiefly in the quartz and is so remarkably uniform in distribution that 20 per cent. of quartz in a stope is ordinarily sufficient to make ore of the present mill grade.

The ore bodies, so far as development has yet gone, are confined to the arkosic beds. Both at the west end, where the shear zones pass into the upper massive greywacké, and at the east end, where they enter the lower greywacké, the definite shear planes, separated by intervening unfractured rock, disappear and become a rather uniform schistosity. In places in this schistose material there are short lenses of quartz, but no persistent veins have been found.

The main vein zone of the Little Long Lac mine has now been opened up for various distances on seven levels, the lowest at a depth of 950 feet. In addition to the main zone, other parallel zones have been found. On the 2nd level (204 feet), a vein roughly parallel to the main vein is intersected by a crosscut

[1]E. L. Bruce, op. cit., pp. 35, 36.

50 feet north of the shaft (Fig. 6). It has been drifted on for 250 feet to the east. The material is of ore grade, although somewhat lower in gold content than the main vein. Another shear zone 225 feet north of the main vein and parallel to it contains some gold, but no material of ore grade has yet been found along it. On the 4th level (450 feet), other vein zones parallel to the main one have been found at distances from it of 45 feet north, 20 feet north, 40 feet south, and 500 feet south (Fig. 7). Ore shoots occur in parts of all of these. On other levels development work has been largely confined to the main zone. Sufficient lateral exploration has been done, however, to show some ore in zones that have the position of the first north zone with relation to the main vein.

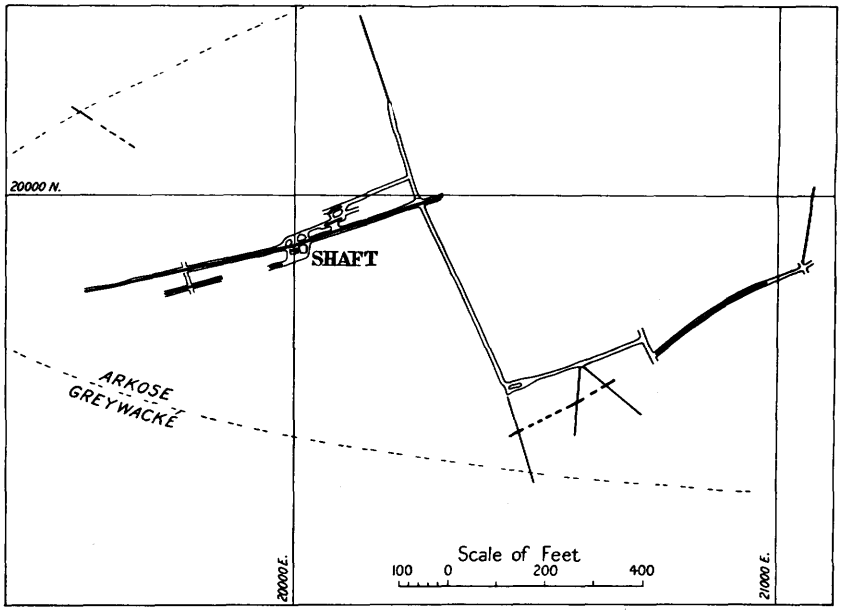


FIG. 7—Plan of the 4th level, Little Long Lac mine.

The results of early diamond-drilling and underground development seemed to indicate a single ore zone with a dip of 70 degrees from the surface to the 200-foot level and a steeper dip, 80° S., below the level. The vein zone cut near the shaft on the 2nd level was assumed to be the downward continuation of the zone on the surface. It now seems that the vein on the surface is actually the north vein zone and that the outcrop of the main vein zone, which has been followed below the 2nd level, has not yet been located.

The quartz-filled shear planes are remarkably regular in most places, but on the 700-foot level the shaft station cut through an anticlinal vein 3 to 4 inches wide, which diverges from the regular zone of veins, arches over to the north, and curves downward to a direction parallel to the main zone (see photograph on page 131). Thus at this place the normal ore width of 6 or 7 feet is increased to 18 feet.

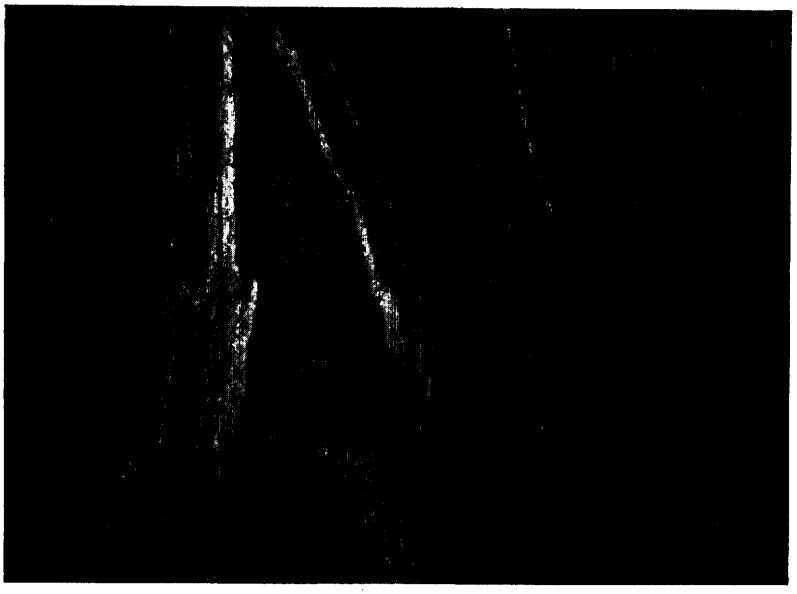
In the writer's 1935 report,[1] the following statement was made about it:—

In the wall of the station there is a vein with a striking anticlinal form. This probably follows the bedding of the greywacké along a minor fold, whereas the regular vein zone as usual follows the shearing. As a result of this subsidiary structure, the lode width at this point is in-

[1]E. L. Bruce, op. cit., p. 37.

creased to 18 feet. If it be assumed that the folded structure which this vein follows plunges westward at 30 degrees as other drag folds do, then the same type of occurrence may be expected on the upper levels to the east of the shaft and on the lower to the west of it.

The anticline outlined by the vein does not plunge with the plunge of the folds in the sediments, but in the opposite direction. A similar structure was found in drifting on the 2nd level and has there been more completely worked out than has been possible in the case of the one in the shaft pillar on the 700-foot level. At the shaft on the 2nd level the ore zone consists of a number of parallel quartz veins spaced at intervals of 1 inch to 1 foot. Thirty feet east of



Vein with anticlinal form showing in the west wall of the station, 700-foot level, Little Long Lac mine. The offset on the north limb of the structure is not a post-vein fault. The triangular piece of quartz below it contained spectacular occurrences of gold. The main shear zone is in the shaft immediately to the left of the picture. The area shown is 11 feet 4 inches by 8 feet 6 inches.

the shaft two 6-inch veins and a number of smaller veins branch off from the main shear zone, curve northward, then westward and in a reverse curve back to the east, continuing eastward as the vein zone mentioned previously parallel to the main vein zone and 50 feet to the north of it (Fig. 8). This fold has been followed upward from the 2nd level and has been found to plunge to the east at an angle of about 50 degrees. The axial plane of the anticlinal part strikes nearly east-west and appears to dip northward at about 70 degrees. The width of the zone of veins is greater near the crest and trough of the fold. A stope opened above the 2nd level and extending 60 feet below it has a width of 40 feet and a length of 60 feet.

A curved vein diverges from the main vein zone on the 5th level (Fig. 10, B). A similar one in the station at 700 feet (Fig. 10, C) has been mentioned above. Neither of these are complete drag folds. The anticlinal part can be recognized readily, but where the veins should curve back in a syncline to join the northern zone, the veins are narrow and the material not of ore grade.

It seems possible that the partially formed drag-folded vein on the 5th level may be the downward extension of the fully formed one on the 2nd level, and that the quartz veins, which become narrower between the 2nd and 3rd levels, may not be present still farther down. No linking quartz veins are present on the 3rd or 4th levels, but some are found in part of the folded structure on the 5th level. The apparent displacement between the curved vein on the 2nd level and that on the 5th level (Fig. 10) may be due to slight variations in the dip of the axial planes of the folds or in the vein zone.

The existence of eastward-plunging curved veins, linking the north zone and main zone, requires some modification of the early conceptions of the way in which the structural features of the ore bodies were produced. The form of

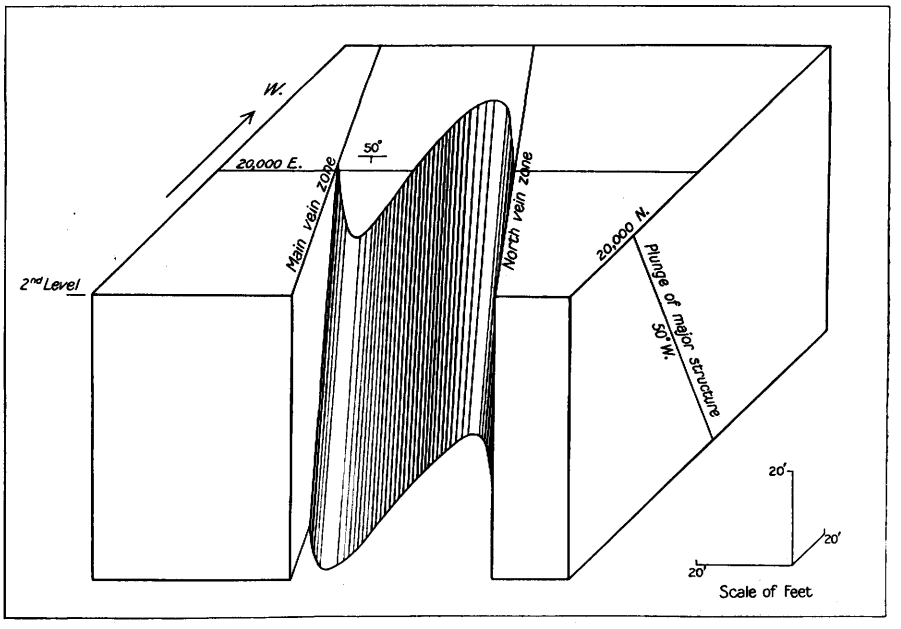


FIG. 8—Block diagram of a vein with drag-folded form linking the south or main vein zone with a north vein zone, 2nd level, Little Long Lac mine.

the westward-plunging drag folds of the beds is normal for the north limb of the major syncline of sediments. The shape of the drag folds shows that the southern beds moved upward relatively to those to the north, as they would be expected to do, or, assuming the plunge to then exist, the direction of relative movement of the south beds was upward at an angle of 50° W. from the vertical. The linking veins apparently formed along some obscure drag-folded structure. Their shapes indicate a movement of the south side upward and to the east. Where the fragmental bed intersected by some of the workings east of the shaft is crossed by the vein zone, there is no offset of the bed in an east-west direction. Movements along the shear zone must, therefore, have been in a direction parallel to the plunge of the beds; that is, the direction of movement of the beds south of the shear zone relative to those to the north of it must have been upward and to the east at 50 degrees from the vertical. Such a movement would produce drag folds of the form shown by the linking veins, plunging eastward at an angle of 40 degrees (see photograph on page 131). The observed angle of plunge of the

fold on the 2nd level is eastward at 50 degrees. Thus the theoretical angle of plunge differs by 10 degrees from the observed plunge. In beds so highly disturbed and heterogeneous as those here involved, some variation of direction of stresses may be expected from place to place. Hence it seems likely that both during the folding of the sediments and during the formation of the shear zones in which the veins lie, the beds to the south moved upward relatively to those to the north, but that, in the latter movement, the direction of movement was at approximately 90 degrees from that which occurred as the sedimentary syncline was formed.

No post-mineral faults yet encountered have displaced the veins much in a north-south direction. The flat fault that caused considerable trouble with

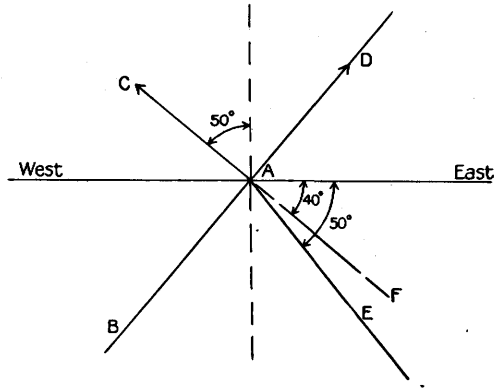


FIG. 9—Diagram showing assumed movements of beds on the south side during the formation of main drag fold and of linking veins. The plane of the diagram is parallel to the axial plane of the fold.

AB—Plunge of fold in sediments.

AC—Direction of movement of beds on south side during drag-folding of sediments.

AD—Direction of movement of south side of shear so that bedding crossed by shear should not be displaced.

AF—Plunge of drag fold that should be produced by movement of south side in direction AD.

AE—Observed plunge of linking veins with drag-folded forms.

water on the 2nd level[1] caused only a slightly noticeable offset in the vein zone. A fault showing in the workings on the 5th and 6th levels dips to the west at an angle of 20 degrees (Fig. 10). The vein to the west and above it is 10 feet to the north of the part to the east and below it. It seems likely that there was a considerable movement parallel to the vein, as ore in the section above the east part of the 5th level does not continue downward beneath the fault plane. A movement of the part above the fault upward and to the east for a distance of 250 feet along the fault plane would correspond to the distance between the partially drag-folded linking vein found on the 700-foot level and that on the 5th level. Evidence favouring such an interpretation is furnished by the fact that no continuation upward of the fold on the 700-foot level has been found west of the shaft.

[1]E. L. Bruce, op. cit., p. 38.
A. A. Barton, "Cementation," Can. Min. Jour., Dec., 1934, p. 529, 530.

In addition to the metallic minerals mentioned in the previous report, berthierite (FeS Sb_2 S_3), tetrahedrite, chalcopyrite, and pyrrhotite have been recognized in the ore.[1] The total amount of metallic minerals present is not large. Calculating the arsenic present in analyses of the mill heads as arsenopyrite gives a content of 0.65 per cent. of that mineral. Even this small amount, however, resulted in considerable loss of gold, since some gold is closely associated with the arsenopyrite. Hence a roasting plant has been installed to treat the concentrates.

The analyses given previously were made in the hope that they might show wall-rock alterations that were not recognizable by microscopic examination

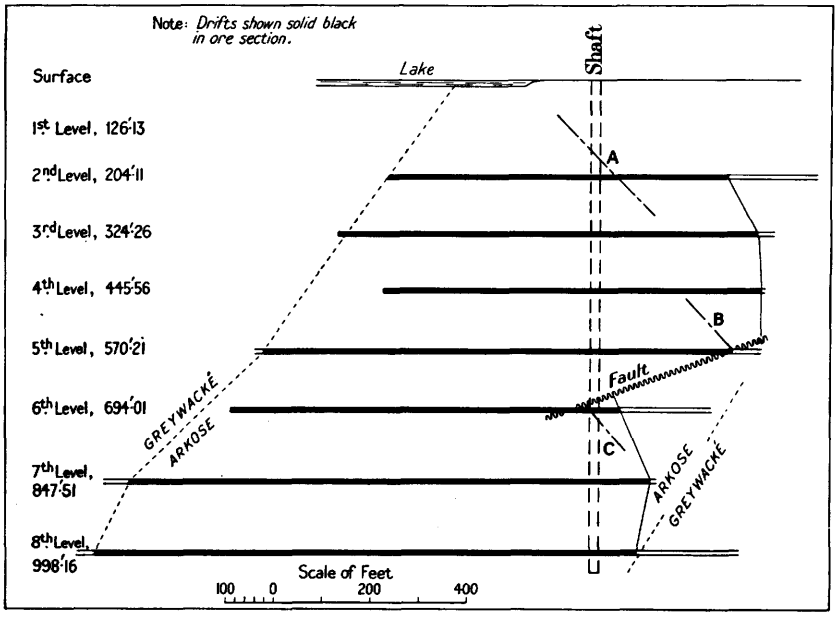


FIG. 10—Longitudinal section, Little Long Lac mine, showing the limits of the ore shoots on the various levels, faults, and positions of the axes of the anticlinal parts of veins of drag-folded form (A, B, C). (Prepared by W. Samuel.)

alone. Both specimens were taken at no great distance from the vein, since in sedimentary rocks it seemed likely that original differences in composition of specimens taken some distance apart might be much greater than the alterations produced by the vein-forming solutions and hence any conclusions based on them might be entirely misleading. There has apparently been but little change that can be attributed to the solutions, since the specimen that was taken at the greater distance from the vein contains more pyrite than that actually in contact with a gold-bearing vein of greater than ordinary width. If the differences shown in the analyses actually do represent any change in a rock of the original composition of No. 1 to one of the composition of No. 2, the decrease in kaolin possibly is the result of sericitization and albitization of the original rock. Such a change would be expected.

[1]Ellis Thomson, "Mineralization of the Little Long Lac and Sturgeon River Areas," Univ. of Toronto Studies, Geol. Series No. 38, 1935, pp. 37-42.

Summary

The Little Long Lac ore bodies are lodes occurring in beds of arkose near the crest of the anticlinal part of a drag fold on the north limb of a major syncline in sediments. The axis of the fold plunges to the west at an angle of about 50 degrees. Subsequent to the folding, east-west shear zones were developed in the arkose. The direction of movement was such that the sediments were not displaced. Hence the movement must have been in a direction parallel to the plunge of the sediments. The linking veins between the strong east-west vein zones have the form of eastward-plunging drag folds. Their shapes indicate a movement of the southern beds, upward relatively to those to the north.

The rate of production at the Little Long Lac mine has been steadily increased since milling began. The discovery that ore occurs not in a single lode put in several parallel lodes with linking veins between some of them has materially increased the possible ore reserves of the mine.

Bankfield and Tombill Mines

Introduction

Gold was discovered on a small reef in Magnet lake in 1931, and the claims of the Bankfield Gold Mines, Limited, were immediately staked. Prospecting of the claims south of Magnet lake resulted in the discovery of two other shear zones containing some gold, and a shaft was begun late in 1934. Underground work has gone on continuously since that time.

The Tombill claims are in Lindsley township, and the Bankfield are situated partly in Lindsley and partly in Errington township.

On the western part of claim T.B. 10,213 of the Bankfield property, consolidated rocks are covered to a depth of approximately one hundred feet beneath the ridge of glacial material that lies west of Magnet lake. The extension of the ore zone on the Tombill claims was located by drilling through this deep overburden. A shaft was sunk on claim T.B. 10,645 during 1936 and, in addition, some underground work was carried on from the 2nd level of the adjoining Bankfield property.

The writer is much indebted to the managements of Bankfield Gold Mines, Limited, and Tombill Gold Mines, Limited, for permission to use information from mine records. Thanks are due to Mr. John Mackenzie, manager of the Bankfield, for many suggestions resulting from his close study of the ore zone from the beginning of its development.

General Geology

The rocks in this area consist of sediments of the Timiskaming series intruded by diorite, feldspar porphyry, and diabase.

A band of iron formation crosses Magnet lake in a direction slightly north of west. It does not outcrop, but its course has been mapped by strong magnetic attractions and it has been cut by drill holes. On both sides of the iron formation are greywackés, some of which are rather high in quartz. Two conglomeratic horizons occur in the sediments. The northern one is exposed for a short distance along the face of the hill 400 feet due east of the Bankfield shaft. It seems to be only a short lens, as no other outcrops of conglomerate have been found along the strike in either direction. South of the Bankfield mine a much more continuous conglomeratic bed has been traced westward through the townsite from the creek entering Magnet lake from the south. It is exposed on the highway south of the Bankfield shaft, where a road cut has opened it up. To the west it dis-

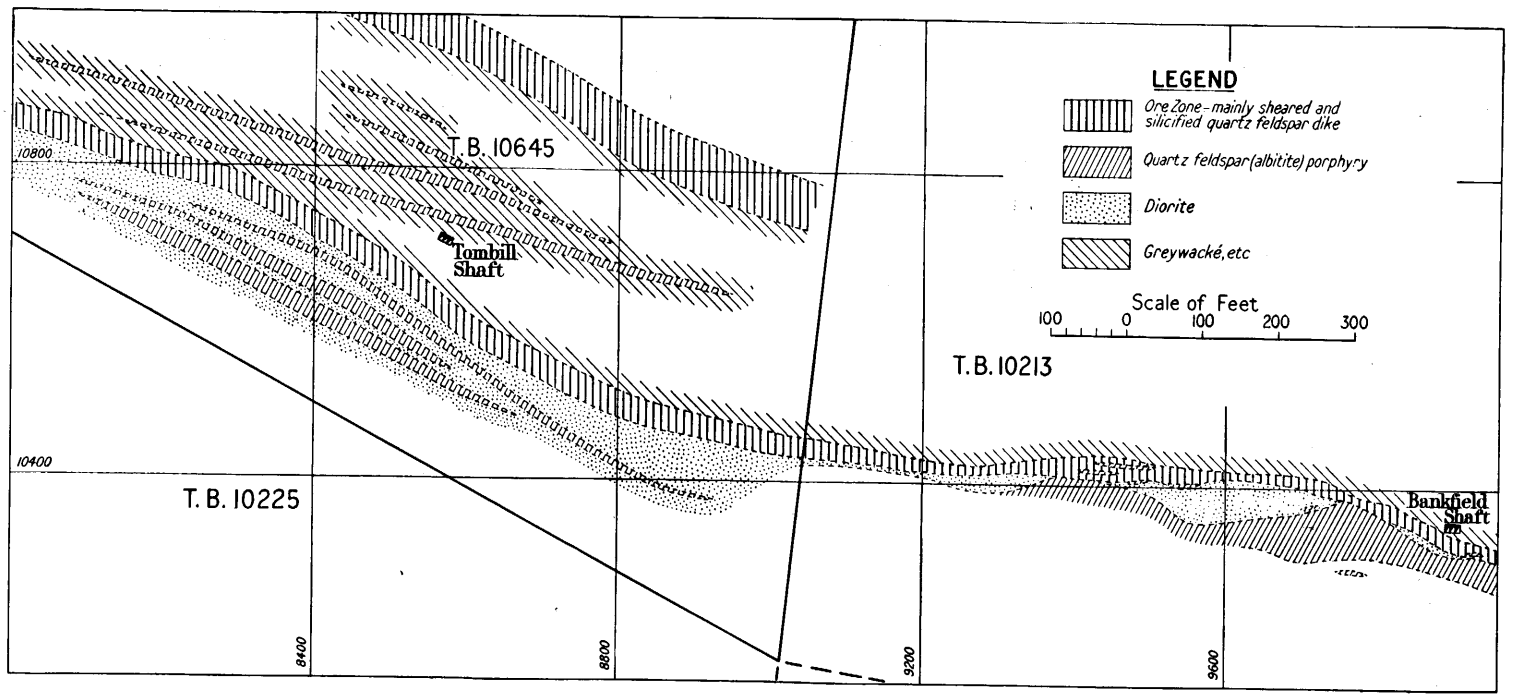


FIG. 11—Sketch map of the Bankfield and Tombill properties showing the surface geology from drill-hole projections.

appears beneath the glacial ridge that lies west of Magnet lake. This bed is approximately on the strike of the conglomerate band that crosses the south end of Mosher lake; an exposure of it is shown on map No. 44d[1] a short distance east of Longacre lake.

Most of the greywackés are fine grained. They weather to shades of grey and in places are well bedded. Freshly broken they are dark-grey with abundant quartz visible. In thin section most of them show angular to subangular quartz grains, fresh plagioclase feldspar (albite), and considerable quantities of sericite, chlorite, and carbonate. There are two types of rock in the series that differ from the normal greywacké. One is darker in colour and apparently near argillite in composition. It probably originally contained a greater proportion of chlorite than the lighter-coloured varieties. The other is a white-weathering, light-grey rock, composed almost entirely of quartz occurring as fine-grained mosaics. Much of the quartz seems to have been introduced. It is likely that some of these zones are silicified greywacké; others may be wholly or in part sheared and silicified porphyry.

Diorite is the oldest of the intrusive rocks. It occurs either as dikes and masses of irregular shape, which are intrusive into the greywackés, or as remnants included within masses of the later feldspar porphyry. The diorite is a dark-green rock, which weathers to a dull-green surface. The texture varies from very fine to medium granitoid. In thin section diorites from the Bankfield property appear very severely altered. The finer-grained ones still have in them some recognizable plagioclase, but so much kaolin, sericite, and other secondary products are present that the variety cannot be determined. Fibrous amphibole and chlorite, probably secondary after hornblende, are the other chief constituents. Some epidote and calcite are present. The coarser varieties contain a larger proportion of basic minerals than are present in the finer ones. Hornblende occurs as remnant grains surrounded by fibrous amphibole. Most of the feldspars are altered to sericite. Epidote, chlorite, calcite, and magnetite are the other chief constituents. Other specimens are made up of aggregates of secondary minerals only: zoisite, epidote, chlorite, quartz, albite, and carbonates. In some places the diorite is schistose. In thin section this rock is found to consist of plagioclase, chlorite, sericite, and carbonate. Forty to fifty per cent. of it is much sericitized andesine. Chlorite, which forms approximately a quarter of it, is in flakes and roughly parallel stringers. Carbonate fills in between the chlorite foils, and irregular areas of it have replaced the plagioclase.

The feldspar porphyries at the Bankfield mine are in dikes or elongated lenticular masses with east-west strikes. The rock weathers light-grey. In thin section it appears porphyritic with phenocrysts of albite feldspar ($Ab_{95}An_5$) ranging in length from 2 mm. to 0.2 mm. Phenocrysts make up approximately one-third of the whole. Most of them are well formed, but many have been fractured or show bent twinning *lamellae*. Some of the phenocrysts are rounded or have ragged edges where they are partially replaced by quartz or carbonates. Sericite is abundant within the feldspar crystals, and commonly the flakes are oriented along cleavage planes of the host mineral. The groundmass is completely crystalline. The minerals recognizable in it are feldspar, quartz, some of which no doubt is primary, ilmenite, apatite, carbonates, and chlorite. The relative amounts of carbonates and quartz vary widely, depending no doubt on the amount of alteration. Pyrite is present in most specimens near the vein. It, also, varies widely in amount. Specimens of the porphyry have been analysed,

[1]"Little Long Lac Gold Area," Ont. Dept. Mines, Vol. XLIV, pt. 3, 1935.

and the analyses recast into the amounts of the various minerals present.[1] Albite makes up over 55 per cent. of the whole, and the rock may properly be called an albitic porphyry.

The Ore Bodies

The original discovery of gold on the Bankfield property was made in a shear zone in greywacké on a reef in Magnet lake. The main ore occurrences are along the zone of porphyry dikes that intrude the greywacké and diorite on claim T.B. 10,213, extend westward into claim T.B. 10,645, of Tombill Gold Mines, and are believed to pass into claim T.B. 10,225. Both the porphyry and the greywacké along the margin of the dikes have been sheared and fractured. The fractures are filled with tiny quartz veins. Metallic minerals, pyrite, arseno-

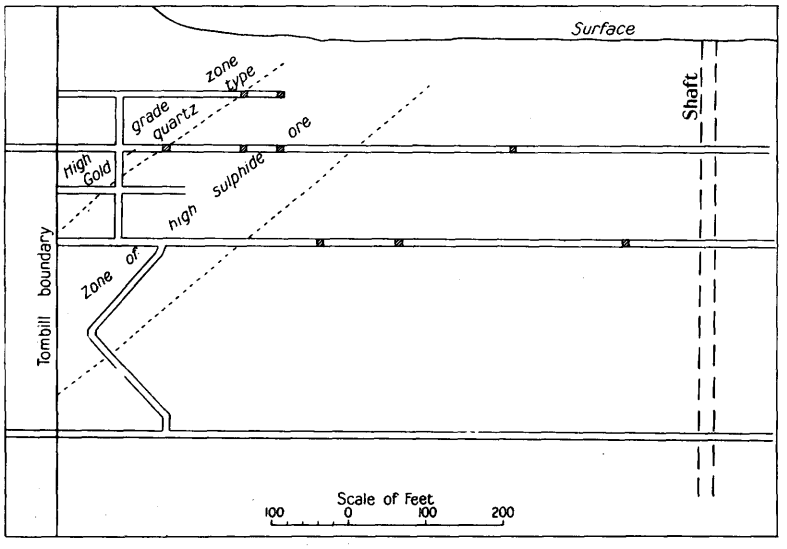


FIG. 12—Longitudinal section of the Bankfield workings west of the shaft.

pyrite, pyrrhotite, chalcopyrite, ilmenite, and some gold, occur disseminated in the sheared rock and in the quartz veinlets.

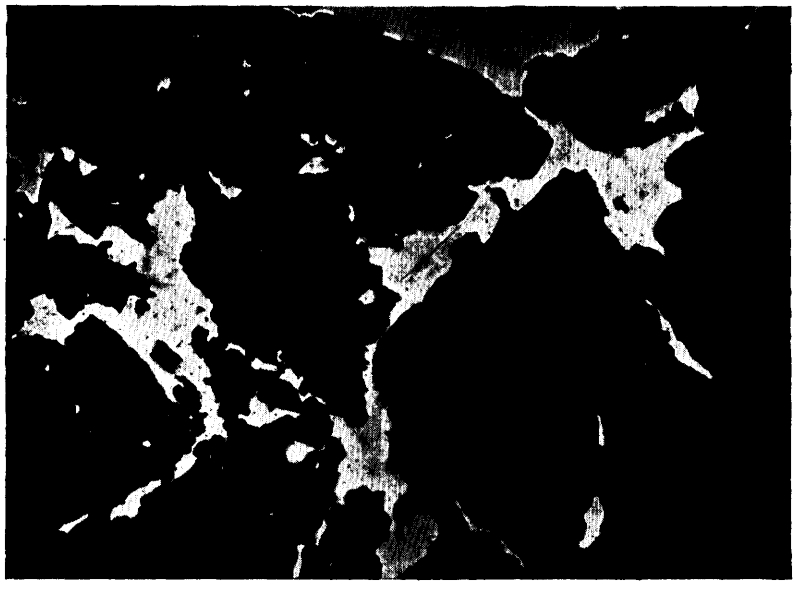
In places the shear zone is wide, but early underground exploration of the main mineralized zone on the Bankfield showed low average gold values. Drilling on claim T.B. 10,645, adjoining the Bankfield claims, indicated a shoot of ore in the westward continuation of the shear zone similar in physical character to the ore found on the Bankfield claims, but of considerably higher grade. Drifting westward on the 1st level (150 feet) of the Bankfield mine disclosed quartz veins containing considerable visible gold 150 feet east of the western boundary of the property, the shoot continuing to the boundary. No similar material was found on the 2nd level, but the vein material contained much arsenopyrite and pyrite in the western 240 feet of the drift. From a point 700 feet west of the shaft on the 4th level (525 feet) an incline was put up at 45 degrees to the west. Ore high in arsenopyrite and pyrite was encountered 100 feet vertically above the level. Evidently, therefore, the ore shoots at this place rake westward (Fig. 12). The zone crosses the Tombill claims, and the strike

[1]E. L. Bruce, op. cit., pp. 21, 22.

indicates that it should pass on to claim T.B. 10,225 of the Bankfield property farther west. On the 525-foot level of the Bankfield a drift has been carried around the acute southeast corner of claim T.B. 10,645 and thence westward. Seven hundred and seven feet west of the corner, diamond-drill holes put down at an angle from the drift are reported to have intersected the ore zone.

As indicated above, the ore in this westward-pitching shoot is of two types: The lower part of it in the Bankfield workings contains a high proportion of sulphides; the upper and western part consists chiefly of quartz veinlets with gold in visible quantities.

Several specimens of ore of the sulphide-rich types were examined microscopically. Most of them show only pyrite. It occurs in part as isolated



Photomicrograph of a polished section of Bankfield ore showing gold (white) in fractures in quartz. (×130.)

grains, but in places the grains are crowded together and coalesce into massive pyrite. In other specimens arsenopyrite is more abundant than pyrite. It is much fractured and appears to have been partly replaced by pyrite. No gold was recognized under the microscope, but assays show that the ore is of good grade.

In a polished section of one of the quartz veinlets in which gold is visible to the naked eye, the gold appears as irregular and discontinuous veinlets (see photomicrograph above). The wall rock of the vein from which the specimen came is nearly black greywacké, the polished section of which shows small grains of arsenopyrite, most of which are several times as long as thick. In one specimen gold borders the end of a grain of arsenopyrite. In another part of the same specimen two tiny grains of arsenopyrite are linked by a thread of gold.

It seems evident that there were at least two periods of mineral deposition. During the first, arsenopyrite, pyrite, a little chalcopyrite, and a small amount of gold were deposited in sheared parts of the main east-west porphyry dikes or in the greywacké along their margins. A later shearing affecting this mineralized zone was probably less intense and opened up new spaces, chiefly along

contacts between rocks of somewhat different physical character. Thus in places the new fractures are along contacts between porphyry and greywacké. In other places bedding planes between light-coloured and dark-coloured greywacké formed zones of weakness. Less commonly a contact of porphyry with diorite localized the new shearing. Subsequently these later fractures were filled by gold-bearing quartz veinlets or by gold associated with pyrite. More gold seems to have been introduced during this period of mineralization than during the earlier one, and the result is a shoot of ore of rather high grade

No examination of ore from the Tombill mine was made, but some specimens seen are very similar to the high-grade material from the Bankfield zone, of which it is the westward extension.

A mill to treat 100 tons of ore per day is now under construction at the Bankfield mine.

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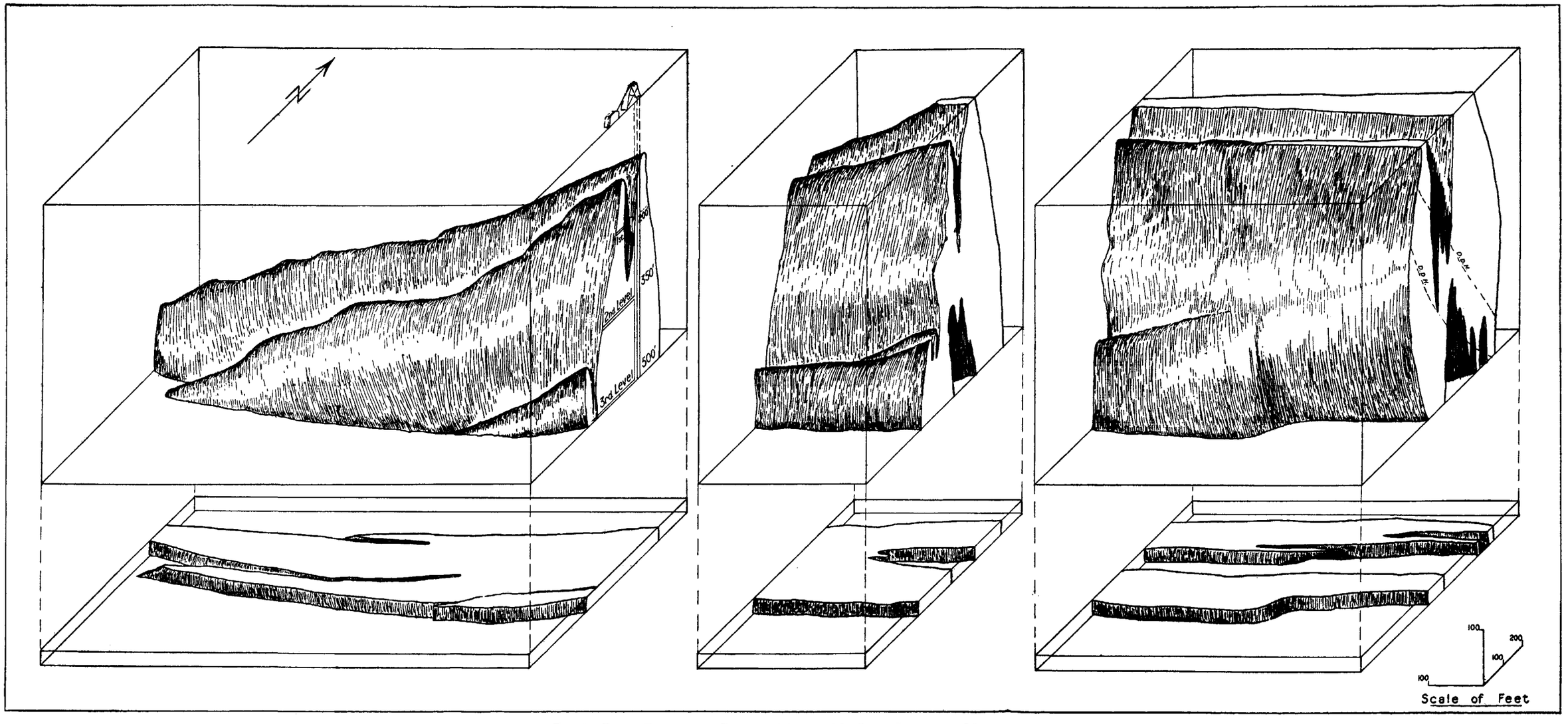


FIG. 1—BLOCK DIAGRAM OF POPHYRY MASSES, MACLEOD-COCKSHUTT MINE.
(Original drawn by N. H. Fraser from drill records and mine plans.)

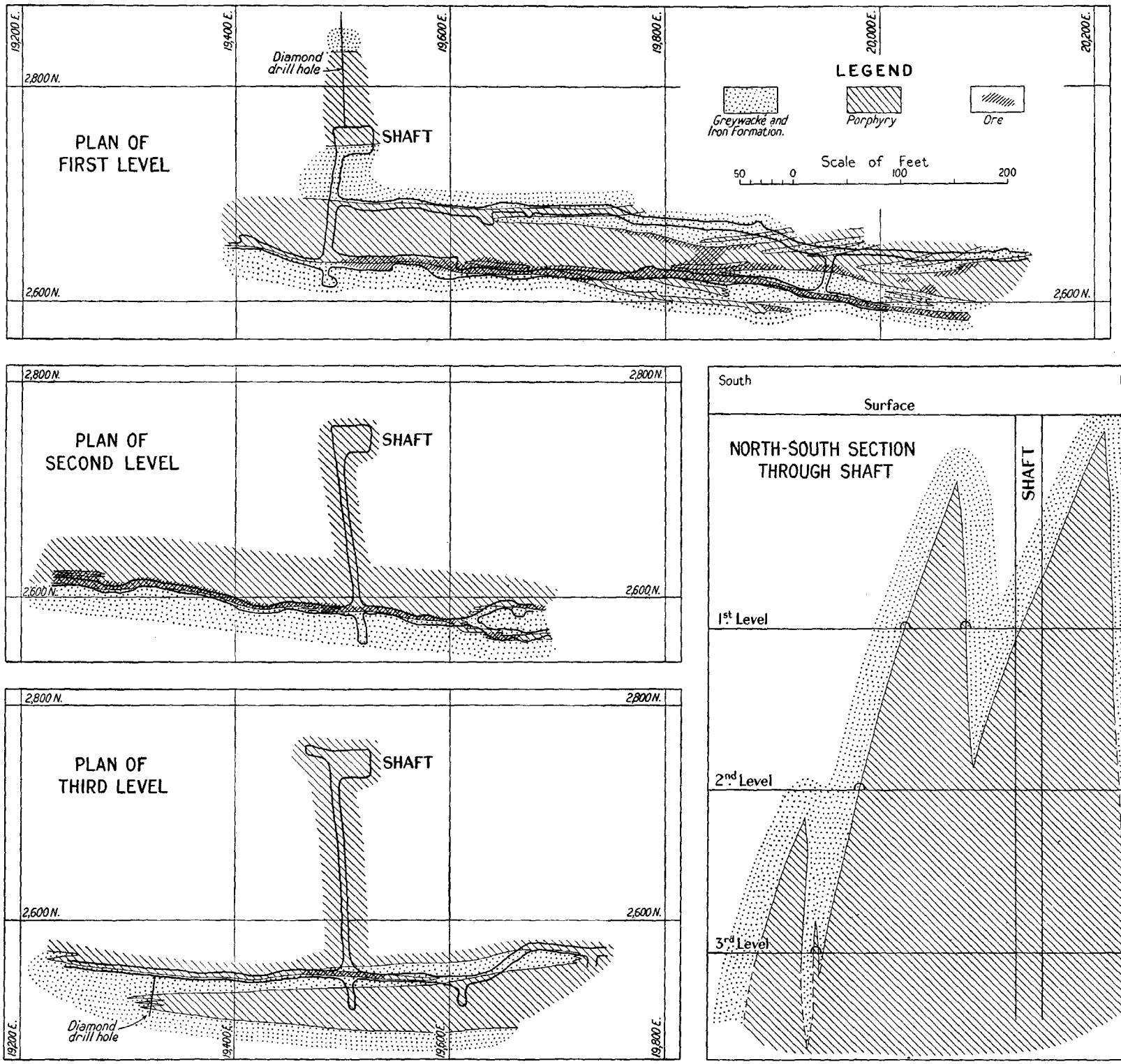


FIG. 2—Plans of the 1st, 2nd, and 3rd levels of the new workings, MacLeod-Cockshutt mine, showing the geology and the relation of the ore zones to the porphyry tongues, and cross-section through the centre of the shaft with idealized section of the porphyry tongues.

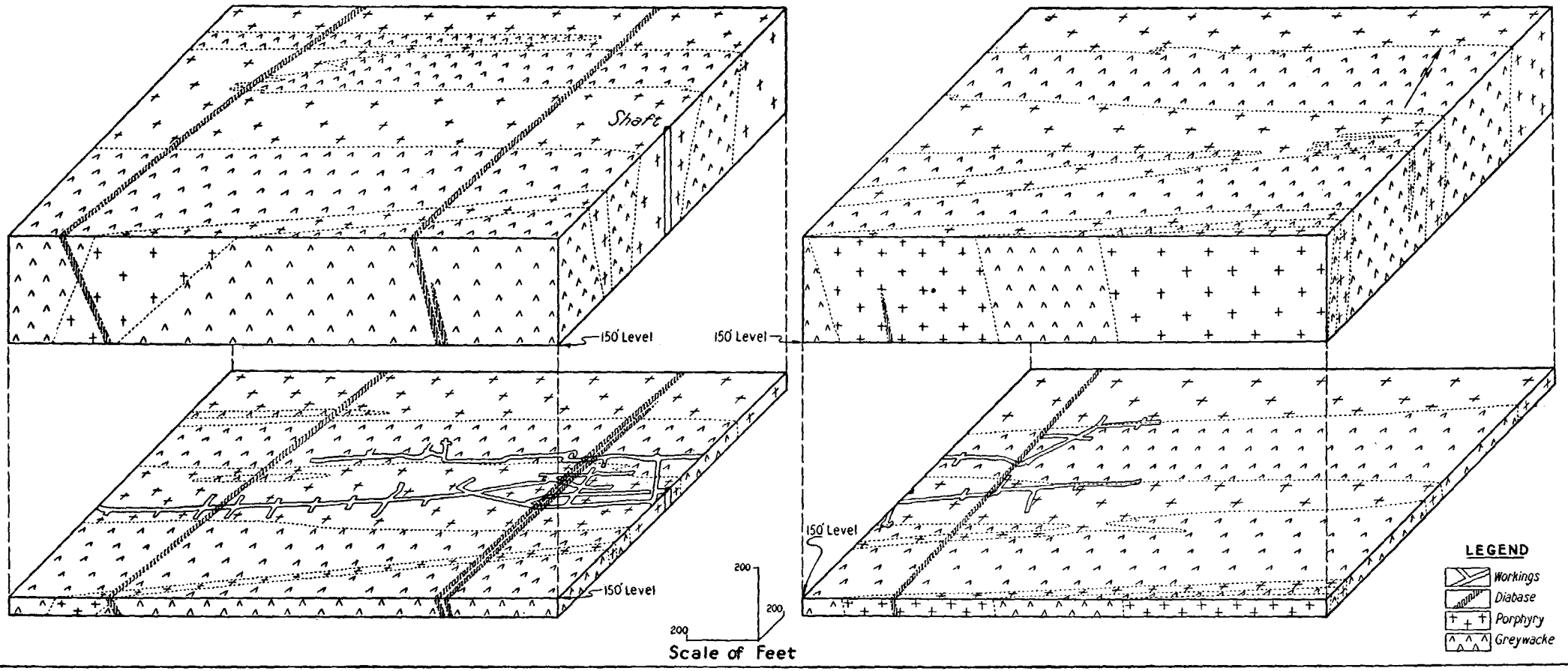


FIG. 3—BLOCK DIAGRAM SHOWING THE GEOLOGY OF THE SURFACE AND THE 1ST LEVEL FROM THE NEW SHAFT, HARD ROCK MINE.
Veins are not shown; the northern drift is along a zone of sulphides in lean iron formation.

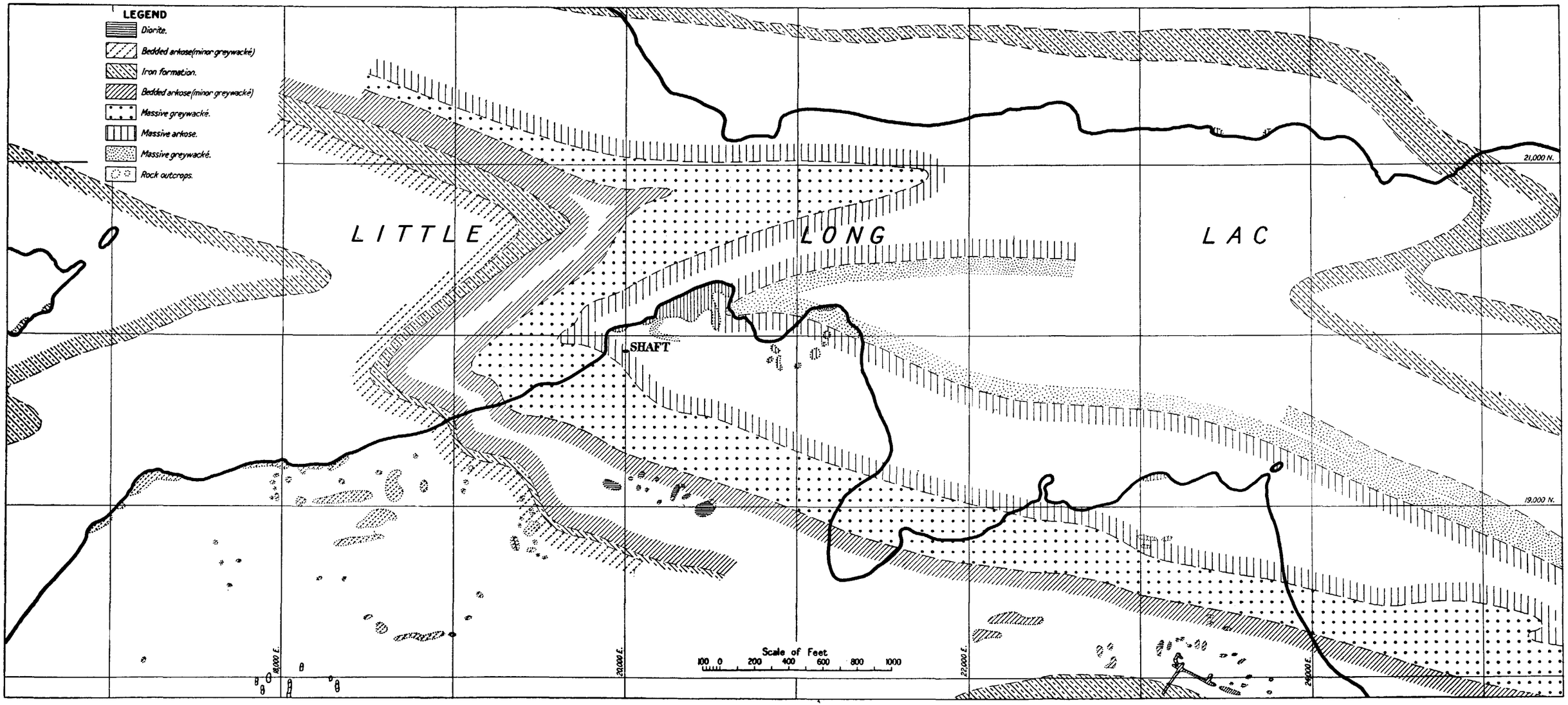


FIG. 4—SKETCH MAP SHOWING THE GEOLOGY IN THE VICINITY OF THE LITTLE LONG LAC MINE.

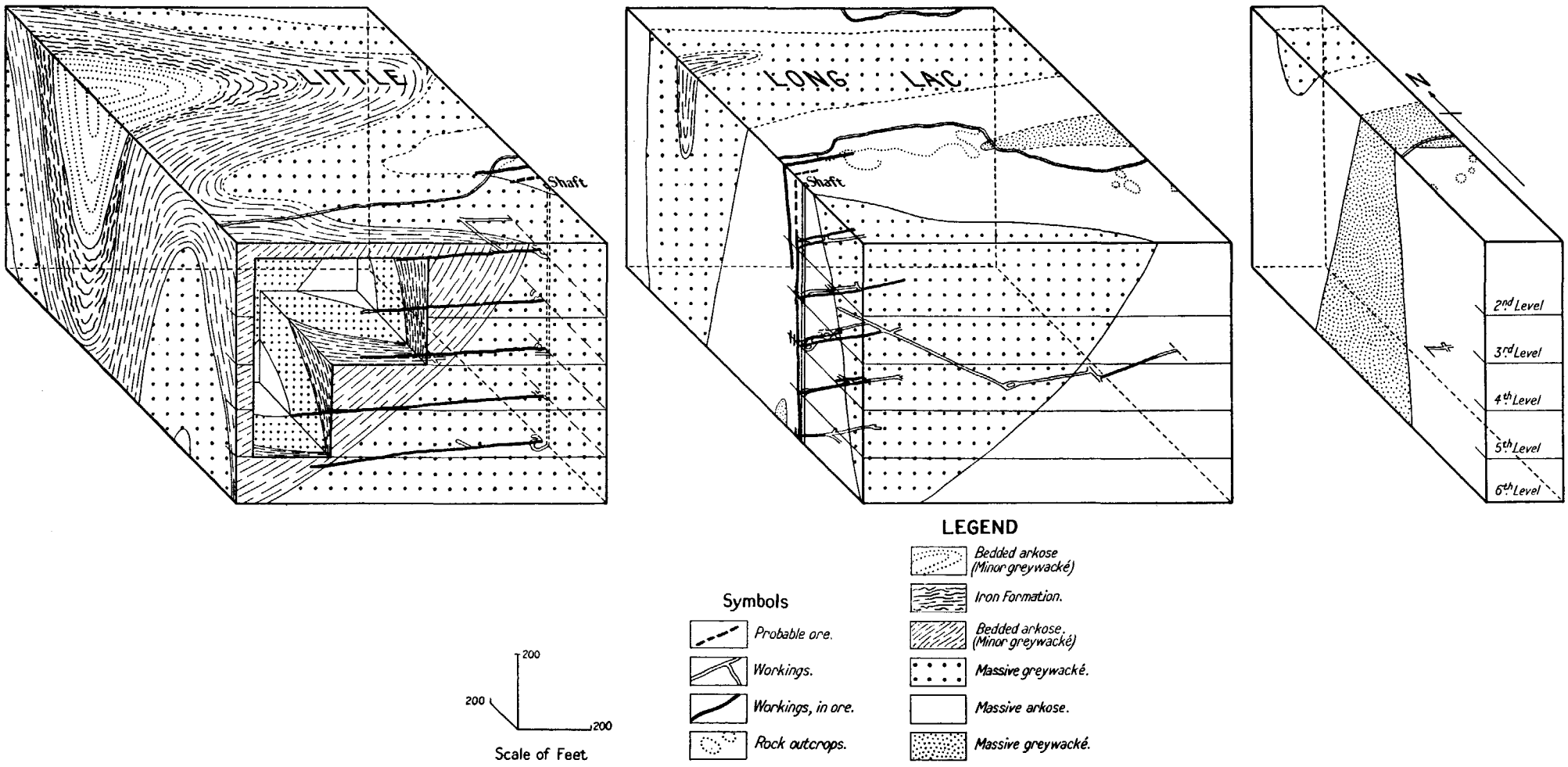
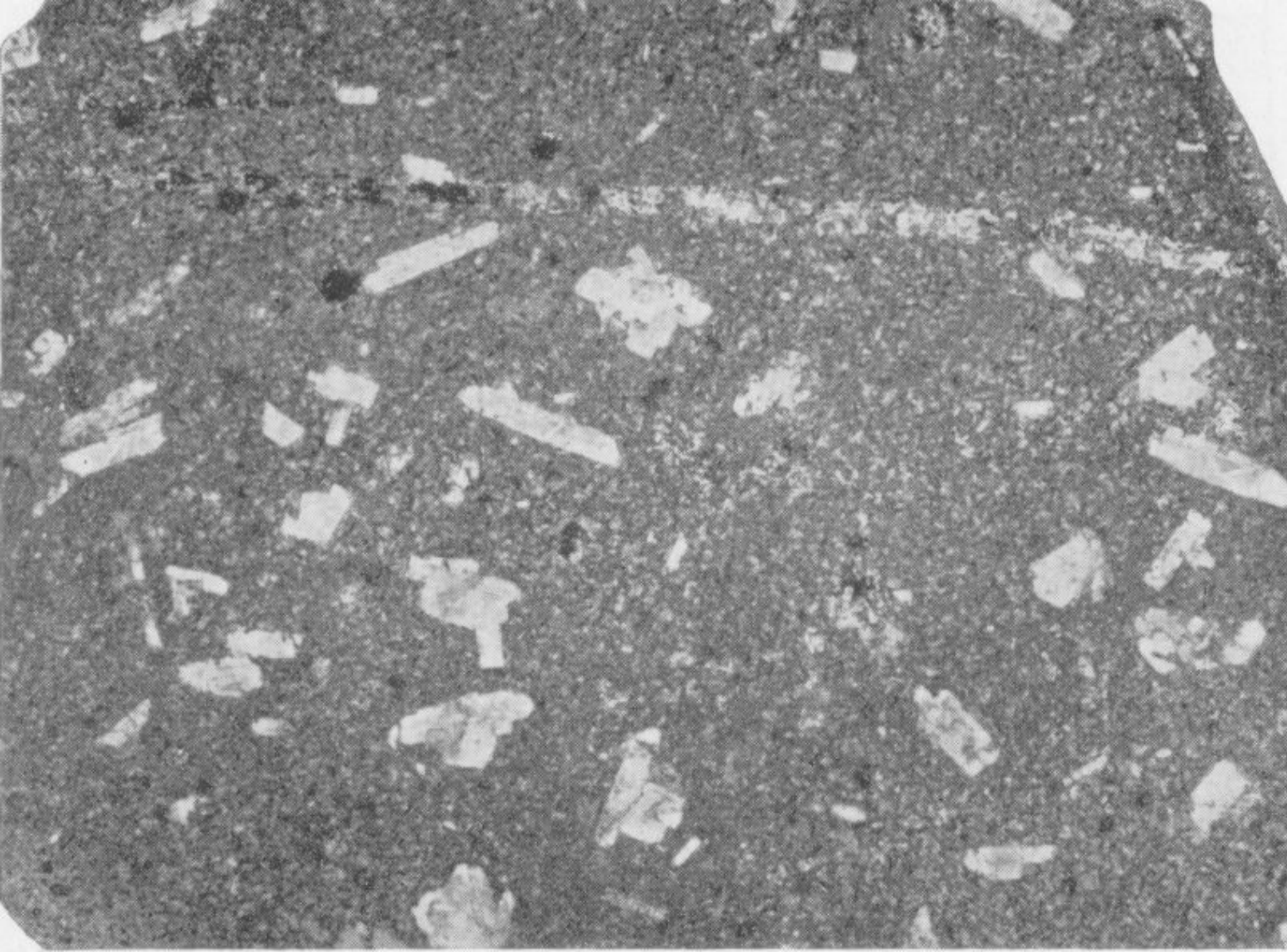


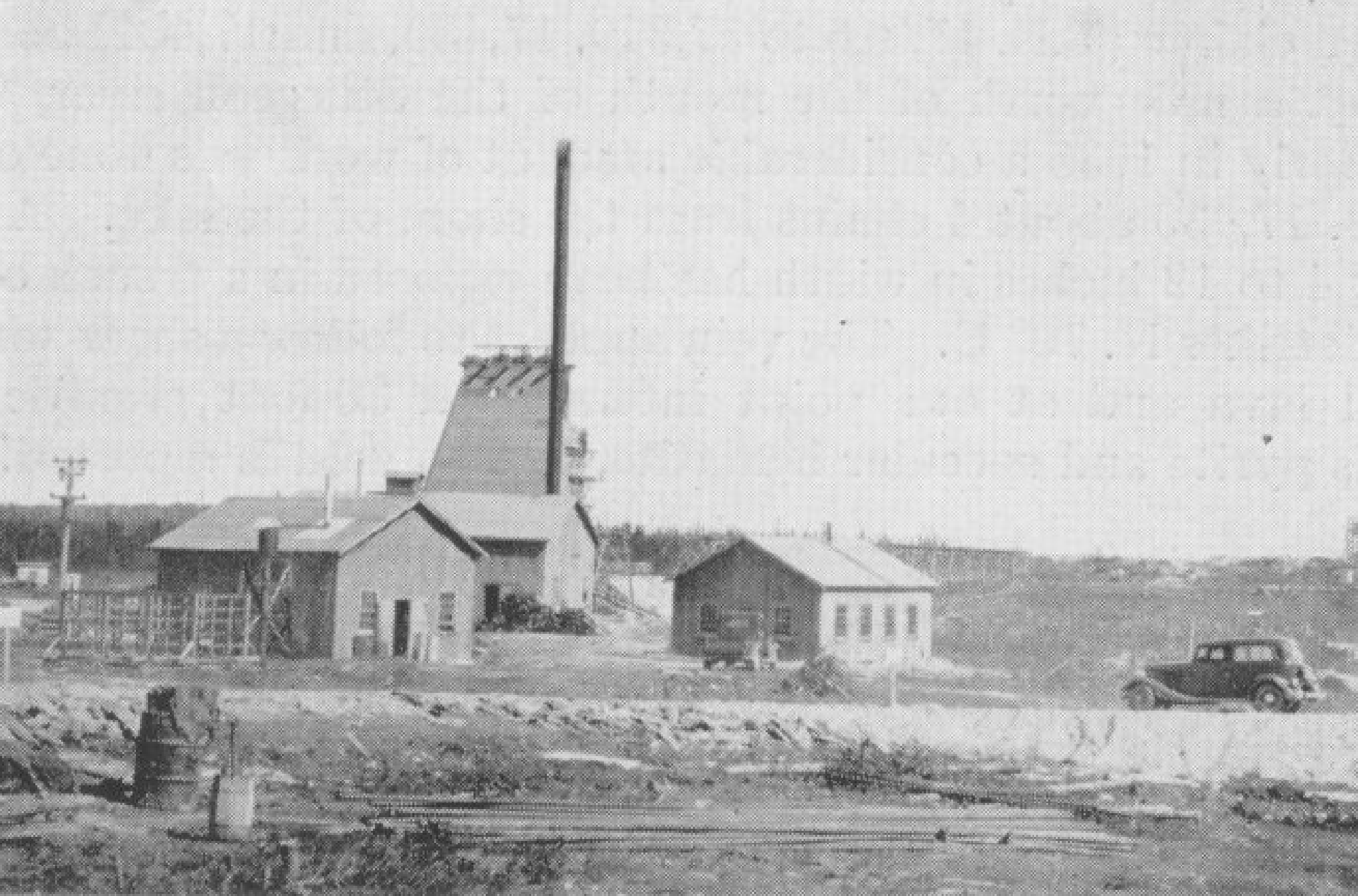
FIG. 5—BLOCK DIAGRAM SHOWING GEOLOGICAL STRUCTURE, LITTLE LONG LAC MINE.





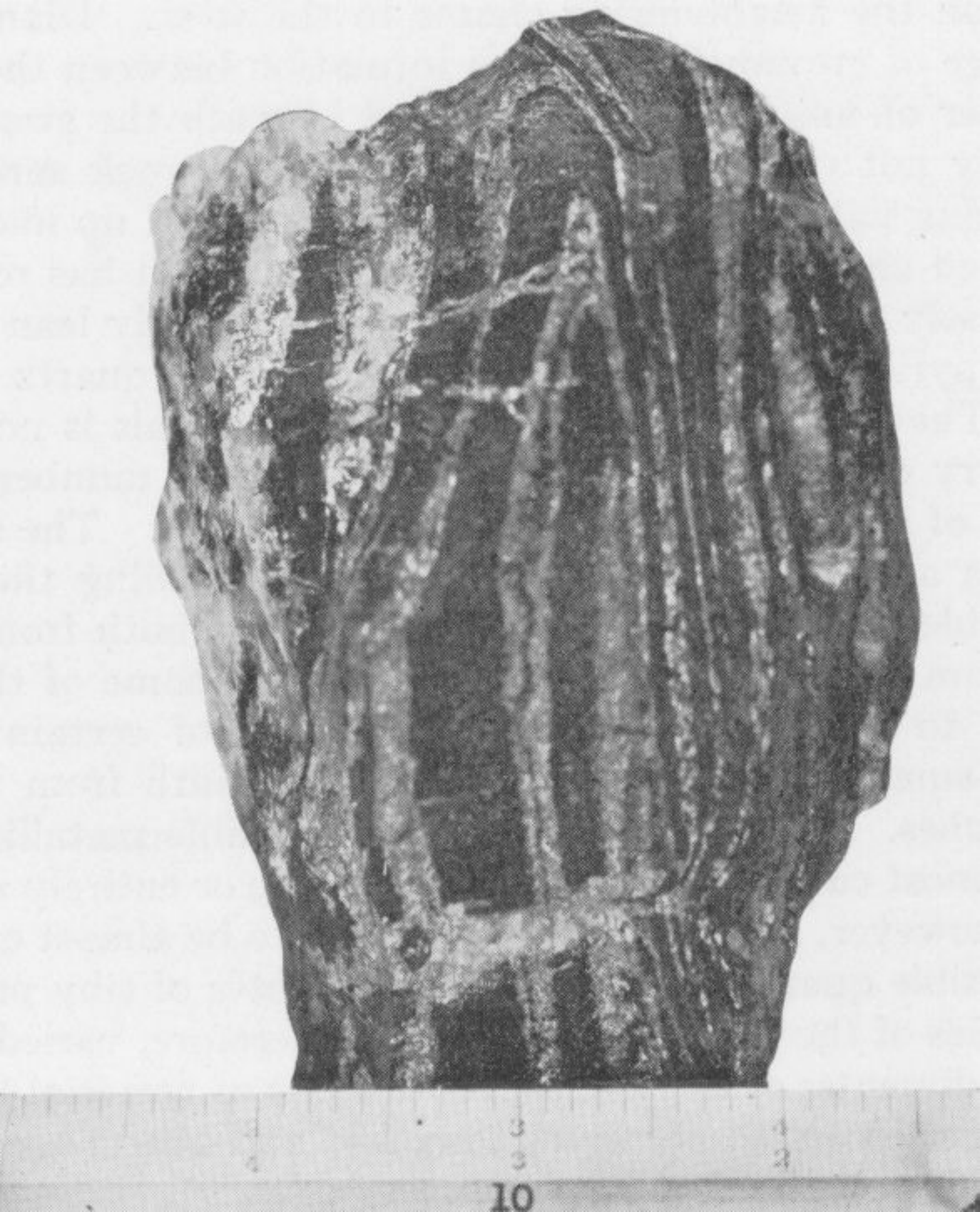






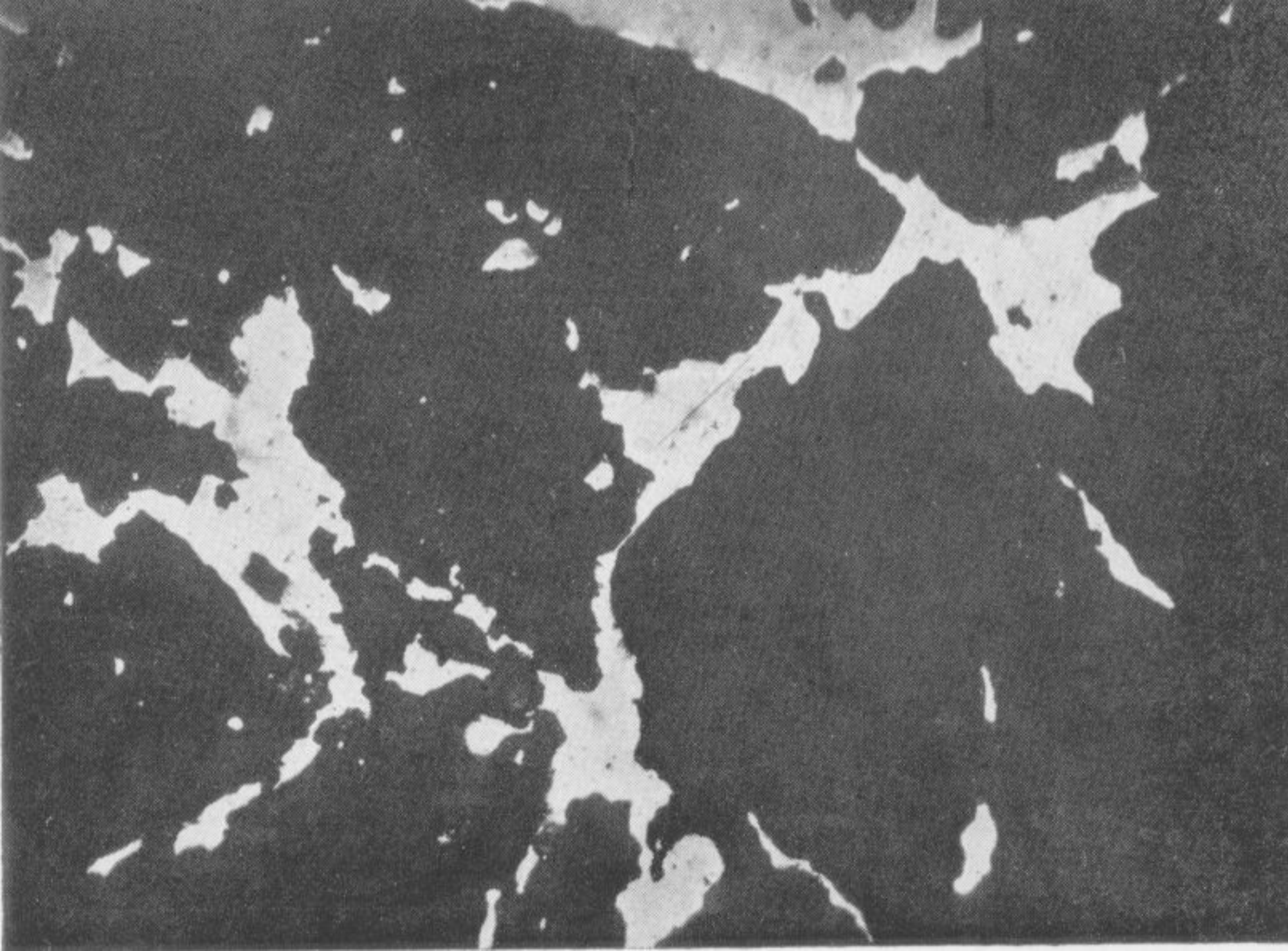

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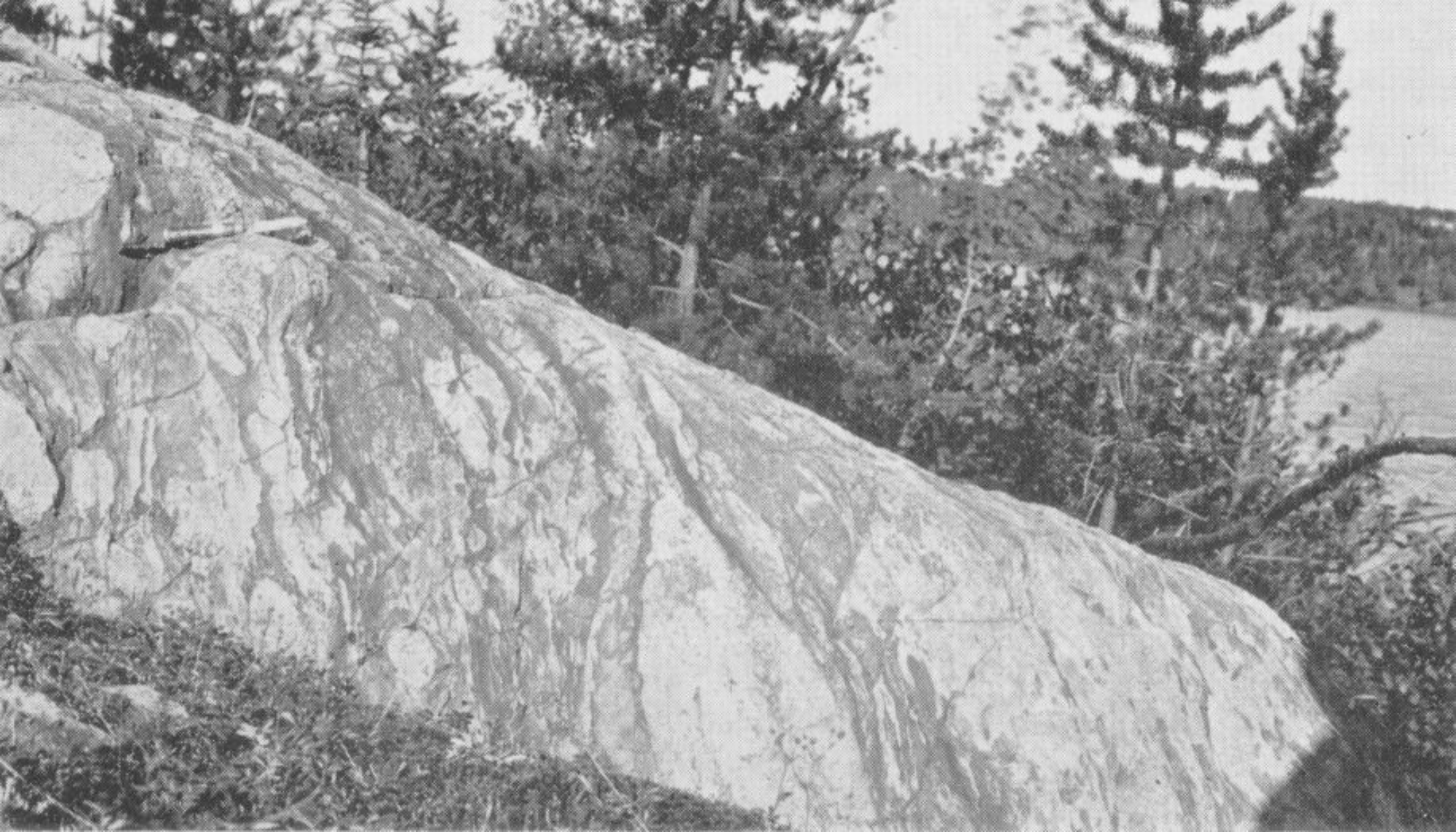

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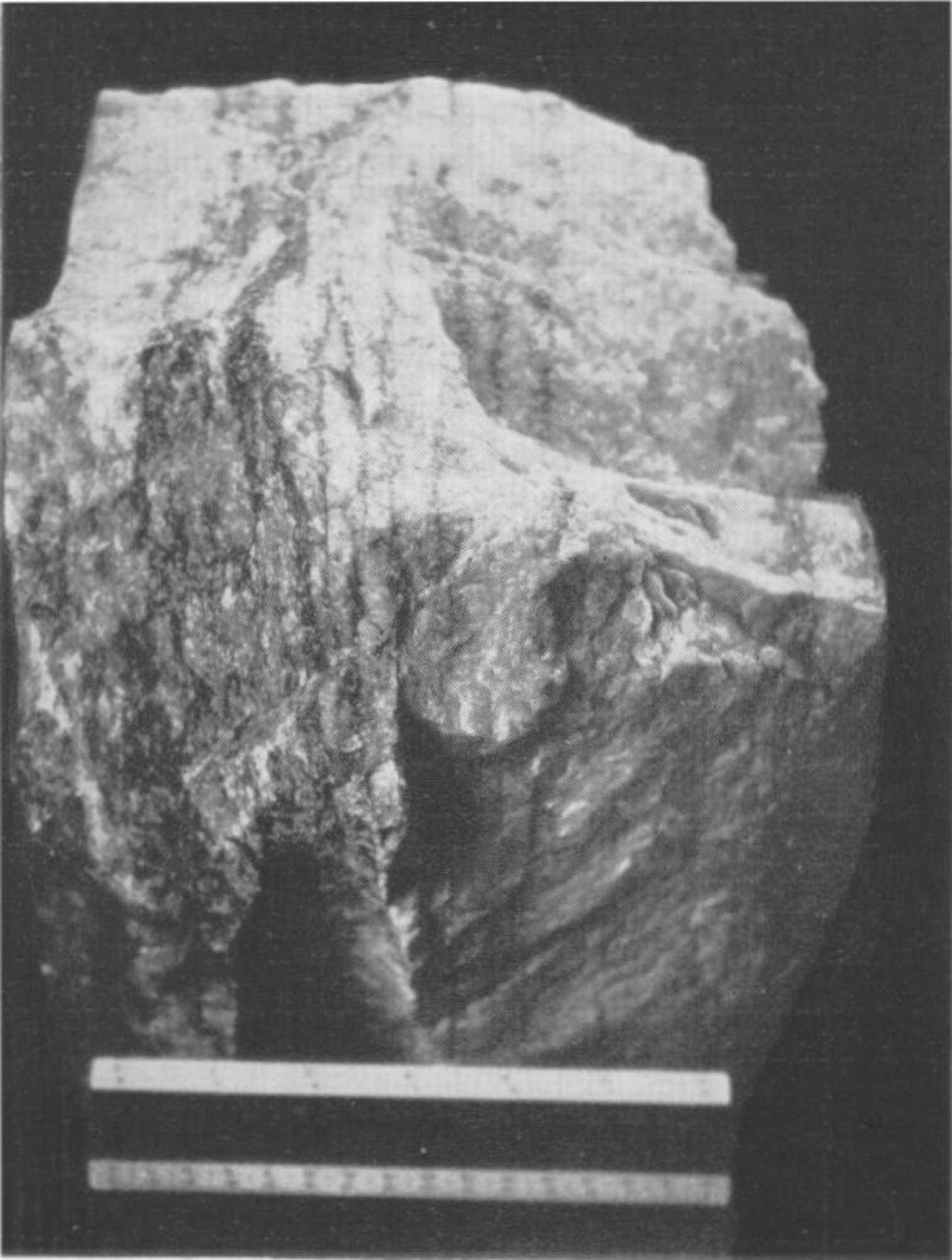


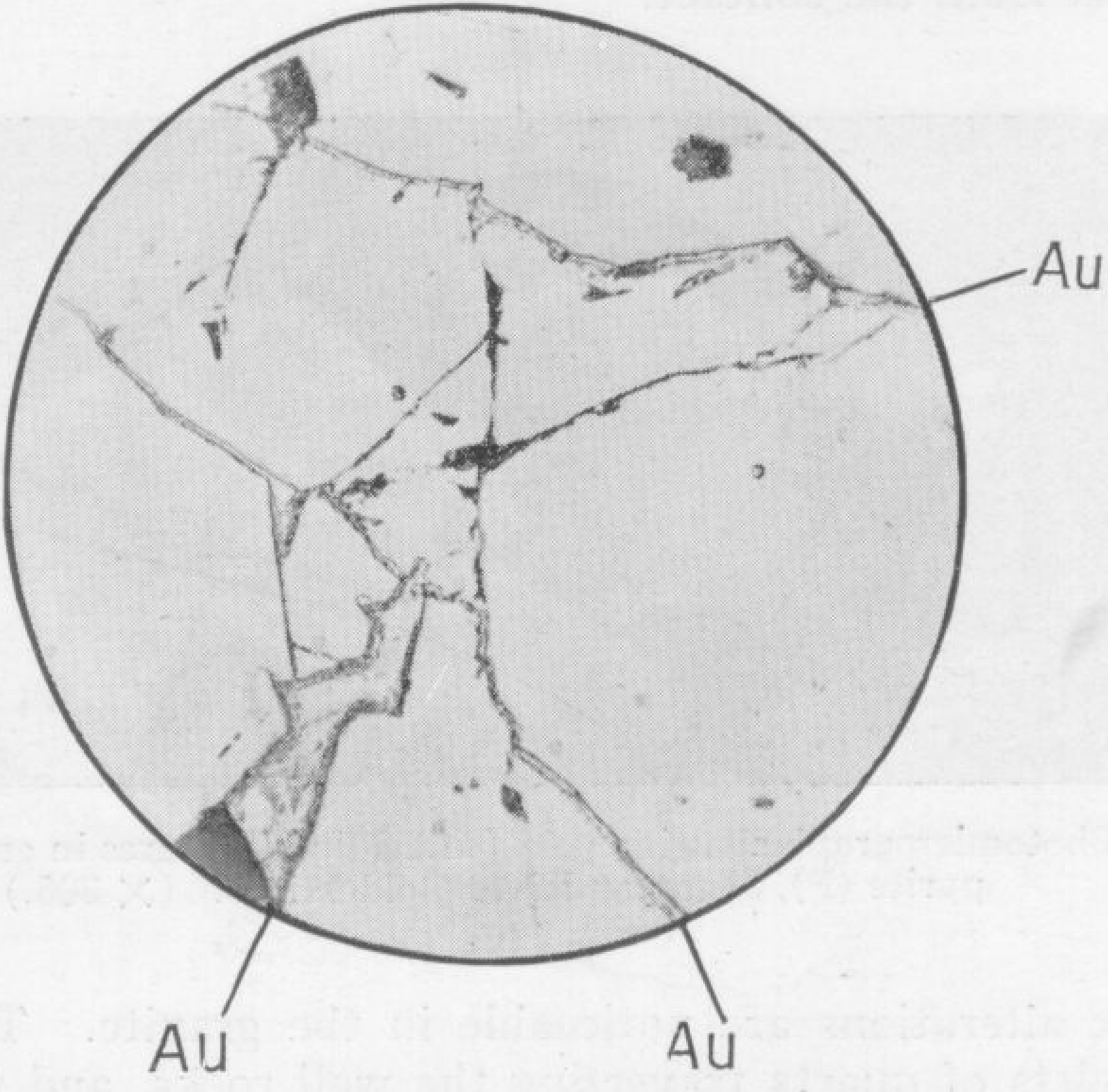


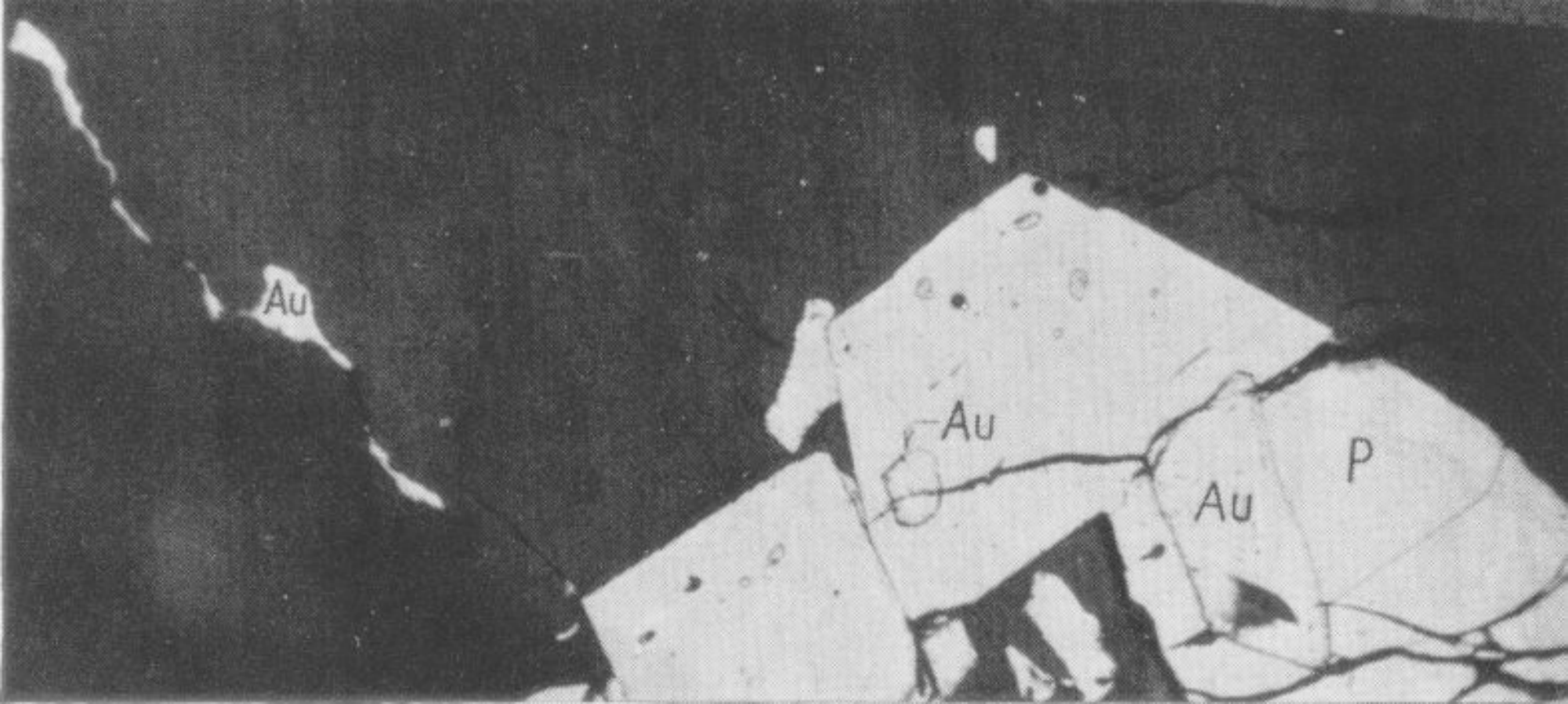








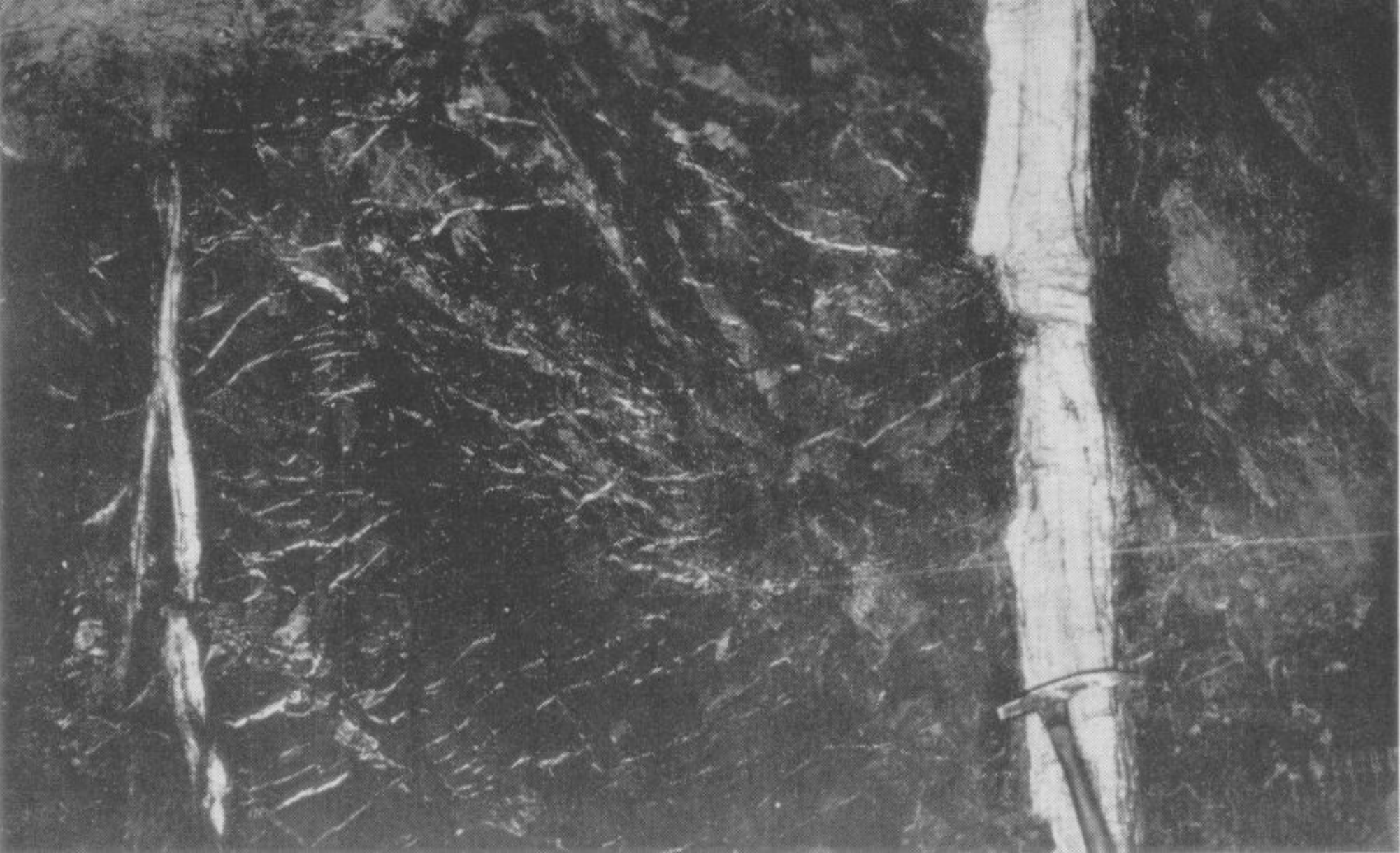

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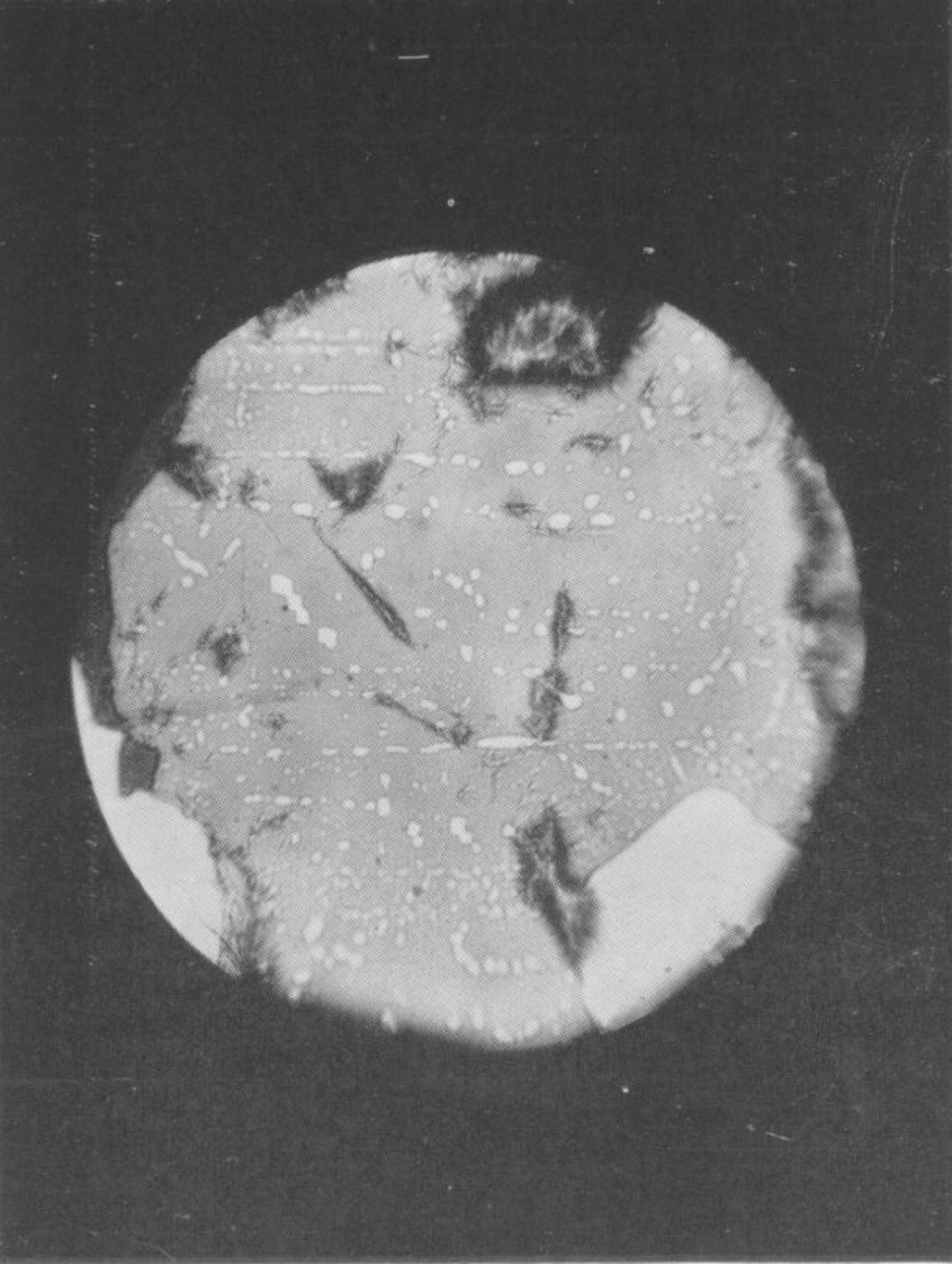

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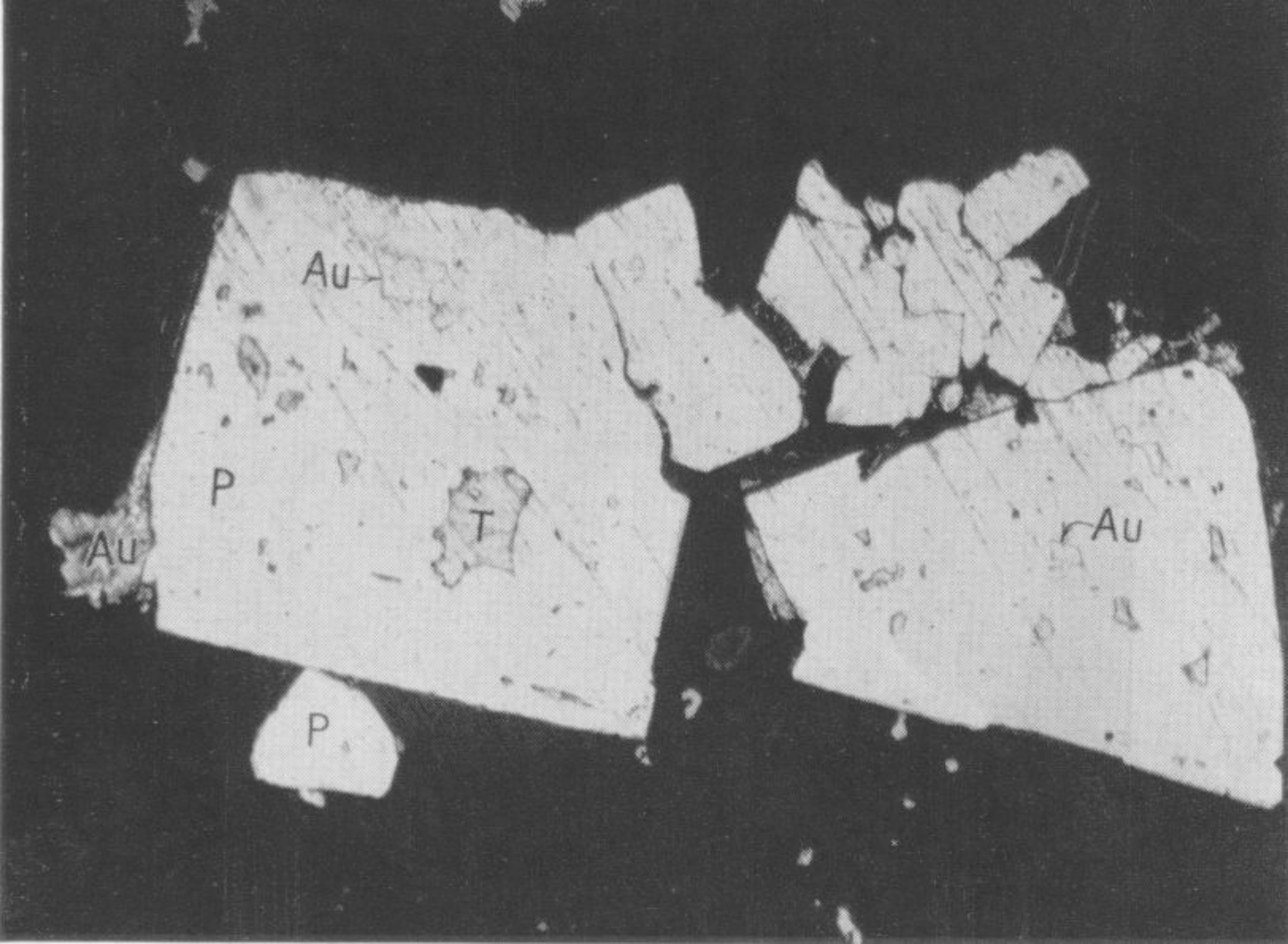




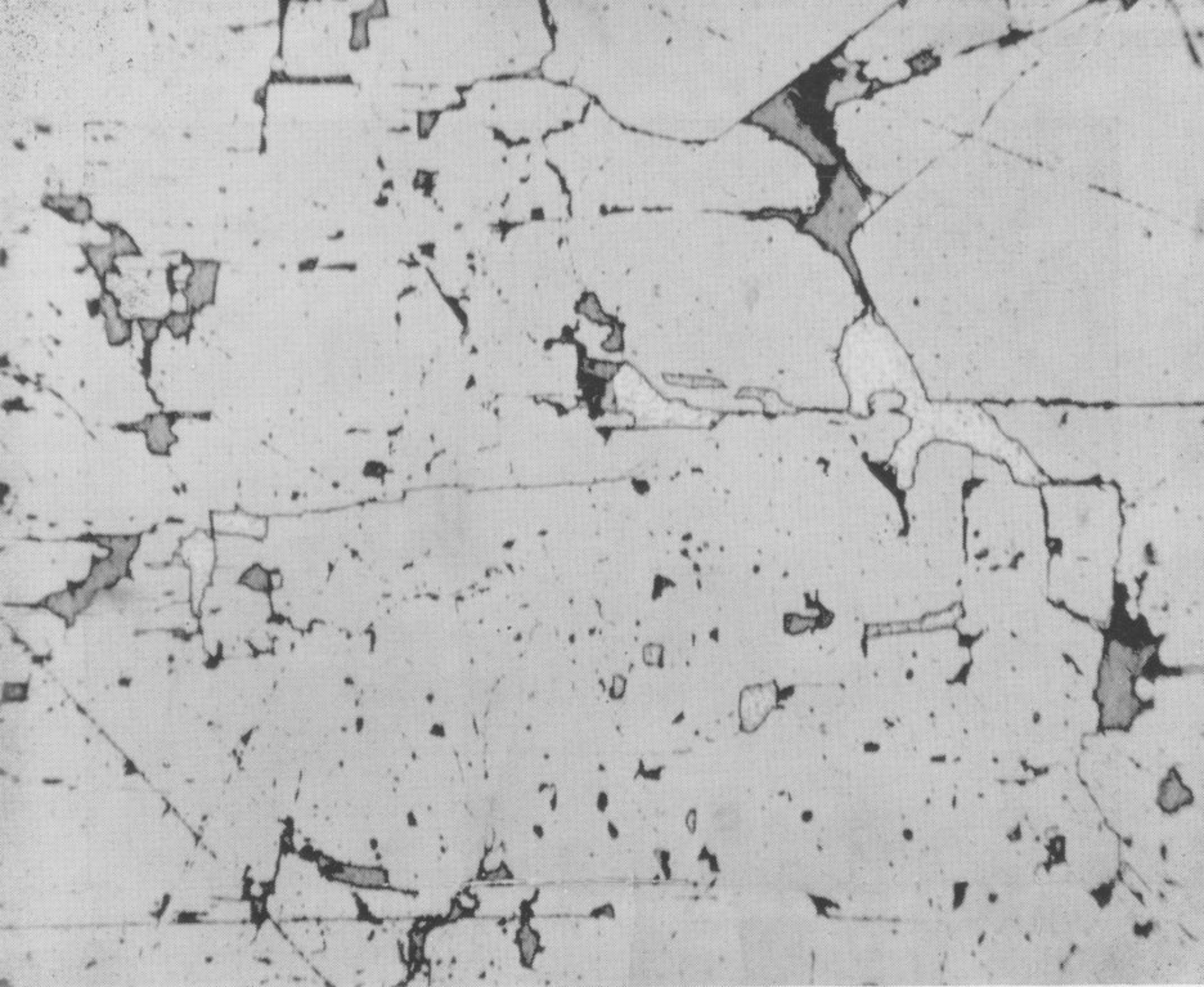


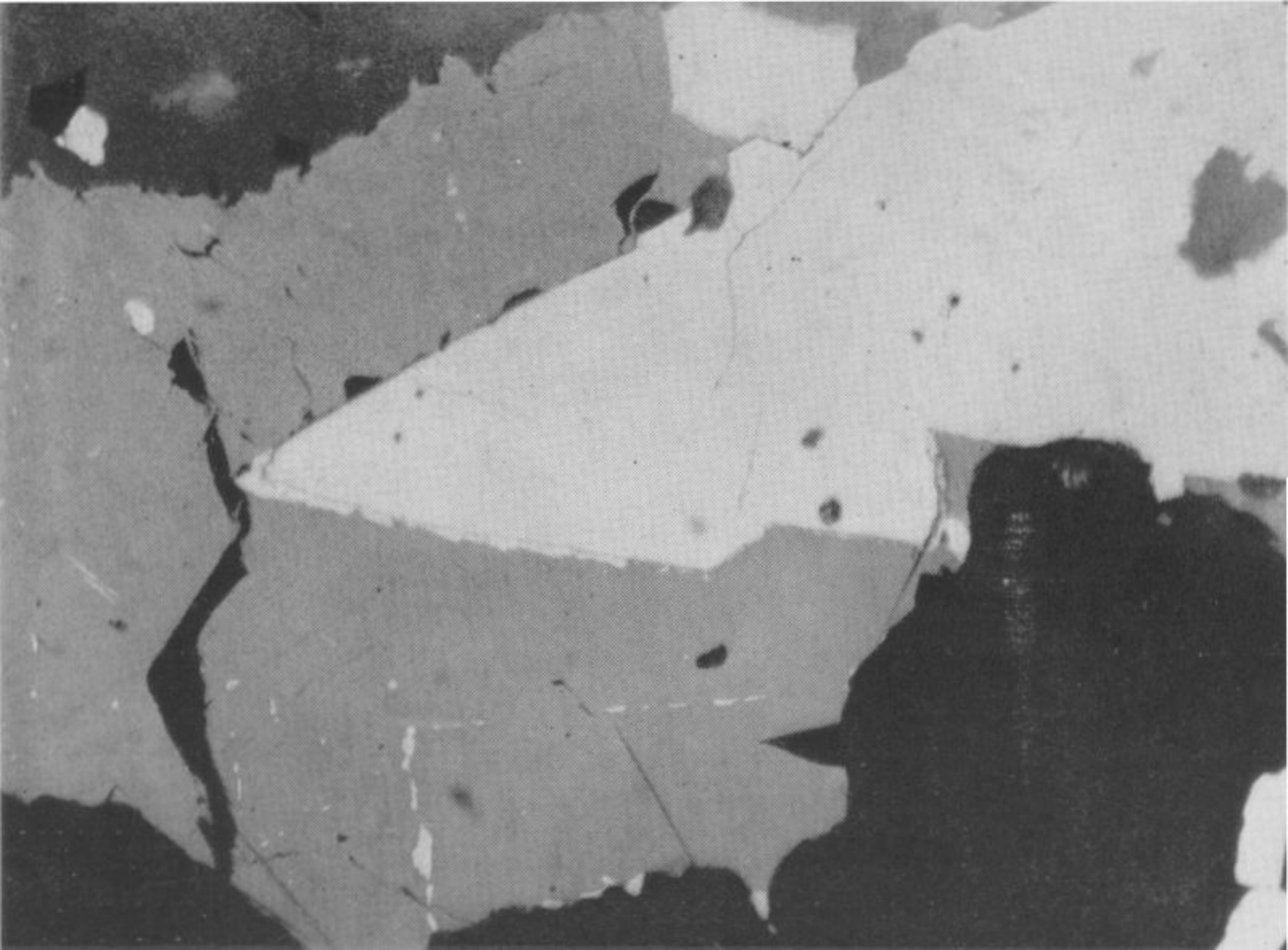


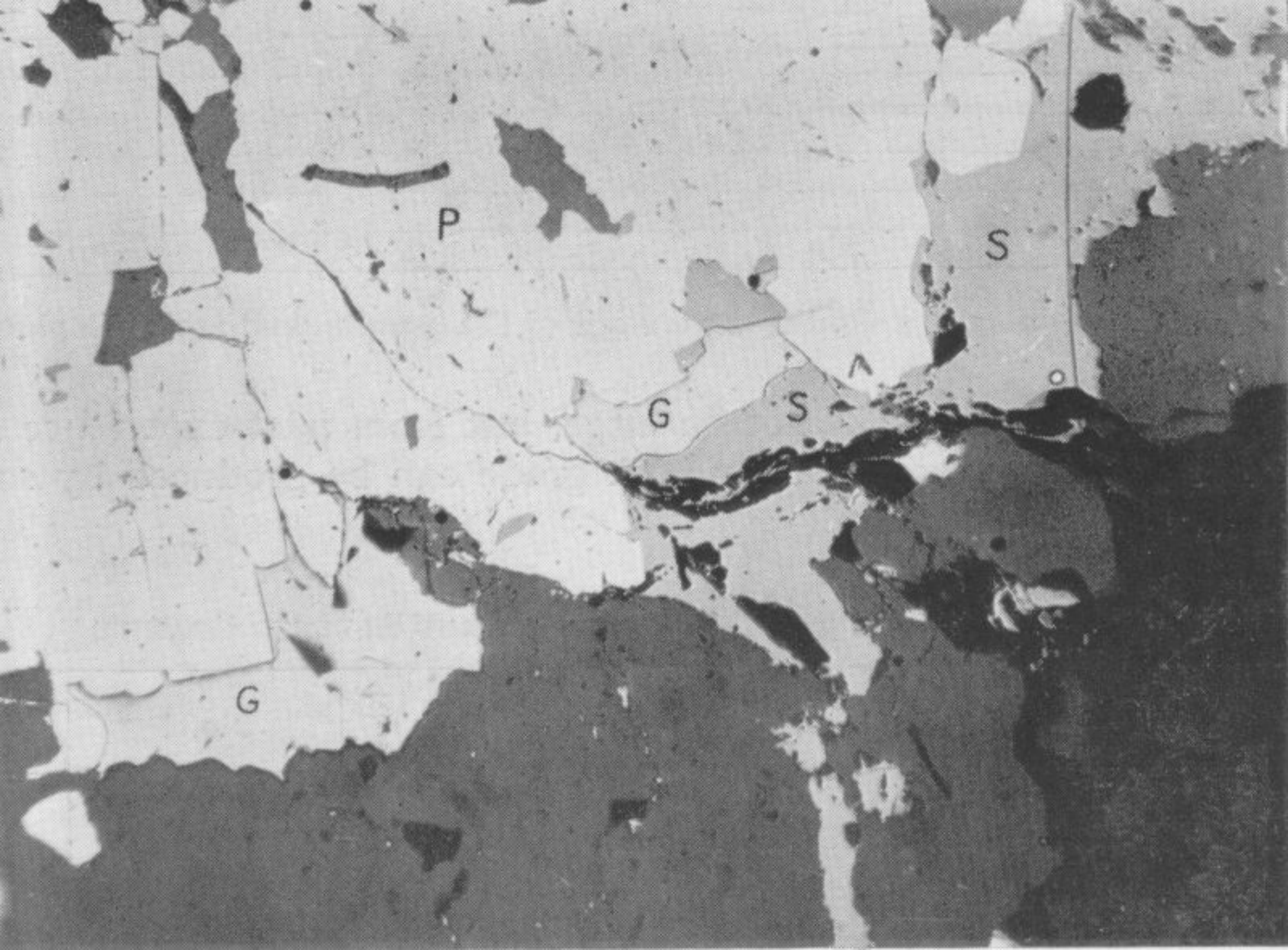



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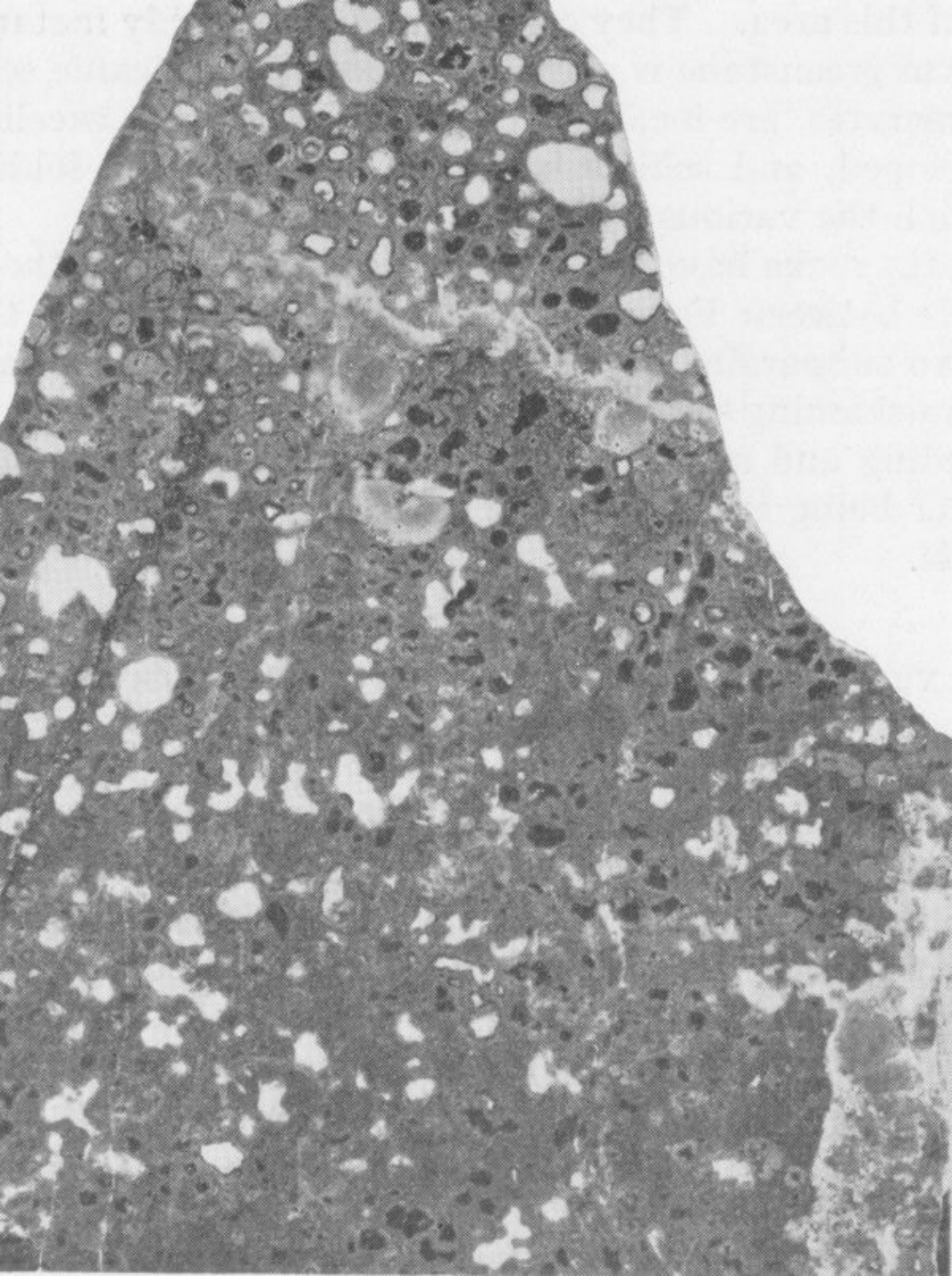


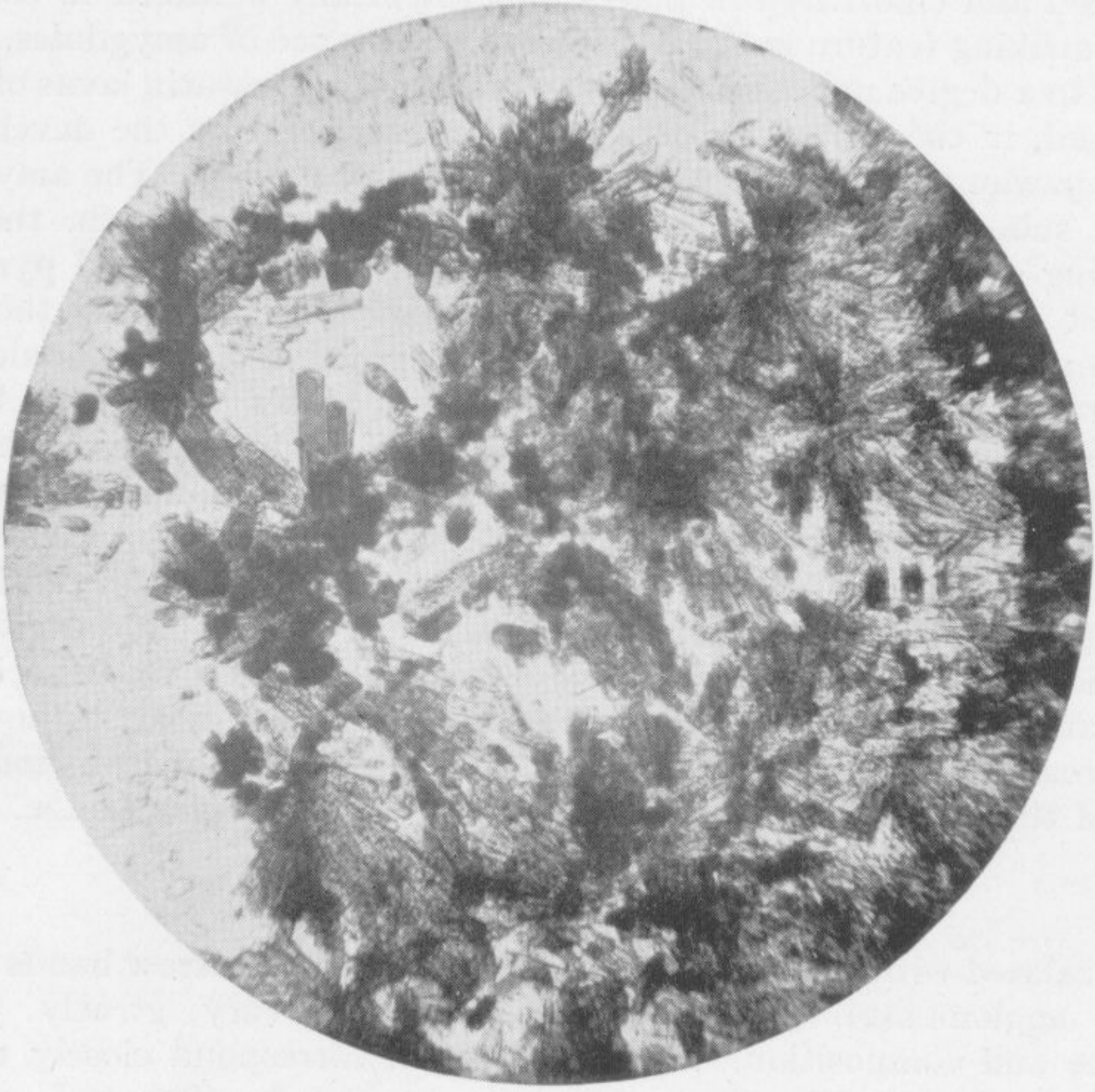

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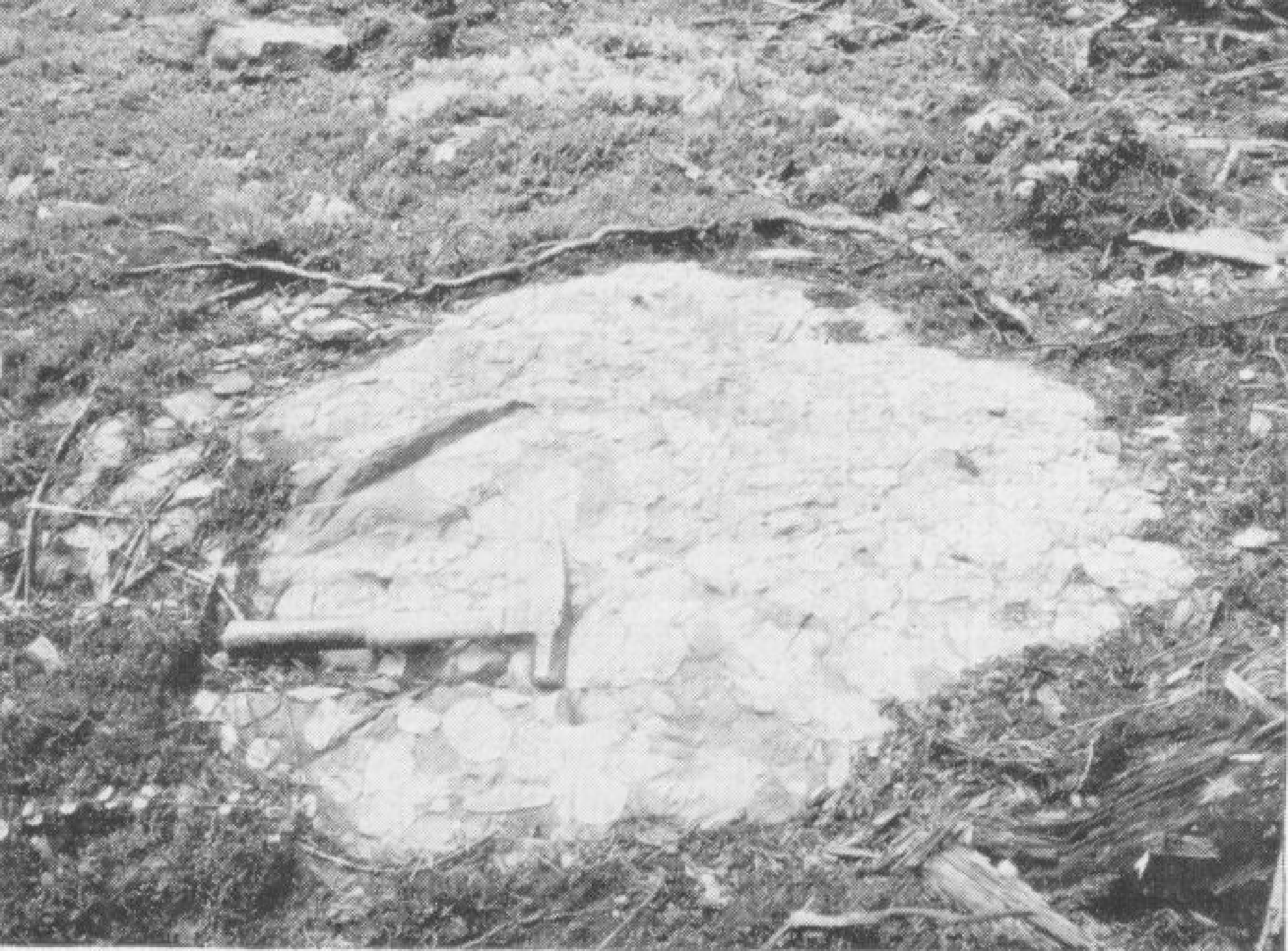




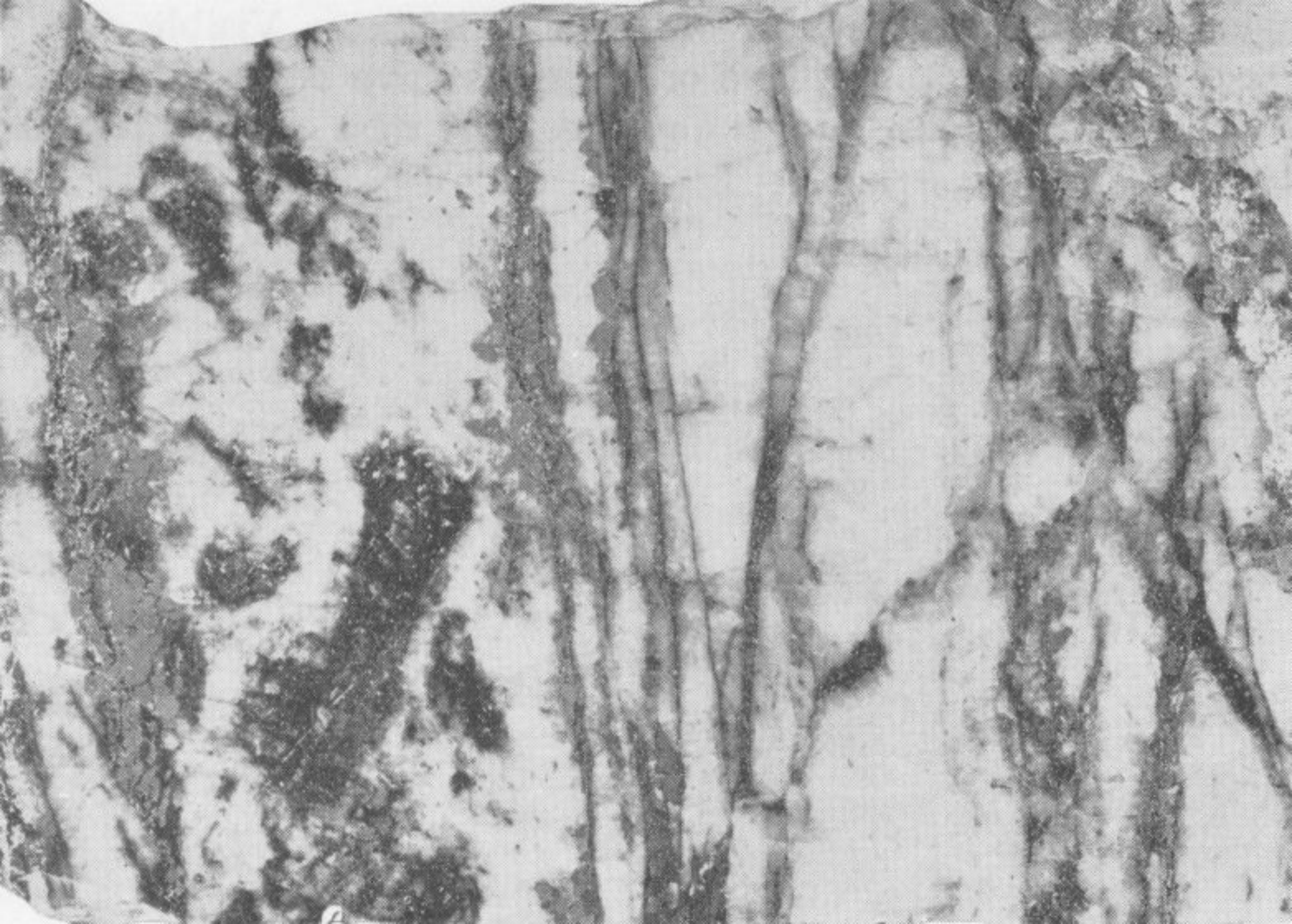

















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PROVINCE OF ONTARIO

DEPARTMENT OF MINES

HON. PAUL LEDUC, *Minister of Mines* T. F. SUTHERLAND, *Deputy Minister*

FORTY-FIFTH ANNUAL REPORT

OF THE

ONTARIO DEPARTMENT OF MINES

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VOL. XLV, PART III, 1936

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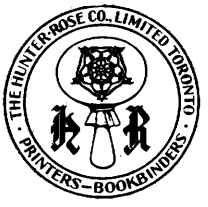

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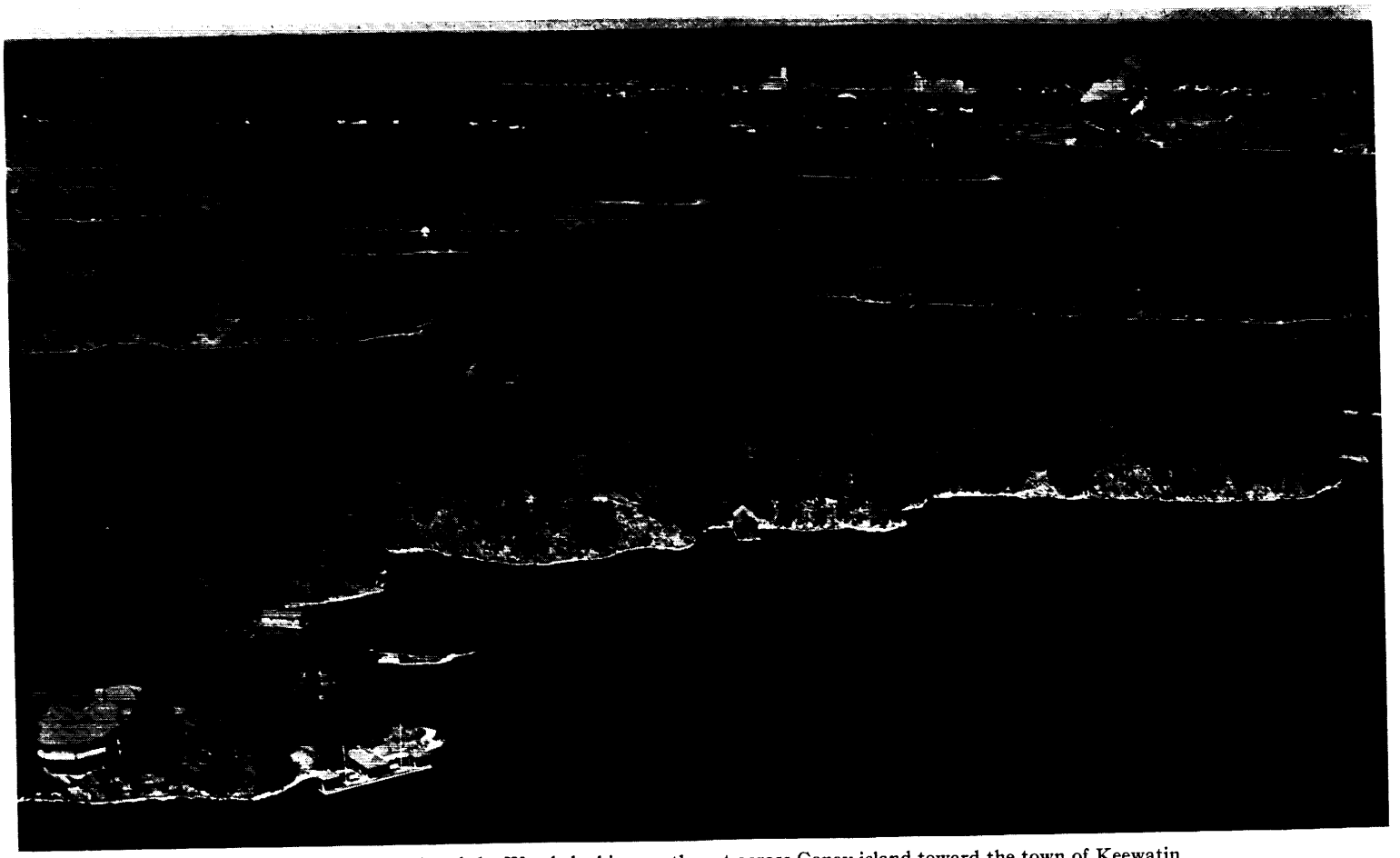
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COLOURED GEOLOGICAL MAP

(In pocket at back of report)

Map No. 45b—North Central Part of the Lake of the Woods, District of Kenora, Ontario. Scale, 1 mile to the inch.

Photo by Royal Canadian Air Force



Aerial view of the Lake of the Woods looking northwest across Coney island toward the town of Keewatin.

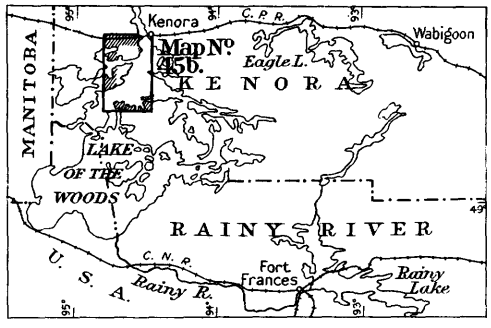
Geology of the North Central Part of the Lake of the Woods

By Jas. E. Thomson

INTRODUCTION

During the summer of 1935, a geological survey was made of the north central part of the Lake of the Woods. This area lies south and west of the town of Kenora on the Canadian Pacific railway. It includes a complete section across the greenstone-sedimentary belt from the granite contact near the Trans-Canada highway on the north to the southern granite contact near Sunset channel, a distance of about 20 miles. The area is bounded on the west by the Shoal Lake map area[1] and on the east by the Bigstone Bay map area.[2] A few of the properties described in this report were examined in September, 1936.

The area contains a number of gold prospects that were developed to a slight extent in the early days of gold-mining activity on the Lake of the Woods,



Index map showing the location of the north central part of the Lake of the Woods. Scale, 60 miles to the inch.

but none produced any appreciable amount of gold. A number of these properties have been examined in recent years, and surface development has been done on some of them. During the summer of 1935 an important gold discovery was made on one of these old properties, known as the Three Ladies mine and now owned by Kenricia Gold Mines, Limited. It is located on the northeast side of Clearwater bay near the Trans-Canada highway. The discovery led to considerable staking and prospecting activity in this vicinity during the latter part of the summer.

The accompanying geological map (No. 45b) covers an area of approximately 350 square miles, but about half of this is covered by water. The Kenora sheet (No. 52E), issued by the Topographic Survey of Canada, is an excellent aerial map of the region and was used as a base map in the preparation of the geological map. The geological data were obtained by first studying the outcrops along the shore line and later by making pace-and-compass traverses about a quarter of a mile apart through the bush. The shore generally presents excellent rock

[1]Leonard Greer, "Geology of the Shoal Lake (West) Area," Ont. Dept. Mines, Vol. XXXIX, pt. 3, 1930, pp. 42-56.

[2]G. G. Suffel, "Geology of the Bigstone Bay Area," Ont. Dept. Mines, Vol. XXXIX, pt. 3, 1930, pp. 57-71.

exposures, worn bare by wave action, and provides an opportunity for detailed examination. The less exposed areas of rock in the bush can be more intelligently interpreted after a study of the shore outcrops.

Acknowledgments

The writer wishes to express his appreciation to the various individuals who provided assistance and information during the summer. Special acknowledgment for many courtesies is due the various mining organizations within the area, the officials of the Ontario Forestry Branch at Kenora, the various lake fishermen who provided transportation, and J. D. C. Smith, mining recorder at Kenora. Able assistance was rendered in the field by Bruce Russell, A. O. Carufel, and W. D. Atchison. Mr. Russell acted as senior assistant and did a considerable part of the geological mapping. Assays and chemical analyses were made by the staff of the Provincial Assay Office.

Access

All parts of the area are easily reached from Kenora or neighbouring villages on the Lake of the Woods. Lake boats and air transport are readily available at Kenora. The Clearwater bay section is adjacent to the Trans-Canada highway and is more quickly reached from this road than by boat. A recently constructed road extends from a point near Keewatin to the east end of White Partridge bay. A canoe route across the Western peninsula is shown on the accompanying geological map.

Previous Geological Work

In 1881 Robt. Bell made a traverse around part of the Lake of the Woods and secured information for a preliminary geological map, which accompanied his report. The first intensive geological study was made by A. C. Lawson from 1883 to 1885. The report, published in 1885, contained a complete topographic and geological map of the Lake of the Woods. It was in this area that Lawson recognized for the first time a series of rocks which he thought were older than the typical Huronian of Sir William Logan, as described in the "Geology of Canada" in 1863. Lawson proposed the name Keewatin for these older greenstones and schists. He also recognized that the granites and gneisses intruded the Keewatin complex and that the gold-bearing veins were located in the vicinity of the contacts between these formations.

Later, a special International Geological Committee examined certain sections on the Lake of the Woods, and published their report in 1905.[1] They found Lawson's description of the formations to be substantially correct. Lawson's map has remained until recent years as the only complete geological map of the Lake of the Woods district. Some minor changes were made to Lawson's map by A. L. Parsons in 1912.

The gold deposits on the Lake of the Woods have been discussed by Lawson, Parsons, Hopkins, Bruce, Thomson, and various inspectors of the Ontario Department of Mines.

In 1929 the immediately adjacent Shoal Lake and Bigstone Bay areas were mapped by Leonard Greer and G. G. Suffel, respectively.

[1] "Report of the Special Committee on the Lake Superior Region," Jour. Geol., Vol. 13, 1905, pp. 95-104.

Bibliography

The following reports deal with the area and the territory immediately adjacent:—

ROBT. BELL, "Report on the Geology of Lake of the Woods and Adjacent Country," Geol. Surv. Can., Rept. of Progress, 1880-81-82, pp. 11-15C.

E. L. BRUCE, "Gold Deposits of Kenora and Rainy River Districts," Ont. Dept. Mines, Vol. XXXIV, pt. 6, 1925, pp. 3-21.

LEONARD GREER, "Geology of the Shoal Lake (West) Area," Ont. Dept. Mines, Vol. XXXIX, pt. 3, 1930, pp. 42-56.

P. E. HOPKINS, "Ontario Gold Deposits, their character, distribution and productiveness," Ont. Dept. Mines, Vol. XXX, pt. 2, 1921, pp. 52-60.

A. C. LAWSON, "Report on the Geology of the Lake of the Woods Region," Geol. Surv. Can, Vol. I, pt. CC, 1885.

A. L. PARSONS, "Gold Fields of Lake of the Woods, Manitou, and Dryden," Ont. Bur. Mines, Vol. XX, pt. 1, 1911, pp. 158-178; Vol. XXI, pt. 1, 1912, pp. 169-196; "The Lake of the Woods and Other Areas," Vol. XXII, pt. 1, 1913, pp. 210-228.

G. G. SUFFEL, "Geology of the Bigstone Bay Area, Lake of the Woods," Ont. Dept. Mines, Vol. XXXIX, pt. 3, 1930, pp. 57-71.

JAS. E. THOMSON, "Gold Deposits on Lake of the Woods," Ont. Dept. Mines, Vol. XLIV, pt. 4, 1935, pp. 29-47; "Gold Deposits of the Belt Extending from Manitou Lake to Lake of the Woods," Bull. Can. Inst. Min. and Met., Oct. 1936, pp. 686-701.

C. R. VAN HISE and C. K. LEITH, "The Geology of the Lake Superior Region," U.S. Geol. Surv., Mon. 52, 1911, pp. 144-147.

History and Development

The gold deposits in the Lake of the Woods region have been of interest for a very long time. On the whole, considering the large number of discoveries that have been made over this long period of years, the country has had a rather disappointing mining history. It is recorded that gold-mining operations on the lake commenced as early as 1852, although very little real development was done before 1890. Between 1885 and 1895, during the famous Lake of the Woods gold rush, a large number of discoveries were made. By 1893 there were some 20 gold-mining locations in the neighbourhood of Rat Portage, now the town of Kenora. The most outstanding of these was the Sultana mine, which eventually became the chief gold producer in the area. The gold production of the Lake of the Woods region steadily rose until the peak year of 1899. During this year, it amounted to $421,951 for the Province of Ontario and was chiefly derived from four mines, the Sultana, Regina, Mikado, and Golden Star, all but the last-named being on the Lake of the Woods.

During 1900 a large number of the mines in the region were closed down, thus manifesting the fact that a strong reaction had set in. Some properties were worked intermittently until 1912, when practically all gold-mining operations ceased. The year 1909 witnessed the discovery and initial development of the Porcupine gold fields. These and other areas attracted prospectors and mining interests, and the Lake of the Woods region was practically neglected for many years. The total gold production during the early mining period on the Lake of the Woods is not exactly known. To the end of 1909, however, the aggregate value of the gold production of Ontario was about $2,500,000, of which much the greater part came from the Lake of the Woods.

Within the last few years a marked revival of gold-mining activity has taken place in this part of the province. This has been partly due to the revaluation of gold and the necessity for the re-examination of old properties to determine whether they could be profitably exploited by modern mining methods at the present price of gold. As a result of this exploration new ore bodies have been outlined and some mines are producing gold.

Between 1890 and 1900 a number of gold discoveries were made within the map area and quite a number of small shafts were sunk for exploratory purposes. So far as is known, none of these properties produced any appreciable amount of gold. In recent years most of these old showings have been examined, and in some cases surface stripping and sampling has been done.

Topography

The topographical features of the Lake of the Woods have been discussed in detail by Lawson.[1] The north central part of the lake is essentially an archipelago. Its whole expanse is thickly studded with islands varying in size from tiny rocky islets to masses of land of great extent. This section of the lake is rather shallow, and shoals and reefs are numerous. These are marked by buoys along the main channels. There are often marshy tracts in the more sheltered parts of the lake, such as secluded bays or narrows between islands.

The land areas occasionally present a somewhat rugged appearance, especially those parts some distance inland, but the relief is never over 200 feet. The central part of the Western peninsula and the part of the map-sheet lying north of the Trans-Canada highway present the most rugged topographic features. The greater part of the land area is rock outcrop. The shore line almost always reveals rock exposures, and the smaller islands show much bed rock. Large islands, such as Shammis, Crow Rock, and Corkscrew, are partly covered with a mantle of drift in the interior. The central part of the Northern peninsula is largely covered by overburden.

The topographic features of the Lake of the Woods have been controlled to a great extent by the nature and structure of the underlying rock. Lawson[2] has discussed this point in great detail and summarizes it as follows:—

> The dependence of the physical features of the earth's surface upon geological conditions becomes more or less apparent in all regions, when carefully studied, but nowhere could a better illustration of so interesting a truth be found than on the Lake of the Woods. The conditions which obtain in the rocks of the region, and which have had the most active influence in determining the aspect of its geographical features, are those of cleavage, relative hardness and mineral composition, and strike and dip. The strike and dip of the strata control more particularly the direction in which the forces of erosion operate, while cleavage, relative hardness, and composition control rather the measure of rapidity with which these forces may act in the direction determined. These general conclusions . . . may be regarded as an imperfect formulation of the law of erosion in these Archean rocks.

The basin of the north central part of the Lake of the Woods lies almost entirely within the area of Keewatin schistose rocks. The general strike of the formation, rock cleavages, and anticlinal and synclinal axes throughout this area average about N. 80° E. It will be noticed that topographic features such as straits, bays, and islands, tend to be elongated in about the same direction. This is especially the case where the rocks are decidedly schistose or where very resistant bands of these rocks, such as diorite or massive lavas, occur between areas of more schistose rock.

Natural Resources

One of the chief sources of revenue of the area is the summer tourist business. The northern part of the Lake of the Woods has long been famous for its great natural beauty. A large number of summer homes have been built on available locations around Rat Portage bay and southward to the more open stretches of the lake. Since the opening of the Trans-Canada highway many summer

[1] A. C. Lawson, Geol. Surv. Can., Vol. I, pt. CC, 1885, pp. 15-28.
[2] Ibid, p. 18.

cottages have been constructed along the north shore of Clearwater bay. Tourist camps are operated on different parts of the lake during the summer months.

Commercial fishing is carried on extensively. Pike, pickerel, and whitefish constitute the main shipments. Maskinonge, bass, and lake trout are caught by sportsmen in different parts of the lake. Game is fairly plentiful.

There is little lumbering activity in the area. Much of the timber is second growth. The chief forest trees are poplar, spruce, balsam, jackpine, red and white pine, cedar, birch, and ash. The only extensive area of recently burnt over country lies along the north side of Aulneau peninsula from a point near Portage de Bois to a point south of Sunset channel. A limited amount of farming and gardening is done in the northern part of the area.

GENERAL GEOLOGY

The outstanding geological features of the north central part of the Lake of the Woods may be summarized as follows: The consolidated rocks are almost entirely of early pre-Cambrian (Archean) age. The greater part of the area is underlain by Keewatin lavas and pyroclastics, with which are associated small amounts of clastic sediments and iron formation. Sedimentary rocks of Timiskaming age lie stratigraphically above the Keewatin series and are probably separated from it by an unconformity. Both lavas and sediments are steeply folded and are intruded by granites and porphyries, probably Algoman in age. A few diabase dikes intersect all other rocks and are presumably Keweenawan in age. Glacial deposits have covered the bed rock in some localities.

The various formations may be classified as follows, the oldest being placed at the bottom:—

QUATERNARY	
PLEISTOCENE and RECENT:	Boulder clay, sand, gravel, peat.
	Great unconformity
PRE-CAMBRIAN	
KEWEENAWAN:	Diabase.
	Intrusive contact
ALGOMAN(?):	Quartz porphyry, quartz-feldspar porphyry, syenite porphyry, aplite, lamprophyre. Granite, gneiss, granodiorite.
	Intrusive contact
TIMISKAMING:	Conglomerate, arkose, greywacké, quartzite, and slate.
	Unconformity
KEEWATIN:	Acid volcanics:[1] Rhyolite and rhyolite porphyry, sericite schist, carbonated acid lavas and schists. Sediments interbedded with lava flows:[2] Greywacké, slate, iron formation, graphitic chert. Volcanic fragmentals:[1] [2] Agglomerate, tuff, and volcanic breccia. Basic volcanics:[1] Andesite, basalt, and pillow lava; hornblende and chlorite schist; amphibolite, carbonated basic lavas and schists; altered gabbro and diorite (some of which are intrusive into the lavas).

[1]In some parts of the area the boundaries between basic volcanics, the volcanic fragmentals, and the acid volcanics are quite sharply defined; in other parts, the rocks of these groups are so intermingled that they cannot be differentiated on a large-scale map such as the one accompanying this report. In the latter case, the rocks are all assigned to the division representing the commonest rock type found locally. The boundaries of such a division must be rather arbitrarily defined on the geological map as they represent only a change in proportion of the different rock types present.

[2]Where the pyroclastics are fine-grained and laminated, e.g. bedded tuffs, they cannot be distinguished from the sediments. Thus locally these two divisions may merge into one.

Keewatin Series

The Keewatin series are an assemblage of (1) igneous, (2) pyroclastic or fragmental, and (3) sedimentary rocks. The igneous rocks are largely lava flows and may be divided into two main groups: (a) the dark-green basic type and (b) the lighter-coloured acid variety. Thus, for purposes of study and description, the Keewatin rocks fall naturally into four distinct groups. In some parts of the country these ancient rocks have their original characteristics well preserved, but in many places they have undergone an immense amount of alteration due to folding movements and igneous intrusion. These metamorphosed phases of the different rocks are represented by schists, gneisses, coarse-grained amphibolites, and carbonated rocks. In the older maps and reports on the region,[1] the Keewatin rocks have been differentiated in geological mapping largely on the basis of the metamorphic derivatives rather than the original nature of the rocks. In the following discussion the metamorphosed equivalents of the various rock types are grouped with the less altered phases of a group. By doing this, a more reasonable picture of the original distribution and structure of the different groups of the Keewatin complex is presented than would be obtained by regarding the metamorphic rocks as separate units.

The different members of the Keewatin series are irregularly distributed, and there is no evidence that any one group occupies a particular stratigraphic horizon in the complex. For example, the available structural information shows that the pyroclastics are erratically distributed at many different stratigraphic horizons from near the base of the Keewatin series to the very top. The same statement might apply to the relationship of the acid to basic lavas, although in the northern part of the map-sheet a large area of acid lavas is found at the very top of the Keewatin complex. The Keewatin sediments were deposited locally at different horizons within the volcanics.

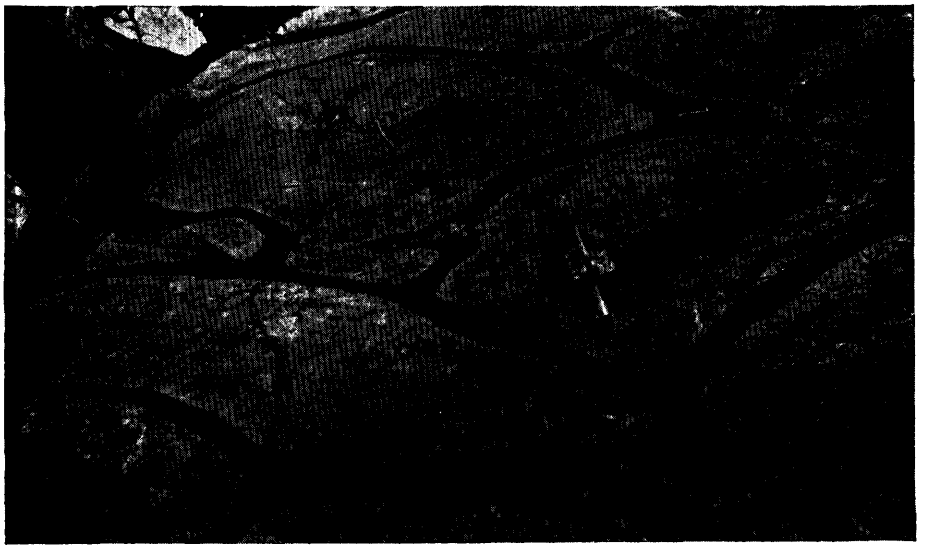
Basic Volcanics

Lavas.—A large part of the Keewatin series consists of lavas ranging from andesite to basalt in composition. They are typically fine- to medium-grained rocks and generally show some alteration. These altered basic lavas are commonly referred to as "greenstones" in the field. In some cases, they show very little variation over considerable areas.

Pillow lavas are rather widely distributed, but the state of preservation of the pillow structures varies greatly. Amongst the best preserved exposures are (1) those on the south shore of island D. 183 and adjacent islands (located between Clearwater and Ptarmigan bays), (2) those on a small island south of the Western peninsula and half a mile north of Bishop point (see photograph on page 7), and (3) those on islands in Wiley bay (Western peninsula), especially island No. 1,001. Pillow structures are sometimes well developed where one or two isolated flows occur between bands of agglomerate. The largest pillows are about 8 feet in length; all gradations are found from this size to those only a few inches long. This type of flow is apt to be amygdaloidal, the amygdules being especially prominent near the margin of the pillows. It is only on rare occasions that the boundaries between similar flows can be recognized, although the contact between an individual acid and basic flow or a basic flow and agglomerate may be observed quite frequently. Most of the basic flows that exhibit a complete cross-section are from 10 to 25 feet in thickness. Thicker flows occur but are almost always covered to some extent with overburden.

[1]A. C. Lawson, op. cit.
A. L. Parsons, Ont. Bur. Mines, Vol. XX, pt. 1, 1911, pp. 158-178.

Lava flows with well-preserved pillow structures afford an excellent criterion for structural determinations. When the necessary observations are accurately made there can be absolutely no doubt of the attitude of these flows. A section across three successive basaltic flows at a well-exposed point on the south shore of island D. 183 between Ptarmigan and Clearwater bays might be taken as an example. The top of these flows is characterized by a narrow brecciated zone that passes downward into pillow structures. These have a characteristic outline due to the fact that the later formed pillow fits into the surface irregularities of the one below it, especially into the triangular space between two older pillows. In some cases the zone of pillows extends across most of the flow, while in other cases the lower part contains fine- to medium-grained lava.



Exposure of pillow lava on a small island south of the Western peninsula and half a mile north of Bishop point.

In a number of places within the greenstone complex there are small areas of basic rock with a coarse dioritic texture that are closely associated with the fine-grained lavas. In many cases this coarse-textured rock grades laterally into typical lava, in which case it is interpreted as being the central part of a flow, which cooled more slowly than the margin, resulting in a coarser crystallization of the constituent minerals. In a few instances this dioritic phase of a flow grades into lava with pillow structure. However, rocks which have a similar appearance but intrude the lavas and associated agglomerate and tuff are also found in the area. These are discussed under the heading of "Basic Intrusives." It is always difficult to distinguish the intrusive from the extrusive rock in the field, and impossible in the case of isolated outcrops. In the accompanying geological map these coarse-textured rocks have not been differentiated from the basic lavas for the reason that no intrusive contacts could be found. The distribution of the larger areas is roughly designated by the symbol "1e."

Occasionally the basic volcanics are fragmental in character. These fragmental lavas are flow breccias and have probably been formed by the shattering of the outer crust of a flow while the interior was still molten. The fragments are of various sizes and have a composition similar to the matrix (see photograph

below). The fragments may be angular or partially rounded. The latter variety has possibly been produced by either movement in the flow or reaction of the rim of the fragment with still molten lava. The lava matrix is uniformly fine-grained; this distinguishes the flow breccia from the agglomerates, described below, which have a matrix of variable grain size and finely fragmental character.

Metamorphosed Basic Lavas.—The greater part of the basic lavas have undergone some alteration. The rock produced by this alteration is dependent upon the type and degree of metamorphism to which the lavas have been subjected. The partially altered greenstone sometimes contains a certain amount of talc, and this soft material forms a poor grade of soapstone. Shearing stresses during the folding of the rocks in the region have locally transformed the basic lavas to chlorite and hornblende schists. Rather narrow bands of fissile chlorite



Basaltic flow breccia, Ash bay.

schists are developed between areas of massive, competent greenstone. These sheared zones probably designate the location of ancient faults along which much movement took place. Zones of intense shearing are found along the south shore of Fox island (south of the Northern peninsula) and on small islands between Whiskey and Mather islands (southeast of the Northern peninsula).

In the vicinity of the granite-greenstone contact along the north shore of Aulneau peninsula, the lavas are intensely deformed and are now largely represented by chlorite and biotite schists, which are highly laminated and intruded by *lit par lit* injections of granitic material. At some horizons, however, the greenstones have undergone recrystallization rather than shearing, and a coarse-grained, massive amphibolite has been formed.

In a few places throughout the area the greenstones have been carbonated locally. These carbonated zones are characterized by outcrops with a reddish-brown gossan due to the weathering of iron-bearing minerals. Hot solutions that carried considerable amounts of carbonates and silica have evidently permeated these areas.

Volcanic Fragmentals

A large part of the area is underlain by fragmental rocks of extremely varied texture, composition, and origin. They consist of agglomerates, massive and stratified tuffs, volcanic breccias, and schistose equivalents. These are intimately associated with all other rock types in the Keewatin series and are interbedded with acid and basic lava flows. The ratio of pyroclastics to lavas varies greatly in different parts of the map-sheet. In some localities there are widespread areas of agglomerate containing only an occasional lava flow. The large band of agglomerate that extends across the northern part of the map area south of the Trans-Canada highway exemplifies this condition. The other extreme shows bands of agglomerate or tuff only a few feet in thickness interstitial between great areas of lava flows. Sometimes the intermixture of these rocks is so complex that only detailed mapping on a small scale would show the true relationships.

Typical agglomerate consists of fragments of light-coloured material, sometimes porphyritic in texture, in a matrix that is generally fine-grained, but occasionally rather coarsely tuffaceous. When the rock is schistose, the fragments are usually elongated parallel to the regional schistosity, but in the massive type they may be quite angular. The fragments show a great range in size, shape, and composition. Some are rhyolite or rhyolite porphyry; others of vesicular texture are probably bombs. Occasionally they are basaltic in composition. On island 94 P., north of Scotty island, the agglomerate contains large angular chert fragments. Throughout the area the agglomerate is predominantly acid in nature and consequently light-grey in colour. Much of the finer-grained part might well be named rhyolite tuff. Such a band extends from Oliver island to Crow Rock island and Wiley bay. This band is very massive and quite acid in composition, and is characterized by large amounts of tuffaceous material, which resembles a quartz-feldspar porphyry in hand samples. This material is distinctly stratified in many places, in which case it was undoubtedly water-laid. Gradation in grain size across individual beds may be clearly distinguished.

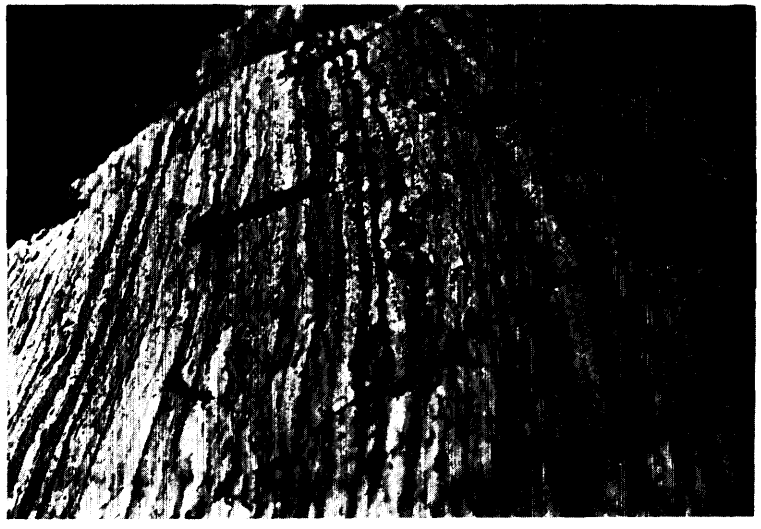
The tuffaceous rocks show much variation. In places coarsely fragmental agglomerate grades into fine-grained tuff, which is well sorted and distinctly sedimentary. It is impossible to distinguish this tuff from an ordinary bedded greywacké. At some points, e.g. the shore of the Western peninsula immediately north of Luella island, narrow bands of agglomerate are interbedded with stratified tuffaceous beds 2 to 4 inches in thickness. Often the tuff contains quartz and feldspar crystals in a cherty or rhyolitic matrix and may or may not contain an occasional bomb-like fragment.

All the fragmental rocks in the area that occur in bands of sufficient size to be shown on the accompanying geological map are grouped together. They are very largely pyroclastics, but some volcanic breccias, i.e., flow breccias, are necessarily included because it is often impossible to distinguish between these rocks of different origin.

The intimate association of these pyroclastics with the lavas is of widespread occurrence throughout the Lake of the Woods region. It indicates that at various intervals during Keewatin time, rock fragments and volcanic ash were ejected from the same subterranean source as the molten lavas and produced the intermingling of the flows and pyroclastics. At certain points the fine ashy material was sorted by erosional agencies and deposited in beds to form the tuffaceous sediments. Even the fragments in the agglomerate are sometimes rounded and pebble-like in appearance as if they had undergone some erosion.

Greer[1] has pointed out that the true agglomerate north of Picture Rock point grades laterally into a type with rounded fragments, which could be termed a volcanic conglomerate. This statement could apply to other localities, especially a number of islands east of Infernal point. The finer-grained tuffs were certainly partly water-laid, and it is very likely that some of the intimately associated agglomerate was affected by the same erosional agencies.

The pyroclastics have been metamorphosed in much the same way as the lavas. They are sheared to sericite schist or chlorite schist, depending upon the original composition of the rock.



Bedded greywacké on the shore of the mainland north of Ferris island.

Sediments

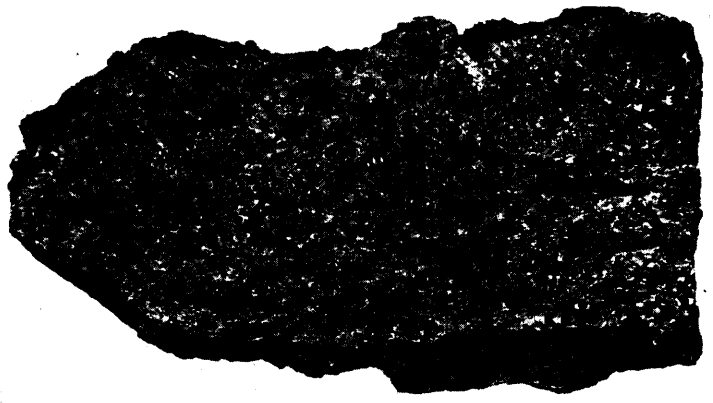
Greywacké and Slate.—It has already been pointed out that some of the well-bedded tuffaceous sediments are indistinguishable from ordinary greywacké. However, besides these sediments associated with the pyroclastics, there are other bands found locally between lava flows. Most of these sediments consist of greywacké, slate, and minor amounts of chert. They are lithologically similar to the sediments of the Timiskaming series, and differ only in their structural relationship. The bands range in width from a few inches to half a mile. Bedding is generally well defined, and the strata may vary from a fraction of an inch to over half a foot in width. They cometimes show distinct gradation in grain size from granular material at the base of a bed to very fine grained slate at the top. In places, thin basaltic flows, sometimes only 2 feet wide, are interbanded with these sediments. An example of this relationship may be seen on the north shore of the southern peninsula of Cliff island (north of Aulneau peninsula).

The largest area of these sediments outcrops on Wiley point, Queen island, Infernal point, and island No. 831. If it is assumed that these areas are part of a continuous band, it would have a length of at least 5 miles and a maximum width of half a mile. The structure of the sediments, as detailed in a later part

[1]Leonard Greer, "Geology of the Shoal Lake (West) Area," Ont. Dept. Mines, Vol. XXXIX, pt. 3, 1930, pp. 45, 46.

of this report, indicates that they are interbanded with the lavas and pyroclastics, i.e. not Timiskaming in age. The sediments are all fine-grained clastics, mostly bedded, but a small amount may be of tuffaceous origin. No lava flows were found within the boundaries of this sedimentary area.

Iron formation.—At two or three places in the area, small bands of lean iron formation are found, but they are so insignificant that they hardly merit description. On the northwest corner of Corkscrew island there is a narrow band of cherty iron formation containing traces of iron oxides. West along the strike this passes into massive chert. The chert is of interest because the black carbonaceous sediments described below are associated with it.



Specimen (one-half natural size) of vesicular graphitic chert from Corkscrew island. Most of the vesicles are empty, but a few are filled with carbon.

Graphitic Chert.—This is a peculiar and unique type of cherty, carbonaceous sediment that is locally characterized by the presence of spherical holes (see photograph above). It is found in a few places around the Lake of the Woods and has been described by Lawson,[1] Parsons,[2] and Greenland,[3] under the name of "carbonaceous schist." Similar rocks have been described in the country east of the Lake of the Woods.[4] The writer prefers the name graphitic chert, owing to the fact that the rock has the composition of a chert and contains a considerable amount of carbon in the form of graphite; it is not always schistose. The rock generally contains a sufficient amount of graphite to soil the fingers on handling. Weathered pieces somewhat resemble gas-blown slag.

Five occurrences of the vesicular rock are known in the area, but by far the best exposures occur on the shore of the northwest corner of Corkscrew island. The vesicular graphitic chert always occurs as part of a band of black slate, massive chert, or lean iron formation. Only relatively few of the black slate bands in the country, however, have the vesicular structure. The maximum observed width of these sedimentary zones was 25 feet. They are always interbedded with altered acid or basic lavas. In the majority of cases the lavas on

[1]A. C. Lawson, Geol. Surv. Can., Vol. I, pt. CC, 1885, pp. 58, 59.
[2]A. L. Parsons, Ont. Bur. Mines, Vol. 22, pt. 1, 1913, pp. 221, 222.
[3]C. W. Greenland, "On the Origin and Structure of the Carbonaceous Schists of the Lake of the Woods," Trans. Can. Min. Inst., Vol. 16, 1913, pp. 584-597.
[4]Jas. E. Thomson, Ont. Dept. Mines, Vol. XLIII, pt. 4, 1934, pp. 9-11; Vol. XLIV, pt. 4, 1935, p. 12.

either side have been greatly sheared and are now sericite or chlorite schists. The cherts, however, by virtue of their composition, have acted as competent rocks and have resisted the shearing movements to such an extent that the vesicles are well preserved. Occasional graphite slip-planes occur throughout the rock. As the chert is composed almost entirely of tiny quartz grains, no platy minerals, such as micas, can develop; and the rock, despite the many holes, is relatively more resistant to shearing stresses than the adjacent lavas. Shearing was evidently localized near the contact of the lavas and this strong competent rock.

The Corkscrew island exposures are worthy of more detailed discussion. Here, a band of sediments has been preserved at various places along the shore and outcrops at intervals for a distance of almost half a mile along the strike. The maximum width of the band is about 25 feet. At this point a detailed section from south to north shows slaty chlorite schist on the south wall, then a series of six interbanded vesicular and non-vesicular chert zones. The vesicular chert ranges in width from 8 feet to less than 1 foot in width. Then comes a zone of black chert 10 feet wide. It is in sharp contact with sericite schist on the north boundary. Samples of typical vesicular chert and the non-vesicular variety were taken from this location for rock analyses, and their composition is recorded below. Contrary to the observations of Lawson,[1] the vesicular chert contains little or no pyrite in the form of round balls filling the spherical holes, although occasionally a few pyrite cubes are found in or near narrow silicified and pyritized zones in the adjoining chert.

Freshly broken samples of the vesicular chert show a dense, black, slate-like groundmass. The spherical cavities generally occur at irregularly located zones in the rock, but some samples are full of these small holes and resemble pumice in texture. The cavities range from half an inch in diameter to microscopic dimensions. The greater number of these are empty, but some are partly filled with rounded masses of graphite; others contain a framework of delicate graphite flakes and fibres. The larger cavities are often enclosed or partly enclosed by a narrow rim of quartz. At a few exposures the vesicles are filled with pyrite or marcasite, but this condition is rare.

Thin sections of the black chert show the rock to be composed of tiny quartz grains with delicate wisps of carbonaceous material interlaminated between bands of quartz. There are also traces of sericite. The vesicular graphitic chert consists of the same mineral assemblage, but the graphite particles are often so numerous that they make parts of the section almost opaque. The primary quartz and graphite of the groundmass appear to have been deposited simultaneously. Secondary quartz occurs as small veinlets, which run in all directions through the groundmass, and also as small columnar crystals arranged in a radial fashion around the rim of a vesicle. Traces of sericite are sometimes found with the secondary quartz.

Chemical tests made on the carbonaceous material show that it is largely in the form of graphite. The soft carbonaceous material that occupies the cavities, when heated over a Bunsen flame, is partially burnt showing that a small amount is amorphous carbon. When the material is boiled in *aqua regia*, however, no noticeable amount goes into solution, showing that by far the greater proportion is crystalline graphite.

Chemical analyses were obtained of both the chert and the vesicular chert from the above-mentioned location on Corkscrew island, and are recorded below.

[1]A. C. Lawson, op. cit., p. 58.

The striking similarity in chemical composition of these rocks shows how closely they are related and suggests a common sedimentary origin. The composition of both rocks checks closely with that of cherts from various parts of the world.[1] Other analyses show considerably more carbon than found in the samples taken by the writer. Lawson[2] states that a sample of the carbonaceous rock was found on analysis to contain 5.77 per cent. carbon, and an analysis by Greenland[3] of similar material from Corkscrew island shows 8.24 per cent. carbon.

ANALYSES OF CHERT FROM CORKSCREW ISLAND

	No. 1	No. 2
	per cent.	per cent.
SiO_2	96.87	94.01
Al_2O_3	1.61	2.27
Fe_2O_3	.03	.59
FeO	.02	nil
CaO	nil	nil
MgO	.22	.32
K_2O	.22	.42
Na_2O	.32	.16
TiO_2	nil	nil
MnO	nil	nil
P_2O_5	.05	.07
CO_2	.09	.11
H_2O	.13	.56
FeS_2	.13	.28
C	.40	1.38
Total	100.09	100.13
Specific gravity	2.655	2.112

Sample No. 1—Black chert, Corkscrew island, Lake of the Woods. Analysis by Provincial Assay Office, 1936.

Sample No. 2—Graphitic chert with vesicles, Corkscrew island, Lake of the Woods. Analysis by Provincial Assay Office, 1936.

The origin of the vesicular rock is rather obscure. Lawson[4] suggests that the confining of gas may have been responsible for the formation of the spherical cavities. Parsons'[5] explanation is as follows:—

> The vesicular structure can probably be best explained by the expansion of gaseous matter in the rock, and is probably due to the coking of carbon compounds, which may have been coal-like deposits or an asphalt vein filling.

Greenland[6] suggests that the vesicles were formed by the removal of pyrite crystals and the subsequent infiltration of silica, and that the carbonaceous material is of inorganic origin and introduced by hot solutions.

The writer would suggest the following origin: Silica, derived by the weathering of adjacent igneous rocks, was transported as colloidal silica and deposited in local shallow ponds or lake basins. This mode of solution and transportion would be similar to that suggested for the Keewatin iron formation by Moore and Maynard.[7] It has already been stated that the graphitic chert passes into lean iron formation along the strike on Corkscrew island. Moore and Maynard[8]

[1]F. F. Clarke, "The Data of Geochemistry," U.S. Geol. Surv., Bull. 770, 1924, p. 551.
[2]A. C. Lawson, op. cit., p. 59.
[3]C. W. Greenland, op. cit., p. 587.
[4]A. C. Lawson, op. cit., p. 59.
[5]A. L. Parsons, op. cit., p. 222.
[6]C. W. Greenland, op. cit., pp. 588-597.
[7]E. S. Moore and J. E. Maynard, "Solution, Transportation and Precipitation of Iron and Silica," Econ. Geol., Vol. 24, 1929, pp. 272-303, 365-402, 506-527.
[8]Ibid, p. 524.

postulate the presence of organic matter in the solutions carrying the iron and silica, this organic matter preventing the iron and silica from mutually precipitating one another until they are finally deposited by the electrolytes of the sea. In the case under discussion, the solutions were almost devoid of iron but rich in silica. The precipitation and consolidation of the silica along with the closely associated organic matter would form the black cherts. These contain a relatively small amount of carbon. At intervals, however, a large amount of organic material may have been collected with the silica to form a thick ooze. It is within the realm of possibility that gases, such as carbon dioxide, methane, and other hydrocarbons formed by the decay of the organic remains under these conditions, would be entrapped, and thus produce the bubble holes or vesicles. The subsequent breaking-down of these confined gases would produce the carbon now found within the vesicles. In support of this idea it may be pointed out that in the analyses shown above the vesicular chert contains between three and four times the amount of carbon found in the ordinary chert. According to this explanation, the vesicular phases of the chert would represent horizons where a proportionately large amount of organic material was entombed. Most of the carbon would be altered to graphite during the subsequent folding of the Keewatin series and the granitic invasion. At that time, also, the secondary quartz and pyrite or marcasite could have been introduced into the cavities.

The above hypothesis postulates the presence of life in Keewatin time, probably in the form of primitive plants or animals. It would be impossible to actually prove the presence of lowly organisms in this case, but several geologists[1] have expressed the opinion that such forms probably existed at that time. It seems more logical to assume the presence of organisms during the Keewatin period than to seek an explanation through the introduction of the carbon from magmatic sources, for which there is no particular evidence. Graton and associates[2] consider that the Keewatin carbonaceous sediments in the Porcupine area are of organic origin.

Acid Volcanics

Lavas.—Rhyolite, rhyolite porphyry, and their schistose equivalents are rather widespread throughout the area, but generally occur as small bands interbedded with other members of the Keewatin complex. The largest area of these acid lavas is found on Rat Portage Indian Reserve No. 38A and on Corkscrew island. The rhyolite is characteristically lighter-coloured than the basic flows and varies from pink or grey to creamy-white in colour. It is generally massive and very hard, and has a dense, cherty appearance. The rhyolite porphyry contains quartz phenocrysts in a cherty, rhyolitic matrix. It is virtually impossible to distinguish this extrusive rock from the intrusive quartz porphyry in hand samples, and any differentiation between the two must be made by a study of their field relationships. In several places throughout the area intrusive quartz porphyry intersects the rhyolite, and there is no doubt as to the age relationships of these rocks. Fine exposures of porphyry intruding rhyolite may be seen on the east side of island No. 757, south of Infernal point (Crow Rock island), and on Mather island.

On the northwest side of Poplar bay (east of the Northern peninsula), a schisted, reddish-grey, rhyolitic rock with conspicuous quartz phenocrysts is found. Westward on White Partridge bay this grades into a normal rhyolite,

[1]See E. S. Moore and J. E. Maynard, op. cit., p. 523.
[2]L. C. Graton, H. E. McKinstry, and Others, Trans. Can. Inst. Min. and Met., Vol. 36, 1933, pp. 4, 5.

which may be traced around the nose of a belt of Timiskaming sediments and west along the southern contact for a distance of 6 miles. There is no evidence that the rhyolite or rhyolite porphyry intrudes the sediments, but the conglomerate of the sedimentary series contains pebbles of the rhyolite. At some places the rhyolite shows flow structure, and narrow bands of agglomerate are interbedded with it. The Western peninsula contains many small bands of rhyolite. When interbanded with the basic lavas this rhyolite always has a sharp contact with them.



Rhyolite breccia on a small island west of island G. 772 in Ptarmigan bay.

The rhyolite throughout the area is often brecciated and associated with acidic phases of the agglomerate. Where shearing has masked the original structure it is often very difficult to differentiate between the acid pyroclastics and the brecciated acid extrusives. A fine exposure of rhyolite breccia occurs on a tiny bare island a quarter mile west of island G. 772 in Ptarmigan bay (south of the Northern peninsula). Here masses of rhyolite, sometimes many feet in diameter, are lodged in a slightly darker coloured matrix (see photograph above). This may have been formed by the shattering of the consolidated crust on the surface of a flow and the engulfing of the fragments in the still molten interior.

Metamorphosed Acid Lavas.—The rhyolitic rocks are greatly altered at some points. In the initial stages of deformation they have simply tended to brecciate

but have yielded to intensive stresses by shearing along local lines of weakness to form sericite schist. This same schist has also been produced by schisting of acidic phases of the agglomerate and tuff or acid sediments. It is thus not always possible to state the origin of the schist.

The rhyolite, especially the schistose phases, is sometimes carbonated in much the same way as the basic lavas.

Basic Intrusives

Certain small dikes or narrow bands of dark-green to greenish-grey basic rocks of medium to coarse texture are intimately associated with the basic lavas. They are generally massive, but are schisted locally, and the mineral constituents are always considerably altered. In the field they may be roughly classified as altered diorite or gabbro.

In a previous section of this report it has been shown that some of these coarse-grained rocks are phases of Keewatin lava flows. In a few places, however, the diorite or gabbro is intruded as dikes that intersect the lavas and agglomerate. In two or three places in the area long narrow bands of coarse-grained dioritic rock strike parallel to the flows. It is probable that this diorite occurs as sills, which were injected parallel to the flows and were derived from the parent magma that produced the lava. Such a sill-like mass of diorite may be traced for about 5 miles in a general direction of N. 60° E. across the central part of Ferris island and the neighbouring islands. The width of the band averages about 300 feet. The strike is parallel to that of adjacent bands of bedded tuff and lava flows.

Sometimes these sills are very narrow and so similar to the lavas that they can be detected only in exceptionally good rock exposures. For example, on the wave-worn shore of a small island north of Copper island in Ptarmigan bay, a diorite sill, 6 feet in width, lies between two flows of pillow lava and shows a sharp intrusive contact. The intrusive nature is accentuated by wave action, but ordinarily this relationship could not be recognized and the rock might easily be taken for an extrusive.

A band of rock, quite basic in composition and distinctly porphyritic in places, extends along the north side of Welcome channel (east of the Northern peninsula) for almost 3 miles. A sample taken from the extreme northeastern tip of the large island northwest of Thompson island was examined microscopically. It proved to be a serpentinized pyroxenite porphyry, and contained large crystals of augite, altered in part to serpentine, in a dark indistinguishable groundmass. Parsons[1] has discussed this band of basic rock and suggested that it may be a basic phase of the Keweenawan diabase dikes. The writer would be inclined to regard it as a phase of the Keewatin basic intrusives.

In the Bigstone Bay area, which adjoins the map-sheet on the east, Suffel[2] has mapped similar bands of diorite, which are regarded as intrusive. At the Wendigo mine they are sill-like in character.[3]

Timiskaming Series

A band of sediments, which lies stratigraphically above the Keewatin complex, runs in an east-west direction across the south side of Clearwater and White Partridge bays. On White Partridge bay this belt is broken into two parts: One branch continues eastward to the end of the bay; the other runs northeast to

[1]A. L. Parsons, op. cit., p. 225.
[2]G. G. Suffel, "Geology of the Bigstone Bay Area, Lake of the Woods," Ont. Dept. Mines, Vol. XXXIX, pt. 3, 1930, p. 65.
[3]Jas. E. Thomson, Ont. Dept. Mines, Vol. XLIV, pt. 4, 1935, p. 36.

Abernethy lake. These sediments consist of conglomerate, arkose, greywacké, slate, and quartzite. No pyroclastics or lavas occur within the boundaries of the sedimentary series. Bedding is generally well preserved, especially in the finer-grained clastics, but some of the arkose is very massive and shows no evidence of sorting over considerable distances. The beds range in thickness from a fraction of an inch to over 2 feet. In many places they show a gradation from relatively coarse-grained sandy material at the base to very fine grained slate at the top. Fine exposures showing this kind of sedimentation may be seen on island P. 105 and in outcrops near the entrance to White Partridge bay. At one or two places in this vicinity wave ripple marks are rather well preserved in bedded greywacké. On the south side of island P. 105 the fine-grained clastics grade into tiny bands of iron formation.



Timiskaming conglomerate showing rounded granite boulders, north shore of White Partridge bay.

Conglomerate is not widely distributed throughout the sedimentary series. The best exposures are found on the north side of White Partridge bay about a mile east of the entrance, and also about a mile northeast of this point. The conglomerate consists largely of pebbles ranging in size from quite small ones up to 8 inches in diameter. They are well rounded and lodged in an arkose or greywacké matrix. Sometimes thin bands or lenses of conglomerate alternate with thicker arkosic strata. In some instances such arkose shows a rude cross-bedded structure. A composite estimate of different kinds of pebbles in the conglomerate, made from several exposures, shows the proportion to be about as follows: granite and porphyry, 45 per cent.; basalt and dioritic greenstone, 25 per cent.; rhyolite, 20 per cent.; vein quartz (?), 5 per cent.; cherty iron formation, 5 per cent.

A poorly developed basal conglomerate occurs in contact with basic lava on the northwest corner of the large island north of Corkscrew island. The greater part of the conglomerate, however, either lies stratigraphically some distance above the base of the sedimentary series or else has been thrust up to the present erosion surface by minor folds, thus exposing the basal horizons.

Arkose is a rather common phase of the finer-grained clastics. Where typically developed, it is a massive, cream-coloured rock containing angular quartz and feldspar grains up to a tenth of an inch in diameter. In hand samples it is not unlike the intrusive quartz porphyry in appearance. Under the microscope, however, the sedimentary nature is definitely determined; angular frag-



Bedded greywacké of the Timiskaming series, south shore of White Partridge bay.

ments of quartz and feldspar crystals occur in a fine-grained groundmass. The grains have been water-sorted and are of uniform size. The name greywacké is applied with rather loose significance to those fine-grained, thin-bedded clastics that are partly slate and partly quartzite or arkose and may often be seen to grade from one into the other. In some parts of the sedimentary series bands of dark-grey or black, thin-bedded slates occur. These are metamorphosed clays.



Bedded slates of the Timiskaming series, south shore of Clearwater bay.

Algoman(?)

Granites and Gneisses

The granitic rocks in the area occur (1) as the border phases of large granite batholiths lying north and south of the greenstone belt on the Lake of the Woods, and (2) as small intrusive stocks within the boundaries of the older lava-sedi-

mentary complex. So far as could be determined, these rocks were intruded during one period of plutonic invasion, although there is a considerable variation in texture, composition, and colour, and gradations from one type to another.

The granite may be generally described as a medium- to coarse-grained rock, pink to grey in colour. It is mostly massive, but gneissic phases occur, especially near the main granite-greenstone contacts. The ratio of hornblende to biotite varies with the locality, the hornblende variety being more abundant near the greenstone contacts.

Contact conditions between the granite and greenstone vary somewhat in different localities. North of the Trans-Canada highway the granite-greenstone contact is quite sharply defined. In contrast to this the contact in places along the north side of Aulneau peninsula is of the gradational type. The greenstones near the contact are highly sheared to chlorite and mica schists and injected by granite dikes in a *lit par lit* fashion. In the transition zone the number of these granite dikes gradually increases until the rock is predominantly granite with occasional xenoliths of mica schist. This is not always the case, for on the east side of Beaver inlet the contact is quite sharply defined.

The numerous small stocks all contain very massive, fresh-looking granite, sometimes quite quartzose. Often small quartz veins and lenticular quartz masses occur in this granite. The contacts between these stocks and the greenstones is always very sharply defined. The granite stock south of Quandary bay contains a more basic marginal phase, which has the composition of granodiorite.

The age of the granite and associated porphyries cannot be very definitely stated. No granite or porphyry dikes were found to intersect the Timiskaming sediments, but a lamprophyre dike cuts them on a small island immediately west of the large western peninsula of Rat Portage Indian Reserve No. 38A. As shown below, the lamprophyre and porphyries are intimately related and of the same general age as the granite. This would indicate a post-Timiskaming age for the granitic intrusives. Lawson differentiated the large granitic areas bordering the greenstone belt, which he thought were granitoid gneisses of Laurentian age, from the small stocks of massive granite. He states that the granite is later in age than the granitoid gneiss, which he correlated with the Laurentian period.[1] However, as stated above, the writer can find no reason for any such distinction and considers that any differences in the nature of the granitic rocks may be due to either differentiation within the granitic magma or the assimilation of basic lavas near the contact with these older rocks. At present there does not seem to be a great deal of evidence that the Laurentian granite is exposed to any extent in the western part of Ontario, and for this reason the writer would be inclined to regard the granitic rocks as very largely, possibly entirely, of Algoman age. There is no doubt that a pre-Timiskaming granite did exist somewhere in the Lake of the Woods region, but where it is now or how it disappeared is still somewhat of a mystery.

Porphyries and Related Intrusives

This group consists of the porphyries, aplite, and lamprophyre. The association, composition, and geological relationships of these rocks shows that they are very closely related to the granites and probably derived from the same parent magma. Porphyritic or aplitic phases may occasionally be found in the granite or vice versa.

A large percentage of the porphyry occurs as dikes or sills. These range from dikes a few inches in diameter to sill-like masses, the largest of which is a

[1]A. C. Lawson, op. cit., p. 100.

quarter of a mile in width and over 2 miles in length. They have been largely injected parallel to or nearly parallel to the strike of the schistosity of the adjacent rocks. The porphyries are typically dark-grey to cream coloured rocks, generally massive but sometimes schistose, and distinguished by the presence of distinct "eyes" of quartz, feldspar, or both minerals. Syenite (feldspar) porphyry differs from the quartzose variety only in the occurrence of feldspar phenocrysts instead of quartz. The majority of the porphyry bodies contain both quartz and feldspar phenocrysts and are thus quartz-feldspar porphyries. The aplite is a dense, fine-grained intrusive and is a finely crystalline equivalent of the granite. Aplite dikes frequently intersect the granite. On the west side of Ash bay there is a band of fine-grained aplitic intrusive rock. This is similar to the rock which Lawson[1] and Greer[2] have named felsite in the adjacent Shoal Lake area.

At a few places the porphyry grades laterally into a non-porphyritic rock of rhyolitic appearance. This condition is well shown in island D. 167, located a half mile northwest of Aylmer point on Thompson island. On the west side of this small island there is a massive syenite porphyry with distinct porphyritic texture. This grades into massive rhyolitic rock on the east side. On the mainland a short distance southwest along the strike the same porphyritic phase distinctly intrudes the greenstones. On island No. 1,144, north of D. 167, the same gradation of porphyry into a rhyolitic phase may be seen.

Some of the porphyry dikes contain a large amount of quartz. This occurs as a stockwork of small veins and stringers, which run in all directions throughout the dike. The pattern formed by the quartz suggests that it occupies tension cracks which were developed by shrinkage of the dike on cooling from a molten condition. Such dikes are generally mineralized with small amounts of disseminated sulphides and are known to contain gold values in a few places.

Lamprophyre dikes are occasionally found. They intrude the Keewatin and Timiskaming rocks and appear to be about the same age as the porphyry. A splendid exposure on the southwest side of island D. 208 (southeast of Crow Rock island) shows the typical relationship of these rocks. Here five successive dikes have been injected into rhyolite tuff. These are alternately syenite porphyry and basic lamprophyre. Although all these dikes run in a parallel direction and are continuously in contact with one another there is no sign of one type cutting the other. The two kinds of rock are distinctly different in appearance, and the contact between them is sharply defined. This same intimate association may be seen in other places and shows the contemporaneity of age between the porphyry and lamprophyre.

The lamprophyre dikes are generally less than ten feet in width. The rock is dark-coloured and medium- to fine-grained, and often contains much mica, usually biotite.

Keweenawan

A few large diabase dikes run in a general northwest-southeast direction across the area, and are presumably part of the Keweenawan basic intrusives so commonly found in the Lake Superior region. Some of the dikes are very persistent and have been traced great distances along the strike. They intersect all other formations in the country. The rock is a quartz diabase, and quartz, orthoclase, labradorite, augite, hornblende, and titanite are the constituent minerals revealed by the microscope. Some of the dikes attain a width of 300 feet.

[1]A. C. Lawson, op. cit., pp. 90-101.
[2]Leonard Greer, op. cit., p. 49.

The diabase in the interior of these large dikes is very coarse grained and roughly banded parallel to the contact. The diabase has been discussed in detail by Parsons.[1]

Pleistocene and Recent

The most extensive drift-covered section of the area is on the Northern peninsula and part of Corkscrew island. Throughout the remainder of the area rock outcrops are abundant, although overburden lies everywhere in the depressions. Morainal deposits of boulders and clay are occasionally seen. A mile and a half west of Beaver inlet there is an east-west trending gravel and sand ridge that is either a kame or an outwash deposit.

A small amount of conglomerate occurs on the south shore of the long peninsula directly north of Victoria island in Ptarmigan bay. The conglomerate lies unconformably on pre-Cambrian rocks and consists of an assortment of water-worn pebbles, including granite, porphyry, and slate. The pebbles are cemented in a limonitic sandy matrix. On the property of Brae-Breest Gold Mines, trenching through overburden about a claim length to the west of the camp has exposed an interesting geological section. A 4-foot deposit of reddish-brown conglomerate lies unconformably on the pre-Cambrian rocks. This contains pebbles of granite, greenstone, and chert, and is well cemented by ferruginous material. A 6-foot section of bedded glacial sand and silt lies on this conglomerate with apparent conformity. The contact between the two sedimentary types is sharply defined.

There are two possible explanations for the occurrence of this conglomerate. It may be glacial gravel cemented by circulating iron-bearing solutions. On the other hand it may be a preserved remnant of some earlier geological period. Isolated patches of Cretaceous conglomerate in the Mesabi district of Minnesota[2] have a similar appearance. It is not known that the Cretaceous seas advanced over the Lake of the Woods district, but it seems possible that they did so. The eastern boundary of the Cretaceous sediments now lies about 150 miles to the west in Manitoba.

The glacial phenomena on the Lake of the Woods have been discussed in great detail by Lawson.[3] Everywhere throughout the country there is evidence of the polishing and grooving effects of the ice passage. The direction of ice movement, as indicated by glacial striae, ranges between S. 27° W. to S. 65° W.

STRUCTURAL GEOLOGY

A certain amount of information regarding the structural features in the map area has been obtained in those parts where the primary structures, such as bedding, pillow structures, etc., are well preserved. Any attempt, however, to trace the continuity of these structures over wide areas is hindered by the large expanses of water and, to a lesser extent, of overburden. A further impediment lies in the fact that the rocks over considerable areas are schistose, and the primary structures by which the attitude of the formations might be determined have been destroyed. Accordingly, while there are areas where the structure may be interpreted with a fair degree of accuracy, the determination of the relationship of these to the intervening areas where no reliable information can be obtained is accompanied by a certain amount of conjecture.

In general, the rocks of the Keewatin and Timiskaming series have been so closely folded into anticlines and synclines that individual lava flows or beds now

[1]A. L. Parsons, op. cit., pp. 222-225.
[2]C. R. Van Hise and C. K. Leith, U.S. Geol. Surv., Mon. 52, 1911, pp. 178, 179.
[3]A. C. Lawson, op. cit., pp. 130-140.

have a vertical or nearly vertical dip and in some cases have been overturned. Thus, a measure of the dip of an individual flow or bed has no significance as to its location on a fold. The general strike of the axes of the folds over a large part of the area would average about N. 80° E; this swings more towards the northeast in the southwestern corner of the map-sheet. Flow contacts, sedimentary strata, and the schistosity consequently have the same general strike, except where distorted by some local influence. The tops of the strata may be determined by (1) gradation in grain size across individual beds, (2) the relation of secondary cleavage to the bedding, (3) cross-bedding, and (4) on rare occasions, wave ripple marks. In the lavas the top of an individual flow may be recognized by the shape and position of the pillow structures, as previously described. A certain amount of discretion must be exercised in the use of these data, for, unless they are fairly well preserved and well exposed, erroneous deductions may easily be made. The most satisfactory results are obtained in those areas where these criteria may be compared with one another. For example, in areas of interbanded lavas and sediments the pillow structures in the lava may be checked against gradation in grain size or cross-bedding in the sediments.

Folding of the Keewatin Series

The most convenient method of discussing the folding of the Keewatin rocks and their relation to the Timiskaming series is by reference to a section across the map area along a line where the rocks are typically developed. All the reliable determinations of flow tops and tops of beds that were made are shown on the accompanying geological map (No. 45b). The interpretation of the structure along the section A-B is based on this information.

North of Clearwater bay no determinations of the attitude of the flows or pyroclastics were obtained, owing to the alteration of the lavas near the granite contact and the absence of stratified horizons in the agglomerate band. However, the structure across the Timiskaming sediments, discussed below, is synclinal, the axis of the folds striking about N. 85° E. near the section line. Between these sediments and the north side of Corkscrew island the lava flows west of the line of section face north. No further information about the attitude of the flows is obtained until the south side of Ptarmigan bay is reached, although on Victoria island to the west the flows face north. At three points on the south shore of Ptarmigan bay the flows and tuffs face north. North of Luella island one point shows the tops facing south. Three miles south of Ptarmigan bay, an anticlinal axis, trending about N. 80° E., which extends across the middle of Mather, Shammis, and Crow Rock islands, and the Western peninsula, would intersect the line of section. Along the north side of these islands the members of the Keewatin formation face north, whereas south of the anticlinal axis the tops are south wherever determined.

Thus at various intervals from the Crow Rock anticlinal axis north to the synclinal axis of the Timiskaming sediments on Clearwater bay the members of the series are found generally facing in the same direction. It is possible that this is a continuous succession of lavas and pyroclastics on the north limb of the Crow Rock island anticline with minor folds superimposed on it, accounting for the occasional top facing south. At two points north of island G. 772 (south of the Northern peninsula) poorly developed pillows suggested south-facing tops, but the evidence was discarded as unreliable. Since the flows and sediments stand almost vertically, the Keewatin series would have an apparent thickness of 7 miles along this line of section if the effects of possible faulting, minor folds, and pre-Timiskaming erosion were disregarded. There is the possibility, however,

that faulting parallel to the strike of the folds may have effected the apparent thickness of the series. Intense east-west shearing along the south side of Fox island and points to the west show the probability of faulting along Ptarmigan bay. Similar shearing at other places across the section, e.g. the north shore of Nancy lake, may also be due to faulting.

South of the Crow Rock anticlinal axis a number of determinations on both sides of the line of section show the tops to face south until Quandary bay is reached. Somewhere between Quandary bay and the southern part of Kennedy island there is another synclinal axis. From Kennedy island to the southern granite contact the few observations obtained show that the lavas and sediments face north. Similar determinations in the southeastern part of the map-sheet indicate that the east-west trending Quandary bay synclinal axis passes somewhere in the vicinity of island D. 27 or Crescent island. West of Quandary bay this same synclinal axis exists but is not very closely defined; it must be somewhere between Bishop point and Lily island. The meagre evidence available from a few locations near the line of section suggests that the axial plane of this syncline dips about 70° to 80° S. and that the flows and sediments on the south limb are overturned to this extent.

The thickness of the Keewatin series between the Crow Rock island anticline and the Quandary bay syncline would be between 5 and 6 miles, if it is assumed no complications exist other than simple folding. The estimate on the southern limb is probably more accurate than on the northern one because there is no concrete evidence of fault movements or minor folds along the line of section. The above estimate would include the Queen island sediments, which have a maximum width of half a mile. The tops of the beds face south across this whole band of sediments and it is only a horizon in the Keewatin complex.

It is interesting to compare the above structural evidence with that obtained by Greer[1] in the adjoining Shoal Lake area. A synclinal axis was found to pass through the northern part of Shoal lake in Indian bay. To the south of this an anticlinal axis lies about a mile north of Galt island. If the Crow Rock anticlinal axis on the Lake of the Woods were projected westward at an angle of W. 10° S., which is its general strike, it would coincide almost exactly with the Shoal lake anticlinal axis. Greer considers that the Keewatin series on the northern limb of this anticlinal axis is about 5½ miles in thickness, if faulting and drag-folding are disregarded. Insufficient data were secured on the south side of Shoal lake to work out the structure, but near Picture Rock point Greer found the lava flows faced south. This agrees with the evidence near Bishop point on the Lake of the Woods.

The above information suggests that two major synclines with an intervening anticline trend in a general east-west direction across the central part of the Lake of the Woods and Shoal lake. It must be remembered, however, that no structural information has been obtained over considerable areas in certain parts of the country, and further detailed examination may modify this conception. There is every reason to believe that this simple picture has been complicated by faulting and superimposed minor structures. The branching of the Timiskaming series on White Partridge bay implies a split in the synclinal axis in that vicinity and the presence of an intervening anticline in the Keewatin series. However, no structural details about the Keewatin rocks were obtained other than the line of contact with the adjacent sedimentary belt.

The three above-mentioned estimates of the apparent thickness of the Keewatin series in different parts of the Lake of the Woods region by Greer and

[1]Leonard Greer, op. cit., p. 52.

the writer range from 5 to 7 miles. These make no allowance for the effect of probable thickening of the section by faulting and minor folds or thinning by erosion before the deposition of the Timiskaming rocks. Greer[1] supposes that the true thickness of the Keewatin rocks in the northern part of Shoal lake may be at least 4 or 5 miles. A similar estimate might be made for the true thickness of the adjacent sections in the north central part of the Lake of the Woods, but it can have only a very general significance for the reason that there must have been considerable variation in the original thickness of the lavas, sediments, and pyroclastics that make up the series. Lawson has elaborated on this point regarding the stratigraphy of the Keewatin series as follows:[2]—

> The conception of the series as a mixture of altered volcanic *ejectamenta* and aqueous sediments, laid down sometimes synchronously, and sometimes in alternations, implies the accumulation of overlapping and interchanging strata, differing in lithological character, some of which might be largely developed in one portion of the basin, and be very meagrely represented or altogether wanting in another at no great distance away.

Although the value of the above estimate of the thickness of the Keewatin series is weakened because of the lack of detailed data, it nevertheless gives some conception of the enormous thickness of lavas and pyroclastics that piled up during Keewatin time.

Folding of the Timiskaming Series

The sedimentary rocks on Clearwater and White Partridge bays are folded into two synclines with an intervening anticline. Excellent exposures in the vicinity of the line of section A-B offer structural criteria that prove the above statement. Along the north side of island P. 105 in Clearwater bay, gradation in grain size shows that the beds face south, while on the southern side of the island the beds face north. This narrow, closely folded syncline is overturned so that its axial plane dips to the north at an angle of 70 to 80 degrees. A narrow band of sediments is found at a few places west of island P. 105 for about 2 miles along the strike and is probably an extension of this syncline. East of island P. 105 this synclinal axis probably extends along the northern branch of the sedimentary belt that runs northeast to Rock lake.

On the shore of the large island south of P. 105 the beds face south, but near the southern contact with the lavas several determinations on the north shore of the long bay west of the narrow isthmus showed that the beds face north. Here again is a syncline. The synclinal axis in all probability extends eastward along the belt of sediments on the south side of White Partridge bay.

Evidence of Unconformity

The structural features show that the Timiskaming series lies stratigraphically above the Keewatin complex. On the south side of the main synclinal axis both lava flows and strata face north. Near the western nose of this syncline one point in the lavas near the contact on the north limb showed the top to face south in harmony with the attitude of the sediments in that vicinity. The nature of the sediments is strongly suggestive of an unconformity between the Timiskaming and Keewatin series. As previously stated, the conglomerate contains rounded boulders of greenstone, rhyolite, and iron formation that undoubtedly have been derived from the erosion of the Keewatin series. The type of sedimentation in the Timiskaming rocks suggests that the strata are of terrestial

[1]Leonard Greer, op. cit., p. 52.
[2]A. C. Lawson, op. cit., p. 101.

origin and were laid down in shallow lakes or seas. The conglomerate was probably derived from a country of pronounced relief and the boulders transported by streams, thus producing rapid erosion and deposition.

No evidence of a structural unconformity was obtained from any point at the immediate contact between these formations. An unconformity, however, is suggested from structural data not far from the contact. The best evidence is found near the east end of the lake immediately south of Abernethy lake. Six hundred to seven hundred feet from the contact the bedding in a narrow cherty horizon in the tuff and agglomerate strikes N. 75° E. Five hundred feet north of this point a slaty horizon in the pyroclastics strikes N. 65° E. The sediments on the lake near the contact strike N. 35° E. Here is an angular discordance in strike of 30 to 40 degrees between the Keewatin and Timiskaming series. Due to lack of good exposures this was not checked at any other place along the contact.

It might be noted that on island D. 183 (northwest of Corkscrew island) and points eastward, the strike of the lava flows is N. 72°-75° E. About a mile east across the lake along the strike of the flows the sediments have a general east-west strike. There is thus some suggestion of an angular discordance, but considering the distance by which these structural features are separated, it cannot be regarded as very reliable evidence.

Faulting

Reference has already been made to the strong sheared zones that strike parallel to the axes of folding. These are probably lines of faulting movements along which the stresses that caused the folding were relieved to some extent. The sediments on Queen island have been offset a small amount by cross-faults. The bedding is distorted and locally drag-folded in the vicinity of the faults, especially near the western one. There is some suggestion that the diabase dikes have been offset by faulting movements at certain points.

Fracturing and Shearing

In a general way, the rocks in the area have yielded to deforming stresses in two different ways depending upon the original nature of the rock. The hard competent rocks, such as cherty rhyolites, intrusive porphyry and granite in the form of dikes or small stocks, and arkosic or quartzitic sediments, have yielded by brecciation or fracturing. On the other hand, the basic lavas, slates, agglomerates, and basic tuffs have sheared to form micaceous schists. Thus, a system of fractures is sometimes found in porphyry dikes, and the fractures are filled with quartz veins or veinlets. Similarly, veins, lenses, or stockworks of quartz are found along fractured zones in small stocks of granite. Fracturing was also observed in arkose and rhyolite. The shearing movements in the softer rocks have not been distributed uniformly but rather concentrated along or near local lines of weakness, while intervening rocks are more massive.

It is interesting to note the amount of granite and porphyry intrusion along the anticlinal axis that runs in an east-west direction across Crow Rock, Shammis, and Mather islands. This anticlinal axis must have constituted a particular line of weakness.

HISTORICAL GEOLOGY

The geological history of the area, covering untold millions of years, may be briefly summarized. The earliest known period (Keewatin) was a time of great volcanic activity. Lava flows were poured out through vents or fissures. At

various intervals the vulcanism was featured by violent explosions that hurled forth rock fragments and great quantities of volcanic ash along with the molten lava. During certain quiescent periods erosional agencies carried some of the material into local bodies of water. The sand, mud, iron oxide, and possibly even primitive forms of life in these shallow basins were eventually consolidated into strata and covered by more volcanic material. Towards the close of the period granitic intrusion must have taken place somewhere, probably coincident with a limited amount of rock-folding and mountain-building. A period of erosion followed during which the rugged mountains were worn down, granites were exposed and eroded, and this rock material was deposited locally in lakes or seas as gravel, sand, and mud. These eventually consolidated to form the Timiskaming sediments.

Great mountain-building movements again affected the region. The Keewatin and Timiskaming rocks were thrown into close folds, and in some places the pressures that produced the folding were relieved in part by faulting. Contemporaneous with or following the folding came the intrusion of an enormous amount of granite (Algoman). Some of this worked up through the older rocks and is found to-day in bodies of various shapes known as stocks, batholiths, and dikes. Offshoots from the granite mass formed the porphyry bodies. It is thought that the gold-bearing veins were formed at a very late stage in this period of granitic intrusion. During a later period of disturbance (Keweenawan), which affected the whole Lake Superior country, the diabase dikes were intruded into all the older rocks.

A great erosion interval followed the Timiskaming-Algoman period of mountain-building. This exposed a large part of the granitic core of the ancient mountains and removed much of the Keewatin greenstones and Timiskaming sediments throughout northwestern Ontario. The net result is that these greenstones and sediments are now preserved only in the deepest parts of the ancient folds, and widespread areas of granite occupy the intervening country. This means that quartz veins and intrusive rocks now exposed were originally formed at great depths below the surface.

Within comparatively recent geological time (Pleistocene), the continental ice-sheet advanced over the country, scouring and polishing the weathered rock surfaces. The thin mantle of sand, gravel, and clay that overlies the bed rock, and the imperfect drainage system of the country, are all the result of this glaciation.

ECONOMIC GEOLOGY

Nature of the Gold Deposits

The only mineral resources within the map area that are of economic interest are the gold deposits. Gold is found at a number of locations in different parts of the area, but at only a very few places is it known at present that there is sufficient continuity in size and grade to constitute some promise of an ore body. Gold generally occurs in quartz veins. These veins have been found in greenstone, rhyolite, agglomerate and tuff, granite and porphyry. The veins in the lavas and pyroclastics occupy sheared zones or fractures; they are sometimes lenticular in outline, sometimes branch in the form of a lode or composite vein, or may occupy a single fissure and have well-defined walls. The veins within small stocks of granite or porphyry may form a stockwork of quartz in irregularly located fractures (e.g. the Gold Mountain mine and possibly the Norah mine) or may be "true fissure" veins. Quartz veins in porphyry dikes are inclined to be

irregular in shape, size, and distribution. Sometimes a porphyry dike containing a network of quartz veinlets and having disseminated sulphide mineralization may be traced for a considerable distance.

The auriferous veins may contain tourmaline and carbonate and varying amounts of such sulphides as pyrite, chalcopyrite, galena, and arsenopyrite, and also native gold. Different generations of quartz occur at the Kenricia mine.

Most of the known gold occurrences in the area are found either in or near dikes or small stocks of porphyry or granite, and there is reason to believe that the gold deposits are genetically related to these intrusives. The quartz veins are later in age than the granite and porphyry; the gold mineralization, in some cases at least, is later than part of the quartz. It is, therefore, evident that the gold-bearing solutions must have been one of the last differentiates from the granitic parent magma.

Prospecting Conditions

In estimating the mineral possibilities of an older mining district such as the Lake of the Woods, there is always a tendency to consider that it was pretty thoroughly prospected during previous periods of mining activity. While it is undoubtedly true that there has been sporadic prospecting in this country over a long period of years, yet the very fact that a property is as readily accessible as the Kenricia mine was dormant from 1890 until 1935 shows that the country still deserves detailed examination by prospectors and field engineers.

Throughout the Lake of the Woods region the majority of the gold deposits are found in the greenstone complex at or near its contact with bodies of granite and porphyry intrusives, especially where the rocks are fractured, sheared, or otherwise ruptured to serve as a source of access for the mineralizing solutions. Dikes and small stocks of these intrusives occur in several parts of the north central part of the Lake of the Woods; in many places the rocks have undergone considerable deformation, as described in a previous section of this report. With these geological conditions, the area may be regarded as containing favourable prospecting territory.

Quartz veins occur in many parts of the area, but a greater number than usual were noted in the following localities: (1) the southern part of the Western peninsula, (2) the burnt-over country northeast of Portage de Bois (near porphyry intrusives), (3) near bodies of porphyry in the vicinity of Bath and Gull islands (north of Cliff island), (4) along a zone of porphyry and granite intrusives on Crow Rock, Shammis, and Mather islands.

Mineralized porphyry dikes that contain quartz veinlets are known to carry gold values in at least three places within the area. A number of mineralized dikes were seen in different parts of the area. The dikes generally carry disseminated sulphides including pyrite, chalcopyrite, and arsenopyrite. Although no particular encouragement has been obtained to date from this type of deposit in the Lake of the Woods region, it deserves some attention due to the possibility of finding large tonnages of low-grade ore.

Replacement bodies of massive sulphides occur in a number of places, especially in the northern part of the area. These bodies are generally small and contain such sulphides as pyrite, pyrrhotite, chalcopyrite, and arsenopyrite. A grab sample of massive sulphides from the shore of a bay a mile southwest of island D. 183 gave a trace of gold when assayed. On claim 5 K. at the west end of Rat Portage bay there is an old test pit on a massive sulphide body containing pyrite, pyrrhotite, and arsenopyrite. A grab sample contained neither gold nor nickel. Rusty zones and mineralized quartz stringers occur in the vicinity of the

contact between Keewatin fragmentals and Timiskaming sediments southwest of Abernethy lake. On claim T. T. 9 an old shaft was found. The rocks are covered with overburden at the shaft but the material on the dump contains some fine-grained pyrrhotite and arsenopyrite in green schist, also a little sugary quartz with sulphides. A grab sample was assayed but contained no gold.

Mineralized carbonated zones rarely occur within the map area. On two tiny islands within the limits of claim W. A. 16, over a mile west of Corkscrew island, a carbonated zone runs for about 300 feet along the shore. It contains an irregular series of small quartz veins, which are mineralized with arsenopyrite. The schist in the zone contains some apple-green mariposite. A grab sample of mineralized quartz assayed 0.01 ounces gold per ton.

A considerable part of the map area, especially in the northern part, is taken up in patented claims and islands and the Indian reservation. Certain parts of the area, including all the islands in the Lake of the Woods, have been set apart by the Department of Lands and Forests of Ontario for summer resort purposes and are not open for staking except when a valuable mineral discovery is made.[1]

Description of Properties

The mining properties in the area fall into two groups: (1) the old workings on which nothing has been done since they were abandoned many years ago, and (2) older properties that have been examined and developed to some extent within recent years, and recent discoveries. Little information was obtained about some of the members of the first group for the reason that the old shafts are filled with water and timbers; in some cases it is even difficult to locate them. Little attempt was made to open up veins by trenches or test pits in the early days. Early prospecting and development methods on the Lake of the Woods have been discussed elsewhere.[2]

OLDER PROPERTIES

Norah Mine

The main workings of the Norah mine are located on claim J.E.S. 38 between Fox and Nola lakes. In 1900, the property consisted of claims J.E.S. 38, 41, 42, the west half of 39, and J.C. 79 and 80. An old road leads to the workings from a small bay on the south side of the central part of Fox lake.

The timbers obscure any sign of a vein at the old shaft, but 10 feet to the east a white quartz vein about 18 inches wide is revealed. It appears to strike about N. 65° E. The vein lies at or near the contact of intrusive porphyry and basic lava. Porphyry may be seen northwest of the vein and greenstone southeast of it. The rock on the old mine dump has been sorted into two heaps. The rock dump is green basaltic lava, and the ore dump (?) contains quartz and porphyry. The porphyry is fractured and intersected by quartz stringers. It is slightly mineralized with pyrite. The quartz is rather white and sugary and contains no sulphides. A little green fuchsite is developed in the porphyry and along fractures in the quartz. The primary quartz has been fractured and recemented by later quartz. There are several tons of quartz and porphyry on this dump. A representative grab sample of this material assayed 0.30 ounces

[1]See The Mining Act, 1935, p. 12, sec. 39c.

[2]W. E. H. Carter, "The Mines of Ontario," Jour. Can. Min. Inst., Vol. 7, 1904, pp. 124-139.
E. L. Bruce, Ont. Dept. Mines, Vol. XXXIV, pt. 6, 1925, pp. 3-21.
Jas. E. Thomson, Trans. Can. Inst. Min. and Met., Oct. 1936, pp. 686-701.

gold per ton. Subsequent sampling by prospectors did not reveal such encouraging gold values.

In 1900, Bow[1] described the underground development as follows:—

On location J.E.S. 38 a shaft with a dip of 79 degrees north has been sunk on the vein to a depth of 120 feet and is being continued. The cross-section at the surface is 4 by 7 feet, and lower down 6 by 10 feet. At a depth of 72 feet the vein appears to split; one branch bending to the north, with a dip of 45 degrees, and the other continuing straight. The north branch was followed for 25 feet by an incline, showing a good hanging wall with selvage. The vein in this incline is well defined. The shaft had subsequently been continued on the other branch, maintaining the same dip as above. The width of the vein underground ranges from 1 to 4 feet. The first level is at a depth of 72 feet; a 4- by 7-foot drift has been driven east 49 feet.

Gold Mountain Mine

Gold Mountain mine on claim K. 4,386 (old location P. 48) is near the south side of the Western peninsula. It was developed by a shaft and some surface trenches. The old workings are on a ridge northeast of Umbel lake. The showing consists of a stockwork of quartz located in a small stock of intrusive syenite porphyry. An irregularly shaped area, striking about N. 70° E., contains a large percentage of quartz. This body is poorly exposed for a length of at least 350 feet and is 30 feet wide in one of the old trenches. The dump at the shaft consists of red porphyry containing variable amounts of quartz in the form of veinlets and stringers, which run in every direction. The quartz is white and of a rather unpromising appearance, but an occasional sample contains pyrite, pyrrhotite, and traces of galena. A representative grab sample of the quartz and porphyry from the dump assayed 0.04 ounces gold per ton. A few feet south of the shaft the rock consists of rhyolite and a narrow band of well-bedded greywacké.

The property was worked in 1895. Blue[2] reported at that time that the quartz had been traced about 1,500 feet across the property and was from 25 to 65 feet in width.

Sentinel Mine

The Sentinel mine was worked in 1898.[3] It consisted of claims W.A. 7, 8, and 9, located on the shore of Labyrinth bay. Two shafts were sunk on claim W.A. 7, one to a depth of 40 feet, the other over 100 feet. A mill test of 60 tons of vein material was made at the Rat Portage Reduction Works in 1898.

Both shafts were located on small amounts of quartz in a stock of massive pink granite. At the deeper shaft a quartz vein, 6 inches wide, may be traced about 20 feet. The quartz is white and sugary in appearance. A grab sample of this material assayed 0.11 ounces gold per ton. Traces of quartz and mineralized granite may be seen on the dump at the other shaft.

Dead Broke Mine

Dead Broke mine was the name applied to some old workings on location 64 P., on an island northwest of Cliff island. A quartz vein, 18 inches wide, may be seen in an old test pit, but is not otherwise exposed. Some of the quartz on the dump is mineralized with pyrite and traces of chalcopyrite and galena. A grab sample of this material contained a trace of gold when assayed. About 100 feet to the south there is a small tunnel on a porphyry dike that intersects the basaltic country rock. The dike is about 6 feet wide and contains quartz masses up to a foot in width. One hundred and thirty feet south of the tunnel there is another parallel porphyry dike.

[1]Jas. A. Bow, Ont. Dept. Mines, Vol. IX, 1900, p. 60.
[2]A. Blue, Ont. Bur. Mines, Vol. V, 1895, p. 187.
[3]Jas. A. Bow, Ont. Bur. Mines, Vol. VIII, pt. 1, 1899, p. 64.

In 1892, Slaght,[1] the mining inspector, made the following comments on this property:—

> The vein has been stripped 50 feet in length and nearly the same in width. An open cut has been made 20 feet in length and 12 feet in width and a few feet in depth, from which about 75 tons of ore have been removed, and showing by frequent assays from $7 to $133 per ton; 25 tons of the ore have been taken to the Reduction Works to obtain a mill run.

The writer did not see the above-mentioned open cut.

Claim S. 70

On the south side of Shammis island on claim S. 70 three old test pits are located on a quartz vein, which has been traced 120 feet. It is about 2 feet wide. The quartz is rather white, but a few samples on the dump at one pit are well mineralized with sulphides. A grab sample of this material did not contain gold when assayed. The vein lies in massive greenstone near porphyry intrusives.

MORE RECENT DEVELOPMENTS

Clearwater Bay Syndicate

Clearwater Bay Syndicate owns 15 claims (K. 4,246 to K. 4,260, inclusive) located on the south side of Clearwater bay. These include some old workings, which were known as the Three Friends mine when originally worked in 1890.

The northern part of this group of claims is underlain by agglomerate and tuff; greenstone lies to the south. These formations are cut by an occasional quartz porphyry dike.

On claims K. 4,248 and K. 4,250, three old shafts and three test-pits are located at intervals for a distance of 550 feet along a zone that strikes N. 65°-70° E. Small lenticular veins of quartz may be seen at each of the old workings; the maximum width of quartz is 2 feet, but none of the lenses can be traced any appreciable distance. The quartz is generally white but occasionally has a bluish shade and may contain a little tourmaline and carbonate with the slightest trace of pyrite and arsenopyrite.

Near the boundary between K. 4,260 and K. 4,259 (A.L. 38) there are some old workings at the lake shore. Some quartz with pyrite, arsenopyrite, and traces of chalcopyrite lie on the dump beside an old test pit in which very little vein material may be seen. A grab sample of the mineralized quartz contained 0.01 ounces gold per ton. A short tunnel was driven from the lake shore towards the pit to intersect this material at a lower level, but very little mineralization can be seen in the tunnel.

About 300 feet west of the above point, old trenches reveal a similar type of quartz in what appears to be a number of small discontinuous veins, scarcely ever more than a foot wide. A grab sample of the mineralized quartz contained a trace of gold.

On a small island at the entrance to a marshy bay near the south boundary of K. 4,246, quartz float and a small vein are exposed at the water's edge. The quartz is well mineralized with arsenopyrite, galena, and a little sphalerite. A grab sample of this assayed 0.02 ounces gold per ton. Samples taken from here by prospectors have shown about the same value.

Lake Hill Gold Mines, Limited

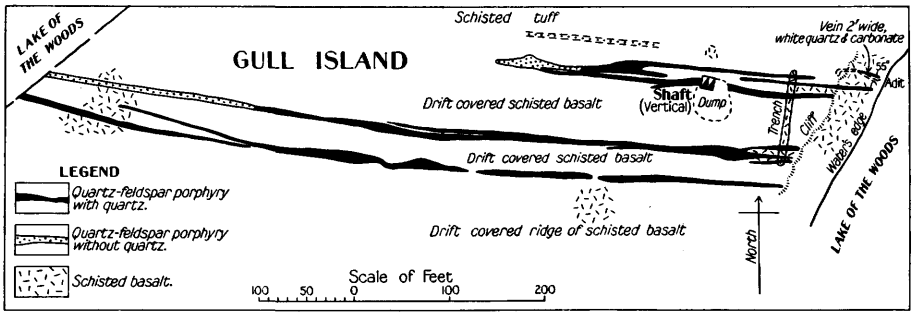
Lake Hill Gold Mines, Limited, was organized in 1934 to develop a group of 7 claims on Gull island. These include the old Ambrose mine, which was worked

[1] A Slaght, Ont. Bur. Mines, Vol. II, 1892, p. 232.

in 1898.[1] Old workings consist of a small shaft and an adit at the lake shore. Recent development work has been devoted to surface trenching and examination of old workings. The property has been sampled by engineers representing several different mining organizations.

The country rock in the vicinity of the showings is schisted basalt and tuff. This is intruded by a number of parallel quartz-feldspar porphyry dikes that usually contain a network of veinlets and irregularly shaped masses of quartz. In some places the quartz would constitute about 30 per cent. of the dike. The quartz is massive and almost devoid of sulphides, but some ankerite occurs with it. Gold values are obtained from this material.

A reddish tuff lies north of the workings and somewhat resembles the porphyry in appearance. Occasionally, however, it shows fragments of cherty and rhyolitic material.



Geological sketch map of the showings on the property of Lake Hill Gold Mines, Limited, Gull island.

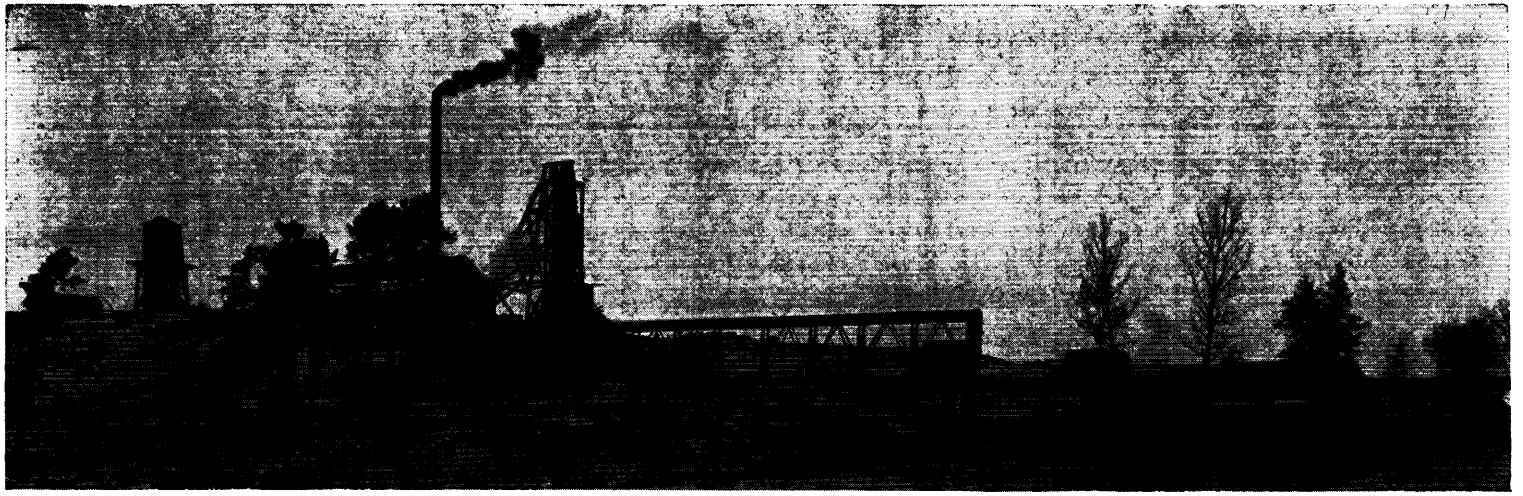
Kenricia Gold Mines, Limited

The main workings of Kenricia Gold Mines, Limited, are on claim P. 211, which is a peninsula located at the northeastern corner of Clearwater bay, about a mile south of the Trans-Canada highway. The company owns a group of 12 unsurveyed claims adjoining P. 211. The property was worked in 1889 and 1890 under the name of the Three Ladies mine,[2] and three small shafts were sunk. During the summer of 1935 it was optioned by Jos. Errington and C. W. Greenland. The showings were developed by surface-trenching and diamond-drilling. This work provided sufficient encouragement for a company, called Kenricia Gold Mines, Limited, to be formed to finance underground development, which commenced in September, 1936.

The country rock on the property is very largely agglomerate. An occasional basaltic lava flow is interbanded with it. The agglomerate has undergone a moderate amount of schisting and is intruded by massive quartz porphyry dikes. In places the porphyry contains quartz veinlets and some pyrite mineralization. This material was found to contain low values in gold.

Veins.—Development work has revealed a number of gold-bearing quartz veins. Veins Nos. 1, 2, 3, and 4 strike in a general east-west direction, which is approximately parallel to the regional schistosity; the dip is almost vertical. By October, 1935, No. 1 vein had been uncovered for a length of 700 feet and traced

[1]Jas. A. Bow, Ont. Dept. Mines, Vol. VII, pt. 1, 1898, p. 39.
[2]A. Blue, Ont. Dept. Mines, Vol. VI, 1896, p. 48.



View of the Kenricia mine, Lake of the Woods.

considerably farther along the strike. It has a maximum width of 6 feet. No. 3 vein has been traced 1,450 feet and opened up for over 950 feet. C. W. Greenland, consulting engineer, reported that sampling had indicated that a section of this vein, 700 feet in length, averaged $20 in gold (at $35 per ounce) across an average width of 30 inches.

Fifteen diamond-drill holes were put down at intervals over this length, most of them intersecting the vein zone at points 100 feet to 125 feet below the surface, but two of them were below 200 feet. All these gave gold values, with

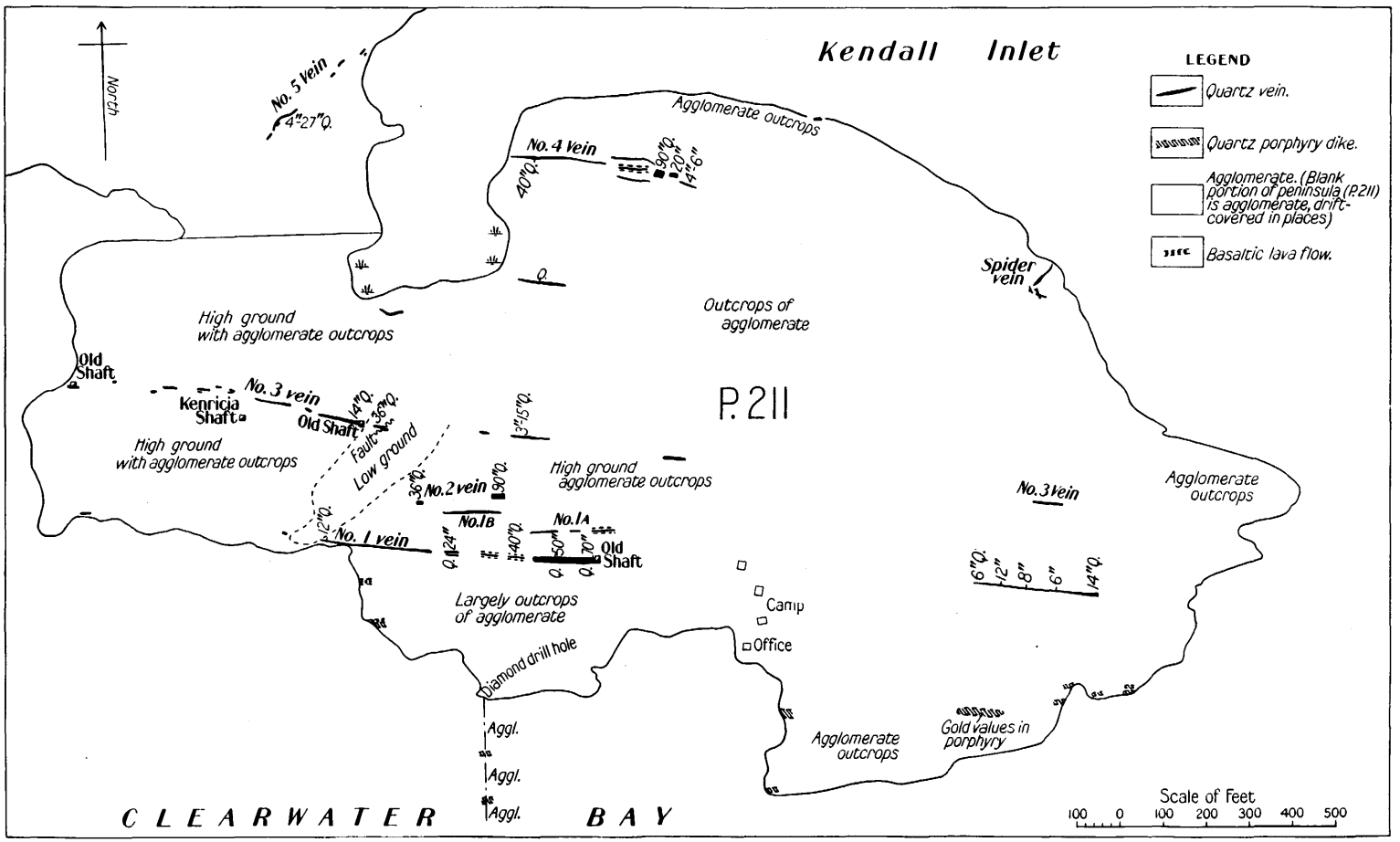


No. 3 vein, Kenricia Gold Mines.

the average bearing out the surface results. The vein zone was shown by drilling to have a width of from 1.8 to 9.2 feet. Three short veins lie between No. 1 and No. 3, and are roughly parallel to them. Vein No. 1B indicated an ore section 35 feet in length on the surface.

No. 4 vein was opened up over a length of 440 feet and shows a maximum width of 90 inches. At this place, the vein has the form of a stockwork of quartz in brecciated agglomerate and schist and is mineralized with pyrite and chalcopyrite. Some coarse gold was panned from the weathered surface of this vein.

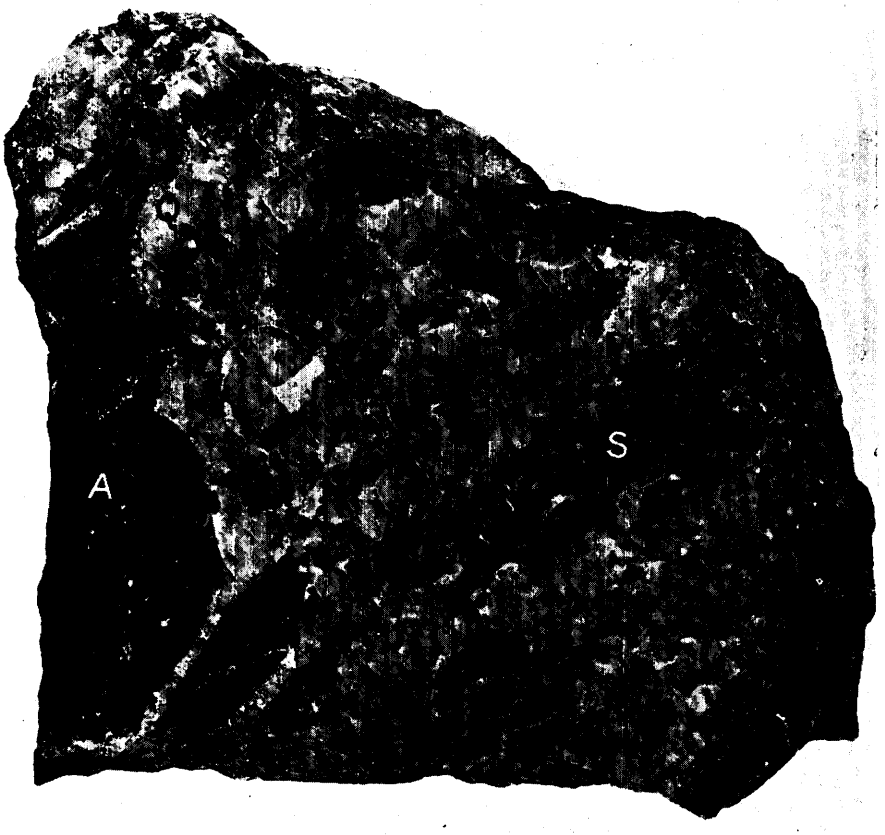
No. 5 vein has been traced 300 feet but is distorted and lenticular, and rolls considerably. It consists of white quartz and tourmaline with spotty sulphide mineralization and carries some gold values.



Geological sketch map of claim P. 211, Kenricia Gold Mines, Limited, Clearwater bay.

The "Spider" vein follows a series of fractures, which run in several directions. It contains reddish vein quartz and tourmaline with varying amounts of chalcopyrite and pyrite; the maximum width of the quartz is 30 inches.

Mineralization.—All the veins on the property consist of quartz, which generally contains some black tourmaline. They are mineralized with pyrite, chalcopyrite, galena, and native gold, which occurs sparingly. Traces of lead telluride (altaite) are found by microscopic examination of the ore. A feature of the veins is the presence of different generations of quartz. In a test pit on



Polished sample (natural size) from No. 4 vein, Kenricia Gold Mines. The vein material is a breccia containing agglomerate (A), schist (S), quartz (Q), and pyrite (P).

No. 3 vein a series of quartz carbonate veinlets in the wall rock are cut off sharply by the main vein (see photograph on page 36). This later vein consists of sugary quartz of a delicate bluish cast with tourmaline occupying lines of fracture, which run more or less parallel to the wall of the vein, and sulphides, which appear to be concentrated along or near the tourmaline zone. Sampling has indicated that this generation of quartz with associated tourmaline and sulphides carries the best ore values, whereas the older quartz contains only low values.

A later (third) generation of white glassy quartz cuts the sugary quartz-tourmaline-sulphide variety (see photograph on page 37). These two types of quartz were carefully separated in a selected sample and assayed. The sugary

quartz-tourmaline vein with sulphides gave 1.46 ounces gold per ton, but the later white quartz gave no values.

There are thus three generations of quartz in the veins. Preliminary development on the property would indicate that the chief gold values are in the intermediate generation of quartz with tourmaline and associated sulphides.

A polished section of the ore from No. 3 vein was examined by Professor J. Ellis Thomson, of the University of Toronto, who reported as follows:—

The chief metallic mineral in this section is pyrite, but it contains also considerable galena as well as minor quantities of gold, chalcopyrite, and altaite. These metallic minerals are associated with a mixed quartz-tourmaline gangue and occur in the following forms: pyrite as isolated crystals or small crystal aggregates scattered through the gangue; galena, chalcopyrite, native gold as short veinlets or tiny blebs in the quartz gangue; altaite as two or three tiny inclusions in the larger galena areas. The order of mineral deposition appears to have been as follows: (1) pyrite and tourmaline; (2) early quartz; (3) galena, chalcopyrite, gold, altaite; (4) later quartz.



Test pit on No. 3 vein, Kenricia Gold Mines, showing two ages of quartz. The older quartz veinlets (A) are cut off sharply by the main quartz vein (B) at the left end of the hammer handle.

Waite Option

J. H. C. Waite optioned a group of claims located immediately west of the Kenricia mine in the spring of 1936. Surface prospecting revealed a few veins, one of which was found to carry gold values over a length of 400 feet. This lies near the southeastern corner of Inglis lake on claim K. 5,849. The vein is narrow, however, averaging less than a foot in width, and the gold values were not encouraging; the option was accordingly dropped.

Westricia Gold Mines, Limited

Westricia Gold Mines, Limited, took over a group of claims lying immediately west of the Kenricia mine in the early months of 1937. These include the claims previously dropped by J. H. C. Waite. Surface-trenching and test-pitting was carried on.

Oliver-Severn Gold Mines, Limited

In the autumn of 1935 a group of six claims were staked and three optioned by Oliver-Severn Gold Mines, Limited, on the south side of Kendall inlet, immediately east of the Kenricia mine. This broad peninsula is underlain largely by agglomerate and tuff with some Timiskaming sediments near the corner of the Indian reserve. In April, 1936, W. E. Segsworth, president of the company, stated that surface exploration of the claims, under the direction

of C. W. Taylor, had revealed 7 gold-bearing veins, which were stripped and sampled, but preliminary work failed to show that any of these were of sufficient size and grade to make ore; these claims were eventually dropped.

A gold-bearing vein on claim K. 3,963 was traced 50 feet and averages 8 inches in width. It is mineralized with pyrite, traces of chalcopyrite and galena, and probably a little magnetite.



Polished sample (natural size) of gold ore from No. 3 vein, Kenricia Gold Mines. Sugary quartz with black tourmaline and pyrite (P) is cut by a slightly later generation of glassy white quartz (G).

Brae-Breest Gold Mines, Limited

Brae-Breest Gold Mines, Limited, owns a group of claims located north of the east end of White Partridge bay. These were staked by Jack Nutt in 1936. The camp may be reached by a motor road and lies about 6 miles southwest of the town of Kenora.

The main showing was developed by surface-trenching and diamond-drilling during the summer of 1936 under the direction of H. M. Whimpster. It consists of mineralized porphyry, probably flow rhyolite porphyry, which is said to carry gold values at certain places. At the showing the porphyry is interbanded with greenstone, but the disseminated sulphides with which the gold values seem to be associated are largely confined to the porphyry. Mr. Whimpster informed the

writer that a channel sample from No. 1 trench assayed $24.60[1] in gold across 17 inches. A long trench, 60 feet southeast of the above, is reported to contain gold values ranging from $1.75 to $3.50[1] per ton over an 80-foot length. These values are from contiguous samples cut in 5-foot sections along the trench. A number of diamond-drill holes were put down in the vicinity of these trenches. The showing is not located on any definite structure; the gold values reported by the company seem to be associated with disseminated sulphides in country rock.

About a claim length west of the above showing, a quartz vein was exposed for a length of about 50 feet when the writer visited the property. It had a maximum exposed width of 9 feet; both ends were covered by overburden. It is a bluish quartz and well mineralized with sulphides, chiefly pyrite and chalcopyrite. The vein lies in a cherty rhyolite.

Other Showings

Claim K. 4,073.—Claim K. 4,073 is located on an island on the north side of Ash bay. A vein has been uncovered in three places along the strike for a distance of 320 feet from the lake shore. It strikes N. 70° W. and dips 60° N.E. The vein lies in massive andesite and consists of quartz, which is fractured parallel to the walls; the fractures are filled with tourmaline. It also contains some carbonate, but sulphides are erratically distributed. In a few places the quartz contains a considerable amount of chalcopyrite. A grab sample of this well-mineralized vein material assayed 0.19 ounces gold per ton. The vein quartz is from 8 to 20 inches in width.

Claim K. 3,888.—Claim K. 3,888 is located between Smiths and Parth lakes on the Western peninsula. A gold-bearing quartz vein, 2 to 8 inches in width, has been traced 130 feet in two sections, one of which is slightly offset from the other. The country rock is agglomerate and is intersected by an occasional porphyry dike. A test pit on the west end of the showing contains massive pyrite and chalcopyrite across a width of one foot. The vein quartz is white and sugary in appearance and contains only a trace of sulphides. A composite sample of quartz chipped from various places along the vein assayed 0.13 ounces gold per ton.

Claim K. 3,645.—Claim K. 3,645 is an island in the northeastern part of White Partridge bay. An old shaft on the north side of the island has been dewatered in recent years and some surface stripping done near by. There is no sign of a vein at the shaft; 20 feet east a quartz vein 4 inches wide is exposed but cannot be traced any distance. A grab sample of the quartz assayed 0.06 ounces gold per ton. West of the shaft a series of white quartz stringers, 18 inches wide, have been traced for a length of 50 feet. The quartz veins lie in massive rhyolite and rhyolitic tuff.

Island No. 616.—Island No. 616, which is sometimes called Little Crow Rock island, lies west of Crow Rock island. A sheared zone, striking about N. 60° E. has been opened up for a distance of 250 feet along the strike. The sheared zone roughly follows the contact between greenstone and tuff and has a maximum width of 8 feet. Rusty carbonated zones and small amounts of massive sulphides occur in the schist. Near the shore small lenses and stringers of quartz are well mineralized with sulphides. A grab sample of this quartz showed no gold content when assayed. Parts of a 2-stamp mill are stored in one of the buildings. It is reported that some gold values can be obtained from the vein.

[1]At $35 an ounce.

PROPERTIES OUTSIDE OF THE MAP AREA

Rush Bay Holding Company, Limited

In 1934 the Rush Bay Holding Company, Limited, acquired a group of 10 claims between Rush bay and Echo bay on the Lake of the Woods. These include the old Golden Horn mine, the main workings of which are located on claim K. 390. This property was first worked in 1901 and operations continued until about 1903. A small amount of ore was milled. It was optioned by the Consolidated Mining and Smelting Company in 1935. The old workings at the Golden Horn mine were dewatered and the vein was sampled, but the option was later dropped.

In the early days a shaft was sunk 255 feet and drifting was done on the 100-, 166-, and 244-foot levels. Some crosscuts were also made. A small amount of stoping was done on the 100- and 166-foot levels. The shaft is located on the hanging wall of the vein and dips about 85° N.

The rocks on claim K. 390 consist of a band of rhyolite flanked on either side by basaltic lava, which has a dioritic texture in places. The rhyolite body is 100 to 175 feet in width and runs in an east-west direction across the claim. The main workings of the Golden Horn mine lie in the rhyolite near the northern contact. A small aplite dike was found on the southern boundary of the claim.

There is no surface exposure of the vein, but it is well defined underground The vein strikes about east-west. It ranges in width from a couple of inches to 3.2 feet, and there are often a number of small quartz stringers running parallel to the main leader. The main vein would average less than a foot in width over the whole of the underground workings. On the 100-foot level the vein is about 190 feet in length. The wall rock is silicified rhyolite with disseminated pyrite.

There are two distinct types of quartz, a blue and a white variety, the latter being by far the commoner. The blue quartz generally occurs near the outer margin of the vein. The vein has a banded appearance in places due to the presence of narrow seams of schist. Sulphide mineralization is scanty and consists largely of pyrite. Some of the blue quartz on the dump contains traces of galena and sphalerite. Sampling of underground workings indicated that the gold values were closely associated with the sulphides in the main vein. It is reported that the wall rock and parallel quartz stringers do not carry gold values.

A few other small, irregular, white quartz veins occur in the vicinity of the main workings. It is reported that sampling of these indicated low gold values at some places.

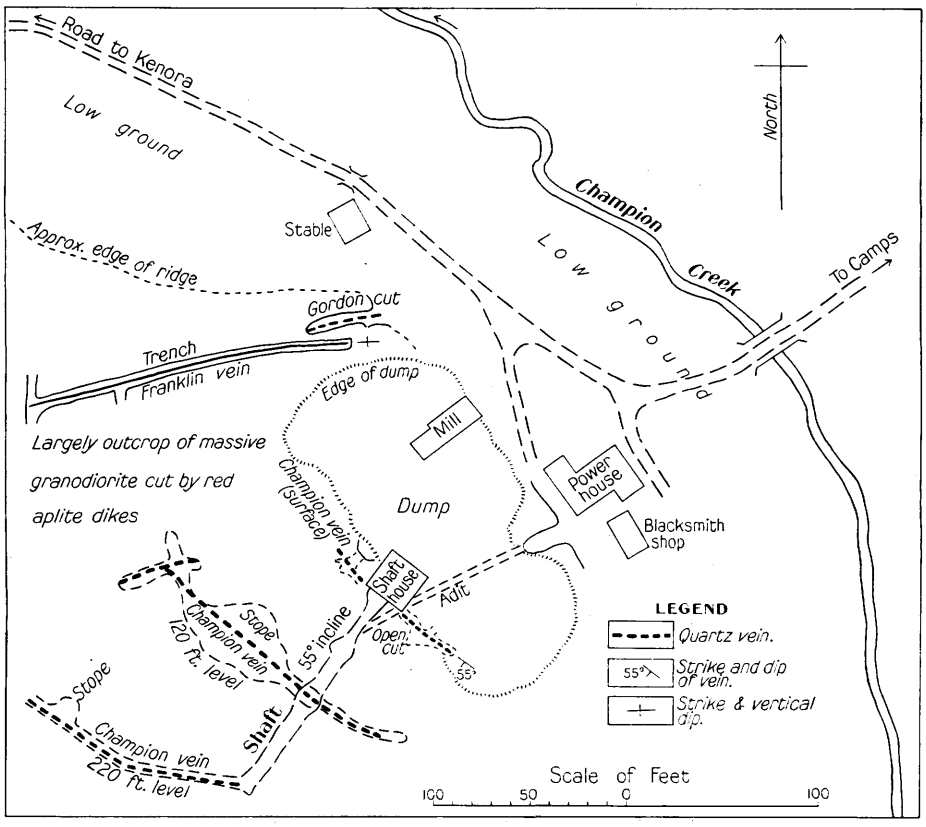
Franklin Gold Mining Company, Limited

The Franklin Gold Mining Company, Limited, was organized in 1934 and took over the property of Ontario Champion Gold Mines, Limited. The property is situated in Haycock township and is 9 miles east of Kenora, and a short distance south of Margach station on the Canadian Pacific railway. The main workings are located on claim P. 349.

The property was first worked about 40 years ago. Some ore was shipped to the Keewatin Reduction Works at that time. The property was reopened in 1925 and operated for about two years. The mine workings were dewatered and re-examined in 1931. During 1935 the company's group of claims was prospected. A diamond-drilling programme was carried out in the vicinity of the main workings during the early months of 1936, and later in the year some underground development was done at the old workings. Toward the end of the year the property was taken over by Franklin Gold Mines (1936), Limited.

In previous development an inclined shaft was sunk on the vein at an angle of 55 degrees to a slope depth of 235 feet. Levels were established at 120 and 220 feet. At a depth of 70 feet an adit was cut to the edge of the hill. Three small stopes were made.

General Geology.—Near the shaft the country rock consists of massive, coarse-grained granodiorite with occasional inclusions of altered basic lava. Some hybrid varieties of a plutonic rock, slightly different in composition from the granodiorite, have been formed by assimilation of the greenstone. Micro-



Sketch map of the main showings on the surface and underground workings, Franklin mine.

scopic examination of the rock 600 feet south of the shaft proved it to be a granodiorite, although the rock somewhat resembles a diorite in hand samples. The granodiorite and related rocks are cut by numerous dikes and small irregularly shaped bodies of red aplite and fine-grained red granite. These granitic bodies are probably a later and more acid differentiate from the same parent magma that produced the granodiorite.

The gold-bearing veins are very closely associated with the aplite dikes. Quartz veins generally occur at or near the contact of aplite and granodiorite, but at some places the quartz is bounded on either wall by aplite. Immediately adjacent to the veins the granodiorite is often sheared to chlorite schist, whereas sericite sometimes borders the veins in aplite. In several places it appears that

the aplite and associated quartz have been injected along previously established fractures in the granodiorite. A few fractures cut across aplite dikes showing that some of this movement is later than the period of gold deposition.

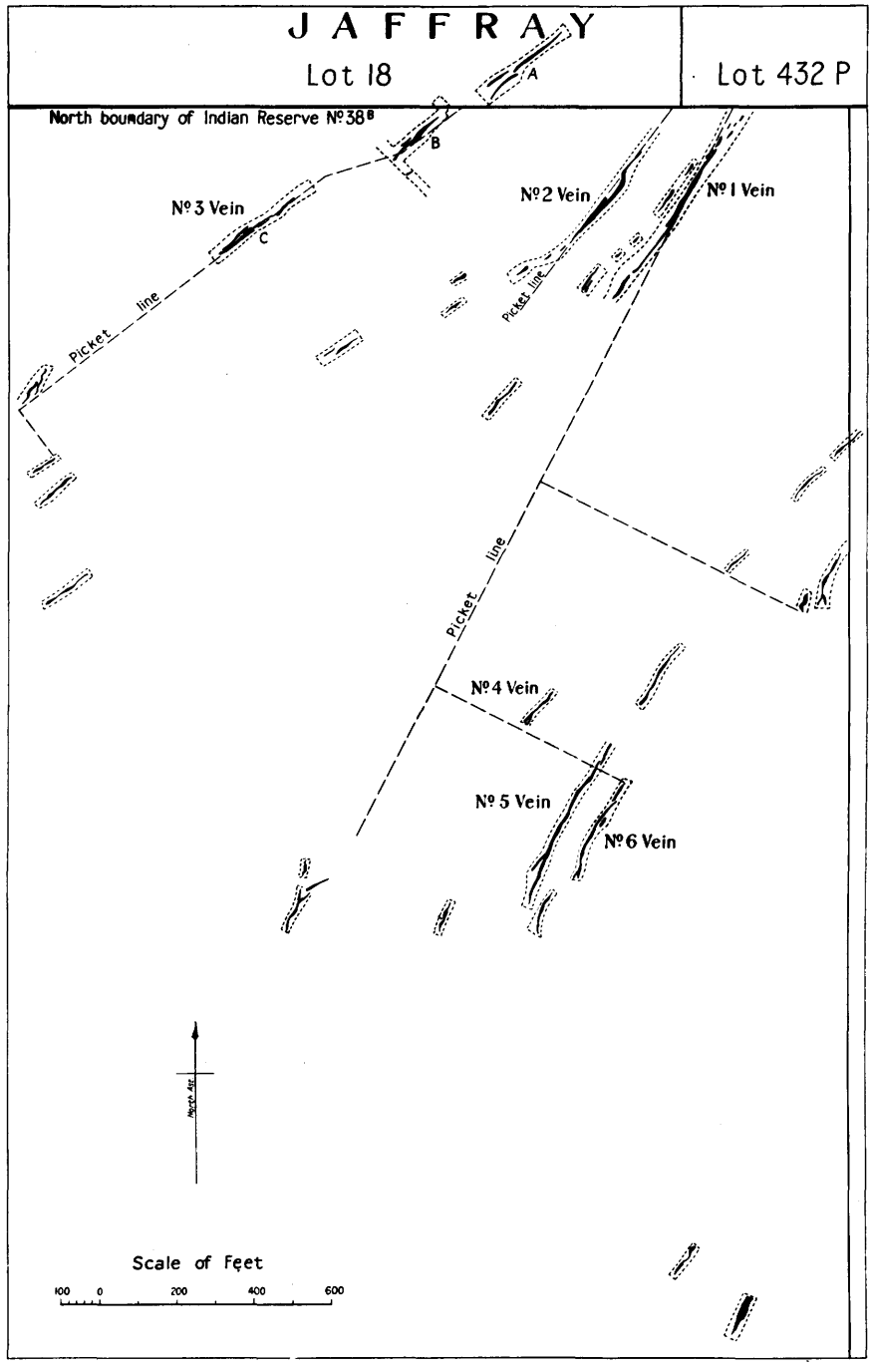
Veins.—The vein on which the shaft is sunk (Champion vein) roughly follows an aplite dike along a fracture zone in massive granodiorite. The vein strikes northwest-southeast and dips 55° S.W. The aplite dike may be traced from the surface to the 220-foot level, but it pinches and swells considerably.



No. 1 vein at the O'Sullivan property (Split Lake Gold Mines, Limited).

On the surface the quartz has been traced about 100 feet and ranges from 8 to 24 inches in width. On the 120-foot level quartz occurs almost continuously along the 180 feet of drifting. It has a somewhat irregular distribution, the veins being controlled by the irregularities of the aplite. The veins on this level are generally from 1 to 24 inches in width, but at one place in the stope the quartz and included schist bands widen out to about 6 feet. On the 220-foot level quartz occurs under the same conditions as on the 120-foot level over a length of 100 feet.

The vein quartz is white and somewhat banded in places due to chloritic seams. Sulphides are sparsely distributed and consist chiefly of pyrite, with



Sketch map showing the location of the veins on the O'Sullivan property (Split Lake Gold Mines, Limited). (After C. W. Taylor.)

traces of galena, sphalerite, and chalcopyrite. The gold is mostly native and occurs in the quartz.

A report on the property in 1931 by P. E. Hopkins, consulting geologist, indicated the possibility of a small ore shoot at the old workings.

In the summer of 1935 a gold discovery was made on claim K. 4,261. A slightly sheared zone in the granodiorite contains some sulphides and gold values over widths up to 4 feet. The zone was traced for 60 feet and then disappeared under heavy overburden.

O'Sullivan Property (Split Lake Gold Mines)

During the summer of 1936, Oliver-Severn Gold Mines, Limited, did a considerable amount of surface-trenching on a group of claims owned by J. J. O'Sullivan. These adjoin the Trans-Canada highway about 5 miles east of the town of Kenora. The group surrounded Hilly lake and included part of the western portion of Indian Reserve No. 38B. The work revealed a number of quartz veins in a body of granite and granodiorite. The greenstone contact is not a great distance away, and inclusions of greenstone are found in the granitic rock. Near these inclusions the intrusive is more basic in composition and might be classified as a diorite.

The vein quartz has a fine-grained, cherty appearance, and is generally banded with tourmaline. It carries sulphides in places, mostly pyrite and chalcopyrite. Native gold occurs in several of the veins and is usually found along fracture planes in the quartz. The walls of the veins are sharply defined, and the wall rock does not carry gold values. Gold values in the quartz are erratic in distribution.

The quartz veins appear to occupy a fracture pattern in the granodiorite and diorite. They strike N. 25° E. to N. 50° E. The more promising veins were opened up and channel-sampled at 5-foot intervals by C. W. Taylor (who prepared the sketch map on page 42). The best values were obtained on No. 2 vein, which was reported[1] by W. E. Segsworth, president of the company, to average 0.53 ounces gold across an average width of 24 inches, over a length of 83 feet. On No. 1 vein, located 100 feet east of the above, a section 38 feet in length was reported by Mr. Taylor to average 1.40 ounces gold across an average width of 7 inches. None of the other quartz veins yielded commercial results.

A small amount of diamond-drilling was done on the main showing (No. 2 vein). The option on the property was dropped in December, 1936.

In the early months of 1937 the property was taken over by Split Lake Gold Mines, Limited, and examined by J. F. Wright, consulting geologist. He reported that No. 2 vein averaged approximately $24 in gold[2] across 3 feet, for a length of 80 feet. Further development work was planned.

[1]Annual report, 1936.
[2]At $35 an ounce.

GOLD DEPOSITS ON SHOAL LAKE (WEST)

By Jas. E. Thomson

Introduction

During September, 1935, a detailed geological examination was made of a group of islands in Shoal lake adjoining Cameron island, on which is situated the Duport mine. Recent developments at the Cedar Island property of Kenora Prospectors and Miners, Limited, were also examined. The writer is indebted to the management of both companies for the information provided and facilities afforded in the course of the field work. The greater part of the geological mapping was done by Bruce Russell, field assistant.

Earlier developments at these properties were discussed in a previous report.[1] The geology of Shoal lake has been described by Greer.[2]

Duport Mine and Vicinity

The success attained by the Duport Mining Company, Limited, at Cameron island has led to surface prospecting and some diamond-drilling of the adjoining islands. Bodies of mineralized felsite, narrow quartz veins, and sheared zones have been found, some of which carry gold values.

GENERAL GEOLOGY

The geological features of Cameron, Stevens, Dominique, and adjoining islands are shown on the accompanying geological map. The geological succession is as follows:—

ALGOMAN(?):	Quartz porphyry, feldspar porphyry, felsite, lamprophyre. Pink biotite granite, grey granite. Granodiorite, quartz diorite. Diorite, gabbro, amphibolite.
KEEWATIN:	Massive basic lava, pillow lava, porphyritic lava.

The Keewatin rocks consist of massive basic lavas ranging from andesite to basalt in composition. They are found on the southern part of Dominique island, Pine island (S. 173), and part of Cameron island. Pillows are found in the lavas on Dominique island, and narrow bands of porphyritic lava occur at a few places. The latter consist of feldspar crystals, up to an inch in diameter, embedded in a fine-grained lava matrix. The porphyritic lavas appear to constitute certain horizons in the volcanics.

The larger part of the area mapped is underlain by a series of plutonic rocks ranging from biotite granite through granodiorite, diorite, gabbro, and possibly amphibolite. There are also intermediate variants of these, a rather common one being quartz diorite. All these plutonic rocks are fairly massive and medium- to fine-grained in texture. There appears to be a gradual transition from the granite through the series to the most basic members. It probably represents some sort of differentiation series influenced to a certain extent by assimilation of the older greenstones near the contact. Despite the fact that transition from one rock type to another is the most characteristic feature of the series, there is some suggestion that the granites are slightly later in age

[1]Jas. E. Thomson, "Gold Deposits on the Lake of the Woods," Ont. Dept. Mines, Vol. XLIV, pt. 4, 1935, pp. 43-47.

[2]Leonard Greer, "Geology of the Shoal Lake (West) Area," Ont. Dept. Mines, Vol. XXXIX, pt. 3, 1930, pp. 42-56.

than the more basic members. Dikes of pink granite cut the granodiorite; porphyry dikes, which are believed to be closely related to the pink granite, cut all the more basic members of the plutonic series.

On the small islands east of Stevens island, the diorite and gabbro contain unassimilated inclusions of fine-grained basalt, and are thus undoubtedly intrusive into the Keewatin lava. Near by are irregular areas of amphibolite, which is interpreted as a hybrid rock produced by contact action of the intrusives on the greenstone. This amphibolite also occurs on Dominique island and the eastern side of Cameron island. It is a dark-coloured, medium- to coarse-grained rock and grades into gabbro and diorite. On Cameron island this amphibolite is composed almost entirely of long black crystals of hornblende. This rock may be either a recrystallized basalt, a basic marginal phase of the plutonic series, or a hybrid rock produced by the intermixture of the intrusives and the older lavas. The irregular distribution of the amphibolite near the contact with lavas or near xenoliths and its peculiar chemical composition, given below, suggest the hybrid origin. In a previous report[1] the rock on the eastern side of Cameron island was interpreted as a diorite, but the chemical analysis shows that amphibolite would be a more appropriate name.

Most of the non-quartzose part of the plutonic series might be appropriately classified in the field as a gabbro or diorite. The presence of bluish opalescent eyes of quartz in the quartz diorite and granodiorite serve to distinguish them from the diorite and gabbro. All these rocks are very intimately associated and grade from one type to another. At a few places on Stevens island the transition zone between granodiorite and diorite could be confined to a distance of about 50 feet. On island M.H. 56, between Stevens and Dominique islands, a massive, pink, biotite granite is found. Along the south side of island S. 173, dikes of the same pink granite cut the greenstone. This granite is similar to that found on the islands near the west side of the lake and is probably part of the large granite batholith that extends across the Interprovincial boundary into Manitoba. At a few places in the northern part of Stevens island segregations of quartzose grey granite occur in the granodiorite.

A large number of thin sections of the plutonic rocks on Stevens and adjoining islands were examined to supplement field determinations. These showed that some of the basic differentiates, such as diorite, gabbro, and amphibolite, have undergone intense hydrothermal alteration, and a great deal of secondary epidote, zoisite, sericite, carbonates, and chlorite is sometimes formed.

All the above-mentioned rocks, with the exception of the granites, are intruded by dikes of porphyry, lamprophyre, and related rocks. These dikes generally exhibit a sharp intrusive contact and are massive in appearance. The acid dikes are of two distinct varieties: (1) the quartz or feldspar porphyries; (2) very fine-grained dikes of cherty or rhyolitic appearance, which are locally called felsite. At one place at the west end of Dominique island a felsite dike branches off at right angles from a quartz porphyry dike. The porphyry grades into the felsite, showing that they are different phases of the same intrusive. The lamprophyre dikes contain much biotite with lesser amounts of albite, traces of quartz, and secondary minerals such as clinozoisite, epidote, and carbonate. They are massive, dark-coloured dikes with a maximum width of 30 feet.

Analyses were obtained of some of the unaltered rock types in the area, and their composition is recorded below. The analyses show that the granite, granodiorite, gabbro, and basalt have a composition quite close to the average

[1]Jas. E. Thomson, op. cit., p. 45

for such rocks, but all are high in alumina; the basalt is deficient in magnesia. The analysis of the amphibolite is rather similar to that of the mineral hornblende except for a deficiency of magnesia and a slightly higher lime content.

	No. 1	No. 2	No. 3	No. 4	No. 5
	per cent.	per cent.	per cent.	per cent.	per cent.
SiO_2	69.30	62.74	47.62	39.20	52.89
Al_2O_3	16.92	19.34	24.02	14.93	17.23
FeO	1.34	2.70	2.22	13.35	7.22
Fe_2O_3	.98	.83	2.05	6.43	1.39
CaO	1.80	4.92	12.29	14.15	8.51
MgO	.60	2.50	5.64	2.30	2.71
K_2O	2.45	1.41	.33	.26	.34
Na_2O	5.97	3.32	1.64	.72	4.13
TiO_2	.23	.46	.24	2.89	2.91
P_2O_5	.....	.14	.05	.16	.33
CO_2	.28	.35	1.04	3.84	1.41
H_2O	.19	1.40	3.00	1.41	.87
MnO	.....	.05	.07	.19	.20
FeS_2	trace	trace	trace	.04	.23
Total	100.06	100.16	100.21	99.87	100.37
Specific gravity	.....	2.788	2.933	3.138	3.022

Sample No. 1—Pink biotite granite, island M.H. 56. Analysis by Bruce Russell, Department of Geology, University of Toronto, 1936.

Sample No. 2—Granodiorite, west shore of Stevens island. Analysis by Provincial Assay Office, 1936.

Sample No. 3—Gabbro, first island southwest of S. 173. Analysis by Provincial Assay Office, 1936.

Sample No. 4—Amphibolite, southeast side of Cameron island. Analysis by Provincial Assay Office, 1936.

Sample No. 5—Basalt, west side of Cameron island. Analysis by Provincial Assay Office, 1936.

Since the greater part of the rocks in the area under discussion are covered by water, a certain amount of conjecture necessarily enters into any interpretation of the inter-relationship of the series of intrusives. The available information suggests that they all belong to one period of batholithic intrusion, but there is some range in the age of the various members. The general geological map of Shoal lake (No. 39e) shows that the nose of the main granite batholith on the west side of Shoal lake projects towards the smaller Canoe lake batholith, the western exposures of which outcrop near the Mikado and Cedar Island mines. There is undoubtedly a connecting subterranean ridge between these two exposed areas. In fact the Stevens island granodiorite band extends towards the Canoe lake granite and has been traced to within at least three miles of it. The Stevens island plutonic series, ranging between granodiorite and gabbro in composition, probably represents the upper and first solidified portion of the parent magma. As cooling and crystallization proceeded to greater depths, differentiation of the magma produced more acid phases, which crystallized to form the granite. The offshoots from this residual acidic portion of the magma into the already solidified granodiorite-gabbro series would thus produce the dikes of porphyries, felsite, and lamprophyre.

ECONOMIC GEOLOGY

Results of development work to date in the area have brought out two important facts about the gold deposition: (1) Gold values are generally connected with sulphide mineralization and tend to be roughly proportional to the amount of arsenopyrite in the ore. This relationship is well shown at the Duport mine

where the high-grade ore contains heavy arsenopyrite mineralization and the lower grade has much less arsenopyrite and a larger proportion of other sulphides. (2) The more important ore occurrences are almost invariably concentrated in the vicinity of felsite dikes. In a number of cases the felsite dikes are mineralized and are occasionally known to carry gold values. At Cameron island, the most favourable host rock for sulphide deposition appears to have been a soft talc schist.

Small quartz veins and narrow sheared zones on Stevens island are known to carry a little gold in some cases. Diamond-drilling off the southwest end of island S. 171 during the winter of 1936 is reported to have traced a gold-bearing vein for a length of about 200 feet under the lake.

Duport Mining Company, Limited

Developments at the property prior to 1935 have been discussed in a previous report.[1] Since that time underground work has been carried on and high-grade gold ore has been shipped to a smelter at Tacoma, Wash. During 1935 and 1936, 1,190 tons of ore were shipped, which yielded 4,571.8 ounces of gold and



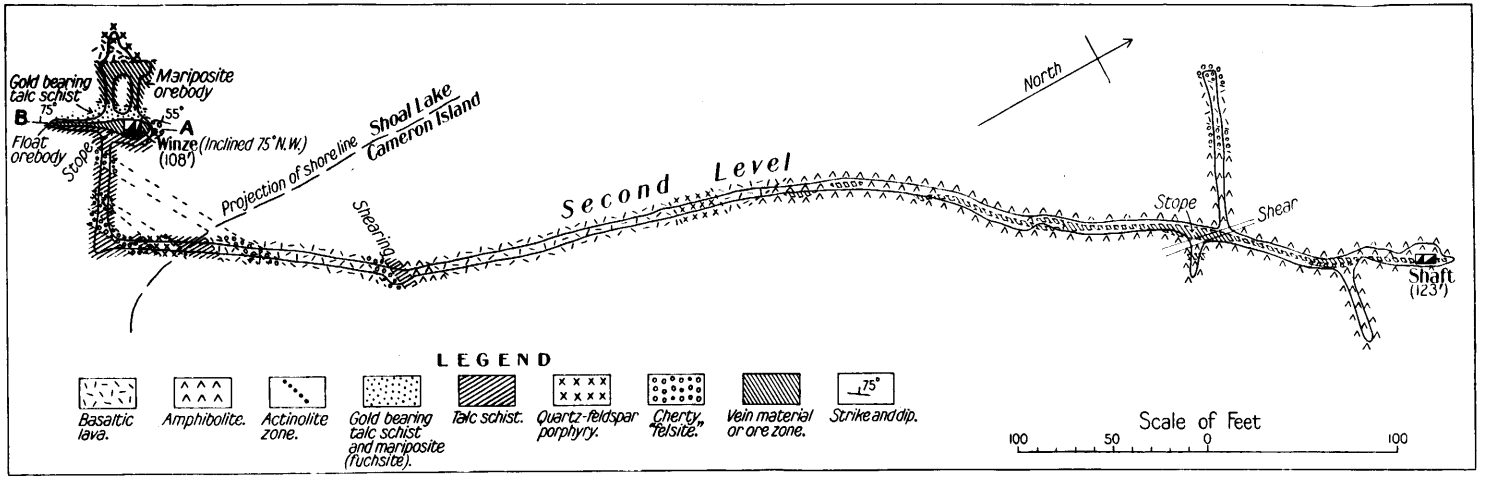
View of Duport mine, Cameron island.

1,143 ounces of silver, or an average of 3.84 ounces gold and 0.96 ounces silver per ton.

A drift on the 2nd (123-foot) level of the old workings was extended southwest towards the ore body encountered by drilling under the lake in 1934. A crosscut from this level intersected the high-grade "float" ore body and the parallel "mariposite" ore body. A winze was sunk in the float ore body and a 3rd level opened at a depth of 120 feet. A sublevel was established at a depth of 60 feet. Drifting and crosscutting had commenced on the 3rd level when the writer visited the property. The 4th level was opened up in 1936, and some underground drilling was done. The mine was closed temporarily in the autumn of 1936. J. G. Cross reported that a new 3-compartment shaft would be sunk in the summer of 1937.

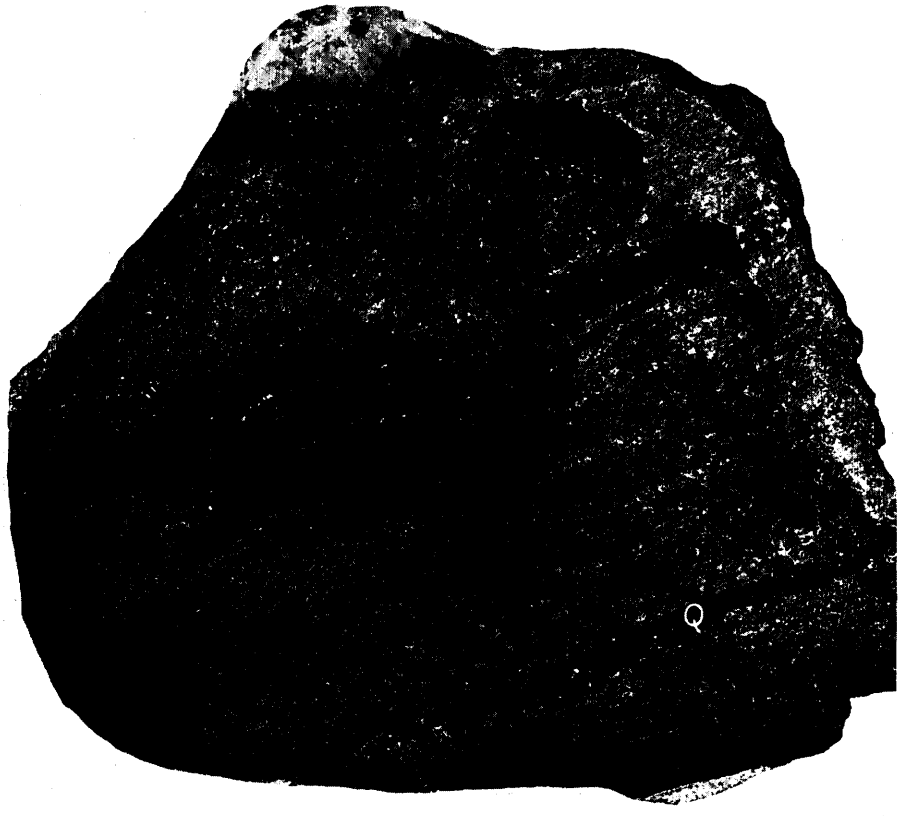
Ore Bodies.—The ore bodies under the lake are sulphide replacements and are largely located in a host rock of talc schist, which is a highly altered phase of the basaltic greenstone. A number of quartz-feldspar porphyry and cherty felsite dikes intrude the greenstone and talc schist in the vicinity of the ore zone. Diamond-drilling and sampling in the crosscut have delimited two more or less parallel ore shoots (the float ore body and the mariposite ore body) separated by a narrow zone that carries low gold values.

[1]Jas. E. Thomson, op. cit., pp. 44-47.



Geological sketch map of the 2nd level and winze, Duport mine.

The high-grade float ore body is regarded as a downward extension of the ore that was found as float boulders on the surface at the edge of the island. It appears to be lenticular in outline and consists of fine-grained arsenopyrite with small amounts of other sulphides. On the 2nd level it is about 50 feet in length and has a maximum width of 15 feet. The ore sometimes has a banded appearance and is cut by tiny quartz veinlets (see photograph above). It contains a high percentage of arsenopyrite, the gangue being largely talc, sericite, chlorite, and secondary quartz. The arsenopyrite occurs as bands of tiny crystals, which



Polished sample (natural size) of high-grade gold ore from the "float" ore body, Duport mine. Very fine-grained arsenopyrite is intersected by quartz veinlets (Q).

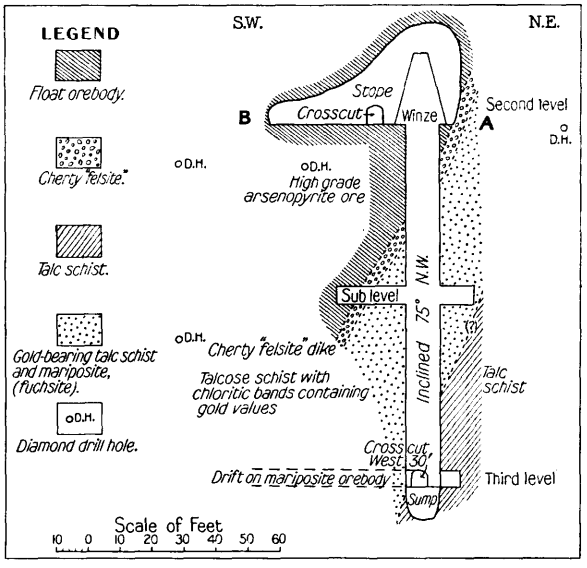
tend to run parallel to the schistosity. At the collar of the winze on the 2nd level the float ore body pitches downward to the southwest at an angle of about 60 degrees. It is picked up in a sublevel at a depth of 60 feet in the winze. Here the ore body appears to lie above and in the trough of a crescentic-shaped cherty felsite dike that controls the dip of the footwall of the high-grade ore and may have some influence on the rake of the ore shoot.

The cherty felsite dike is also mineralized and carries gold values. A thin section of the felsite near the collar of the winze shows that it has been considerably altered. A fair amount of sericite has been formed, and secondary quartz veinlets and arsenopyrite crystals are arranged parallel to the schistosity.

The felsite sample from which the section was made assayed 0.80 ounces gold and contained 5.33 per cent. arsenic, which is equivalent to 11.7 per cent. arsenopyrite in the rock.

Below the felsite dike in the winze the rock is largely talcose schist but includes small irregular areas of dark-coloured chloritic schist. J. G. Cross, the manager, reports that these chloritic schist bands are sometimes rich in gold. Under the microscope the talc schist from this vicinity consists of talc, sericite, a few rutile crystals, and a little arsenopyrite. When arsenopyrite is present, this material contains some gold.

The mariposite ore body lies on the west side of the float ore body. It contains lesser amounts of sulphides than the latter; the arsenopyrite content is lower, and more pyrite, pyrrhotite, and chalcopyrite are present. The gangue



Section in plane of float ore body and winze, Duport mine.

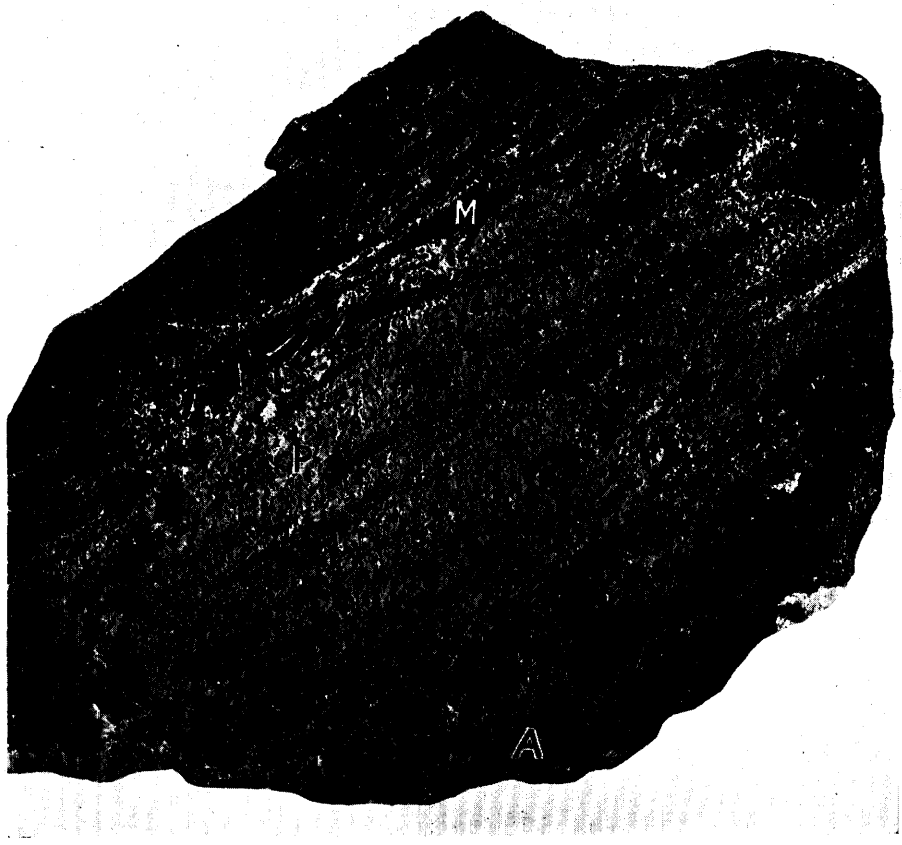
contains a considerable amount of apple-green chrome mica (mariposite or fuchsite). Due to the more disseminated arsenopyrite mineralization, gold values in the mariposite ore body are much lower than in the float ore body. Where it is intersected on the 2nd level, however, a fine grade of ore occurs over widths of 23 and 26 feet on either side of the crosscut. Mineralization similar to that of the mariposite ore body had been encountered in the drift on the 3rd level in October, 1935.

Sampling of the vein material on the 2nd level southwest of the shaft and of surface veins near the shaft indicates an ore body in that vicinity. It is reported that this shoot is 232 feet in length on the 2nd level.

Ore Relationships.—Microscopic examination of the ore at the Mines Branch,[1] Department of Mines, Ottawa, has shown the presence of arsenopyrite, pyrite, pyrrhotite, ilmenite, and native gold. The larger part of the gold occurs with the arsenopyrite. Spectral analyses showed that submicroscopic gold is

[1]Mines Branch, Can. Dept. Mines, Bull. No. 736, 1932, p. 60; and unpublished report of July 30, 1936.

present in arsenopyrite in quantities probably exceeding two or three ounces per ton (of arsenopyrite). Native gold occurs (1) as free grains in the gangue, (2) as small grains within and attached to pyrite and arsenopyrite, and (3) associated with pyrrhotite in the gangue. Most of the visible gold was seen in the gangue.



Polished sample (natural size) of gold ore from the "mariposite" ore body, Duport mine. The lighter-coloured pyrite and pyrrhotite (P) and darker arsenopyrite (A) replace schist which contains green mariposite (M).

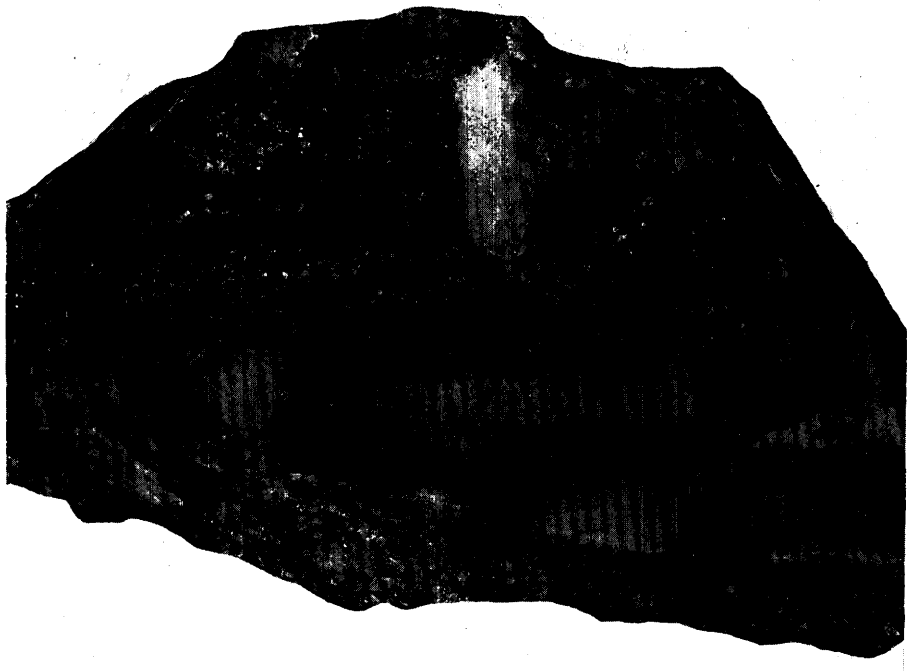
Kenora Prospectors and Miners, Limited

Underground development of the Cedar Island property has continued since the last report was written.[1] No. 2 shaft has been deepened, and levels are established at 283, 383, 500, and 625 feet. A 40-ton mill was installed in the fall of 1935. Production to the end of the first quarter of 1936 amounted to 2,202.63 ounces gold and 1,084.23 ounces silver from 7,377 tons of ore milled, or an average of 0.30 ounces gold and 0.15 ounces silver per ton.

The mine is located in basaltic greenstone a short distance from the contact with a granite batholith. Dikes of granite, pegmatite, feldspar porphyry, aplite, and lamprophyre cut the lava in the mine workings. A mass of granite

[1]Jas. E. Thomson, op. cit., pp. 43, 44.

was encountered in the east drifts on the 283-foot level. The vein material is closely associated with a series of aplite dikes, which appear to be the latest phase of the series of intrusives. The vein often follows along the contact of the aplite and greenstone but in places will angle away from it and broaden out in the form of a stockwork of quartz stringers in the lava. Values seem to fall off in this structure. At certain locations the aplite simply grades into vein quartz. This association has produced irregular bodies of quartz, which are sometimes lenticular, sometimes contorted and folded. Such a condition makes it difficult



Polished sample (natural size) of gold ore from the Cedar Island mine, Kenora Prospectors and Miners, Limited. The darker-coloured quartz containing sulphides is cut by slightly later white quartz. Pyrite is present in the form of crystals and also in a finely granular state along fractures.

to correlate the showings on the various levels and more or less limits ore reserves to rock actually broken.

On the 144-foot level, which was developed from No. 1 shaft, a section of the veins 180 feet in length is reported to average 1.476 ounces gold per ton across 46 inches. The other levels were opened from No. 2 shaft. Little ore was found on the second (283-foot) level. On the 383- and 500-foot levels three more or less parallel veins were found. A section of ore was delimited on the 383-foot level on both the No. 1 and No. 2 veins. On the 500-foot level sections of ore are reported on both the No. 2 and No. 3 veins. In the spring of 1936 drifting was being done on vein material on the 625-foot level, but it was not definitely known how this lined up with any of the veins on the upper levels.

There are two generations of vein quartz. The earlier quartz is fine-grained and sugary in appearance, and generally contains narrow bands or wisps of

chlorite. It is fractured, and fine-grained sulphides, chiefly pyrite, occur along the fractured zones. Two generations of pyrite occur, the first as distinct crystals, the second as fine-grained material. In some cases the fine-grained



View of Cedar Island mine, Kenora Prospectors and Miners, Limited, Shoal lake.

pyrite surrounds the earlier-formed crystals. Small amounts of pyrrhotite, arsenopyrite, sphalerite, galena, and chalcopyrite also occur in the quartz. Gold occurs as small grains and veinlets in the quartz and is usually associated with the later pyrite. A slightly later generation of white quartz cuts across the earlier quartz and sulphides.

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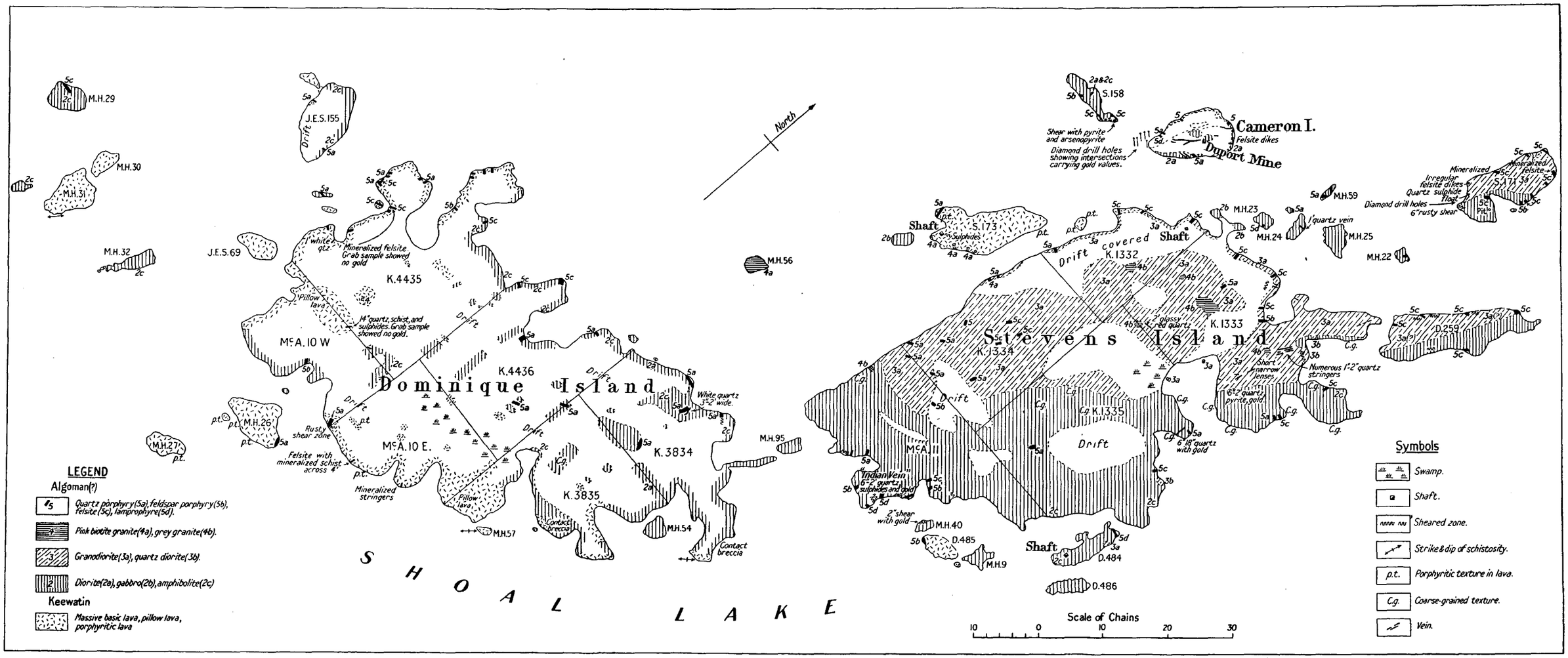
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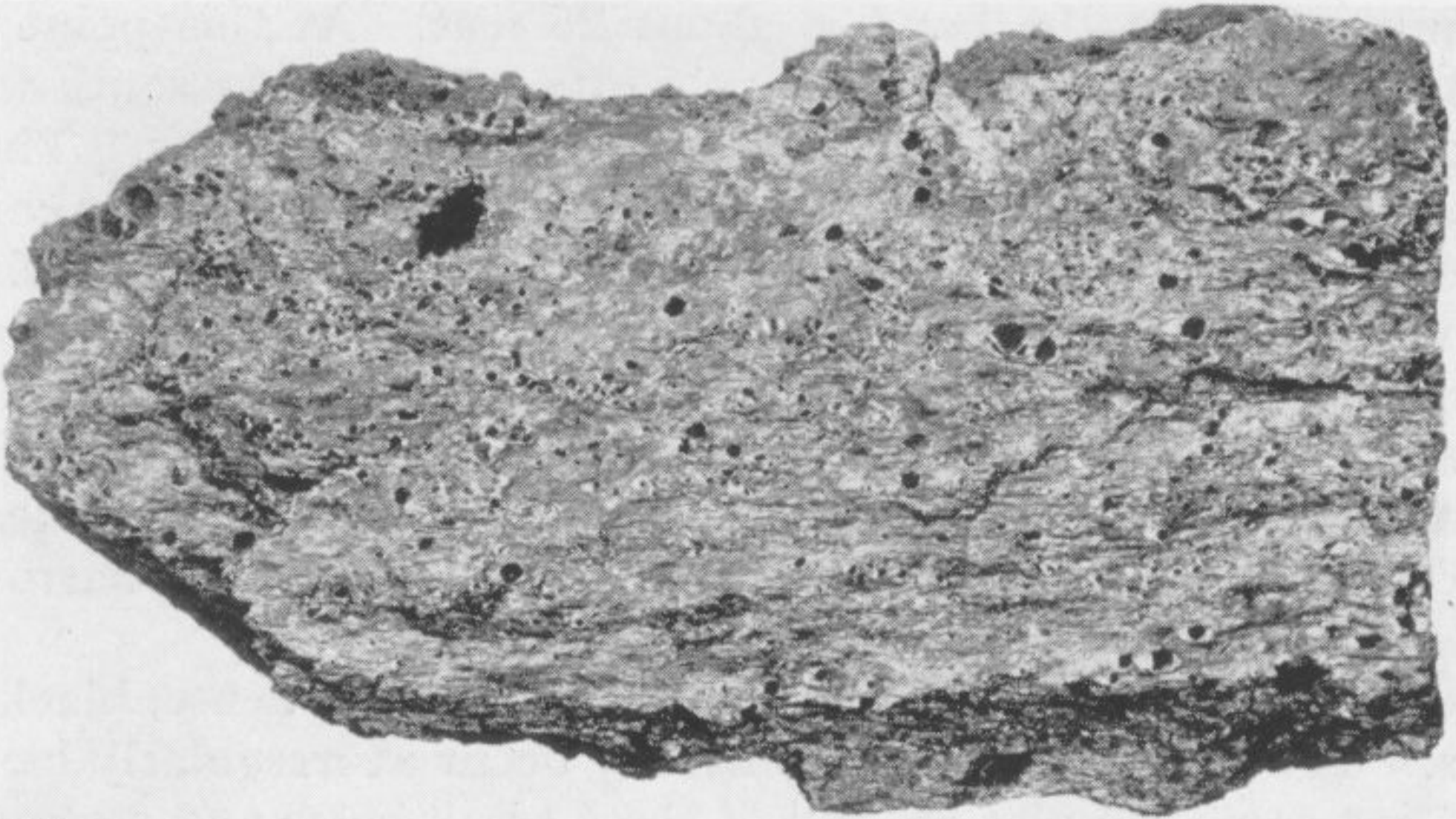
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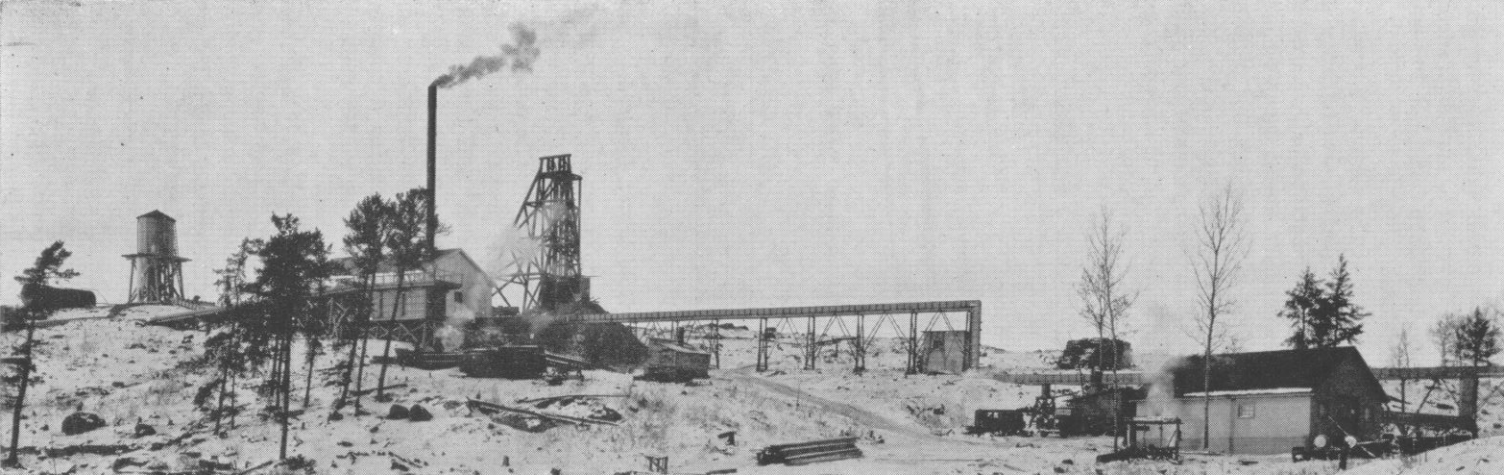
GEOLOGICAL MAP OF CAMERON, STEVENS, DOMINIQUE, AND ADJACENT ISLANDS, SHOAL LAKE.



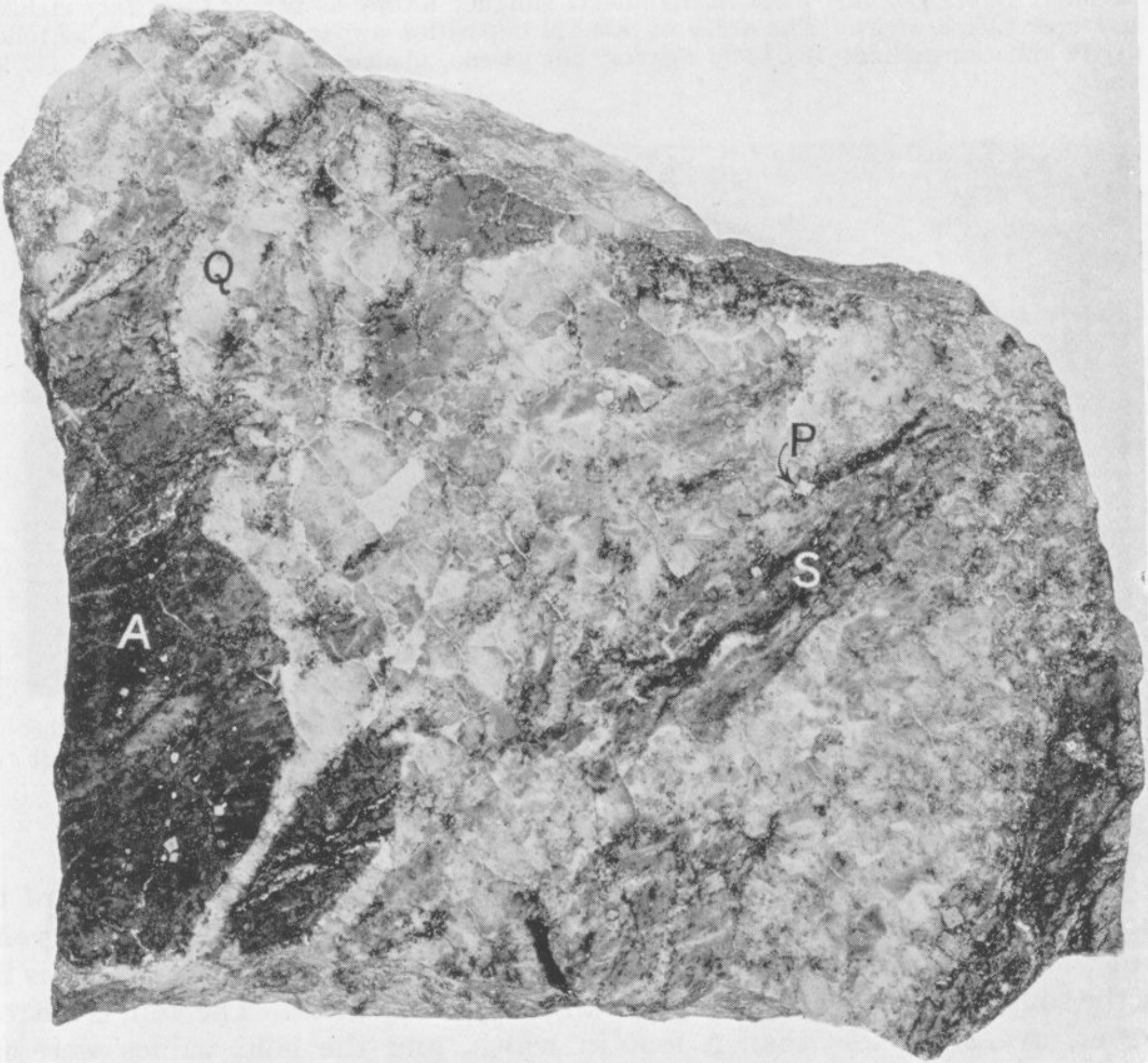


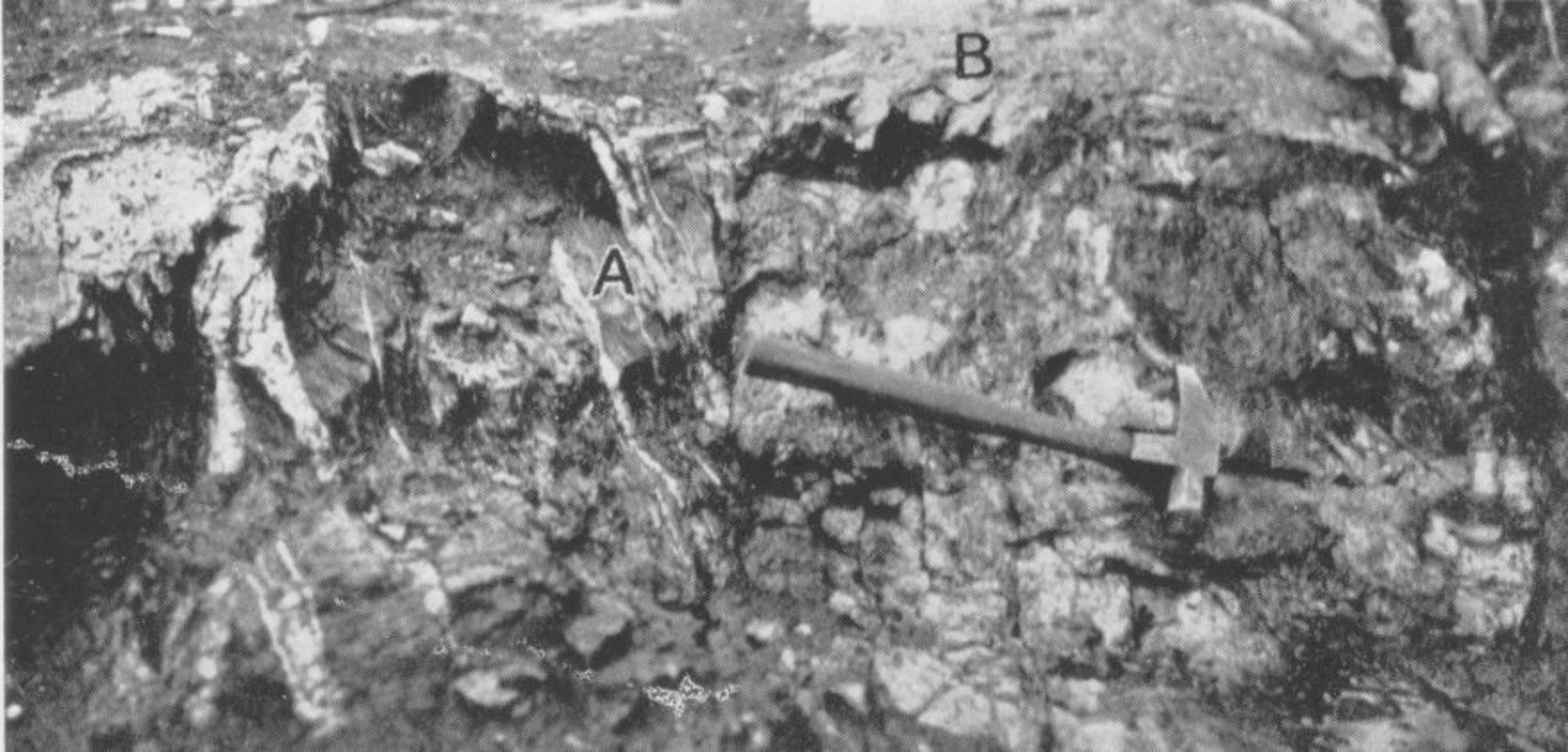


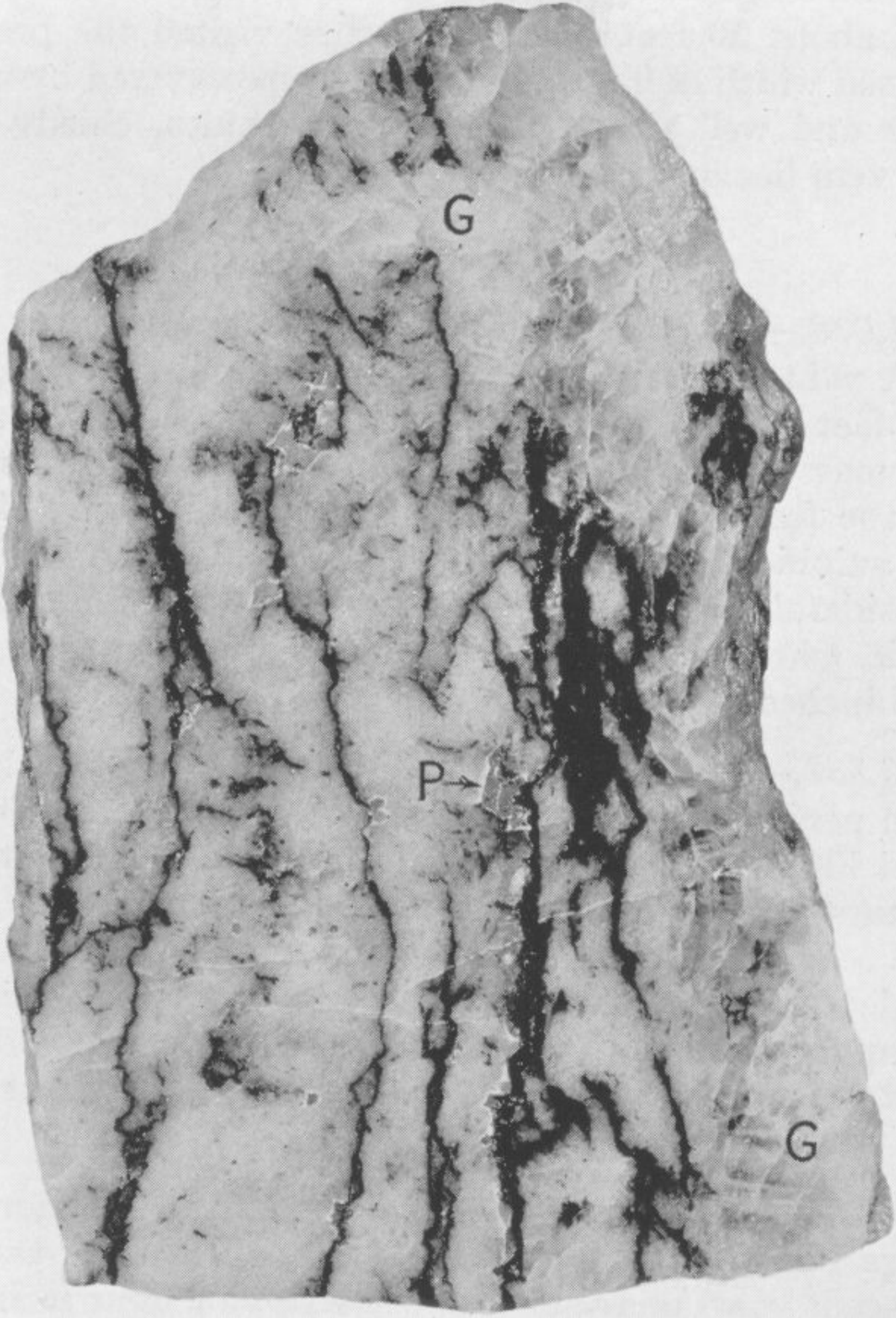




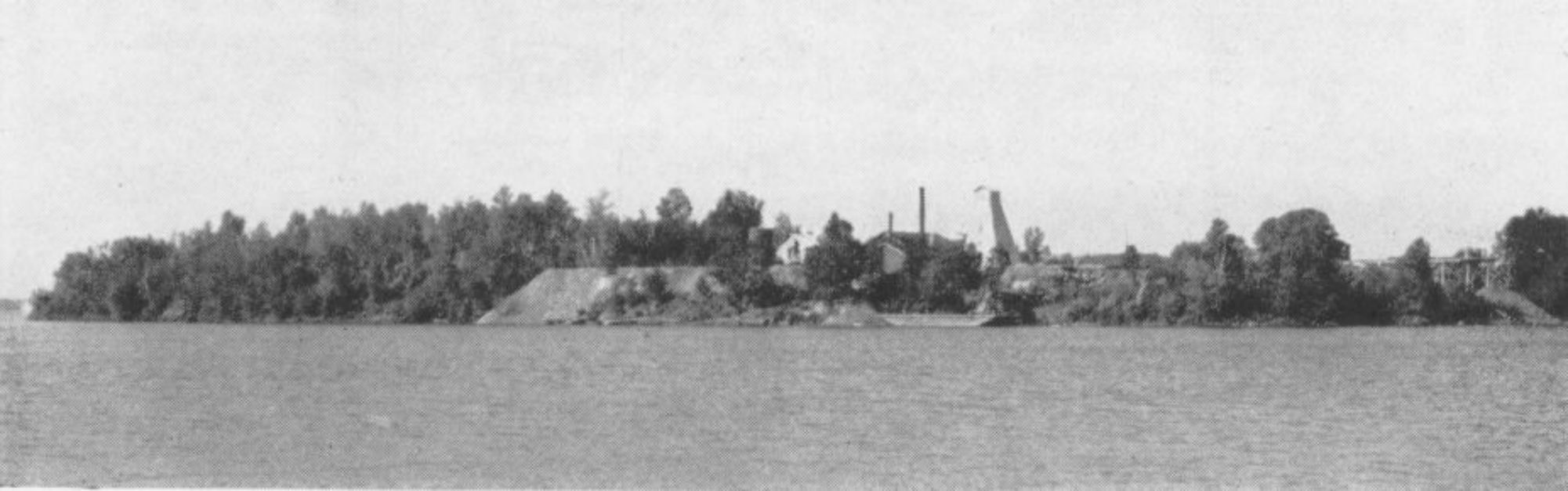


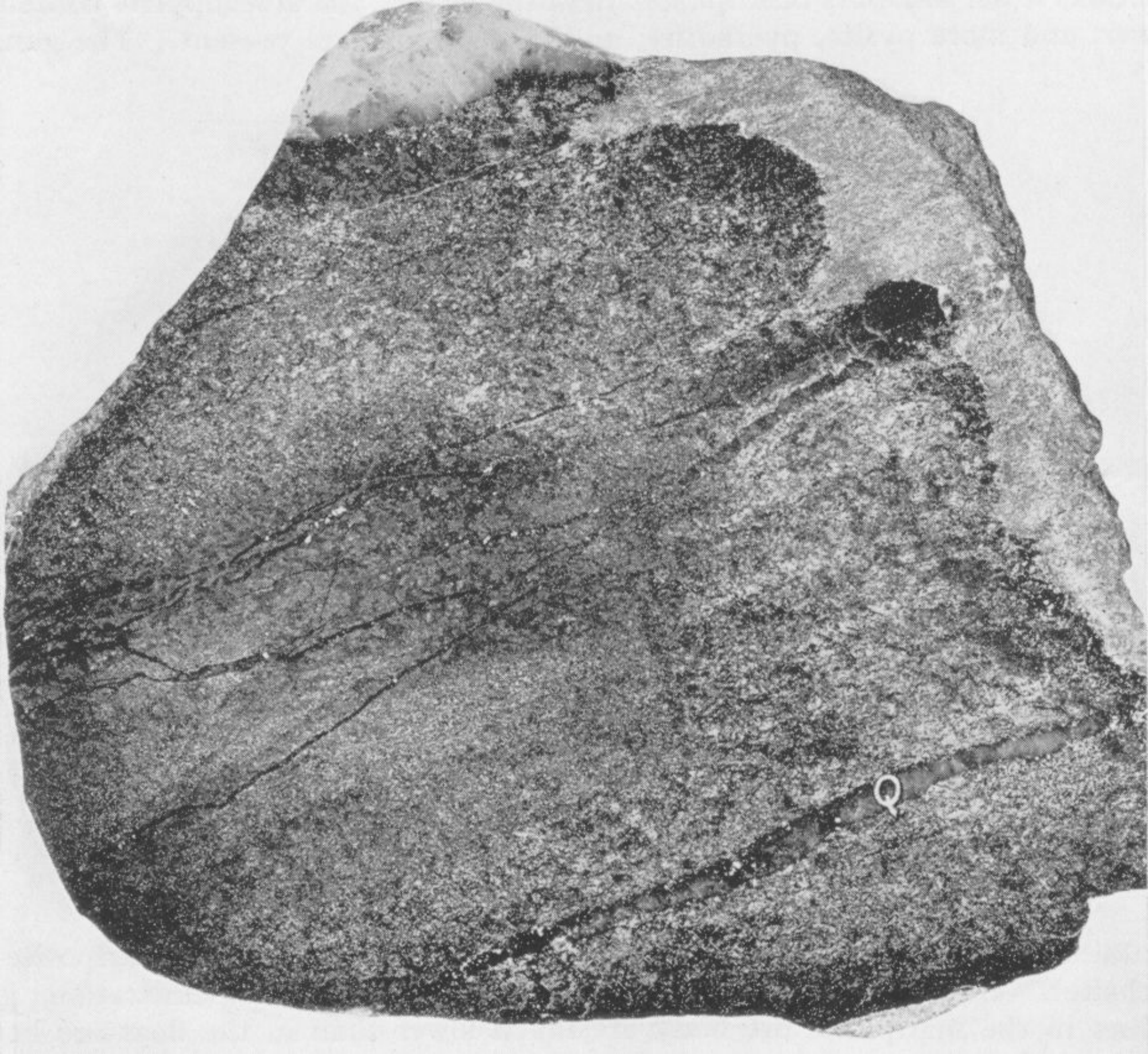

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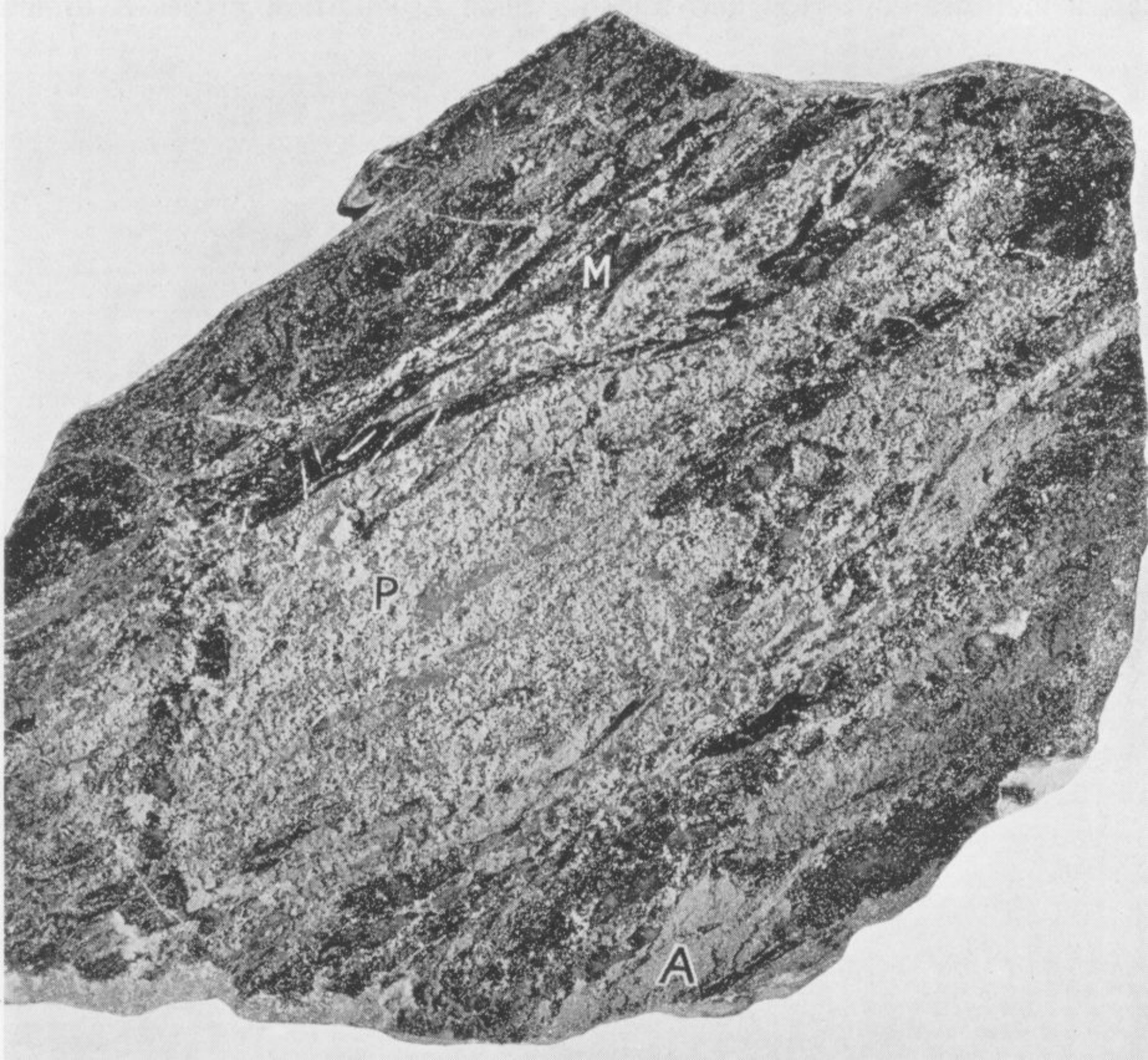

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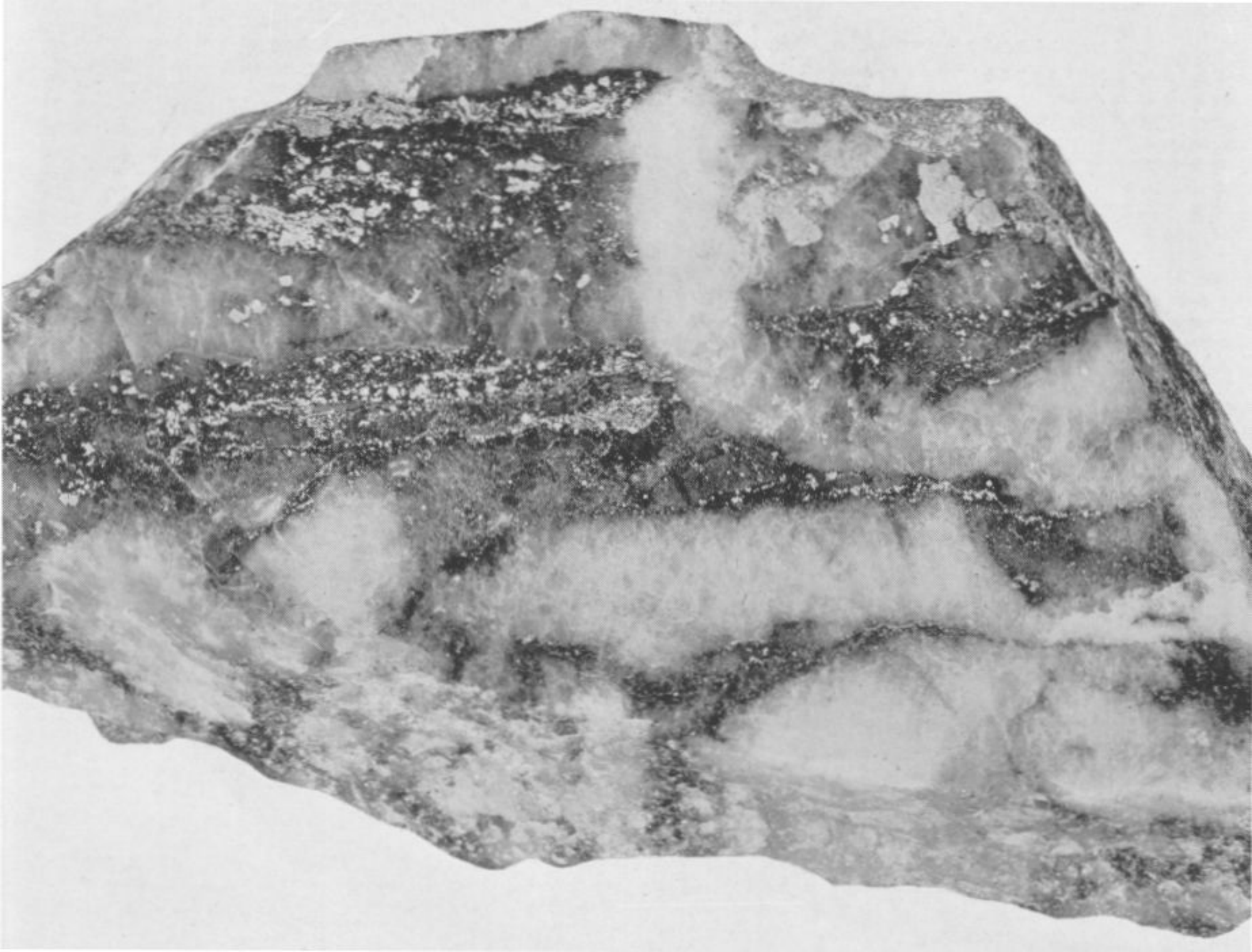

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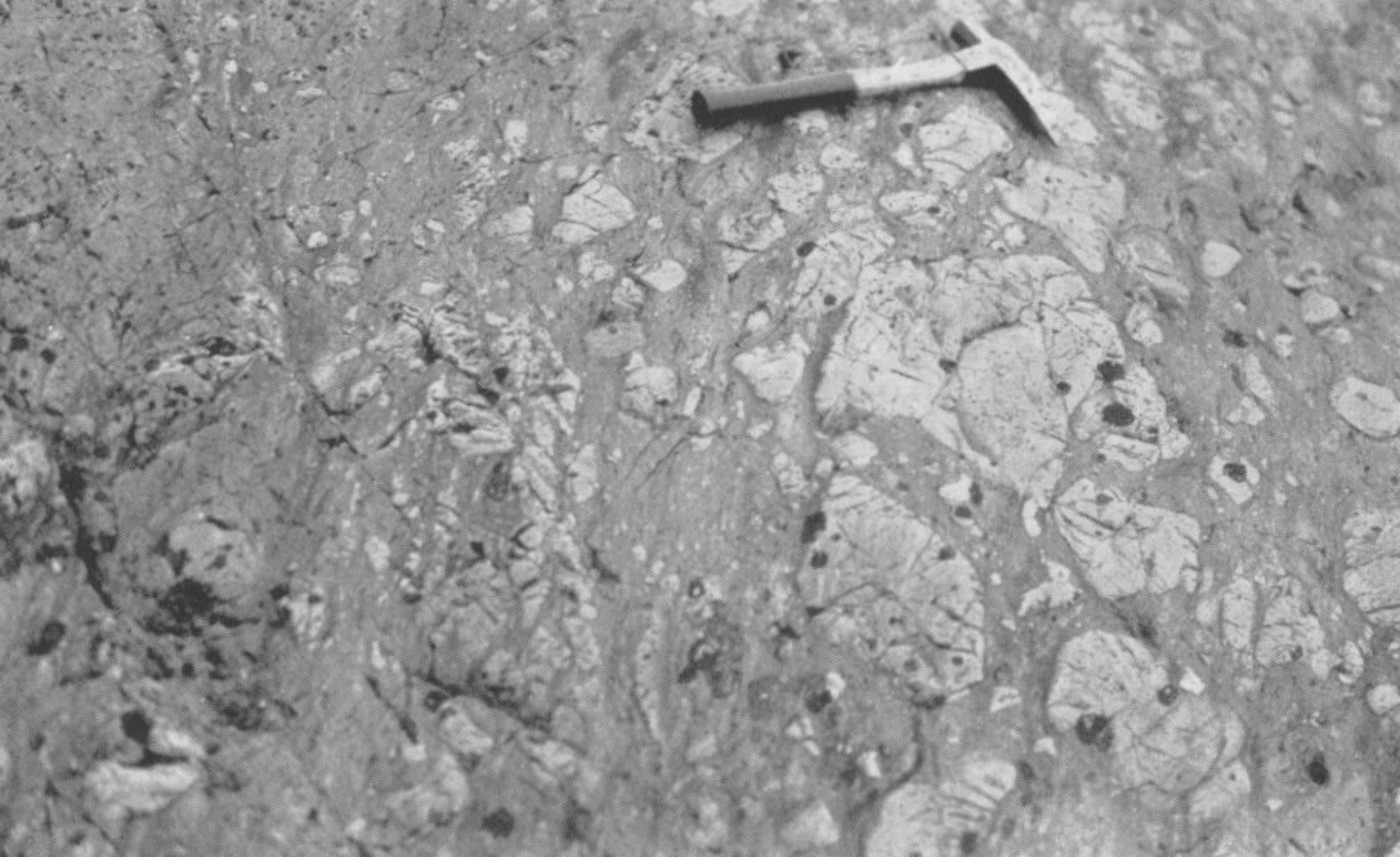

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PROVINCE OF ONTARIO

DEPARTMENT OF MINES

HON. PAUL LEDUC, *Minister of Mines* T. F. SUTHERLAND, *Deputy Minister*

FORTY-FIFTH ANNUAL REPORT

OF THE

ONTARIO DEPARTMENT OF MINES

BEING

VOL. XLV, PART IV, 1936

Geology of the Birch-Springpole Lakes Area

By

W. D. HARDING

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1936


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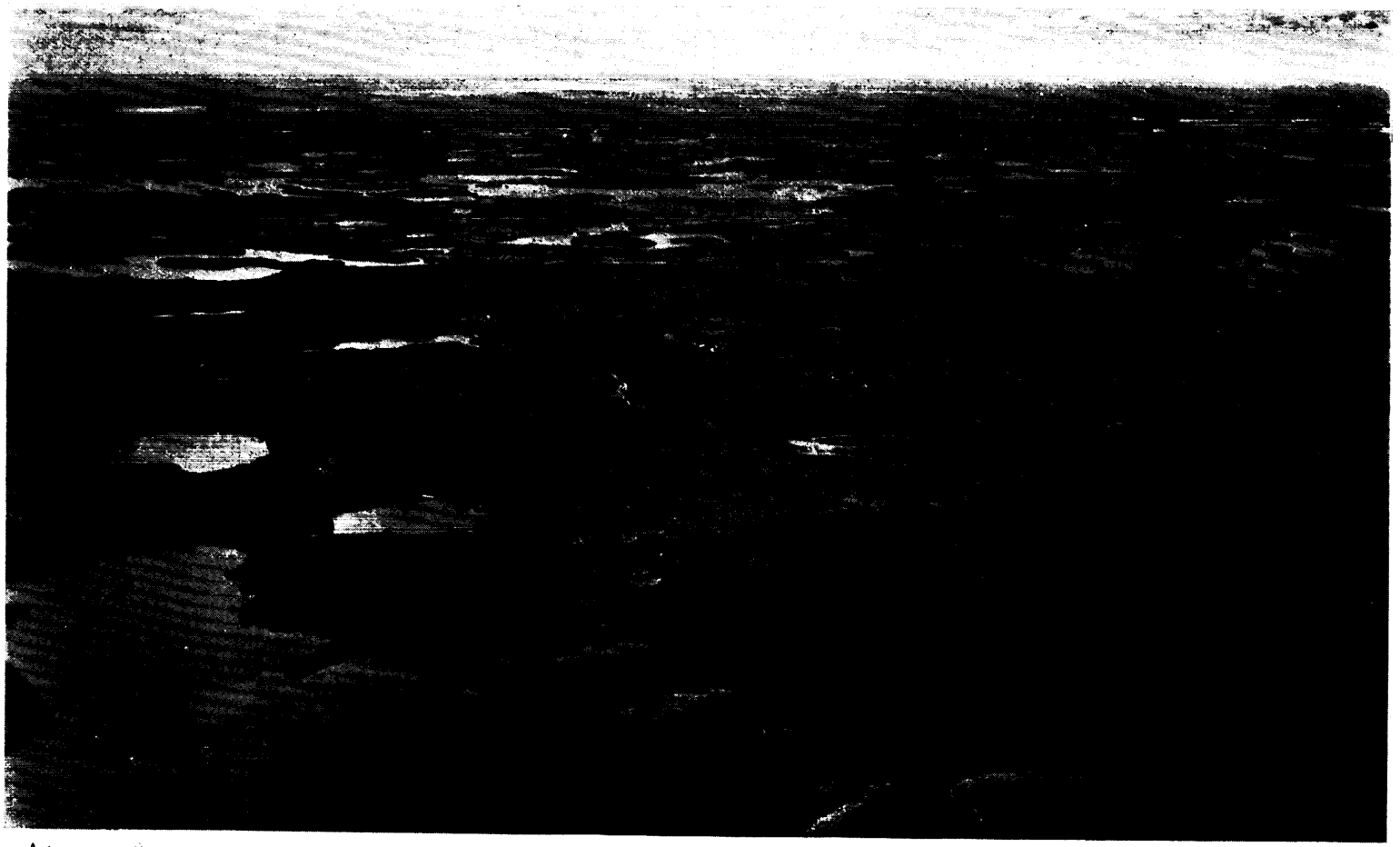
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COLOURED GEOLOGICAL MAP

(In pocket at back of report)

Map No. 45c—Birch-Springpole Lakes Area, District of Kenora (Patricia Portion), Ontario. Scale, 1 mile to the inch.



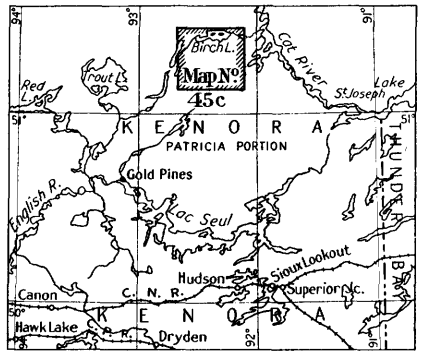
AERIAL PHOTOGRAPH LOOKING WEST TOWARDS WASHAGOMIS AND WOMAN LAKES FROM THE WEST END OF OKANSE LAKE, SHOWN IN THE FOREGROUND.

Geology of the Birch-Springpole Lakes Area

By W. D. Harding

INTRODUCTION

The Birch-Springpole Lakes area is situated in Patricia portion of Kenora district directly north of Lac Seul. Geologically it constitutes a small part of the extensive belt of pre-Cambrian greenstones and sediments that has been traced intermittently for over 150 miles from Red lake eastward through Woman lake, Birch lake, the Cat river, Fry lake, and Kawinogans lake to Pickle lake. The area examined covers about 325 square miles. It extends from Perrigo lake on the south, northward to Birch lake, and from Swain lake on the west, eastward to Seagrave lake, and includes the townships of Honeywell and McNaughton and parts of the townships of Agnew and Costello.



Key map showing the location of the Birch-Springpole Lakes area. Scale, 70 miles to the inch.

Birch lake, the waters of which flow through Springpole lake to the Cat river, constitutes part of the Lake St. Joseph–Albany River drainage system. Its irregular shores circumscribe an area of approximately 50 square miles. The clearness of its waters, the picturesqueness of its wooded and rocky islands, and the intricacies of its shore line, are only a few of the many delightful and fascinating features that characterize its natural beauty.

Besides being on the canoe route to James bay by way of Lake St. Joseph and the Albany river, Birch lake also gives access to the route to Hudson bay by way of the English and Berens rivers, Lake Winnipeg, and the Nelson river. Its location suggests that it may have been travelled by the early Canadian explorers, but no mention of it was found in the records examined. Nevertheless, Birch lake has long been recognized as a travel route between Cat lake and the English river, and its use in this respect goes back into the traditional history of the oldest Indian inhabitants. Flint arrow heads, rude stone ornaments, and fragments of broken pottery of Indian origin found in the vicinity of Birch lake point to a culture which existed when the first white explorers penetrated the district. It is interesting to note that, although the local Indian inhabitants are

aware of the origin of the arrow heads, neither memory nor tradition has preserved for them any record regarding the origin of the pottery, the making of which is a forgotten art.

Acknowledgments

During the period of field work, which lasted from late May to early October of 1935, the writer was ably assisted by H. W. Fairbairn and A. G. Darling, of Queen's University and P. A. Chubb, of the University of Toronto. Dr. Fairbairn accompanied the party as senior assistant and did a considerable amount of the geological mapping. The writer is indebted to him for many useful observations and for discussion of various geological problems.

It is impracticable to attempt to acknowledge individually the numerous courtesies and favours received by the writer and the members of his party during the period of field work and during the preparation of this report. The useful information and hospitality extended by prospectors and by the staffs of the various mining companies made the association with them a pleasure. The co-operation received from the Ontario Forestry Branch and from the Provincial Air Service eliminated much of the arduous work associated with the transportation of provisions and equipment. The hospitality extended by Deputy Chief Ranger N. Bamford at Swain Lake and by Chief Ranger M. Roadhouse at Goose Island (Lac Seul) was indeed appreciated.

The writer wishes to thank Dr. J. Satterly, of the University of Toronto, for information on the country that lies between Christina lake and Slate falls (on the Cat river) and on parts of the Birch-Springpole Lakes area.

The assays for gold, various qualitative tests, and the rock analyses were carried out under the direction of W. K. McNeill, Provincial Assayer.

Bibliography

The following selected bibliography provides the most authentic sources of information regarding the Birch-Springpole Lakes area and surrounding sections:—

THOS. FAWCETT, Dept. of the Interior, Canada, Ann. Rept. 1885, pt. II.

R. B. DOWLING, "Report on the Country in the Vicinity of Red Lake and Part of the Basin of Berens River, Keewatin," Geol. Surv. Can., Vol. VII, pt. F, 1894.

CHAS. CAMSELL, "Country around the Headwaters of the Severn River," Geol. Surv. Can., Vol. XVI, pt. A, 1904, pp. 143-152.

A. W. G. WILSON, "Report on a Traverse through the Southern Part of the Northwest Territories from Lac Seul to Cat Lake in 1902," Geol. Surv. Can., Pub. No. 1006, 1909.

W. G. MILLER ET AL., "Reports on the District of Patricia, recently added to the Province of Ontario," Ont. Bur. Mines, Vol. XXI, pt. 2, 1912.

E. M. BURWASH, "A Geological Reconnaissance into Patricia," Ont. Dept. Mines, Vol. XXIX, pt. 1, 1920, pp. 157-192.

E. L. BRUCE, "Iron Formation of Lake St. Joseph," Ont. Dept. Mines, Vol. XXXI, pt. 8, 1922, pp. 1-32; "Eastern Part of Lake St. Joseph," ibid, pp. 33-37.

J. W. GREIG, "Woman and Narrow Lakes Area," Ont. Dept. Mines, Vol. XXXVI, pt. 3, 1927, pp. 85-110.

E. L. BRUCE, "Gold Deposits of Woman, Narrow, and Confederation Lakes," Ont. Dept. Mines, Vol. XXXVII, pt. 4, 1928, pp. 1-51.

GEO. D. FURSE, "Geology of the Shabumeni-Birch Lakes Area," Ont. Dept. Mines, Vol. XLII, pt. 6, 1933, pp. 21-51.

W. D. HARDING, "Geology of the Cat River–Kawinogans Lake Area," Ont. Dept. Mines, Vol. XLIV, pt. 6, 1935, pp. 53-73.

Previous Geological Work

There is no mention of Birch lake in the records of the early Canadian explorers. The fact that a Hudson's Bay Company's post was established at

Cat lake long before geologists visited the region proves, however, that its location was known to the early employees of that company.

In 1885, Thos. Fawcett of the Department of the Interior of Canada made a survey from Lake St. Joseph to Cat lake.[1] Fawcett did not visit Birch lake, but his written observations on the area north of Lake St. Joseph constitutes one of the earliest authentic records of that large region of which the Birch-Springpole Lakes area forms a small part.

It was not until 1904 that Chas. Camsell, who was commissioned by the Geological Survey of Canada to explore a large area in the vicinity of the headwaters of the Severn river, examined the section between Kapikik and Shabumeni lakes and described the rocks in the vicinity of Birch lake.[2] This is the first mention of Birch lake in the literature, and no doubt the name originated with Camsell.

Subsequent work, including reconnaissance surveys by E. M. Burwash[3] in 1919 and by J. W. Greig[4] in 1926, had to some extent defined the distribution of the greenstones, sediments, and granites of the Birch-Springpole Lakes area. The work described in the present report was more detailed in character than these early surveys. Those parts of the area that had been previously mapped were remapped with more precision, and the country that extends from Perrigo lake to Birch lake in the centre of this area and which was not previously examined by geologists was mapped for the first time.

The area that lies immediately west of the field examined and includes Narrow, Woman, and Confederation lakes, was mapped by E. L. Bruce[5] in 1927. The Shabumeni-Birch Lakes area, which lies to the north and northwest of the area described in this report, was mapped by G. D. Furse[6] in 1933. During the summer of 1935 the Geological Survey of Canada had parties engaged in geological reconnaissance work in the Papaonga Lake area and the Trout Lake area, which lie, respectively, to the south and to the southwest of the Birch-Springpole Lakes area.

History of Development

Prior to the rush of prospectors to Red lake in 1925, little was known of the area surrounding Birch lake. Commercial activities had until that time been confined largely to trapping, and despite the fact that prospectors had from time to time penetrated various sections, the area had little significance as a mineral field. Sudden developments coming in quick succession soon changed this peaceful picture. By 1926 the prospecting activity that was focused on Red lake was deflected in the direction of Woman lake, Narrow lake, and Birch lake. Hundreds of claims were staked on locations widely scattered throughout the region, which within a few months was transformed from a relatively uninhabited wilderness into an active prospecting field. The details of this rather spectacular staking rush would provide material for a colourful chapter in a history of the search for gold in Ontario. The country in the vicinity of Woman and Narrow

[1]Thos. Fawcett, Dept. of the Interior, Canada, Ann. Rept., 1885, pt. II.

[2]Chas. Camsell, "Country around the Headwaters of the Severn River," Geol. Surv. Can., Vol. XVI, pt. A, 1904, pp. 147-151.

[3]E. M. Burwash, "A Geological Reconnaissance into Patricia," Ont. Dept. Mines, Vol. XXIX, pt. 1, 1920, pp. 157-192.

[4]J. W. Greig, "Woman and Narrow Lakes Area," Ont. Dept. Mines, Vol. XXXVI, pt. 3, 1927, pp. 85-110.

[5]E. L. Bruce, "Gold Deposits of Woman, Narrow, and Confederation Lakes," Ont. Dept. Mines, Vol. XXXVII, pt. 4, 1928, pp. 1-51.

[6]G. D. Furse, "Geology of the Shabumeni-Birch Lakes Area," Ont. Dept. Mines, Vol. XLII, pt. 6, 1933, pp. 21-51.

lakes was staked solid. For some time Birch lake was situated on the margin of this activity, but subsequently scores of claims were also staked in that neighbourhood. Activities there were chiefly confined to the region extending north from the lake. Several mining companies were organized and funds were raised to develop gold properties scattered throughout the area. In spite of rather favourable geological conditions and interesting surface showings, operations were not highly successful. Subsequently the flow of funds for development work was curtailed by the financial slump of 1929. Interest in the new field lagged for a period, and many of the claims were abandoned. The recent high price of gold, coupled with a general upward trend in business conditions, has been responsible for a revival of interest in this field. and some ground has been restaked. The number of prospectors now living in the area, however, is not large, and the task of developing gold mines, which was begun by hundreds of prospectors in 1926, is now being pursued by a relatively small band.

Future of the Area

Up to the present time (1935), there have been no important gold-producing mines in the area surrounding Birch, Woman, and Narrow lakes. Despite mining activities spread over almost a decade and the erection during that period of small mills on several of the properties, the entire gold production of the area including Birch lake, Woman lake, and Narrow lake, amounts probably to less than $70,000. Of this total, about $50,000 has been produced by the J-M Consolidated Gold Mines, Limited. On many of the claims little work has been done. For this reason and also because of the presence of rather favourable geological conditions, the Birch-Springpole Lakes area, together with the neighbouring areas, constitutes a field that still offers inducements to prospectors.

Topography and Physiography

The Birch-Springpole Lakes area lies well within the borders of the Canadian pre-Cambrian peneplain. Topographically the area lacks prominent features, and when viewed from the air the country appears almost flat. Actually it consists of a rather monotonous succession of low hills composed of rock or glacial debris separated by shallow depressions containing swamps and lakes. The highest ground is situated in the southern part of the area in the vicinity of Okanse and Perrigo lakes. On account of the general absence of topographic forms, some of the few present assume a position of great relative importance. For example, a rocky hill that rises from the west shore of Sundown lake to the modest height of about 200 feet above the lake provides an excellent view of the surrounding country and is one of the highest points in the area. The altitude of Birch lake is 1,276 feet and Springpole lake, with an altitude of 1,270 feet, is the lowest lake in the area. None of the high ground anywhere in the area rises as much as 300 feet above the level of Springpole lake. Most of the drainage of the area is through Birch lake to Springpole lake, thence to the Cat river and Lake St. Joseph. The waters of Perrigo and Cook lakes, however, which flow southwestward, belong to the Lac Seul–English River system.

Owing to the numerous lakes, the physiography of the area has many interesting features and provides a pleasant contrast to the monotonous topography. It has been estimated that approximately one-third of the surface of the area is covered with water, represented by the various lakes and streams, and that more than one-half of the remainder consists of swamp and muskeg. Of the high

ground still remaining, much is covered with morainal overburden. It is obvious, therefore, that the total area of exposed rock is relatively small and that only a limited part of the surface is accessible to the prospector who is equipped merely with hand tools. The best rock exposures are found in the northeastern part of the area in the neighbourhood of Birch, Springpole, and Seagrave lakes. Good exposures, however, occur in many other localities. That part of the area that lies between Perrigo, Okanse, Grace, Bertha, and Cook lakes consists largely of swamp and muskeg.

Power Development

No water power has been developed in the vicinity of Woman lake and Birch lake, and very little is available from streams within these areas. At the present time, power for mine development is being supplied by wood-fired boilers and from Diesel-type motors. The plant of the Hydro-Electric Power Commission at Ear Falls on the English river is the nearest place at which power is now being produced and is probably the most suitable source of power for the area. Present equipment at Ear Falls is capable of producing 5,000 horsepower, all of which is consumed by the mines of Red Lake and vicinity. According to information supplied by the Ontario Hydro-Electric Power Commission, plans are under way for the development of further power from Ear falls for use in Red Lake and other fields, such as the Birch-Springpole Lakes area.

GENERAL GEOLOGY

All the consolidated rocks of the area are of pre-Cambrian age. On the basis of age relationships they may be divided into three groups. The oldest rocks belong to the Keewatin group and consist largely of lavas, with which are intercalated minor beds of sediments. Above and younger than the Keewatin are rocks of the Timiskaming type, which consist predominantly of rather coarse sediments, but which may include minor phases of lavas. Algoman rocks, which are the third group, consist altogether of plutonic types, most of which are of granitic character. They intrude both the Keewatin and Timiskaming types. The Algoman rocks, therefore, are the youngest rocks of the area. Unconsolidated sediments of Pleistocene time have been distributed in patches here and there over the pre-Cambrian surface. The gap between the youngest Algoman rocks and the Pleistocene sediments represents a very long geological time interval, records of which have been preserved in many places on the earth's surface, but which are entirely lacking in the Birch-Springpole Lakes area.

The following classification shows the position of the various rocks in the geological time table:—

QUATERNARY	
RECENT:	Unconsolidated stream sediments.
PLEISTOCENE:	Unconsolidated glacial gravels, sands, clays. Lake deposits.
	Great unconformity
PRE-CAMBRIAN	
ALGOMAN:	Quartz veins. Pegmatite. Syenite, quartz porphyry. Granite, granite gneiss, granodiorite. Diorite, hornblendite.
TIMISKAMING(?)	Greywacké, quartzite, arkose, slate. Conglomerate. Iron formation.
KEEWATIN:	Acid volcanics. Basic volcanics and intercalated sediments.

Keewatin

From an areal standpoint the Keewatin rocks constitute about one-half of the surface of the field examined. They are the oldest and therefore the most highly metamorphosed rocks of the area. In general this group is composed of types that have been formed at or near the surface of the earth. From the standpoint of origin, appearance, and composition, the Keewatin rocks of the Birch-Springpole Lakes area largely resemble the original Keewatin series identified by Lawson[1] in the Lake of the Woods area in 1885. This group consists predominantly of basic and acid lavas, with which are associated basic and acid pyroclastics, including both tuffs and agglomerates. Intercalated with these volcanics are numerous sedimentary beds including iron formation, which with some minor intrusives complete the Keewatin rocks. These types cover large sections near Okanse and Perrigo lakes and in the vicinity of Sundown and Honeywell lakes, the Shabumeni river, Birch, Springpole, Seagrave, and Bertha lakes.

To some extent the difficulty with which the various types are recognized is a measure of their alteration. Heat, pressure due to burial, and emanations from neighbouring bodies of magma are thought to have been the most potent factors in their metamorphism. The margins of the Keewatin rocks near their contacts with granite are locally marked by the development of hornblendite and hornblende schist. All the Keewatin rocks have been subjected in varying degree to rock flowage, evidence of which is seen in folded structures and in the development of widespread foliation. Lava pillows, conglomerate boulders, and amygdaloidal cavities have been elongated in such a manner that the maximum axes of elongation lie parallel to the planes of schistosity.

Basic Volcanics

The basic lavas, with which are associated basic pyroclastics, compose the largest part of the Keewatin rock areas. The lavas consist of ellipsoidal, amygdaloidal, ropy, and brecciated types of andesites and basalts. Associated with these rocks are thin beds of banded tuffs, which in some places are difficult to distinguish from the beds of normal sediments, which also occur between the flows. Amygdaloidal and pillow lavas of basic character form most of the basin of the north arm of Springpole lake. They extend west from Springpole lake to Birch lake, where they form the east shore of Wagner bay. Here they include sedimentary beds, some of which are rather black and slaty and contain much magnetite. Pillow lavas and amygdaloidal lavas of andesitic character with associated minor sediments occupy most of the section that extends north from the east arm of Springpole lake to Birch lake. The lavas in this vicinity locally contain spheroidal amygdules up to one inch in diameter filled with granular quartz. In the southern part of this section near Springpole lake the rocks have been very highly metamorphosed, owing to their proximity to the Seagrave granite batholith, and are largely hornblende schists. They have been mapped as Keewatin by the writer and they probably represent highly altered lavas and sediments. In the vicinity of the Dole claims some metamorphosed flows contain large crystals of white feldspar and are difficult to distinguish from metamorphosed conglomerates. A large area of Keewatin rocks in the vicinity of Seagrave lake has, for mapping purposes, been classed as basic volcanics.

[1]A. C. Lawson, "Report on the Geology of the Lake of the Woods Region, with special reference to the Keewatin (Huronian?) belt of the Archæan rocks," Geol. Surv. Can., Vol. I, pt. CC, 1885, pp. 10-15.

Much of this part of the area, however, is covered with lavas of intermediate composition. Dark ellipsoidal andesites, locally of very fresh appearance due to the presence of much hornblende, occur east of Okanse lake and between that lake and Perrigo lake.

In the vicinity of Philchub lake these hornblendic lavas are associated with diorites, which are similar in appearance to the lavas, and it is difficult to distinguish between intrusives and extrusives. Some thin beds of sediments intercalated with the lavas were identified in this section. Dark-weathering andesitic lavas are well exposed in a belt, which strikes almost east-west, north of Bertha lake. The western part of this belt contains well-formed pillow structures. As the belt is followed eastward the pillows are less abundant and the rocks more massive and more hornblendic, until finally in the vicinity of the east end of Bertha lake they become hornblendites in which no flow structures are visible. Some masses of hornblendite porphyry in this section which occur near granite intrusions and which have been designated as Algoman by the writer may have resulted from the contact metamorphism or refusion of Keewatin basic lavas.

Keewatin basic flows also occupy most of the area between Sundown and Grace lakes as well as a considerable area in the vicinity of the western part of Birch lake and along the Shabumeni river.

Basic pillow lavas of spherulitic character were identified near the northern end of Honeywell lake and on the east and south shores. Bruce[1] found a similar type of spherulitic lava near the outlet of Lost bay of Confederation lake, which he has described as follows:—

> The rocks at Confederation lake seem to be the result of the segregation of the feldspathic and quartzose material without the formation of phenocrysts. Under the microscope a specimen appears as a fine-textured aggregate of feldspar-chlorite and brownish-green biotite. The boundaries of the white areas are fairly sharp, and the outer rim consists of material of still finer grain, which is muddy in appearance and lacks both biotite and chlorite. The rim probably was originally composed of feldspar. Within this is a coarser-grained feldspathic material and some quartz, and the centre of most of the nodules consists of clear quartz in a mosaic pattern. Thus the whole arrangement is similar to the structure of those agates that have a central core of coarsely crystalline quartz. It seems likely that the nodules are explainable as rhythmic crystallizations in the cooling lava.
>
> In a specimen from a lake east of Washagomis on the route to Sundown lake, not all of the nodules are complete, but in some there is simply a spherical shell of white material enclosing within it material similar to the matrix in which the spherule is embedded. Under the microscope this interior part seems to be much finer grained than those described above and is brownish in colour. It probably represents a rock cooled too quickly to allow the completion of the migration of the material necessary to form a solid spherule, chilling having arrested the segregation in an intermediate stage between the homogeneous greenstones and the perfectly formed spherulites.

The location of these last-described spherulites found by Bruce at "a lake east of Washagomis" appears to be the first lake north of Sundown lake, where the writer found spherulites on the shore. These appear to be similar in character to those at Honeywell lake, to which Bruce's theory of origin is also applicable.

Coarse basic pyroclastic material of agglomerate type, though perhaps widely distributed, does not cover a very large part of the Birch-Springpole Lakes area. Some material of this type is, however, associated with the basic lavas that occur north of McNaughton lake and also in the section between Okanse and Grace lakes. None of the agglomerate masses identified in the area were traced for more than a few hundred feet.

Fine tuff appears to be widely distributed throughout the area, although much of it is difficult to distinguish from other types of volcanics and from normal

[1]E. L. Bruce, op. cit., p. 7.

sediments. East of Okanse lake fine-grained, well-bedded tuffs are difficult to distinguish from the Timiskaming type of sediments that occur in that vicinity. A thin-bedded tuff from Wagner lake examined under the microscope shows as many as twenty laminations to the inch. The minerals include fragments of quartz, orthoclase, plagioclase, and alteration products such as carbonate and kaolin. Some iron oxide is also present, but femic minerals are practically absent. These minerals do not correspond to any of the common rock types. Fine-grained tuffs also occupy horizons in the vicinity of the Keewatin-Timiskaming contact on the north shore of the southwest arm of Birch lake and on the south shore of the eastern part of Birch lake.

Acid Volcanics

The Keewatin acid volcanics consist mostly of light-coloured rocks. They cover only a small part of the map area. Some rather light-coloured volcanics of intermediate composition have been included with the basic rocks.

The largest area of acid volcanics is a mass about 11 miles long and up to 1½ miles in width, which strikes northeast through the western part of Birch lake. Most of this mass is rather light-weathering, and in places where the composition is highly acid the rock has the striking whitish-green colour that distinguishes weathered acid lavas in many parts of Ontario. The belt is moderately sheared, and in a few places along the shore of Birch lake the weathered outcrops display much loose flaky material characteristic of the disintegrated products of highly foliated rocks. In most of this belt the rock texture is so fine that individual minerals cannot be easily identified. Phenocrysts of quartz, however, were recognized in various places in the mass. Under the microscope the mineral composition appears to be limited largely to quartz and remnants of orthoclase surrounded by carbonate. Kaolin, sericite, and magnetite are also present, but there are practically no basic rock-forming minerals. A considerable amount of acid fragmental material of agglomeratic type appears to be associated with this belt.

A small mass of light-weathering acid lavas similar to those of the belt just described is exposed on the big island in the southwest bay of Birch lake. This mass, which also contains basic lavas, is surrounded by Timiskaming sediments. Although the true relationships are obscured by folding, the writer tentatively regards this mass as belonging to the same horizon as the acid belt described above.

Rather dark-coloured acid lavas occur in the vicinity of the north arm of Seagrave lake, where they are exposed on some of the islands and on the south shore east of the narrows. The acid lavas here vary considerably in composition and are intimately associated both with other flows and with sediments.

Several masses of an unusual light-coloured, reddish-weathering rock, composed mainly of light-coloured feldspar, are exposed among the basic volcanics on the north side of the big island in the north arm of Springpole lake and on the mainland to the northeast. Some of this rock is exposed in the vicinity of the eastern part of the Dunkin claims. The feldspar crystals are somewhat brecciated and exhibit a parallel arrangement suggestive of a flow structure. A thin section examined under the microscope shows that this rock is composed mostly of altered orthoclase with much carbonate, and small amounts of acid plagioclase and pyroxene. Pyrite and very small grains of magnetite were also identified. A chemical analysis showed the following constituents:—

	Per cent.
SiO_2	57.92
Al_2O_3	18.76
Fe_2O_3	1.24
FeO	.48
CaO	4.36
MgO	.47
Na_2O	4.68
K_2O	7.89
H_2O	.91
CO_2	3.25
TiO_2	.16
P_2O_5	.16
MnO	.11
FeS_2	.30
Total	100.69

Both the mineral and chemical composition suggest that the rock belongs to the syenite family, and as it is probably a flow it might be called a trachyte.

Sediments

The Keewatin sediments are represented largely by thin beds which lie between the flows. On account of their close association with the flows and also because of their widespread distribution, no attempt was made to separate them for mapping purposes. They consist largely of conglomerates, greywackés, fine slaty sediments, iron formation, and tuffaceous material, some of which was probably deposited in water. These sediments do not cover extensive areas, but they occur in most localities where Keewatin lavas are found. In general, the Keewatin sediments may be distinguished from those of the Timiskaming type by their dark colour, in which respect they resemble the Keewatin lavas, their position between lava flows, and the fact that they consist largely of partly sorted volcanic detritus. In general they represent minor phases of sedimentation, such as might occur between periods of volcanic activity. Nevertheless, on account of the complex folding that characterizes the area it is, in places, difficult to distinguish these sediments from remnants of folded Timiskaming rocks. No pronounced angular discordance was observed anywhere in the area between Keewatin and Timiskaming rocks. There is reason to believe that in this area late Keewatin time was characterized by sedimentation to a greater extent than earlier Keewatin time. The apparent lack of evidence of an impressive erosion interval and the conformable relationship between Keewatin and Timiskaming type rocks suggest that earth movements at that time were not revolutionary in character. Possibly the change was a gradual one from a period dominantly volcanic to one featured largely by the processes of sedimentation.

Keewatin sediments associated with Keewatin lava flows are well exposed at several places along the east shore of Wagner bay of Birch lake. The beds in this vicinity include conglomerate, greywacké, fine-grained siliceous material, dark-green sediments, and slaty iron formation.

In the vicinity of Seagrave lake the Keewatin sedimentary horizons are composed largely of conglomerates, and long tongues of Timiskaming sediments from the large Timiskaming area to the west extend into and are infolded with the Keewatin lavas and sediments.

In the section that extends north from the east arm of Springpole lake to the south shore of Birch lake there are a few highly metamorphosed sedimentary horizons composed of greywacké and conglomerate. In the large Keewatin

areas north of Perrigo lake and north of Okanse lake the sedimentary horizons are confined to a few thin beds and to lenses of both fine- and coarse-grained material.

Intrusives

The Keewatin intrusives are plutonic rocks of pre-Timiskaming age. Rocks of this type are rare in the Birch-Springpole Lakes area. They include a few scattered dikes and possibly some irregular-shaped intrusive masses. Some of the apparent Keewatin intrusives probably represent extruded magmas, which welled up into fissures and cavities formed in cooling lavas. Keewatin intrusives of positively deep-seated origin are not conspicuous. One or two dikes of dioritic character which cut the Keewatin volcanics on the property of the Sol D'Or Gold Mines, Limited, probably belong to this category. Dikes of dioritic character similar in composition to the lavas which they intrude were identified in that part of Birch lake that lies east of Wagner bay and north of Springpole lake. East of Okanse lake andesitic pillow lavas are associated with massive, well-textured diorites, some of which may possibly be intrusive.

Laurentian Granite.—The term "Laurentian granite" is reserved for those granites that intrude only pre-Timiskaming rocks. No such granite was identified in the Birch-Springpole Lakes area. The presence of granite boulders, however, in the Timiskaming conglomerates of the area suggest that a mass of Laurentian granite was exposed to erosion somewhere in the region during Timiskaming time. As far as the writer knows, no masses of pre-Timiskaming granite have been identified by the geologists who have examined neighbouring areas.

Timiskaming(?)

The rocks of the Timiskaming type, which are represented almost entirely by sediments, cover large parts and form one of the interesting features of the Birch-Springpole Lakes area. In age and character this group appears to be analagous to the Shabu series described by Furse.[1] On account of the complex folding the maximum thickness of the Timiskaming series of the Birch-Springpole Lakes area could not be satisfactorily estimated. That part of the series that is exposed on the south shore of Birch lake east of Wagner bay has a thickness of over 7,000 feet. The largest area of these sediments and the locality in which the series probably attains its maximum thickness lies in the section that extends from Birch lake south toward Bertha lake. Although the thickness of the series in this vicinity is unknown, it probably exceeds by a substantial amount the above estimate of 7,000 feet. The lower horizons of the series are composed of highly metamorphosed volcanics, iron formation, and conglomerate. The upper part consists of metamorphosed conglomerate, greywacké, impure quartzite, arkose, and some slate. Volcanics were not positively identified in the upper horizons of the Timiskaming-type series.

Iron Formation

Most of the iron formation occurs in thin, dark, slaty magnetite beds, which are scattered throughout the Keewatin sections of the area, but are probably most common in the vicinity of the east shore of Wagner bay of Birch lake.

Iron formation of highly banded character is best exposed on the south shore

[1]G. D. Furse, "Geology of the Shabumeni–Birch Lakes Area," Ont. Dept. Mines, Vol. XLII, pt. 6, 1933, pp. 24-26.

near the east end of Birch lake, where a belt over 400 feet wide strikes northwest along the water's edge for a distance of about 1,500 feet. This belt lies in a transition zone between the Keewatin and the Timiskaming-type rocks. As this iron formation somewhat resembles the Timiskaming iron formation identified by Furse on an island that lies along the strike of the rocks several miles to the northwest, it has been classed with the Timiskaming rocks. The iron formation is locally much folded. It appears to dip steeply to the northeast and disappears under the waters of Birch lake, so that its entire width was not determined. South of the belt lie Keewatin rocks composed mostly of lavas with beds of sediments and possibly tuffs, the strike and dip of which conform approximately to the bands of the iron formation. There is no visible angular discordance or erosional unconformity between the iron formation and the Keewatin rocks. The rocks to the north of the belt are covered by the waters of Birch



Banded iron formation on the south shore near the east end of Birch lake.

lake, but the presence of Timiskaming sediments to the northwest suggests that the iron formation may be situated in the lower horizons of the Timiskaming series. The individual beds range in thickness from very thin laminations that measure only a fraction of an inch to bands of 3 or 4 feet. There are no white pure silica bands. All beds are dark in colour and are composed of slaty greywacké and impure quartzite with varying amounts of magnetite. Some very thin laminations examined under the microscope were composed almost entirely of quartz and magnetite. The banding is primarily due to a difference in composition, but it has been strikingly accentuated by weathering. The iron formation belt is traversed by a few small stringers and veins of quartz, some of which contains a little pyrite.

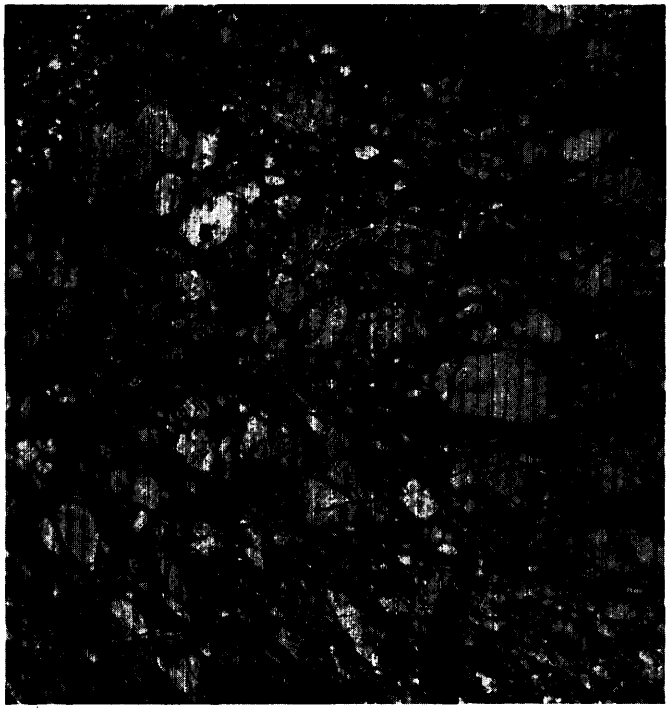
Iron formation consisting of thin slaty magnetic beds was identified at several places on the south shore of Birch lake between Wagner bay and the east end of the lake. All the occurrences in this section are confined to the transition zone between the Keewatin and Timiskaming rocks.

Well-banded, distinctly folded iron formation associated with sediments of Timiskaming type occur northeast of Bertha lake. On account of the overburden in the vicinity no estimate could be made of the magnitude of this belt. Other

small bands of iron formation belonging to both Keewatin and Timiskaming rocks occur near Lindsay lake, near the east shore of the Shabumeni river, and in the vicinity of the northwestern part of Birch lake.

Conglomerate

The Timiskaming conglomerates are best exposed on islands of Wagner bay, and along the south shore and in South bay of Birch lake. Coarse conglomerates also occur in the vicinity of Cromarty and Grace lakes. In most of these places the conglomerates are interbedded with greywacké and impure quartzite, but



Timiskaming type of conglomerate exposed in the vicinity of the northwest shore of Perrigo lake.

in places also with arkose and slate. The material that composes the conglomerates ranges from coarse sand to boulders over a foot in diameter. Most of the Keewatin types were recognized among the conglomerate boulders. They include ellipsoidal and amygdaloidal andesites and basalts, diorites, hornblendites, acid lavas, quartz porphyries, feldspar porphyries, slate and banded sedimentary material, banded iron formation, and vein quartz. Granite boulders from an unknown source were also identified. A few of the boulders have a nodular appearance similar to spherulitic lavas. In most of the conglomerate, boulders are well rounded. The matrix consists of greywacké, impure quartzite, and other fine-grained clastic material.

Greywacké, Quartzite, Arkose, Slate

The finer-grained sediments, although associated with the conglomerates, also cover substantial areas elsewhere in the area. Greywacké and impure

quartzites cover large areas between Birch lake and Bertha lake. The sediments in the vicinity of Bumpy and Cook lakes are largely mica schists, which, under the microscope, were found to be composed mostly of quartz and biotite. They probably represent the metamorphosed equivalents of impure quartzites.

Slates have not been developed on a prominent scale anywhere in the area, although thin beds of slaty material are widely distributed. In the vicinity of Grace lake contorted slates are interbedded with the coarser sediments. The sedimentary belt that extends north from Perrigo lake to McNaughton lake contains beds of conglomerate, slate, and other fine-grained sediments, as well as thin beds of fine-grained tuffaceous material.

Arkose, which might be mistaken for altered quartz porphyry, is well exposed on the west shore of South bay of Birch lake.

All the Timiskaming sediments are highly folded and extensively metamorphosed. Nevertheless, the bedding is still apparent in most localities. Structures such as ripple marks were not identified and if once present have been obliterated. Cross-bedding is not common, and the few occurrences recognized were of no use in determining the positions of the beds.

Algoman

The Algoman rocks of the Birch-Springpole Lakes area consist of plutonic types which intrude the Keewatin and Timiskaming groups. The oldest Algoman rocks are diorite and hornblendite. Next in sequence follow the granites and granite gneisses, which occupy extensive areas. The youngest Algoman rocks, which represent the closing stages of Algoman activity, are pegmatite dikes and quartz veins.

Diorite and Hornblendite

Diorite and hornblendite have been indicated on the map accompanying this report as of early Algoman origin. Some of these rocks undoubtedly belong to early Algoman time, but others, which may belong to the same period, could not be certainly determined as Algoman. Some of the diorite and hornblendite masses definitely intrude pre-Algoman rocks, as for example those situated in the vicinity of the western part of Birch lake near the Shabumeni river and others situated near the south end of South bay of Birch lake. The latter cut Timiskaming sediments. In the vicinity of the east end of Bertha lake, however, masses of hornblendite porphyry occur in highly metamorphosed Keewatin lavas. Granite is exposed in the neighbourhood, and it is possible that granite also occurs at shallow horizons below the hornblendite porphyry. These masses, too, have been tentatively designated as Algoman by the writer, although they may have resulted from contact metamorphism or refusion of Keewatin basic lavas.

The diorite and hornblendite identified in localities west of Cook lake are undoubtedly marginal phases of the granite. These masses not only lack precise boundaries but they appear to grade imperceptibly, by gradual change in composition, into pink granite. Genetically they may be explained as the result of assimilation of greenstone by granite or as the result of the migration of basic material toward the margins of cooling granite magma.

Granite and Granite Gneiss

All the light-coloured granite rocks in the margins of the area as well as those masses within the area that are surrounded by greenstones and sediments are of Algoman age, as are the vast granite fields that extend eastward from the borders of the area for an unknown distance into unexamined country. They

include the Seagrave lake batholith, the Bumpy lake and Deaddog lake granites, the Perrigo lake and Okanse lake batholiths, and the isolated smaller masses of granite that intrude the greenstones and sediments in various parts of the area, the exact relationship of which to the large granite masses is unknown. Some small marginal phases of granodiorite and syenite and a few quartz porphyry dikes are also of Algoman age.

The granites vary in colour, mostly from pink to grey, but near the contacts with basic lavas they have been darkened, owing to assimilation. They are composed largely of quartz, orthoclase, a little oligoclase, and either biotite or hornblende. Two thin sections of granite were examined under the microscope. One was obtained from the Perrigo lake batholith and the other from the small batholith on the west shore of South bay of Birch lake. Each contained small amounts of both biotite and hornblende. In the larger Algoman areas granites and granite gneisses are intimately associated, with confused relationships. Most granite masses exhibit foliation to a minor degree, but nowhere in the area were the granites intensely foliated. The absence of foliation suggests that there has been no major deformation in the area since Algoman time. The small batholith on the west shore of South bay of Birch lake and the one about three miles to the north on the north shore of the main part of Birch lake are rather more massive and of finer texture than the granites of the Perrigo, Seagrave, or Okanse batholiths.

Syenite

Syenites are rare and appear to be confined to very highly coloured, locally porphyritic phases associated with the granites in the vicinity of the north shore of Perrigo lake and a few red dikes and small masses, containing much orthoclase feldspar, which occur in the vicinity of the north arm of Springpole lake. Under the microscope samples from both these localities showed considerable quartz. It is doubtful, therefore, if there are any true Algoman syenites in the area.

Quartz Porphyry

The quartz porphyries also occur infrequently. They appear to be limited to a few dikes in the vicinity of the Dole claims north of the east arm of Springpole lake and localities near the eastern part of Exit bay of Birch lake. One mass is exposed on the north shore of Satterly lake. These dikes are composed almost entirely of bluish quartz and white orthoclase with varying amounts of sulphide. Some small masses of quartz feldspar porphyry were also identified in the vicinity of the western part of Birch lake. None of the quartz porphyry masses examined were associated with pegmatite dikes, and the age relationships of these two Algoman types could not be ascertained.

Pegmatites and Quartz Veins

The granite pegmatites cut the Keewatin and Timiskaming, as well as the earlier Algoman rocks. They appear to be associated mostly with the granites, and with the Keewatin and Timiskaming rocks near the margins of granite masses. They are the result of the slow crystallization of granitic material rich in silica and other hydrothermal solutions that filled the fractures caused by the cooling of previously crystallized granitic magma. Pegmatite dikes in the vicinity of Cook and Bumpy lakes are composed mostly of quartz, orthoclase, muscovite, and biotite. One dike in the vicinity of the granite-sediments contact on the survey line that runs south from the north end of Cook lake contains suggestions of graphic texture. The pegmatites of the other granite sections

of the area do not differ materially in composition from those of Cook lake. The flat-lying dikes that cut the granite at Deaddog lake are perhaps a little unusual. The fresh undisturbed appearance of the granite suggests that the dike material was deposited in a set of horizontal fractures which have not been greatly disturbed.

Quartz veins, most of which are small, represent the last phases of Algoman activity. The veins cut all the consolidated rocks of the area including the pegmatite dikes.

Pleistocene

The topography of the Birch-Springpole Lakes area is the result of the action of the continental glacier which once covered most of the northern part of North America. The pre-glacial mantle of residual soil was swept away by the ice-sheets, and the debris redistributed over a smoothed and locally polished surface. Mounds of boulder clay and of gravel, sand deposits, remnants of eroded eskers, and rounded hillocks of rock are characteristic features of this typical glacial topography. Probably the most pronounced effects of glaciation are the numerous lakes, which owe their origin chiefly to the uneven redistribution of the glacial debris. It is doubtful if any lakes existed in the Birch-Springpole Lakes area immediately prior to glacial time, as a base-levelled topography, such as then existed, did not provide basins for water to accumulate. The pre-glacial rivers were largely confined to the major troughs, which, although modified in detail, have nevertheless prevailed throughout the glacial period to form the main water channels of the present time.

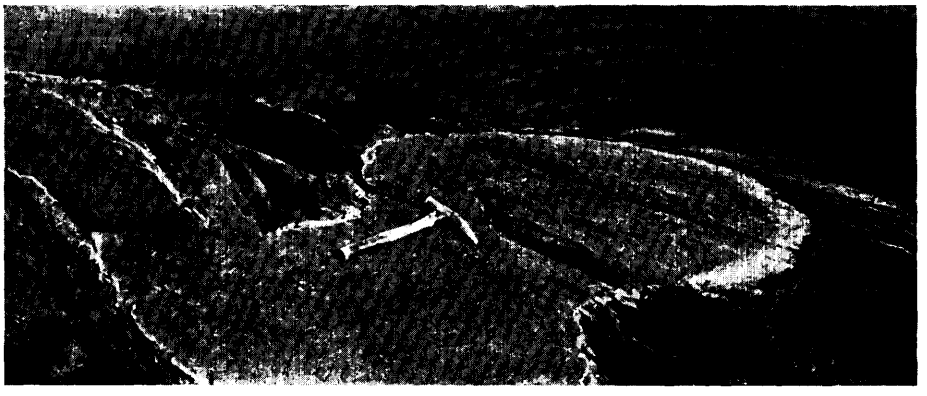
Structural Geology

Most of the folded structures of the Birch-Springpole Lakes area are the result of Algoman earth movements. The complexity of these folded rock structures is one of the outstanding features of the area. Throughout most of the area the sedimentary beds and flows have been tilted and now stand in nearly vertical positions. Furthermore, the planes of schistosity throughout most of the area are also almost vertical and appear to bear a parallel relationship to the steeply dipping beds and flows. This parallelism between the beds and planes of schistosity suggests deformation that resulted in close folding. It has been observed, moreover, that this parallel relationship exists in many places where sudden changes in strike show that the schistose rocks have been subjected to crumpling. Crumpling of this character occurs frequently in the Timiskaming sediments in the vicinity of Birch lake. It is apparent, therefore, that there have been two distinct periods of deformation: first, a period of close folding, during which schistosity was developed, in the main parallel to the limbs of the folds; second, a period of deformation which locally crumpled the schistose beds and complicated the previously formed structures. The stresses that produced the second deformation were not severe enough to obliterate the primary cleavage. Partial development of secondary cleavage was identified in the vicinity of the northwest corner of Perrigo lake, and visibly folded fracture cleavage is exposed on the east shore of Wagner bay of Birch lake south of the point where the shore line turns eastward. There is no evidence that any great time interval elapsed between the two periods of deformation. In fact the entire sequence might be regarded as having progressed without interruption during Algoman time.

The rocks north of Perrigo lake and near Okanse lake strike approximately north-south. Farther to the north, in the vicinity of the western part of Birch

lake, the strikes change gradually to northeast; and farther eastward the rocks of Seagrave, Springpole, and Birch lakes strike almost east-west. Observations of the plunge of the schistosity (plunge of the elongation of mineral grains) made at various places along this changing strike show that the plunge changes from steeply south in the vicinity of Perrigo and Okanse lakes, to steeply southwest in the northwestward-striking rocks of the west part of Birch lake, and finally to steeply west in the east-west striking rocks of the eastern part of the area. The consistency of the plunge of schistosity observed on this huge structure, which was followed from the southwestern to the northeastern part of the area, substantiates the view already stated concerning two periods of deformation.

Some problems involving rock deformations in the Birch-Springpole Lakes area have been discussed by H. W. Fairbairn in a paper entitled "Elongation in Deformed Rocks," which was presented at the annual meeting of the Geological Society of America held in New York in December, 1935.



Drag-folded dike exposed on the north shore of the large island situated near the south shore of Birch lake not far east of Wagner bay.

One of the most obvious structures of the area is a folded anticline which is exposed in the vicinity of Springpole lake. This structure has been described by Burwash[1] as follows:—

> The axis of the anticline . . . is occupied by the northern arm of Springpole lake, and by a bay which extends south from Birch lake and lies to the west of the north arm of Springpole lake. . . . Passing over the portage from the north arm of Springpole lake to Birch lake we descend the northern limb of the anticline.

Keewatin volcanic rocks, which strike northwest from the north arm of Springpole lake to Birch lake, are exposed along the centre of this structure, and the younger Timiskaming sediments are exposed on the limbs to the northeast and to the southwest. The Timiskaming sediments in the southwest limb of this fold extend into a large area of folded Timiskaming rocks, the structural details of which the writer was unable to solve in the time at his disposal. It appears, however, that there are some warped folds in this section which strike nearly east-west.

The basic and acid volcanics exposed in the vicinity of the large island in Birch lake west of Wagner bay probably represent a window of Keewatin rocks surrounded by Timiskaming sediments.

[1]E. M. Burwash, "A Geological Reconnaissance into Patricia," Ont. Dept. Mines, Vol. XXIX, pt. 1, 1920, pp. 174, 175.

ECONOMIC GEOLOGY

Mineralization

The mineralization of the Birch-Springpole Lakes area is similar in some respects to that of the Red Lake and Pickle Lake–Crow River sections of the same belt.

Mineralized quartz veins, sulphide-bearing porphyry dikes, and shear zones containing both quartz and sulphides have been located in various parts of the area. In some cases the flows, sediments, and granites contain small amounts of disseminated sulphides. Although the entire area is of potential importance most of the interesting mineralization discovered so far is confined to the northern sections of the area, in the vicinities of Grace, Springpole, and Birch lakes. North of the east arm of Springpole lake highly folded Keewatin rocks, which strike almost east-west and dip to the north, are cut by dikes of pink granite and quartz porphyry and by quartz veins. Some of the veins cut across, others conform to the strike of the surrounding rocks. Many of them are small and irregular, and the majority appear to carry only a little sulphide. Pyrite, chalcopyrite, pyrrhotite, and some small cubes of galena were identified in the veins. The mineralization in a quartz porphyry dike in this section appeared to be limited to a little pyrite. Some staking was done in this neighbourhood by Dole Brothers in 1934.

The numerous Algoman red porphyry dikes that cut the Keewatin lavas and sediments in the vicinity of the north arm of Springpole lake appear to be almost barren of sulphides. On account of their striking red colour these dikes are very conspicuous and may be readily recognized among the dark Keewatin rocks. Disseminated pyrite was the only sulphide recognized in the dike material. An assay of a sample from a dike that outcrops on the east shore of the north arm of Springpole lake gave no gold.

Prospectors reported that a gold concentrate could be obtained by panning the light-coloured, reddish-weathering trachyte that is associated with the dark Keewatin lavas on the mainland to the north and northeast of the big island in the north arm of Springpole lake. A grab sample of some of this material, which contained a little disseminated pyrite, was assayed by the Provincial Assayer and yielded a trace of gold.

Mineralization of rather interesting character occurs in a shear zone in metamorphosed Keewatin lavas just east of the portage at the north end of Springpole lake. The shear zone contains quartz veins and lenses and bands of schist and parallels the foliated lavas, which strike about N.65°W. and dip 50°N.E. Some sediments and light-weathering masses of trachyte occur in the vicinity. Intrusions of Algoman granite are found about a mile to the east, and Timiskaming sediments lie in contact with the Keewatin rocks some hundreds of feet north of the shear zone. The mineralized zone contains tourmaline, ankerite, and various sulphides. At the time of the writer's visit the mineralized exposures were confined to the Dunkin claims; to the east the rocks are largely obscured by muskeg and overburden, and to the west they consist of metamorphosed Keewatin volcanics. Numerous claims were staked in this neighbourhood in 1935.

Interesting gold mineralization associated with quartz veins has been found at Grace lake and in the section north of Bergstrand lake and west of South bay of Birch lake. Visible gold has been found at three scattered locations in this neighbourhood, as follows: at the property of Sol D'Or Gold Mines, Limited, situated on Grace lake; on the Bergstrand claims, north of Bergstrand lake;

and on the Harris-Swain-Cavano claims near South bay of Birch lake. At the Sol D'Or property the veins occur in Keewatin volcanics, but at the other two properties they cut Timiskaming sediments. The veins so far exposed are small, and as the gold appears to be confined within the vein walls the amount of ore indicated is small. Probably deep-seated granite masses have been the source of the mineralization. A granite batholith is exposed at the east end of Swain lake. Geologically this neighbourhood is worth intensive prospecting.

A few small quartz veins and some quartz porphyry dikes were identified in the vicinity of the east end of Exit bay. In this section the mineralization appears to be confined to pyrite. Near the south shore of Exit bay old stakings are evidence of previous prospecting activity. The rocks here include sediments, greenstones, and diorites. Sulphide mineralization associated with fracturing was the reason for the previous interest of prospectors in this locality.

In the neighbourhood of the western part of Birch lake and along the Shabumeni river quartz veins up to 4 feet in width cut the Keewatin rocks. Most of these consist of barren quartz. One vein, however, exposed on the south shore of Birch lake near the mouth of the Shabumeni river, contains a variety of minerals, including quartz, tourmaline, calcite, ankerite, albite, pyrite, chalcopyrite, and probably other sulphides. An assay of a grab sample which contained sulphide material from this vein gave no gold values.

Description of Properties

BIRCH-SPRINGPOLE LAKES AREA

Sol D'Or Gold Mines, Limited

The property of Sol D'Or Gold Mines, Limited, consists of 24 unsurveyed claims situated on Grace lake in the northeast corner of Honeywell township, the northwest corner of McNaughton township, and in the block immediately north of these two townships. Adjacent ground held under option brings the total present (July, 1935) holdings to 38 claims. The original staking dates back to 1927, when 18 claims were staked by Messrs. T. W. Bathurst, R. Ellis, and Walter Johnson for the T. W. Bathurst Syndicate. Shortly afterwards the Rainbow Lake Gold Mining Company, Limited, was organized to take over the property, and funds were made available for the erection of camps and for mining work, including a small shaft to 34 feet. In 1930, the name of the company was changed to Rainbow Lake Gold Mines, Limited. Subsequently the ground became open for staking, and in 1932, it was restaked by Earl McDougall. In the fall of 1932, the property was leased to T. W. Bathurst, and a 3-ton Jack Nutt mill was installed. The mill was first operated in November, 1932, and in December of the same year the first gold was shipped to the mint at Ottawa. In 1934, the property was acquired by the Sol D'Or Gold Mines, Limited. During the summer of 1935 this company installed a 5-ton Straub mill with amalgamation plates and concentrating table. The mill was first operated in September, 1935, and was driven by a new 8 h.p. Diesel-type Lister motor.

The rocks on the property are Keewatin lavas and volcanic fragmentals, which near the north end are in contact with Timiskaming sediments. The mineralization occurs in a fracture zone, about 350 feet in width, and consists of six small parallel quartz veins, each of which is less than 10 inches wide. The veins dip from 40° to 70°N.E. and strike N.70° to 80°E. They contain pyrite, chalcopyrite, galena, sphalerite, and fine visible gold. Tellurides are also

present. Operations to date have been confined mainly to open-cut mining on No. 3 vein. Officials state that up to July, 1935, about 400 tons of ore had been milled, which yielded approximately $7,500 in gold. During the winter of 1934-35, the vein zone was explored by diamond-drilling. Ten holes ranging in depth from 150 to 650 feet and aggregating 3,000 feet were completed. Some ore was indicated over narrow widths. Sampling done so far indicates that the gold is confined almost entirely to the narrow quartz stringers.

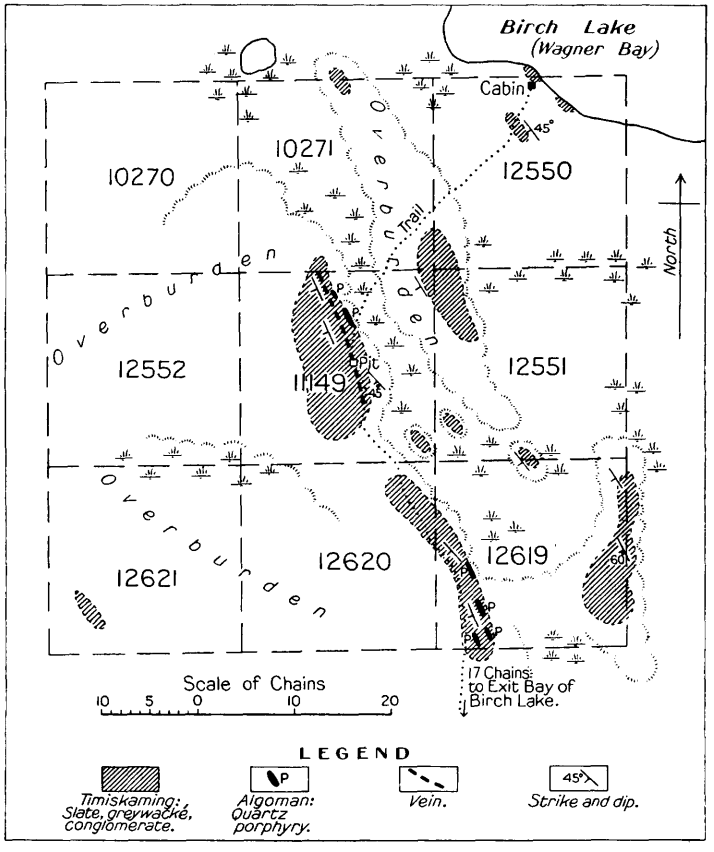


Open cut showing No. 3 vein on the property of Sol D'Or Gold Mines, Limited, Grace lake.

Swain, Harris, and Cavano

The Harris-Swain-Cavano holdings consist of 9 claims situated near the west shore of South bay of Birch lake. The country rock of Timiskaming sediments consists of beds of conglomerate, greywacké, arkose, and slate, which strike almost east-west and dip about 60°S. These rocks are highly altered, and the character of some of them suggests the presence of intrusives or other igneous types. The claims were staked in September, 1934, by Bob Harris, who had panned visible gold from rusty gossan associated with the bedded rocks. A 5-foot pit sunk into the gossan on claim K.R.L. 12,258 lies wholly in rusty oxidized material. The work done at the time of the writer's visit was not sufficient to allow any reliable estimate of the size of the gold-bearing zone. Conditions suggest that the showing is the location of small gold-bearing quartz veins containing tourmaline, pyrite, chalcopyrite, abundant mispickel, and gold. The gossan has resulted from the decomposition of the vein material and of the

hydrothermally carbonated wall rock. About 75 feet north of the pit some small sulphide-bearing quartz veins have the same strike as the sediments. In August and September, 1935, a few ounces of gold were recovered from the gossan by means of pans and rockers. In view of the gold mineralization and owing to the fact that gold has also been discovered elsewhere in the neighbouring sections, the property merits further prospecting.



Geological sketch map of the Wagner-Melanson claims, Wagner bay of Birch lake. Scale, 10 chains to the inch.

Wagner and Melanson

The Wagner-Melanson group of 9 claims is situated at the south end of Wagner bay of Birch lake. The rocks here are Timiskaming sediments, which include conglomerates, greywackés, and slates. The beds strike north-northwest and dip steeply to the southwest. Structurally this section is thought to be on the southwest limb of an anticline, the axis of which strikes northwest through Springpole lake towards Birch lake. The ground was first staked in 1930 by Louis Wagner, Jack Kerr, and Henry Mayo, but at present it is held by Wagner and Melanson. The main showing consists of a quartz vein, which has a maximum width of 8 feet and strikes north-northwest through the centre of claim K.R.L. 11,149 for a distance of over 700 feet. The vein conforms in dip and strike to the surrounding sediments, which are largely greywackés. At one

place near the centre of claim K.R.L. 11,149 the vein zone consists of several parallel folded quartz veins spaced over a total width of about 25 feet. The sulphide mineralization is confined to pyrite, which carries the gold values and is found in the vein and in the walls close to the vein. In 1930, the group was optioned to the Consolidated Mining and Smelting Company, Limited, which did some stripping, trenching, and sampling. Gold values as high as $13.65 (gold at $20.67 per ounce) are reported to have been obtained. The option was not exercised. Since 1930, the property has been examined by various interests. Very little additional work has been done.

Dunkin

The Dunkin holdings consist of 8 claims most of which are situated on the north shore of the north bay of Springpole lake. The Northern Aerial Minerals Exploration Company, Limited, did some prospecting in the vicinity in 1928. It was not until 1934, however, that the ground was staked by Tom Dunkin, who did a little stripping and trenching on a northwestward-striking mineralized shear zone in chloritized Keewatin greenstones. Most of the rocks in this vicinity are Keewatin lavas, with which are associated some thin beds of sediment. The beds and flows strike N.60°W. to N.75°W and dip 50° to 80°N.E. North of the Keewatin rocks lies a rather extensive mass of Timiskaming sediments. The main showing consists of a mineralized belt containing two parallel shear zones, both of which contain mineralized quartz stringers and mineralized schist. One of these shear zones has been traced intermittently along the strike for about 500 feet and has a maximum width of about 25 feet. Some of the schist in the vicinity is highly foliated. The sheared belt conforms in strike and dip to the greenstones. Sulphides, including pyrite, chalcopyrite, pyrrhotite, galena, zinc blende, and probably mispickel, are associated with the schist and the quartz stringers. Tourmaline and ankerite are also present. As high as one ounce of gold per ton is said to have been obtained. No visible gold, however, was identified in the mineralized material. A grab sample taken by the writer from a well-mineralized part of the zone gave no gold. A number of claims adjoining this group were staked in September, 1935.

Bergstrand

The Bergstrand holdings consist of claims K.R.L. 10,586, 10,587, and 10,588 at the northeast end of Louwag lake and K.R.L. 11,344, 11,345, and 11,346 just north of Bergstrand lake. Only the last-mentioned group was visited by the writer. The rocks in the vicinity consist of eastward and northwestward striking, vertically dipping Timiskaming sediments, including greywacké, impure quartzite, and thin beds of slate. Conglomerates also occur on the property. The mineralized zone consists of small quartz stringers, which lie both parallel and transverse to the sedimentary beds. The veins contain various sulphides, including pyrite, galena, and chalcopyrite. They also contain fine visible gold. The stringers are narrow and are not spaced closely enough to make one ore body. A considerable amount of stripping and trenching has been done, the deepest pit being down about 9 feet. Apparently the gold-bearing zone has never been systematically sampled. A few ounces of gold were recovered by Ephraim Bergstrand by means of hand-crushing and panning.

Dole Brothers

Dole Brothers hold 9 unsurveyed claims, which were staked in May, 1935, on the north shore of the east arm of Springpole lake. The group extends north-

ward to the east bay of the north arm of Springpole lake. The rocks in the vicinity consist mostly of highly altered Keewatin lavas, chiefly hornblende schist. They strike almost east-west and dip to the north at angles ranging from 15 to 55 degrees. They are cut by masses of diorite, dikes of granite, syenite porphyry, and quartz porphyry, and quartz veins. The main showing consists of a combined shear zone and quartz vein, which strikes about east-west in the northwestern part of claim K.R.L. 12,591. The shear zone, which is about 4 feet wide and at this place dips about 45°S., contains quartz stringers and gouge. The minerals include quartz, tourmaline, ankerite, pyrite, and chalcopyrite. At the bottom of a 10-foot pit sunk in the shear zone mineralized schist is exposed, with a mineralized quartz vein about one foot wide. Gold values as high as $16.00 per ton are said to have been obtained from this mineralized material. A considerable amount of stripping and trenching has been done at various other places on the property, and several small mineralized veins have been located.

ADJACENT TO THE BIRCH-SPRINGPOLE LAKES AREA

Johnson-Dynes

The Johnson-Dynes property, which was formerly known as the Dynes claims, is situated on Casummit creek, about 1½ miles east of Casummit lake and about 1 mile north of Birch lake. The property has been described by Furse[1] in his report on the Shabumeni-Birch lakes area. The mort important mineralization disclosed so far is associated with a moderately sheared zone containing quartz stringers and lenses, which strikes almost east-west and dips steeply to the north. The strike and dip of the quartz veins and stringers conform to those of the surrounding greywacké. During the summer of 1935, the vein zone was explored by drilling. Altogether 10 holes were completed, which aggregated 1,500 feet. The vein was located along the strike for a distance of about 800 feet. The sulphide mineralization, which is confined mostly to the schist but which also occurs in the quartz at some places, consists mostly of pyrite and mispickel. The writer did not take samples, and as the drill-core was not logged or assayed at the time of his visit, nothing is known of the gold values. No visible gold was identified on the property by the writer.

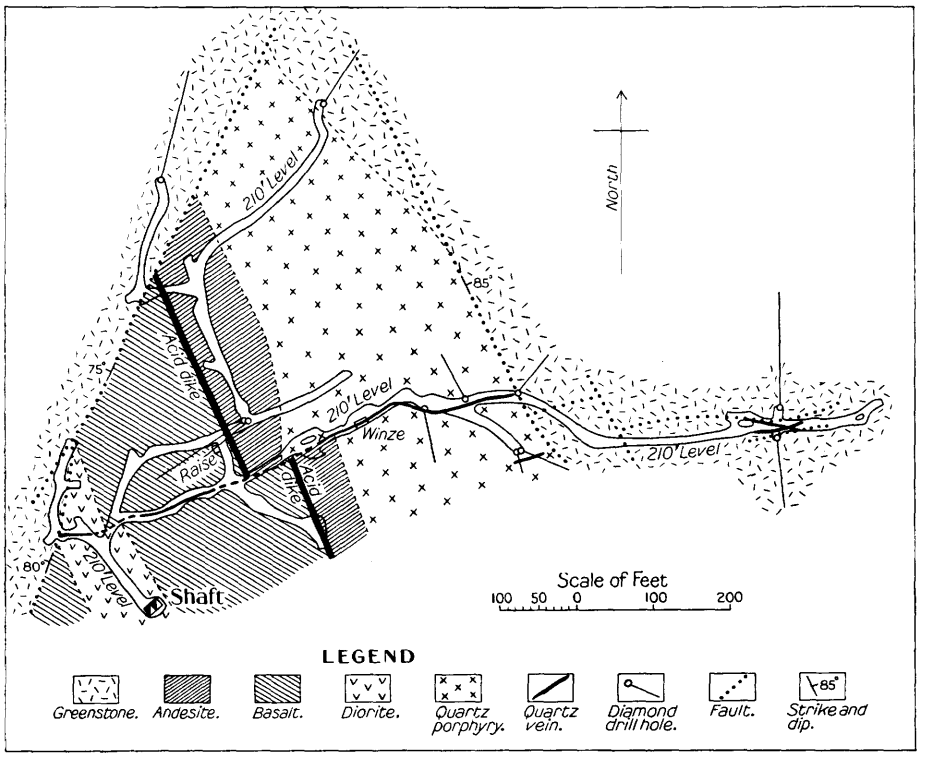
Cooper and Barry (McIntyre)

The claims of the W. D. Cooper and P. A. Barry lease are situated on the north shore of Birch lake. The geology of this property has been previously described by Furse.[2] The rocks in the vicinity are Keewatin volcanics and sediments. A mineralized shear zone with a steep northerly dip parallels the lava flows and strikes almost east-west through the property. The zone ranges in width from 2 feet to 15 feet and has been traced intermittently along the strike for about 2,000 feet. It contains veins and lenses of mineralized quartz as well as mineralized schist. The mineralization includes quartz, tourmaline, pyrite, mispickel, and gold.

The claims were originally staked by Jack Miller for McIntyre-Porcupine Mines, Limited, and early work consisted of stripping, trenching, and diamond-drilling. In 1933 the property was leased to W. D. Cooper and P. A. Barry, who commenced shaft-sinking at a mineralized section of the shear zone. A 25-ton Tremaine mill with amalgamation plates was installed and was first operated

[1]G. D. Furse, "Geology of the Shabumeni-Birch Lakes Area," Ont. Dept. Mines, Vol. XLII, pt. 6, 1933, pp. 39, 40.
[2]Ibid, pp. 40, 41.

in August, 1934, mill feed being obtained from shaft-sinking. At a depth of 70 feet the mineralized zone was lost owing to a fault, and at 90 feet shaft-sinking was suspended and operations were confined to drifting both east and west on the 40-foot level above the faulted zone. Only a small amount of lateral work was done. In the summer of 1935 additional exploration work was carried out along the shear zone by diamond-drilling. Altogether 9 holes, totalling 2,000 feet, were drilled. Apparently the gold values in the mineralized zone are erratic, and the ore pockets located have been small. In October, 1935, mining operations were suspended. The amount of gold produced was not large, amounting to 23 ounces, worth $825.

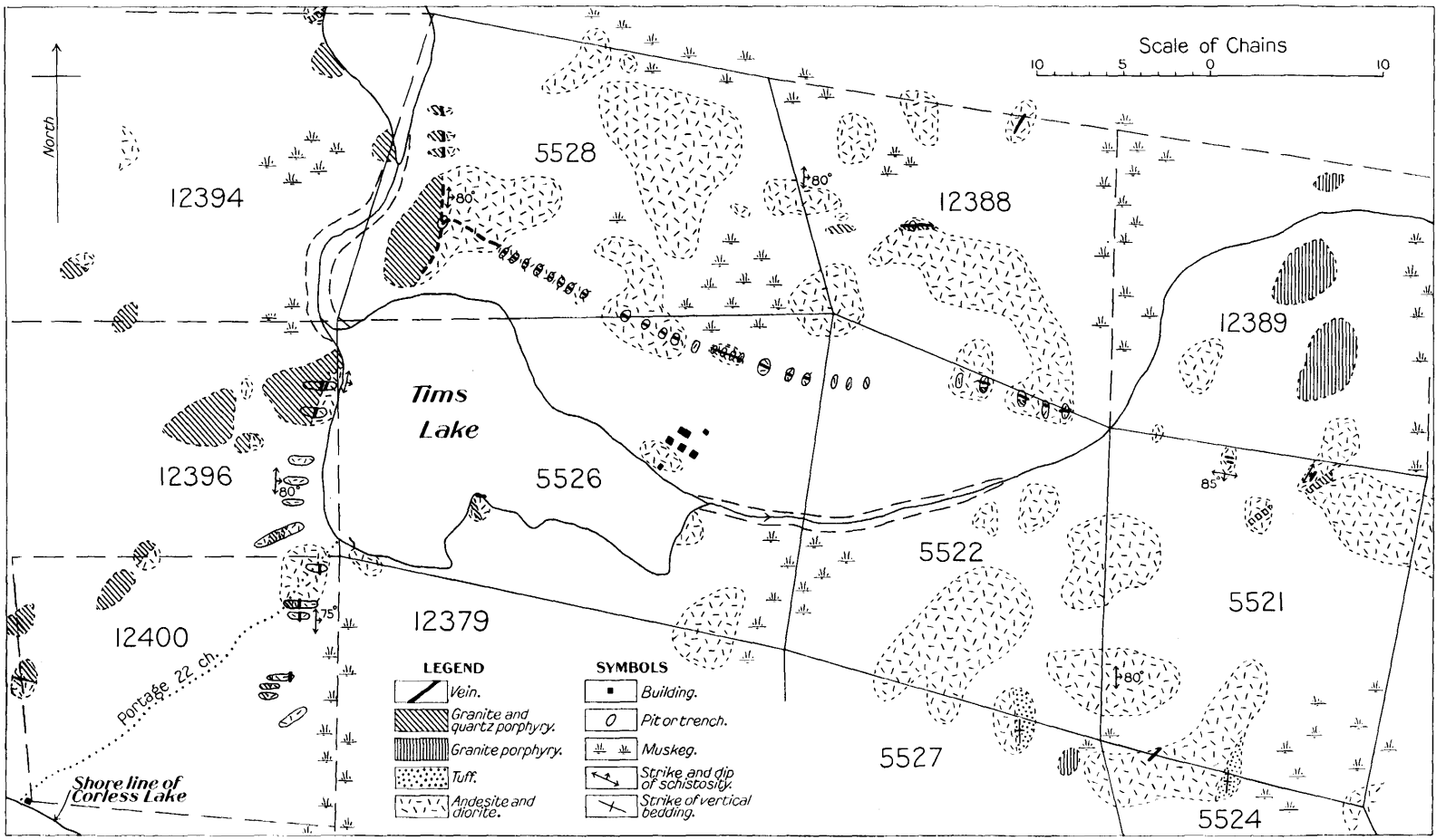


Plan showing the geology and workings on the 200-foot level, Hudson-Patricia Mines.

Hudson-Patricia Gold Mines, Limited

The geology of this property has been previously described by Bruce[1] and Furse.[2] In 1934, Hudson-Patricia Gold Mines was organized to acquire the property of Metals Development, Limited, situated between Woman and Confederation lakes. There are several quartz veins on the property. The most important operations have been carried out on claim K.R.L. 5,603, on a gold-bearing quartz vein ranging in width from a few inches to over 3 feet. This vein, which strikes about N.65°E. and dips 65°N.W., cuts Keewatin basic volcanics, which strike about N.10°W. and dip 80°N.E. A vertical shaft was sunk

[1]E. L. Bruce, "Gold Deposits of Woman, Narrow, and Confederation Lakes," Ont. Dept. Mines, Vol. XXXVII, pt. 4, 1928, p. 45.
[2]G. D. Furse, op. cit., pp. 45, 46.



Geological sketch map of the western section of the property of the Corless Patricia Gold Mines, Limited.

on the vein by Metals Development, Limited, in 1931-32, and spasmodic underground operations have followed. Up to July, 1935, the workings consisted of a vertical shaft to 237 feet, with levels at 80 and 210 feet; a winze to the 325-foot level; and a raise from the 210-foot level to the 80-foot level. Over 3,000 feet of lateral work has been completed, most of which has been confined to the 210-foot level. Work done so far indicates two almost vertically plunging bodies of material reported to be of ore grade. The writer was informed that 1,500 tons of ore were on the dump and that a considerable amount of ore was indicated underground. The vein minerals include pyrite, galena, chalcopyrite, sphalerite, and gold. A qualitative test for tellurium was made on a grab sample of vein material that contained a variety of minerals and gave a negative reaction. Since 1934, an aggregate of about 2,400 feet of diamond-drilling in 20 holes has been done from underground. Mine officials state that the drill-holes that intersected the vein zone at the 450-foot horizon indicated two quartz veins, each of which carry gold values. Intricate faults have complicated mining operations at this property. In July, 1935, at the time of the writer's visit, both ends of the 210-foot level had reached points where the vein was faulted off. Mining operations were temporarily suspended in September, 1935. In March, 1936, the writer was advised by mine officials that a 50-ton mill was being installed on the property and that it was the intention of the management to dewater the workings and resume operations in the near future.

Corless Patricia Gold Mines, Limited

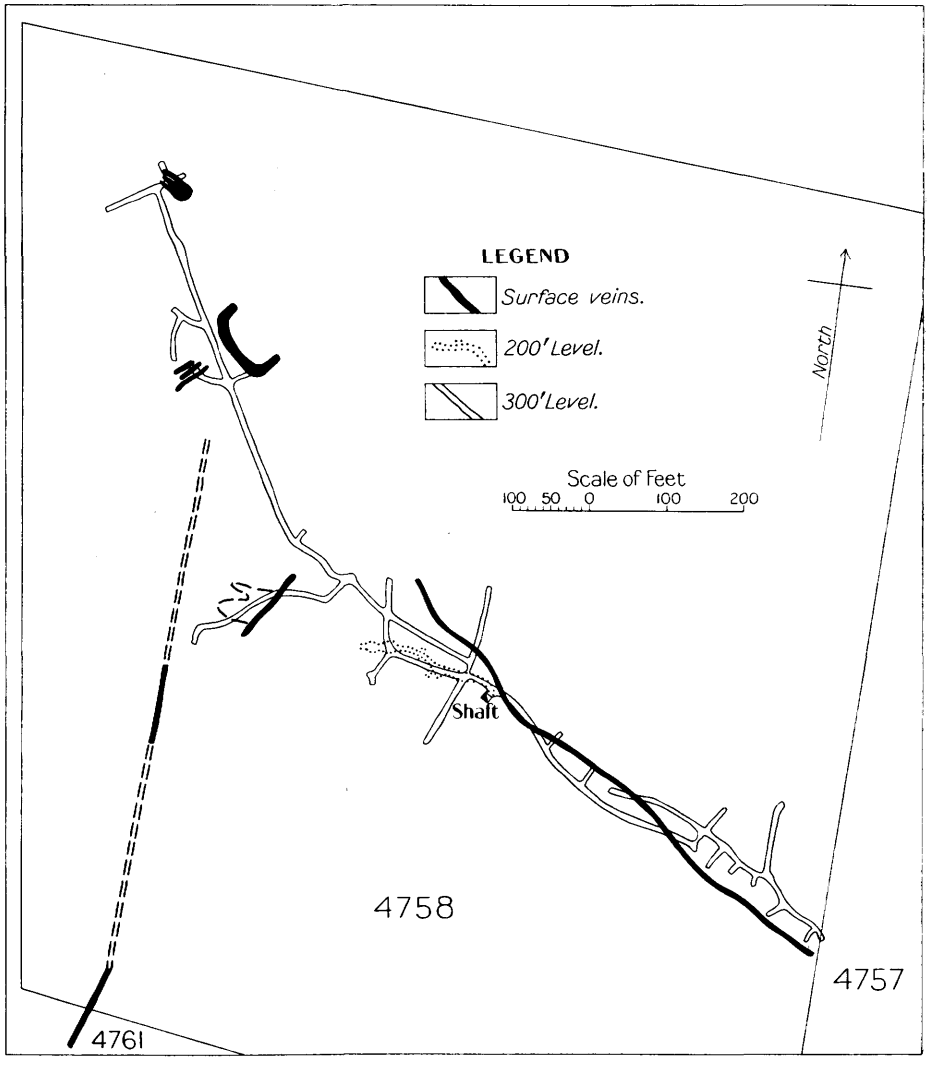
Corless Patricia Gold Mines, Limited, was organized in 1934 to take over the property of Henry Brothers situated in Corless township near the south end of Woman lake. The claims were staked by Henry Brothers in 1926. Since the claims were acquired by the new company an active programme of work, consisting of stripping, trenching, and diamond-drilling, has been in progress on the western part of the property in the vicinity of Tims (Smith) lake. This property has been described by Bruce.[1] In this section andesitic lavas and pillow lavas of Keewatin age have been intruded by diorite, and subsequently both were intruded by Algoman granite. Quartz veins genetically related to the granite also cut the Keewatin rocks. No. 5 vein, which lies just north of Tims lake, consists of a mineralized shear zone in Keewatin rocks, which has been traced for approximately 2,000 feet and has a maximum width of 20 feet. This zone strikes nearly east-west, dips almost vertically or steeply south, and contains stringers and lenses of quartz separated by bands of schist and silicified material. A very dark quartz porphyry occurs in the eastern part of this zone. The sulphides present include pyrite, chalcopyrite, and pyrrhotite, which are associated with both the quartz and the schist.

On October 1, 1935, mine officials stated that sampling done up to that time had indicated a 500-foot section of ore grade over mineable widths. No visible gold was identified by the writer. An assay of a grab sample of well-mineralized material in the zone gave no gold. Assay results from 3,000 feet of diamond-drilling were not available at the property at the time of the writer's visit. A considerable amount of surface work has also been done on No. 6 vein, which strikes a few degrees east of north on the west side of Tims lake. Flakes of molybdenite and much disseminated pyrite were identified in a pit at the junction of No. 5 and No. 6 veins. A good deal of surface work has been done on other sections of the property in past years but without important results.

[1]E. L. Bruce, op. cit., pp. 34, 35.

Bathurst Gold Mines, Limited

The property of Bathurst Gold Mines, Limited, is situated between Bathurst and Car lakes in Skinner township in the Narrow Lake area. The surface geology has been described in some detail by Bruce.[1] Operations on this property were begun with the object of mining a gold-bearing quartz vein, surface

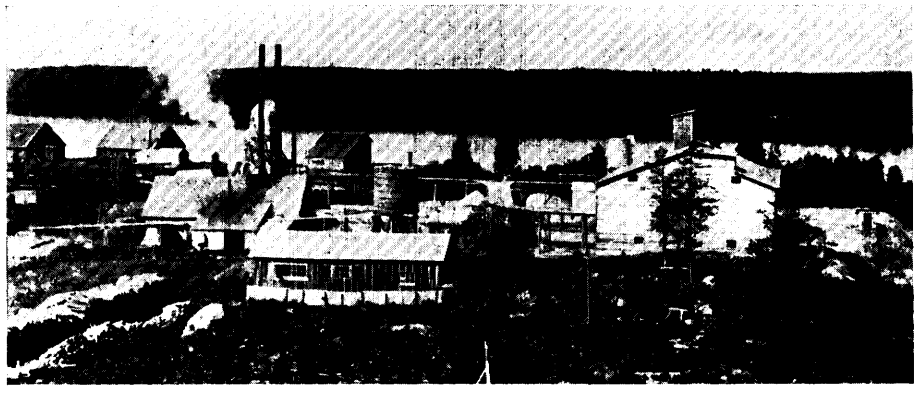


Composite plan of a section of the Bathurst mine, showing the 200- and 300-foot levels and the surface veins.

sections of which had indicated high gold values. Present workings include a vertical shaft to 420 feet and levels at 200 and 300 feet. Altogether about 2,700 feet of lateral work has been done on the two levels. Shaft-sinking on the property was first commenced in April, 1928, and during the period from that date to December, 1929, when operations were temporarily suspended, most of

[1]E. L. Bruce, op. cit., pp. 40-43.

the present underground work was accomplished. This work included the sinking of the shaft to over 300 feet practically all the present work on the 200- and 300-foot levels. The property then remained inactive until 1934, and in August of that year the mine was dewatered and shaft-sinking was resumed. No additional lateral work was undertaken. By December, 1934, the shaft was sunk to a depth of 420 feet, when operations were again suspended. No underground work has been done since. In September, 1935, the workings were filled with water and inaccessible to the writer. The property is equipped with boilers, compressor, and hoists capable of operating to a depth of 1,000 feet. In 1929, a 10-ton Tremaine stamp mill with amalgamation plates was installed, and according to mine records about 160 ounces of gold was recovered during spasmodic mill operations spread over two months. The failure to locate ore bodies of sufficient size to feed the small mill was responsible for the suspension of mining operations. In the spring of 1935, the property was optioned to Erie Canadian Mines, Limited (subsidiary of Sylvanite Gold Mines, Limited), which did considerable surface work on other veins. These operations were discontinued in September, 1935.



Plant of the J-M Consolidated Gold Mines, Limited, near Woman lake.

J-M Consolidated Gold Mines, Limited

The J-M Consolidated Gold Mines, Limited, was organized in 1932 and acquired the properties formerly held by the Jackson-Manion Mines, Limited, and Mint-Ore Mines, Limited, to the south of the Jackson-Manion, in the Woman Lake area. The early history and the surface geology has been described by Bruce.[1] Underground operations were undertaken on this property for the purpose of mining a gold-bearing quartz vein which had been exposed at intervals on the surface for a distance of over 2,300 feet, with a maximum width of 20 feet. The vein lies in basic Keewatin lavas and strikes about north-south, with a dip of 80° to 85°E.

Shaft-sinking was begun by hand in 1927. In 1928 a mining plant was installed, and underground development was continued until February, 1929, when work was suspended. Operations were resumed in November, 1933, and were still in progress when the writer visited the property in June, 1935. At that time the workings consisted of a vertical shaft to 404 feet and levels at 125, 240 (sublevel), 250, and 375 feet. Over 4,200 feet of lateral work had been done

[1]E. L. Bruce, op. cit., pp. 24-33.

on these levels. Underground workings indicate a vein of strong character, which in some places consists of a zone of quartz stringers and schist. At intervals along the strike there are pronounced drag folds, which plunge steeply to the south, indicating that the relative movement of the west wall has been to the south. In general the folds and faults so far encountered have not seriously complicated mining operations. The vein minerals consist largely of quartz, tourmaline, pyrite, and visible gold. Bruce also found petzite in the vein material.[1] Work done so far indicates that the ore exists in southward-plunging shoots. At July 1, 1935, the total ore reserves were estimated at over 33,000 tons, which included 4,000 tons of broken ore in a stope and about 1,500 tons on the dump. This ore represents the tonnage of one ore body, which extends from the surface to below the 250-foot level. The bottom limit of this ore body apparently lies above the 375-foot level.

In 1934, a 25-ton mill was installed and operated for 152 days, producing in that time about $50,000 in gold from 4,200 tons of ore.

When the writer visited the property in September, 1935, a vertical winze had been commenced from the 375-foot level north of the shaft with the object of exploring new low horizons.

On March 16, 1936, T. J. Day, secretary-treasurer of the company, advised the writer that the winze had been pushed to a vertical depth of 482 feet, at which horizon a new level had been commenced. Drifting in the vein at this level has indicated the presence of a second vertically dipping ore body situated to the north of the previously located ore section. Although the limits of this newly indicated body have not been defined, the writer was informed that 150 feet of drifting on the 482-foot level was in ore and that the face north of the winze was still in material of ore grade.

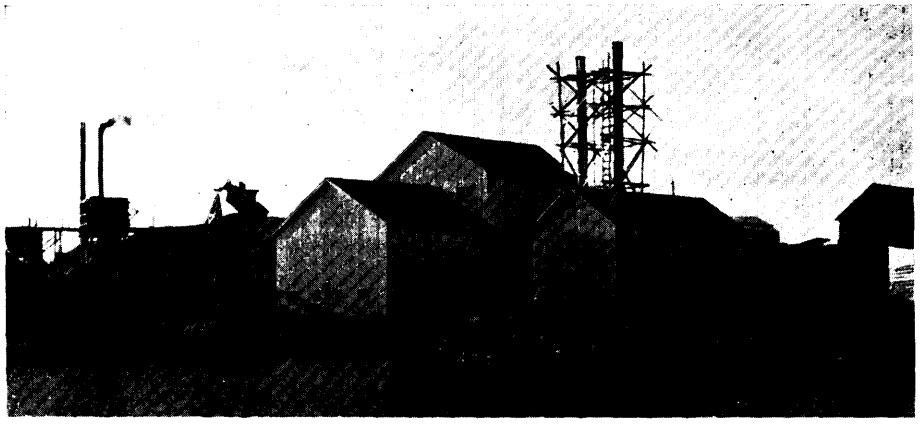
Mr. Day also stated that a raise had been put up from the 250-foot level to the surface and that equipment for a new 125-ton mill had reached the property. It is expected that the mill will be in operation by midsummer, 1936.

Argosy Gold Mines, Limited

The property of Casey Summit Gold Mines, Limited, situated on Casummit lake was acquired by Argosy Gold Mines, Limited, in the spring of 1935. The geology of the property has been described by Furse.[2] The rocks on the property are Keewatin lavas, tuffs, and sediments. There are several quartz veins, most of which strike approximately north-south. The original mine workings are located on No. 2 vein, which strikes almost north-south from the north shore of Casummit lake and dips about 45°W. This vein, which is characterized by very gently undulating folds, varies in width from 1 to 4 feet. In May, 1935, the workings, which then consisted of a vertical shaft to 300 feet with levels at 75, 200, and 300 feet, were dewatered, and an active programme of underground exploration was commenced by the new company with the object of locating additional ore bodies. Previous work had indicated about 400 feet of ore above the 300-foot level. At the time of the writer's visit to the mine in August, 1935, a new Diesel-driven compressor had been installed, and the company's development programme was well under way. Drifting was in progress on No. 2 vein on the 300-foot level south of the shaft, and a crosscut was being run west from the 300-foot level on No. 2 vein to intersect No. 3 vein. The object of this crosscut

[1]E. L. Bruce, op. cit., p. 31.
[2]G. D. Furse, op. cit., pp. 30-34.

was the underground exploration of No. 3 vein situated in an unexplored section to the west. A winze was also being sunk from the 300-foot level to explore lower horizons on No. 2 vein. In March, 1936, a company official informed the writer that drifting on the 300-foot level on No. 2 vein had reached a point about 700 feet south of the shaft and that the inclined winze on No. 2 vein had been sunk to a vertical depth of 500 feet, with a new level at 400 feet and a station at 500 feet. About 800 feet of lateral work had been completed on the 400-foot level, which included drifting on No. 2 vein both north and south of



Plant of the Argosy Gold Mines, Limited, Casummit lake.

the winze. Work on No. 2 vein has indicated the presence of a 450-foot ore body between the surface and the 400-foot level. The crosscut west from the 300-foot level on No. 2 vein intersected No. 3 vein at a distance of about 600 feet. About 500 feet of lateral work had been done on No. 3 vein on this horizon, including drifting both north and south of the crosscut. Work done so far indicates that the strike and dip of No. 3 vein conforms roughly to the strike and dip of No. 2. A well-mineralized section associated with iron formation and carrying high gold values was encountered on this vein to the north of the crosscut.

Underground exploration by the new company has produced very encouraging results. As no raises have been completed, no ore has been actually blocked out, but it appears that ore bodies exist in both No. 2 and No. 3 veins. A 125-ton cyanide mill is being installed on the property and is expected to be in operation during the summer of 1936.

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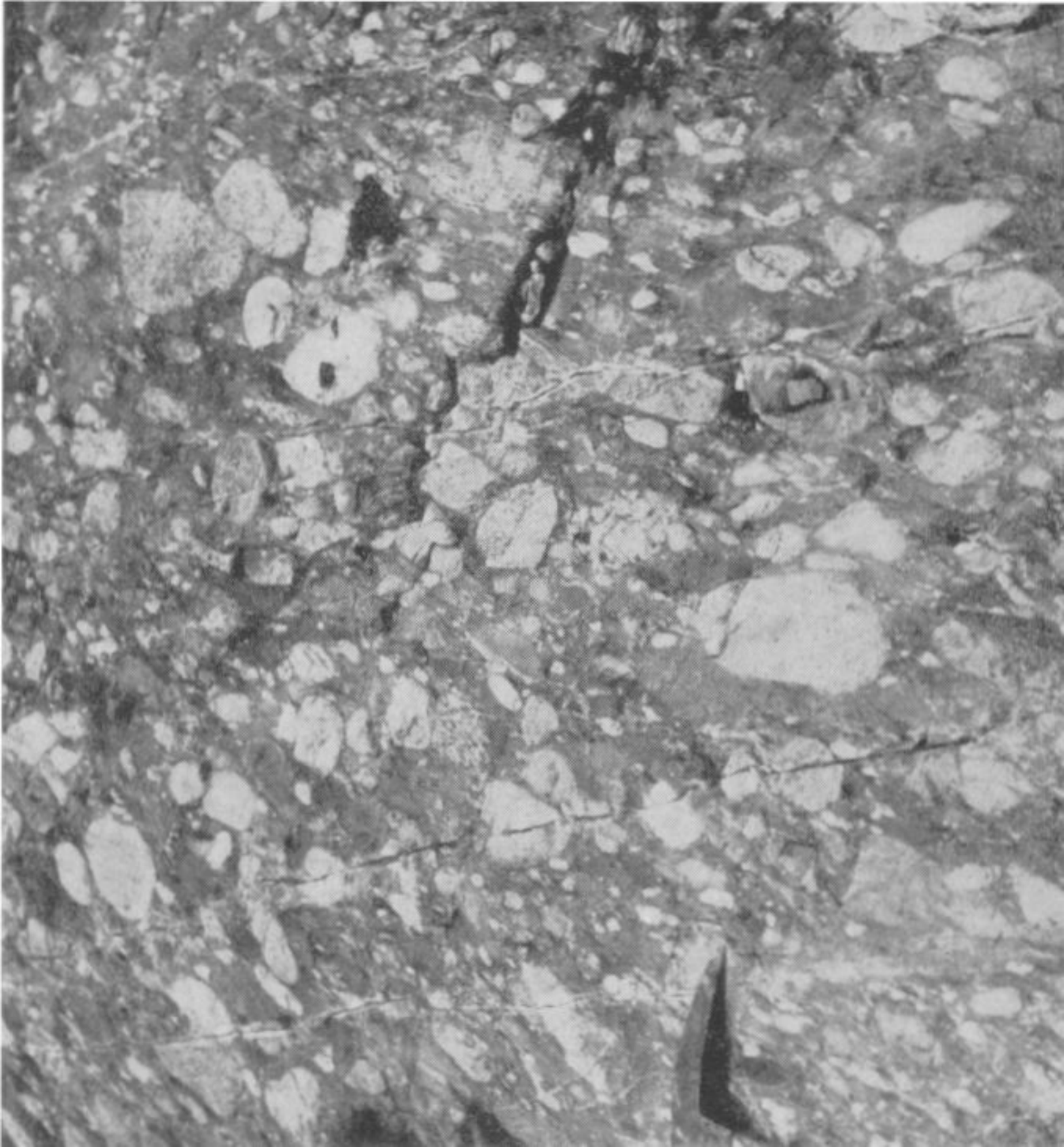
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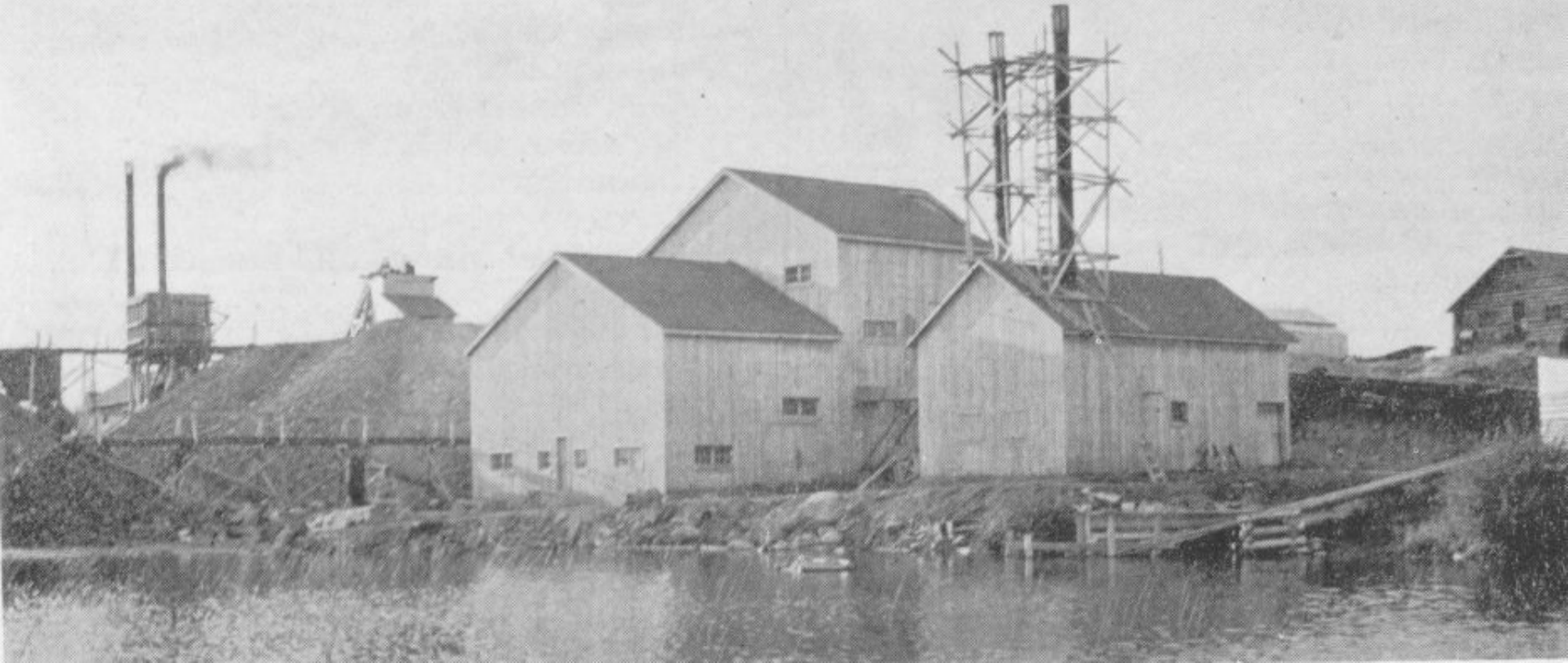














PROVINCE OF ONTARIO

DEPARTMENT OF MINES

HON. PAUL LEDUC, *Minister of Mines* T. F. SUTHERLAND, *Deputy Minister*

FORTY-FIFTH ANNUAL REPORT

OF THE

ONTARIO DEPARTMENT OF MINES

BEING

VOL. XLV, PART V, 1936

Natural Gas in 1935, by R. B. Harkness - - - 1-74

Petroleum in 1935, by R. B. Harkness - - - 75-79

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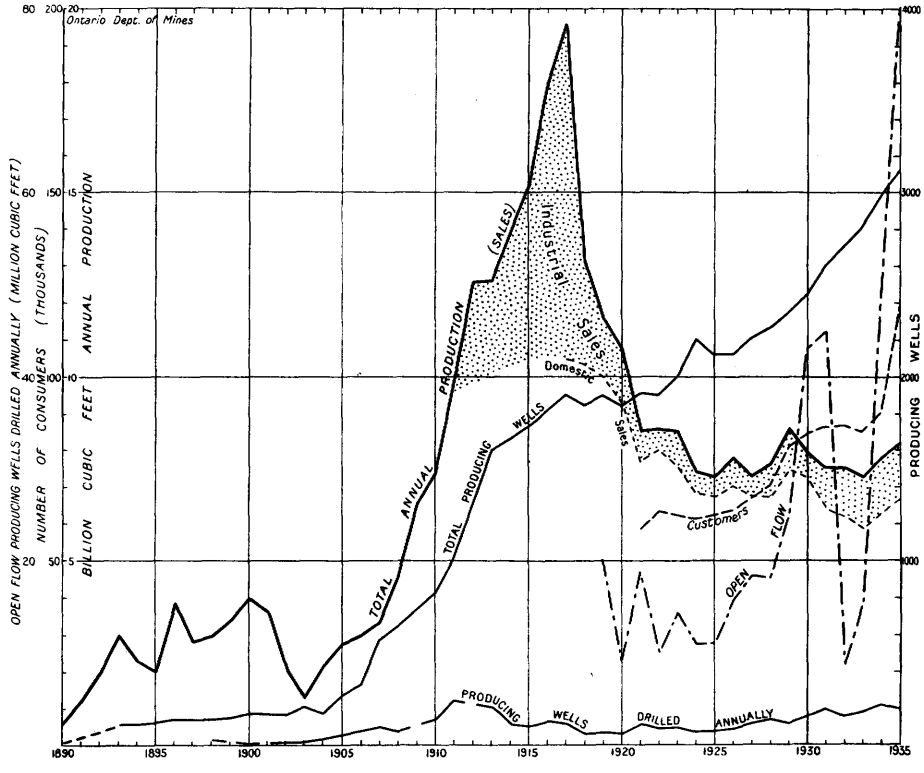
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NATURAL GAS IN 1935

By R. B. Harkness

General

Again the consumption of natural gas in Ontario shows a substantial increase, being 8,185,825 million cubic feet in 1935, as against 7,682,851 million cubic feet in 1934, with a value of $4,938,004, as against $4,741,368. This increase was apparently due entirely to an increase in the number of customers, the total now being 119,457, as against 89,990 in 1934, or an increase of over 27 per cent.

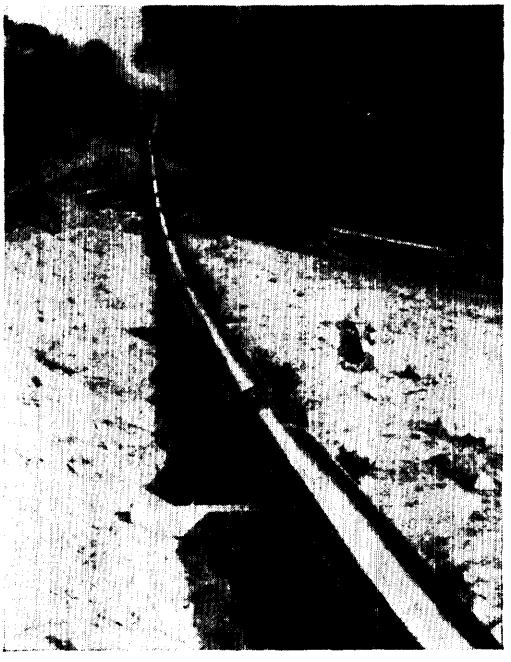


Graph of the natural gas industry in Ontario for the past forty-five years.

It will be noted in Table II and in the graph above that these consumers are using a smaller amount each year. The general improvement in appliances has accounted for a certain reduction in the per customer consumption, but the sudden drop in 1935 is difficult to explain, unless, as in London, the increase in consumers throughout the gas-using municipalities came at the end of the year.

The 27 per cent. increase in customers will cause a heavy draught on the reserves in the old gas fields; but fortunately the available supply, as reflected in the open flow of new wells, has shown a large increase in the past two years, 1935 being well above any year on record. It would have been better if this open flow had come from a greater number of new wells, for even with this excellent showing it is evident that exploratory work must be carried on still more vigorously in the future.

In the year 1935 two producing wells were drilled in Dereham township, Oxford county, and they may be considered as a new discovery, although the results obtained leave much to be desired if the discovery is to develop into a



A section of the Union Gas Company's 10-inch pipe line from the Dawn gas field to London. This pipe has been coated with a rust-resisting material and is now ready to be lowered into the trench.

gas field of importance. The gas is sour gas (high in hydrogen sulphide, and similar to a discovery referred to last year[1]), which renders it unfit for domestic consumption in an area where only sweet gas is distributed. It remains for further development to indicate whether there is a sufficient volume to demand a purification plant in this area.

Exploratory drilling was carried out in Bruce county with indifferent results and in Beverly township, Wentworth county, with negative results. In Chatham township, Kent county, development work is still going forward, but so far with negative results. Further extensions were made to the Declute field in Raleigh township, the Dover field has been extended in Raleigh township, and extensions were made to the Bayham gas field.

[1]Ont. Dept. Mines, Vol. XLIV, pt. 5, 1935, p. 11.

TABLE I—NATURAL GAS PRODUCTION BY FIELDS, 1932–1935

County	Field	1932	1933	1934	1935
		M cu. ft.	M cu. ft.	M cu. ft.	M cu. ft.
Essex	Kingsville	4,506,072	4,201,704	4,093,186	4,161,186
Kent	Tilbury				
	Dover	275,958	252,694	363,344	935,446
Lambton	Dawn	170,671	265,061	517,009	411,944
	Oil Springs				
Elgin	Bayham	45,708	45,968	51,483	116,118
Norfolk	Norfolk	365,638	346,621	354,274	472,993
Lincoln	Lincoln				
Haldimand	Haldimand	1,453,864	1,524,251	1,801,160	1,576,323
Wentworth	Wentworth				
Brant	Onondaga	140,612	121,578	109,486	120,461
Bruce	Amabel	500	500	500	400
Welland	Welland	351,616	333,619	318,409	290,119
Wells in surface drift	Howard and Sarnia	15,515	14,663	14,000	14,000
Private wells		60,000	60,000	60,000	60,000
Total produced		7,386,154	7,166,659	7,682,851	8,158,825
Value		$4,719,297	$4,523,084	$4,741,368	$4,938,084
		M cu. ft.	M cu. ft.	M cu. ft.	M cu. ft.
Imported mixed gas		111,727	97,075	102,667	98,848
Total distributed		7,497,881	7,263,734	7,785,518	8,257,673

TABLE II—DOMESTIC CONSUMPTION OF NATURAL GAS, CAPITAL INVESTED, AND WAGES PAID, 1921–1935

Year	Retail rate, cents per M cu. ft.	No. of pay consumers	Total quantity used	Quantity used per consumer	Capital invested in all natural gas operations[1]	No. of men employed	Wages paid
			M cu. ft.	M cu. ft.			
1921	47	58,609	5,937,316	101.3	$17,328,757	632	$592,606
1922	47	63,229	6,028,947	95.3	17,769,664	692	539,072
1923	50	62,352	6,210,459	99.6	25,570,972	603	633,365
1924	55	61,100	5,933,595	97.1	24,781,723	727	639,167
1925	56	62,338	5,300,424	85.6	26,111,387	692	625,826
1926	57	63,695	5,595,521	87.8	30,500,874	860	842,305
1927	60	66,818	5,210,315	78	31,987,879	1,123	1,148,339
1928	60	70,259	5,699,553	71.2	36,601,828	1,209	1,497,999
1929	58	80,991	6,336,873	78.2	35,162,736	1,323	1,529,367
1930	64	84,135	6,332,519	75.2	36,162,268	1,328	1,545,648
1931	62	86,050	5,607,744	65.1	42,921,142	1,241	1,383,286
1932	63	86,631	5,409,154	62.2	45,982,719	893	1,059,643
1933	63	84,933	5,102,340	60	51,766,592	958	958,336
1934	62	89,990	5,262,631	58.5	41 934,395	931	1,010,979
1935	60	118,719	5,553,902	46.8–52[2]	42,975,846	1,273	1,219,520

[1]This includes capital invested in drilling, producing, and distributing.
[2]See page 4.

Analysis of Gas Consumption

Tables III and IV give in detail the analysis of natural gas consumption in all the gas-consuming municipalities in Ontario during 1935. Similar tables have been published since 1921, and these enable a comparison to be made of the quantity of gas used at varying rates over a period of fifteen years.

In general, the steady improvement in the efficiency of appliances and the introduction of automatic appliances has reduced the consumption of natural

gas per consumer, but seasonal changes of temperature and wind velocity, as well as the variation in the price of competitive fuels, has a very considerable effect on the annual quantity of gas used in the homes of Ontario.

An error in the reported number of consumers in the Border Cities in 1934 has been corrected in Table II, and a corresponding correction in the quantity used per consumer shows that there was a decrease from the year before, instead of an increase as indicated in the report of last year. Two numbers are given under quantity used per consumer for the year 1935, the smaller one (46.8) is the average for the figures as given in the table, but as 14,674 consumers in the city of London used gas only in the last three months of the year, the average is not accurate; the second figure (52) is a calculation with the London consumers omitted.

In addition to the capital invested by operating companies in the natural gas industry, as shown in Table II, the consumers have invested in equipment of all kinds at a low valuation $7,000,000, an investment that is increasing annually.

The rates for natural gas in Ontario, as indicated in the right-hand column of Tables III and IV by letters of the alphabet, are given in detail below. This will afford a much better basis of comparison than the maximum and minimum rates previously shown in these tables. These rates are net rates, but in some cases there is an additional charge for meter rental. Meter rental is either fixed by agreement between the company and the municipality, or by the company under the Public Utilities Act, R.S.O. 1927, Chapter 249, Section 46 (2). It should be noted that further steps in some of the rates in favour of large commercial users have been omitted, strictly domestic rates only being given.

NATURAL GAS RATES, 1935

Classification letter	Season, company, or locality	Classification according to amounts of gas used	Net rate and seasonal discount
A		Up to 10M cu. ft.	85c. per M cu. ft.
		Over 10M cu. ft.	60c. per M cu. ft.
B	October to April	Up to 10M cu. ft.	55c. per M cu. ft.
		From 10M to 20M cu. ft.	60c. per M cu. ft.
		Over 20M cu. ft.	70c. per M cu. ft.
	May to September		80c. per M cu. ft.
C	October to April	Up to 10M cu. ft.	50c. per M cu. ft.
		From 10M to 20M cu. ft.	55c. per M cu. ft.
		Over 20M cu. ft.	65c. per M cu. ft.
	May to September		75c. per M cu. ft.
D	October to April	Up to 10M cu. ft.	40c. per M cu. ft.
		From 10M to 20M cu. ft.	45c. per M cu. ft.
		Over 20M cu. ft.	55c. per M cu. ft.
	May to September		65c. per M cu. ft.
E	October to April	Up to 10M cu. ft.	60c. per M cu. ft.
		From 10M to 20M cu. ft.	65c. per M cu. ft.
		Over 20M cu. ft.	55c. per M cu. ft.
	May to September		85c. per M cu. ft.
F		Less than 1M cu. ft.	$1.50
		From 1M to 10M cu. ft.	$1.00 per M cu. ft.
		Over 10M cu. ft.	$1.30 per M cu. ft.
	Where imported mixed gas is used		Additional charge for duty
	City of Niagara Falls	Over 10M cu. ft.	$1.00 per M cu. ft.

NATURAL GAS RATES, 1935—*Continued*

Classification letter	Season, company, or locality	Classification according to amounts of gas used	Net rate and seasonal discount
G		Minimum bill	80c.
		Up to 10M cu. ft.	80c. per M cu. ft.
		From 10M to 25M cu. ft.	65c. per M cu. ft.
		Over 25M cu. ft.	55c. per M cu. ft.
H		Up to 5M cu. ft.	$1.00 per M cu. ft.
		From 5M to 10M cu. ft.	90c. per M cu. ft.
		Over 10M cu. ft.	60c. per M cu. ft.
I		Up to 5M cu. ft.	$1.00 per M cu. ft.
		From 5M to 10M cu. ft.	90c. per M cu. ft.
		From 10M to 15M cu. ft.	80c. per M cu. ft.
		From 15M to 25M cu. ft.	70c. per M cu. ft.
		Over 25M cu. ft.	60c. per M cu. ft.
J		Up to 200 cu. ft.	40c. per hundred cu. ft.
		From 200 cu. ft. to 5M cu. ft.	70c. per M cu. ft.
		From 5M cu. ft. to 10M cu. ft.	60c. per M cu. ft.
		Over 10M cu. ft.	45c. per M cu. ft.
	October to April, discount	On bills under $5.00	15 per cent.
		On bills between $5.00 and $10.00	10 per cent.
	May to September, discount	On bills under $5.00	10 per cent.
K		Up to 200 cu. ft.	40c per hundred cu. ft.
		From 200 cu. ft. to 5M cu. ft.	75c. per M cu. ft.
		From 5M cu. ft. to 10M cu. ft.	65c. per M cu. ft.
		Over 10M cu. ft.	50c. per M cu. ft.
	October to April, discount	On bills under $5.00	15 per cent.
		On bills between $5.00 and $10.00	10 per cent.
	May to September, discount	On bills under $5.00	10 per cent.
L	Fonthill-Ridgeville Gas Co.	First 400 cu. ft., minimum charge	85c.
		Over 400 cu. ft.	75c. per M cu. ft.
	Dominion Natural Gas Co.		75c. per M cu. ft.
M		Up to 15M cu. ft.	75c. per M cu. ft.
		Over 15M cu. ft.	55c. per M cu. ft.
	Saltfleet township	Minimum bill	75c.
N		Up to 1M cu. ft.	$1.00 per M cu. ft.
		From 1M to 10M cu. ft.	80c. per M cu. ft.
		From 10M to 25M cu. ft.	65c. per M cu. ft.
		Over 25M cu. ft.	55c. per M cu. ft.
O		Up to 5M cu. ft.	80c. per M cu. ft.
		Over 5M cu. ft.	70c. per M cu. ft.
	Port Colborne	Over 10M cu. ft.	55c. per M cu. ft.
	Summer residents		$2.00 per M cu. ft.
P		200 cu. ft. or less	$1.00
		Over 200 cu. ft.	60c. per M cu. ft.
R	May to October	Up to 10M cu. ft.	70c. per M cu. ft.
		Over 10M cu. ft.	55c. per M cu. ft.
	November to April	Up to 10M cu. ft.	65c. per M cu. ft.
		Over 10M cu. ft.	55c. per M cu. ft.
S		Up to 5M cu. ft.	$1.00 per M cu. ft.
		From 5M cu. ft. to 10M cu. ft.	90c. per M cu. ft.
		Over 10M cu. ft.	60c. per M cu. ft.

TABLE III—GAS CONSUMPTION IN TOWNS AND CITIES, 1935

Town or city	Population	No. of consumers		Quantity consumed			Distance from gas field	Net rate per M cu. ft.
		Pay	Free	Pay	Free	Industrial		
				M cu. ft.	M cu. ft	M. cu. ft.	miles	
Alvinston	650	198	1	10,761	4	484	20	A
Aylmer	1,990	680	....	26,535	.....	.....	16	70c.
Bartonville	602	128	....	5,850	.....	.....	19	60c.
Belle River	719	146	....	10,337	.....	563	29	B
Belmont	317	117	....	3,508	.....	.....	9	$1.00
Binbrook	100	14	1	216	300	.....	1	50c.
Blenheim	1,702	583	1	52,734	140	4,002	20	C
Bothwell	685	136	1	9,306	14	.....	14	A
Brantford	30,611	4,584	2	212,161	1,231	12,423	140	G
Brigden	433	160	....	8,452	.....	278	30	B
Burlington	3,562	283	....	26,095	.....	.....	48	H
Cainsville	324	100	....	4,411	.....	.....	4	G
Caledonia	1,475	495	....	35,857	.....	18,054	7	60c.
Canfield	166	60	....	4,238	.....	.....	1	60c.
Cayuga	693	215	1	18,361	86	286	6	60c.
Chatham	16,140	4,033	3	374,162	4,215	17,749	22	J
Coatsworth	101	23	1	1,314	53	101	4	D
Comber	506	136	....	13,045	.....	3,546	19	C
Cottam	425	73	2	5,648	156	103	35	60c.
Courtland	348	46	....	2,663	.....	111	3	60c.
Courtright	338	106	1	5,861	75	609	53	C
Crystal Beach	529	176	....	2,816	.....	.....	1	F
Delhi	1,269	424	....	29,578	.....	387	4	60c.
Dorchester	403	116	1	6,749	89	.....	95	E
Dresden and Tupperville	1,469	484	2	41,449	143	759	38	C
Dundas	5,032	1,127	2	53,834	29	5,154	172	70c. (M.B.[1] $1.00)
Dunnville	3,632	994	3	90,690	422	11,100	7	60c.
Dutton	798	237	3	19,058	251	732	52	B
Echo Place	732	73	....	3,336	.....	.....	5	G
Eden	76	28	....	1,384	.....	.....	11	60c.
Essex	1,786	458	1	38,072	151	2,251	33	B
Fairground	75	15	....	454	.....	.....	1	60c.
Fenwick	328	96	....	5,754	.....	.....	18	75c.
Fingal	169	29	....	2,105	.....	.....	71	B
Fisherville	162	47	....	3,388	.....	57	2	50c.
Florence	184	66	....	3,500	.....	.....	5	J
Fonthill	872	254	....	6,786	.....	.....	25	L
Fort Erie	5,366	1,380	2	53,184	1,615	.....	8	F
Galt	14,057	2,227	1	89,502	19	7,994	147	G
Grimsby	1,952	275	....	8,198	.....	.....	10	85c.
Grimsby Beach		60	....	2,082	.....	.....	11	85c.
Hagersville	1,355	409	....	29,424	.....	.....	14	60c.
Hamilton	153,504	10,236	3	360,703	1,038	583,607	47	M
Hepworth	380	5	2	100	300	.....	1	75c.
Hespeler	2,798	340	....	16,543	.....	1,152	155	N
Highgate	343	107	2	8,503	472	.....	32	R
Ingersoll	5,104	1,016	2	45,547	279	2,541	100	G
Inwood	250	83	....	3,752	.....	.....	14	A
Jarvis	531	202	....	16,191	.....	.....	9	60c.
Kingsville	2,354	633	1	58,573	202	125	30	55c.
Lake Shore	.....	290	....	4,340	.....	.....	16	F
Lambeth	172	118	....	8,690	.....	.....	85	K
Leamington	5,004	1,412	....	134,486	.....	7,193	20	55c.
London	73,880	14,674	3	145,735	438	8,950	55	K
Lynedoch	175	40	....	2,919	.....	.....	2	60c.
Merlin	190	144	2	11,002	1,604	1,437	2	D
Merritton	2,490	456	....	14,955	.....	3,472	35	75c.
Nelles Corners	86	7	....	812	.....	.....	1	60c.
Niagara Falls	18,193	3,360	....	98,824	.....	17,333	11	F

TABLE III—GAS CONSUMPTION IN TOWNS AND CITIES, 1935—*Continued*

Town or city	Population	No. of consumers		Quantity consumed			Distance from gas field	Net rate per M cu. ft.
		Pay	Free	Pay	Free	Industrial		
				M cu. ft.	M cu. ft	M. cu. ft.	miles	
Oil Springs	462	125	....	7,156	.....	.....	2	R
Paris	4,300	888	2	41,640	175	7,787	129	G
Petrolia	2,715	771	1	69,563	388	1,214	60	B
Port Burwell	423	239	1	10,185	42	.....	3	60c.
Port Colborne and Humberstone	7,860	1,842	4	79,701	319	300	5	O
Port Dover	1,692	570	....	41,907	.....	329	1	60c.
Port Rowan	692	237	....	12,606	.....	.....	1	60c.
Preston	6,290	911	1	37,869	83	2,704	151	G
Ridgetown	1,914	635	4	55,979	1,964	1,714	28	C
Ridgeway	1,100	227	....	12,258	.....	.....	1	F
Rodney	750	232	1	15,581	100	377	40	B
St. Anns	120	24	....	865	.....	.....	7	85c.
St. Catharines	26,400	5,322	1	219,209	485	31,634	35	70c.
St. George	510	123	....	3,993	.....	.....	148	80c.
St. Williams	270	106	....	4,830	.....	485	1	60c.
Sarnia and Pt. Edward	18,956	5,160	1	307,011	1,688	32,660	55	B
Selkirk	196	138	1	9,393	82	.....	1	60c.
Shedden	235	89	....	5,861	.....	366	63	B
Simcoe	5,200	1,821	2	172,583	892	11,901	20	60c.
Smithville	570	174	....	7,158	.....	.....	6	75c.
Sombra and Port Lambton	420	155	....	9,805	.....	156	45	C
Stevensville	420	30	....	1,650	.....	.....	1	F
Straffordville	255	92	....	6,351	.....	308	6	60c.
Thamesville	765	239	2	15,666	33	2,329	13	J
Thorold	4,950	1,049	....	35,896	.....	765	35	75c.
Tilbury	1,900	547	2	43,926	626	3,883	14	C
Tillsonburg	3,380	1,095	1	80,903	459	94,048	16	63c.
Vienna	225	87	1	4,118	77	.....	1	60c.
Vittoria	205	78	....	4,121	.....	.....	3	60c.
Wallaceburg	4,460	1,176	1	93,932	337	368,655	19	C
Wallacetown	143	45	1	3,200	36	548	60	B
Waterdown	900	21	....	1,163	.....	.....	45	I
Waterford	1,213	182	....	10,671	.....	146	30	P
Welland	10,600	2,898	6	80,017	847	3,160	3	F
West Lorne	775	161	1	11,001	128	348	49	B
Wheatley	755	224	....	16,336	.....	148	12	C
Windsor (Border Cities)	114,391	19,169	3	1,105,496	7,107	254,897	45	K
Woodstock	11,007	2,072	3	96,433	215	3,337	110	G
Wyoming	505	145	1	8,747	6	.....	65	A
Total	.....	110,204	85	4,999,313	29,415	1,536,752	.....	.....

[1]M.B.—Minimum monthly bill.

TABLE IV—GAS CONSUMPTION IN TOWNSHIPS, 1935

County and township	Population	No. of consumers		Quantity consumed, M cu. ft.			Net rate per M cu. ft.
		Pay	Free	Pay	Free	Industrial	
ESSEX:							
Gosfield North	2,164	107	2	6,868	213	178	60c.
Gosfield South	2,311	503	.....	34,960	.....	35,674	60c.
Maidstone	2,976	71	7	5,454	1,436	.....	B
Mersea	4,929	365	2	27,160	706	15,766	60c.
Rochester	2,260	193	7	13,530	1,226	.....	B
Sandwich East	5,376	10	1	765	359	.....	B
Sandwich South	2,066	111	2	7,992	790	.....	B
Tilbury North	1,920	33	.....	2,367	.....	1,444	C
Tilbury West	1,554	18	1	1,298	168	.....	C
LAMBTON:							
Brooke	2,217	24	.....	470	.....	.....	A
Dawn	2,160	84	3	4,374	574	1,322	D
Enniskillen	2,725	134	.....	5,684	.....	465	B
Moore	2,873	328	.....	17,599	.....	3,090	B
Plympton	2,681	6	.....	431	.....	.....	B
Sarnia	3,156	.....	7	.....	2,001	.....	B
Sombra	2,746	57	.....	3,007	.....	390	B
KENT:							
Camden	2,152	18	.....	624	.....	.....	C
Chatham	5,832	80	.....	4,964	.....	603	C
Dover	3,906	419	1	35,446	156	6,291	D
Harwich	5,010	443	10	32,493	3,827	246	C
Howard	2,813	155	3	12,460	691	.....	C
Orford	1,718	21	2	2,619	214	.....	C
Raleigh	4,230	601	28	48,949	6,914	1,237	D
Romney	1,456	70	40	4,498	11,848	.....	D
Tilbury East	3,406	236	72	17,387	21,560	1,740	D
Zone	859	18	.....	650	.....	.....	J
ELGIN:							
Aldborough	2,708	19	1	733	394	.....	B
Bayham	3,265	74	18	3,047	3,122	391	60c.
Dunwich	2,357	54	.....	3,055	.....	.....	B
Malahide	2,714	46	3	1,473	303	.....	70c.
Southwold	2,397	109	2	6,506	131	201	B
Yarmouth	5,030	38	.....	686	.....	.....	A
MIDDLESEX:							
North Dorchester	2,932	13	.....	744	.....	.....	E
Westminster	6,730	225	.....	22,484	.....	.....	K
NORFOLK:							
Charlotteville	2,978	13	5	886	1,012	.....	60c.
Middleton	2,493	48	2	3,354	397	.....	60c.
North Walsingham	2,118	7	1	690	195	.....	60c.
South Walsingham	1,711	21	4	1,685	626	.....	60c.
Townsend	2,968	30	.....	2,710	.....	.....	60c.
Windham	3,618	2	3	196	599	.....	60c.
Woodhouse	2,308	175	10	15,270	1,491	.....	60c.
BRANT:							
Brantford	7,336	45	.....	2,105	.....	.....	G
Burford	3,697	3	.....	141	.....	.....	G
Onondaga	964	44	9	2,467	1,250	.....	70c.
South Dumfries	2,523	18	.....	710	.....	.....	80c. (M.B.[1]50c.)
Tuscarora	2,654	6	.....	524	.....	.....	25c.
OXFORD:							
East Oxford	1,957	6	.....	267	.....	.....	80c. (M.B. 50c.)
West Oxford	1,796	56	.....	2,214	.....	.....	G

TABLE IV—GAS CONSUMPTION IN TOWNSHIPS, 1935—*Continued*

County and township	Population	No. of consumers		Quantity consumed, M cu. ft.			Net rate per M cu. ft.
		Pay	Free	Pay	Free	Industrial	
HALDIMAND:							
Canborough	840	94	41	5,587	7,230	220	60c.
Dunn	805	138	10	6,248	868	.....	60c.
Moulton	1,590	160	13	6,415	1,959	.....	60c.
North Cayuga	1,282	47	11	3,672	2,283	.....	60c.
Oneida	1,301	66	8	3,494	1,379	.....	60c.
Rainham	1,608	160	26	8,192	4,222	1,224	60c.
Seneca	1,590	146	35	9,498	6,379	.....	60c.
Sherbrooke	350	25	7	2,271	762	.....	60c.
South Cayuga	580	56	11	2,189	2,853	.....	60c.
Walpole	3,145	333	55	19,353	8,550	69	60c.
LINCOLN:							
Caistor	1,260	57	5	2,188	370	155	60c.
Gainsborough	2,090	68	7	1,593	470	.....	60c.
Grantham	5,010	9	.....	522	.....	.....	75c.
Louth	2,905	10	.....	590	.....	.....	75c.
WELLAND:							
Bertie	4,175	174	59	9,336	9,006	.....	F
Crowland	5,082	55	16	2,093	1,822	.....	F
Humberstone	2,370	269	29	12,389	4,334	.....	F
Pelham	2,690	61	1	3,538	84	.....	L
Stamford	8,020	85	4	4,505	604	.....	F
Wainfleet	2,720	230	19	4,104	3,325	.....	60c.
Willoughby	905	28	25	1,512	3,750	.....	F
WENTWORTH:							
Ancaster	3,606	157	.....	16,573	.....	.....	70c.(M.B.$1.00)
Barton	1,840	266	.....	27,237	.....	.....	60c.
Binbrook	1,080	96	21	6,405	3,716	413	60c.
East Flamborough	3,705	50	.....	3,060	.....	.....	S
Glanford	1,265	130	4	10,587	1,062	511	60c.
Saltfleet	4,837	318	.....	14,997	.....	.....	M (M.B. 75c.)
WATERLOO:							
North Dumfries	2,361	57	.....	2,149	.....	.....	80c. (M.B. 50c.)
Waterloo	7,591	13	.....	296	.....	.....	G
Total	.....	8,515	653	554,589	127,231	71,630	.....

[1]M.B.—Minimum monthly bill.

SUMMARY

	M cu. ft.
Total distribution to customers	7,318,930
Used by companies for all purposes	51,091
Used by private well-owners	74,000
Leakage in transmission lines	446,159
Leakage in distribution plants	352,062
Leakage in rural lines	15,431
Total amount of gas distributed	8,257,673

Gas Wells and Their Production

In Table V is given a summary of all the phases of the production of natural gas; much of this will be seen in comparison with previous years in the graph on page 1, in which the annual increase in the total of natural gas wells and the open flow of new wells drilled are shown, as far as records are available.

TABLE V—GAS WELLS AND THEIR PRODUCTION, 1935

County	Township	No. of wells producing	No. of wells abandoned	Wells drilled			Production	Rock pressure, lbs. per sq. in.	Acres under lease	Rental paid
				No. dry	No. producing	Open flow				
						M cu. ft.	M cu. ft.			
Essex	Gosfield South	26			3	185		150	881	$446
	Mersea	3						250		
Kent	Chatham			1			4,161,021			
	Raleigh	44	1	3	2	36,000		556	52,911	150,911
	Romney	141	1					206		
	Tilbury East	154		1	1	15		206		
	Dover	22		2	10	24,779	935,446	825	11,426	
Lambton	Dawn	23					403,644	654	18,512	
	Enniskillen	4					7,156	240	1,000	
	Moore								4,000	
	Sarnia	13					1,144	70	5,000	
Middlesex	Mosa	3						570		
	North Dorchester	3		1				50		
Oxford	Dereham	2			2	450		465		
Elgin	Bayham	47	1		9	6,917	116,118	600		
	Malahide	1						210		
Norfolk	Charlotteville	13						218		
	Houghton	4	1					395		
	Middleton	48		1	2	2,235		600		
	North Walsingham	9	1				472,993	315		
	South Walsingham	17	1	1	2	112		350		
	Townsend	2						240		
	Windham	10						214		
	Woodhouse	64		2	5	253		241		

Haldimand	Canborough	199			13	324		91			
	Dunn	51	2		1	37		196			
	Moulton	127	9	8	4	135		122			
	North Cayuga	197	2	6	21	1,012		195			
	Oneida	74	2	12	15	679		120			
	Rainham	291	5	12	16	847		233	300,406	112,458	
	Seneca	186	3	8	13	600		90			
	Sherbrooke	17	1					230			
	South Cayuga	55		2	1	8	1,576,323	148			
	Walpole	375	2	14	50	4,838		251			
Wentworth	Ancaster	1						40			
	Beverly			1							
	Binbrook	53						72			
	Glanford	13			2	60		58			
Lincoln	Caistor	64	1		4	196		69			
	Gainsborough	15	2		1	37		106			
Welland	Bertie	99	1	1	1	8		110			
	Crowland	26	3					150			
	Humberstone	57	3				290,119	58			
	Wainfleet	28	1	1	2	70		57			
	Willoughby	43		2	1	5		210			
Brant	Onondaga	45	1	4	5	112	120,461	82	46,500	680	
	Tuscarora	78	4		6	376		90			
Bruce	Amabel	5		4	3	80	400	100	50		
Grey	Keppel	1		1	1	30					
Peel	Caledon	5									
Surface wells	Harwich	69					14,000[1]				
	Howard										
Private wells[2]		300					60,000[3]				
Total		3,127	48	88	196	80,400	8,158,825		440,686	$264,495	

[1]This gas is not metered and therefore must be estimated. The wells are owned privately, and the gas is used for domestic purposes.
[2]Principally in Haldimand, Norfolk, and Welland counties.
[3]Estimated.

A comparison of this table with that for 1934 shows the extraordinary results obtained from two wells in the Declute field in Raleigh township. The Dover field is second in average open flow; 2 dry wells to 10 producing wells were drilled in 1935, as compared with 7 dry wells and 1 producing well in 1929, at which time practically all drilling in this field stopped. The tracing of the trend of the Dover fault in the past two years has been the cause of the great increase in producing wells in 1935.

In the Eden field in Bayham township excellent results have been obtained; 9 wells were drilled, none of which were dry. The average open flow is very high for this area, as is the rock pressure, and the field shows considerable promise.

In Middleton township, Norfolk county, two wells at comparatively shallow depth show a very high average open flow, but unfortunately they are not useful for domestic purposes, on account of the high hydrogen sulphide content of the gas; of necessity the total output is being diverted to industrial use.

In Haldimand county and in the adjacent counties, there were fewer wells drilled than in 1934, but the open flow compares favourably with that of last year. It will be found of interest to compare the average open flow of new wells in the different parts of Haldimand county. The rule appears to be that the deeper wells have a higher rock pressure and open flow than the shallower wells in the same formation. The gradation of open flows can be easily followed by referring to this table.

The Haldimand field shows the greatest increase in dry holes. This is to be expected, for since 1929, 1,052 producing wells and 362 dry holes, a total of 1,414 wells, have been drilled within the limits of this old gas field, which includes the adjacent portions of Brant, Wentworth, Lincoln, and Welland counties. If each well were drilled on 25 acres, which is a low estimate, the number of wells would represent 35,350 acres drilled, of which 26,300 acres is productive. Should drilling continue at the present rate, it must extend beyond the limits of the present field.

Fifty-four drilling rigs were in operation in 1935; they drilled 88 dry holes, with a total footage of 84,601 feet, and 201 producing wells, with a total footage of 194,930 feet; in all, 279,531 feet, or 6,320 feet more than in 1934. The acreage under lease shows a decline of about 11,000 acres, but the rental paid shows an increase of $12,846.

Drilling contractors in the natural gas fields of Ontario have an investment of $294,623 and employ 184 men, to whom they pay $129,611 in wages. These figures are included in Table II.

Gas Wells Drilled in 1935

The total number of gas wells drilled, both dry and producing, is only seven less than in 1934, but the proportion of dry holes in 1935 is considerably higher, 31 per cent. in 1935 as against 26 per cent. in 1934. It is to be expected that the proportion of dry holes will increase as the more favourable locations within the gas fields are drilled, and with the absence of new locations within the gas field must come more exploratory drilling.

The greatest activity in drilling is still centred in Walpole township, Haldimand county, although drilling activity has fallen off slightly in 1935. Other centres of activity are in Dover and Raleigh townships, Kent county; Bayham township, Elgin county; and Dawn township, Lambton county, where the success met with last year caused considerable interest.

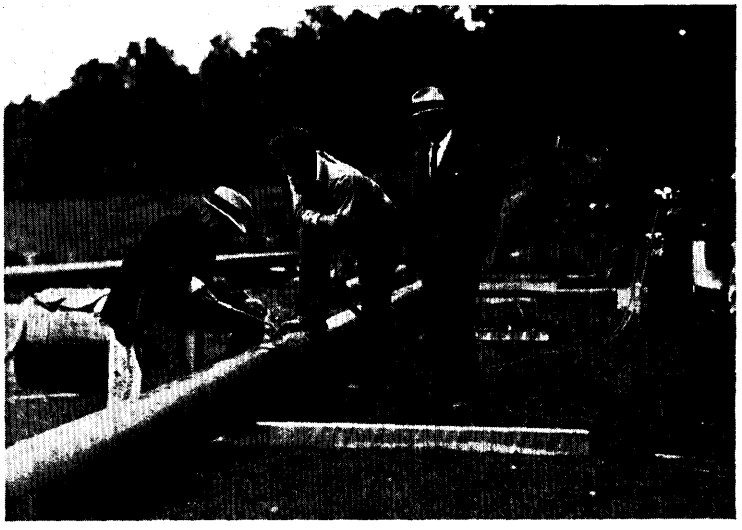
Exploratory work has been carried out in Norfolk county, in Houghton and South Walsingham townships; in Oxford county, where two producing wells

were drilled in Dereham township, the gas, which is of the sulphur variety, coming from the Guelph formation, as in the sulphur-gas wells in Middleton township referred to in last year's report[1]; and in Chatham township, Kent county, where exploratory drilling has been carried on for the past two years with indifferent success.

Additions and Improvements

City of London

The city of London had been served with manufactured gas from 1854, when the coal-gas plant was built, to September, 1935. The City Gas Company was purchased by the Union Gas Company of Canada, Limited, and in August, 1935, they began laying a 10-inch gas transmission line from the Dawn gas field



Welding the section of the pipe line to London that is to be laid under the Thames river.

to the city limits of London, a distance of about 55 miles, where it connected with the mains of the City Gas Company. The pipe line was laid about 2½ feet underground, and the lengths were connected together with "Dresser couplings." The Sydenham and Thames rivers were crossed, but did not present any serious engineering difficulties.

On September 23, natural gas was introduced into the distribution plant, and at the same time about 300 specially trained men began work on a carefully prepared plan of converting the appliances in use from 530 B.t.u. manufactured gas to 1,045 B.t.u. natural gas, taking the city section by section. The work consisted mainly of changing the spuds and pilot-lights and adjusting the air-shutters of the burners. Natural gas requires about ten parts air mixed with the gas as against about five parts air with manufactured gas; in order to use the same burners the opening in the spud should be reduced about 50 per cent. and the air part opened slightly. This change occupied about two weeks' time.

[1]Ont. Dept. Mines, Vol. XLIV, pt. 5, 1935, p. 11.

Demonstration in the use of natural gas had been carried on in different parts of the city for some weeks prior to the change-over, in order to familiarize the public with the proper adjustments of appliances, particularly the proper flame length and its relation to complete combustion. At the same time the gas company inspected every appliance and put it in fit condition to use natural gas; vents and flues were installed where none existed. The result was that the change-over was completed with only one fatality, and this resulted from a water heater installed by some incompetent person without the knowledge of the gas company.

Tilbury Gas Field

The Southern Ontario Gas Company, Limited, completed the necessary changes in their system in the Tilbury gas field for bringing raw gas to their



LAYING THE LONDON PIPE LINE
After all the lengths of pipe are welded together a plug is put in each end and the section is rolled into the river and floated into position.

purification plant at Glenwood. These included duplication of the 8-inch pressure field lines and the installation of additional compressor capacity. The sulphur content of the raw gas, which is 350 grams per cubic foot, is reduced in the purification plant to approximately 15 grams per cubic foot[1] before it is passed into the transmission lines for distribution. Prior to 1935, unpurified gas was supplied by the Southern Ontario Gas Company, in Romney, Mersea, and Gosfield townships; the consumers in Mersea and Gosfield had been accustomed to a sulphuretted hydrogen gas since 1890, when the old Leamington field supplied this area, and while consumers in the counties east of Kent complained bitterly of this evil-smelling gas, those to the west had become so familiar with the odour that they made no objection. The one great objection to the use of "sulphur" gas is its corrosive action on copper and brass. Most water heaters have copper coils, and the latest stoves and furnaces are equipped with brass

[1]Ont. Dept. Mines, Vol. XXXIV, pt. 5, 1925, pp. 7, 8.

fittings; in order to make these available to customers it became necessary to purify the gas. The citizens of these townships, including the towns of Leamington and Kingsville, may now enjoy modern gas-burning equipment heretofore denied them.

The Southern Ontario Gas Company exercised their rights in Yarmouth township, obtained the year before, and laid four miles of 4-inch high pressure pipe line to the suburbs of the city of St. Thomas in Yarmouth township, where a distribution plant was installed and these residents supplied with natural gas. A long section of the Southern Ontario Company's transmission lines in Dunwich township was repaired.

The Dominion Natural Gas Company, Limited, report having carried out leakage surveys in Port Dover, St. Catharines, Dunnville, Wheatley, Merritton, Dundas, and Simcoe, and along their transmission lines.



LAYING THE LONDON PIPE LINE
A gang of men at each end pull the pipe into place in the ditch and then connect each end to the pipe line with Dresser couplings.

Small extensions have been made in many distribution plants to supply the growing population of towns, and this is reflected in the general increase of gas consumers in the province.

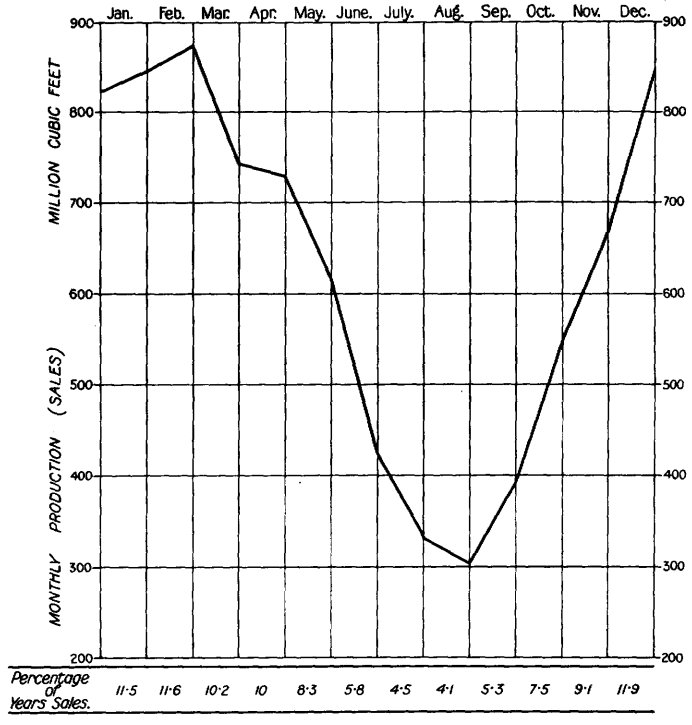
Monthly Demand for Natural Gas

Within the past five years the number of small companies producing natural gas for sale to distributing companies has increased enormously; very few of these are managed by men experienced in natural gas production, and scarcely any by men with knowledge of gas distribution and the fluctuation in daily and monthly demand.

Most transmission pipe lines in Ontario are 8 and 10 inches in diameter. The longest line, from the Tilbury gas field to Hamilton, is 12 inches in diameter for a little less than half of its length. A pressure is maintained on these pipe lines that will deliver a given quantity of gas to the various markets at a predetermined pressure at that market. Most distribution plants are so designed that a pressure of 20 pounds per square inch at the regulators in the distribution plant will give a sufficient supply and pressure to each consumer. If this pressure falls below the minimum, the service is impaired. As regulators in the distribu-

tion plant maintain an even pressure at the consumer's appliance of from 4 to 6 ounces per square inch, raising the pressure on the transmission line above the minimum does not benefit anyone, and would only result in an unnecessary increase in the leakage on the transmission line.

The responsibility for delivering sufficient gas to maintain a pressure of 20 pounds per square inch in the distribution plant rests with the superintendent in the gas field. In winter he must be prepared to increase and in summer to curtail deliveries. The above graph shows this monthly variation. It is impractical to show the daily fluctuations in the demand for gas; but everyone is familiar with the sudden changes in temperature, as between a warm day



Load curve of natural gas distributed in 1935.

followed by a cold, windy night, that cause a sudden demand for more and more gas. Under such circumstances, no matter whether it is night or day or how thick may be the blizzard, the men in the gas field must find their way to perhaps one hundred gas wells and open them into the gas line to supply the sudden demand. In natural gas practice, there is no excuse to offer the public should the supply of gas fail to meet the demand. It is the responsibility of the gas companies to have a sufficient reserve at all times, and it is therefore evident that some wells must always be held in reserve. If all wells must be turned on to meet a "peak" demand, it is a warning to the distributing company that they are facing a shortage of gas and that steps must be taken immediately to find new sources of supply.

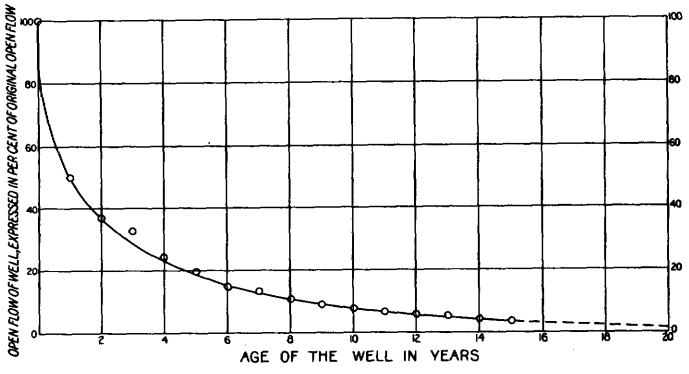
The table below indicates the relation between open flow, rock pressure, and delivery from an average well into a pipe line against winter maximum and summer minimum pressures, as shown. These are actual figures for the year

1935 and differ slightly from those of other years. It is the writer's opinion, however, that these are representative figures and reflect average conditions, with the exception of Lambton county, where the Dawn gas field is shut in most of the year, which is the cause of the low delivery.

DAILY DELIVERIES FROM GAS WELLS, 1935

County	No. of wells measured	Average rock pressure	Average open flow per day	Production per day per well	Percentage open flow delivered to pipe line	Field line pressure
		lbs. per sq. in.	cu. ft.	cu. ft.	per cent.	lbs. per sq. in.
Kent	352	223	390,000	39,650	10	50 to 125
Lambton	43	418	1,656,000	26,256	1.5	50 to 200
Elgin	43	234	100,000	7,400	7.5	50 to 75
Norfolk	166	260	36,000	2,850	8	50 to 75
Greater Haldimand	1,707	170	21,800	2,515	11.5	50 to 100
Brant	101	95	12,400	3,268	26	10 to 30

It would appear that approximately 10 per cent. of the daily open flow of a well in an old gas field is delivered into the pipe line carrying from 75 to 100 pounds pressure. The controlling feature in the delivery of gas from a well to a pipe line is the differential between the rock pressure and the pipe line pressure. Next in importance is the open flow. No matter how great the open flow of a



THE RELATION OF THE OPEN FLOW OF A GAS WELL TO THE YEARS THAT IT IS OPERATED

This graph has been compiled from the actual records of over 500 wells in the Haldimand gas field. It may be taken to represent to some extent the decline in production of an average natural gas well. (Copied from chart by H. R. Davis, Buffalo.)

gas well may be, it will deliver nothing into the pipe line unless the pressure of gas in the rock (rock pressure) is greater than the pressure of gas in the transmission line.

A study of the daily deliveries and the graph of monthly sales (production), will give some information as to the delivery that might be expected from a well answering the specifications in the table; by applying the percentages that the month's sales bear to the year's sales (see bottom of the graph), the average daily sales for any month may be approximated.

The question most often asked by investors in natural gas and inexperienced operators is, "How many years will a well continue to produce gas?" This question cannot be answered definitely. The thickness of the gas sand (producing horizon), the porosity, the ratio of rock pressure to pipe-line pressure, the open flow, and water encroachment, are all variables that affect the life of a well. Excessive cost of operation may make one well unprofitable, while a well with an equal delivery and a low operating cost may be kept in operation years longer. The table of daily deliveries on page 17 would indicate that a gas well in the Haldimand field, where 11½ per cent. of the open flow is delivered into the pipe line, must last much longer than a well in the Brant county (Onondaga) gas field, where 26 per cent. of the open flow is delivered. In addition a well with an initial open flow so small that it is on the borderline between a profitable or unprofitable well, would soon pass into the ranks of unprofitable wells; but, as in the case of the table of daily deliveries, the results shown in the graph on page 17 are averages for the Haldimand gas field. A well at about the half-way point in its life, having an open flow of 21,800 cubic feet per day, should approximate the deliveries shown in this table.

Another matter that is not made clear to the investor in small natural gas projects is that the money he receives each year is not only the return on his investment (interest) but also the return of his investment (amortization). A commercial well must produce enough gas to repay the capital invested in the gas well and to pay a rate of interest commensurate with the risk involved. The ratio of dry holes to producing wells in 1935 is 88 to 196. Interest rates are about 4½ per cent. on sound securities, and applying this ratio gives a rate of about 10 per cent. on investments in natural gas ventures where production only is involved. This is probably a loose calculation as it is based on the numbers of wells and not the profits obtained from these producing wells as against losses in dry holes; on such a basis, this rate would undoubtedly be less. With regard to amortization: After ten years the cost of operation and repairs is likely to increase and incidental expenses to multiply; it has consequently been found expedient to return the money, or amortize the cost of wells in from five to six years.

There are not sufficient wells where the production is metered independently to compare the annual production with the decline in open flow. The only complete record of a gas field over any considerable number of years is in the Tilbury gas field, and for the years the record was published[1] extraordinary conditions in the gas field[2] nullified the results for purposes of such a comparison; but in general there is a parallelism between the decline in annual open flow and production, and good management would dictate that book-keeping should be brought into line with existing conditions.

Leakage

Leakage has again increased and is undoubtedly much too high in distributing plants and on transmission lines. Tables VI, VII, and VIII show the progressive reduction of leakage from 1922 to about 1932, and the increase from 1932 to 1935. As stated in the report of last year,[3] this increase in leakage appears to have followed a decrease in the number of employees; it is hoped that the increase in employees in 1935 will be reflected in a decrease in leakage in the year 1936.

[1]Ont. Dept. Mines, Vol. XXXIII, pt. 5, 1924, pp. 26, 27.
[2]Ont. Dept. Mines, Vol. XXXV, pt. 5, 1926, p. 2, paragraph 3; Vol. XXXVI, pt. 4, 1927, p. 2, paragraph 2.
[3]Ont. Dept. Mines, Vol. XLIV, pt. 5, 1935, p. 13.

Of the places mentioned in last year's report, an improvement is noted in all but Dunnville, Sarnia, and Simcoe; in these the leakage has increased. Increases in leakage are also noted in Galt and South London.

TABLE VI—LEAKAGE IN DISTRIBUTION PLANTS IN ONTARIO, 1922–1935

Year	No. of plants	Equivalent miles of 3-inch pipe	Leakage		No. of consumers	Leakage per consumer	Average pressure, ounces per sq. in.	Percentage of leakage
			Actual	Allowable				
			M cu. ft.	M cu. ft.		cu. ft.		
1922	17	461.87	251,845	92,374	24,839	10,139	5.31	11.41
1923	17	478.33	172,953	95,666	23,445	7,375	5.3	8.39
1924	31	734.53	226,758	146,906	36,099	6,281	5.65	6.15
1925	32	804.3	544,260	160,860	39,701	13,709	5.19	12.73
1926	37	808.39	305,921	161,778	40,190	7,611	5.35	7.13
1927	39	840.87	333,141	168,174	44,150	7,545	4.84	8.15
1928	42	873.97	346,717	174,794	47,428	7,310	4.9	7.53
1929	42	912.28	369,360	182,456	54,801	6,740	4.66	7.11
1930	48	1,247.84	288,367	249,568	54,372	5,304	4.71	5.62
1931	42	753.96	197,876	150,792	40,185	7,325	4.5	6.76
1932	42	1,347.05	267,439	269,410	55,439	7,810	4.5	6.18
1933	48	1,248.84	228,045	249,768	54,850	7,397	4.6	6.13
1934	47	1,259.47	349,673	251,894	55,963	6,250	4.5	8
1935	47	1,483.34	352,062	296,668	76,693	5,790	4.5	7.93

TABLE VII—LEAKAGE IN TRANSMISSION LINES IN ONTARIO, 1922–1935

Year	No. of lines	Size of pipe lines	Equivalent miles of 3-inch pipe	Actual leakage	Average pressure on pipe lines	Percentage of leakage
				M cu. ft.	lbs. per sq. in.	
1922	6	.....	1,396.2	955,746	.....	16.6
1925	7	6- to 12-inch	1,397.4	432,728	12–120	8.17
1926	8	4- to 12-inch	1,402.1	534,324	5–120	8.01
1927	8	4- to 12-inch	1,403.3	573,144	12–120	10.45
1928	7	4- to 18-inch	1,519.04	394,805	25–100	6.86
1929	7	4- to 18-inch	1,589.63	578,962	25–100	8.78
1930	7	4- to 18-inch	1,700.19	413,619	25–100	7.09
1931	7	4 -to 18-inch	1,692.64	323,509	25–100	6.21
1932	7	6- to 18-inch	1,720.05	240,509	25–80	4.49
1933	8	6- to 18-inch	1,752.05	274,367	20–80	5.35
1934	8	6- to 18-inch	1,752.05	368,738	20–80	6.76
1935	8	4- to 18-inch	1,684.25	446,159	20–80	8.3

TABLE VIII—LEAKAGE ON RURAL LINES IN ONTARIO, 1922–1935

Year	No. of townships	No. of lines	Equivalent feet of 3-inch pipe	Leakage		No. of consumers	Leakage per consumer	Percentage of leakage
				Actual	Allowable			
				M cu. ft.	M cu. ft.		cu. ft.	
1922	6	24	68,276	11,346	2,586	239	47,472	30.6
1923	11	102	585,655	69,476	22,184	2,114	32,864	14.33
1924	12	91	680,620	80,739	25,780	2,155	37,465	20.50
1925	14	81	502,631	64,285	19,039	1,748	36,776	23.03
1926	14	90	420,284	41,482	15,920	2,071	20,030	14.14
1927	15	90	558,295	51,692	21,147	2,275	22,721	17.98
1928	14	86	560,605	33,954	21,235	2,171	15,639	11.65
1929	11	76	545,486	17,313	20,663	1,886	9,180	7.09
1930	12	74	546,918	15,881	20,717	2,124	7,476	6.97
1931	14	.....	574,831	13,530	21,774	2,116	9,588	6.66
1932	13	.....	551,154	9,106	20,876	1,981	9,272	4.96
1933	14	.....	553,936	10,824	20,981	2,016	8,158	6.1
1934	14	.....	487,454	16,347	18,459	1,666	8,928	10.98
1935	14	.....	555,725	15,431	21,046	1,885	8,186	9.81

TABLE IX—LEAKAGE IN DISTRIBUTION PLANTS, 1935

Cities and towns	Company	Equivalent miles of 3-inch pipe in distribution plants	Volume received	Volume delivered	Leakage for year		Average No. of consumers	Leakage per consumer	Pressure distribution plants, ounces per sq. in.
					Actual	Allowable			
			M cu. ft.	M cu. ft.	M cu. ft.	M cu. ft.		cu. ft.	
Belle River	Union Gas Co.	4.41	11,880	10,899	981	882	146	6,719	6
Belmont	Ontario Salt Co.	6	4,929	3,508	1,421	1,200	117	12,145	6
Blenheim	Union Gas Co.	12.95	85,078	84,063	1,015	2,590	584	1,721	5
Brantford	Dom. Nat. Gas Co.	94.25	244,669	229,212	15,457	18,850	4,586	3,372	4
Brigden	Union Gas Co.	3.88	9,676	8,740	936	776	160	5,850	5
Cainsville	Dom. Nat. Gas Co.	5.57	8,662	7,746	916	1,114	173	5,295	4
Chatham	Union Gas Co.	81.34	408,533	396,118	12,415	16,268	4,036	3,076	5
Comber	Union Gas Co.	3.51	16,759	16,588	171	702	136	1,258	5
Corunna	Union Gas Co.	5.33	9,139	8,854	285	1,066	252	1,131	6
Courtright	Union Gas Co.	3.86	7,227	6,535	692	772	107	6,467	5
Dorchester	South. Ont. Gas Co.	2.86	8,943	7,620	1,323	572	117	11,308	4
Dresden	Union Gas Co.	12.28	44,685	42,351	2,334	2,456	486	4,802	5
Dundas	Dom. Nat. Gas Co.	12.68	64,681	58,981	5,700	2,536	1,129	5,048	4
Dunnville	Dom. Nat. Gas Co.	13.87	99,758	90,422	9,336	2,774	997	9,364	4
Essex	Union Gas Co.	11.53	59,192	58,473	719	2,306	459	1,566	5
Fenwick	Dom. Nat. Gas Co.	1.51	6,686	5,907	779	302	96	8,114	4
Fonthill	Fonthill Gas Co.	5.33	8,507	6,786	1,721	1,066	254	6,775	5
Galt	Dom. Nat. Gas Co.	34.14	106,947	96,892	10,055	6,828	2,228	4,513	4
Hagersville	Dom. Nat. Gas Co.	7.38	32,180	29,424	2,756	1,476	409	6,738	4
Ingersoll	Dom. Nat. Gas Co.	20.82	48,788	46,565	2,223	4,164	1,018	2,183	4
Kingsville	South. Ont. Gas Co.	13.49	64,963	61,275	3,688	2,698	634	5,817	4
Leamington	Leamington Corp.	25.47	166,824	141,679	25,145	5,094	1,412	17,808	8
London	City Gas Co.	207.36	184,973	155,123	29,850	41,472	14,674	2,034	6
Merlin	Union Gas Co.	2.58	14,512	14,043	469	516	146	3.212	4
Mt. Hamilton	Dom. Nat. Gas Co.	22.91	51,502	46,379	5,123	4,582	2,500	2,049	4
Paris	Dom. Nat. Gas Co	14.92	48,485	44,365	4,120	2,984	890	4,629	4
Petrolia	Union Gas Co.	16.36	82,910	71,166	11,744	3,272	772	15,212	6
Port Burwell	Dom. Nat. Gas Co.	3.84	7,179	5,803	1,376	768	240	5,733	4
Port Lambton	Union Gas Co.	2.02	4,480	3,916	564	404	72	7,833	5
Ridgetown	Union Gas Co.	17.88	65,773	60,357	5,416	3,576	639	8,475	5
St. Catharines	Dom. Nat. Gas Co.	59.16	341,627	310,449	31,178	11,832	5,323	5,857	4
St. George	Dom. Nat. Gas Co.	2.11	4,222	3,992	230	422	123	1,870	4
Sarnia	Union Gas Co.	91.73	357,315	322,616	34,699	18,346	5,161	6,723	5
Shedden-Fingal	South. Ont. Gas Co.	6.11	10,221	8,322	1,899	1,222	118	16,093	4

Simcoe	Dom. Nat. Gas Co.	29.69	204,070	188,815	15,255	5,938	1,823	8,368	4
Sombra	Union Gas Co.	2.62	6,788	6,043	745	524	83	8,976	5
South London	South. Ont. Gas Co.	8.87	23,568	18,925	4,643	1,774	224	20,727	4
Straffordville	Dom. Nat. Gas Co.	1.39	7,678	6,780	898	278	92	9,761	4
Thorold	Dom. Nat. Gas Co.	13.37	42,804	39,310	3,494	2,674	1,049	3,330	4
Tilbury	Union Gas Co.	9.23	49,387	48,442	945	1,846	549	1,721	5
Tillsonburg	Dom. Nat. Gas Co.	23.49	89,510	83,990	5,520	4,698	1,096	5,036	4
Vienna	Dom. Nat. Gas Co.	1.04	1,545	1,343	202	208	88	2,295	4
Wallaceburg	Union Gas Co.	25.12	105,997	99,640	6,357	5,024	1,177	5,401	6
West Hamilton	South. Ont. Gas Co.	3.81	8,619	8,086	533	762	247	2,158	4
Wheatley	South. Ont. Gas Co.	3.46	17,646	16,479	1,167	692	224	5,209	4
Windsor (Border Cities)	Union Gas Co.	483.36	1,431,453	1,357,916	73,537	96,672	19,169	3,836	4
Woodstock	Dom. Nat. Gas Co.	48.45	111,974	99,944	12,030	9,690	2,075	5,797	4
Total		1,483.34	4,792,944	4,440,882	352,062	296,668	78,090		

TABLE X—LEAKAGE IN TRANSMISSION LINES, 1935

Transmission lines	Size of pipe line	Equivalent miles of 3-in. pipe	Volume received	Volume delivered	Actual leakage	Average pressure on pipe lines
			M cu. ft.	M cu. ft.	M cu. ft.	lbs. per sq. in.
Dundas to Hamilton	6-inch	8.08	135,240	135,232	8	20
Gas field to Sarnia and Petrolia	6-, 8-, 10-, 12-inch	380.57	1,653,970	1,581,414	72,556	40–80
Leamington to Hamilton	8-, 10-, 12-inch	710.05	1,629,562	1,359,744	269,818	75
Gas field to Windsor	8-, 10-, 12-, 18-inch	356.7	1,629,909	1,591,750	38,159	30–80
Gas field to Ridgetown	6-, 8-inch	81.56	226,359	197,838	28,521	25–80
Gas field to Bothwell	4-, 6-inch	32	36,575	35,072	1,503	30–50
Gas field to Hamilton	8-inch	58.28	136,272	123,750	12,522	30–50
Dunnville to St. Catharines	8-inch	57.01	384,898	361,826	23,072	50
Total		1,684.25	5,832,785	5,386,626	446,159	

TABLE XI—LEAKAGE ON RURAL LINES, 1935

Township	Equivalent feet of 3-inch pipe in all rural lines	Volume received	Volume delivered	Leakage for year		Average No. of consumers	Leakage per consumer	Average pressure on pipe lines	
				Actual	Allowable			Low pressure	High pressure
		M cu. ft.	M cu. ft.	M cu. ft.	M cu. ft.		cu. ft.	ozs.	lbs.
Chatham	4,656	2,543	2,340	203	176	39	5,205	6	3
Dawn	13,581	2,760	2,663	97	514	28	3,464	8	.....
Dover	102,857	32,311	29,767	2,544	3,896	330	7,709	6	9
Enniskillen	10,173	2,415	2,219	196	385	40	4,900	5	.....
Harwich	102,851	30,293	26,765	3,528	3,895	438	8,055	6	5
Howard	18,905	7,085	6,529	556	716	88	6,318	6	3
Moore	11,214	2,103	2,065	38	425	56	678	6	.....
Raleigh	144,391	37,593	34,735	2,858	5,469	374	7,641	6	6
Raleigh (Blake system)	32,319	6,027	3,551	2,476	1,224	87	28,459	4	.....
Rochester	34,983	13,573	13,027	546	1,325	142	3,845	5	12
Sandwich, East	2,386	738	643	95	90	13	7,308	6	5
Sandwich, South	21,799	7,120	6,797	323	825	60	5,383	6	6
Sombra	2,052	577	475	102	78	10	10,200	6	.....
Tilbury, East	53,558	27,716	25,847	1,869	2,028	180	10,383	6	7
Total	555,725	172,854	157,423	15,431	21,046	1,885	.....	.....	.....

Licenses Issued in 1935

The Natural Gas Conservation Act, R.S.O., 1927, The Well Drillers' Act, R.S.O., 1927, and the Regulations made under these Acts require that the several operations carried out shall be done under license. Tables XII to XVI show a list of those to whom licenses were issued during 1935.

The licenses required under the above Acts and the cost of each are as follows:

To Lease and Prospect for Natural Gas	$5.00
To Drill or Bore for Natural Gas or Oil	5.00
To Produce Natural Gas	10.00
To Distribute Natural Gas	10.00
To Operate Natural Gas Pipe-Lines	10.00

TABLE XII—OPERATORS LICENSED TO LEASE AND PROSPECT FOR NATURAL GAS, 1935

License No.	Name	Address
778	Acme Gas and Oil Co., Ltd.	Toronto, Ont.
822	Adams, L. W.	Espanola, Ont.
811	Aetna Oil Co., Ltd.	Windsor, Ont.
773	Ajax Oil and Gas Co., Ltd.	Toronto, Ont.
807	Benner, K. W.	Fisherville, Ont.
823	Bryson, George	Petrolia, Ont.
798	Carrothers, Irwin	Kerwood, Ont.
806	Colbert, Norman C.	Hagersville, Ont.
751	Coste, L. A.	Chatham, Ont.
812	Craft, Fred W.	Detroit, Mich.
791	Daly, C. A.	Tupperville, Ont.
781	Domestic Gas Syndicate	Toronto, Ont.
756	Dominion Natural Gas Co., Ltd.	Buffalo, N.Y.
816	Draymond, Francis R.	Chatham, Ont.
808	Dufferin Natural Gas Syndicate	Shelburne, Ont.
803	Elliot, George A.	Toronto, Ont.
790	Fisher, C. W.	Chatham, Ont.
800	Fitzpatrick, P. H.	Detroit, Mich.
809	Gardiner, Alex.	Sarnia, Ont.
782	Gaul, Henry J.	Stratford, Ont.
760	Gray, Ira	Merlin, Ont.
766	Grimsby Natural Gas Co., Ltd.	Grimsby, Ont.
769	Haldimand Natural Gas Syndicate	Stevensville, Ont.
762	Heal, A. A.	Petrolia, Ont.
786	High Grade Natural Gas Co., Ltd.	Chatham, Ont.
755	Holmes, A. B.	Toronto, Ont.
779	Hoover, A. E.	Selkirk, Ont.
759	Howard, W. C.	Leamington, Ont.
771	House, Charles C.	Stevensville, Ont.
804	Hulse, J. W.	Buffalo, N.Y.
824	Jansen, H.	Buffalo, N.Y.
758	James, F. L.	Toronto, Ont.
761	Jasperson, Bon	Kingsville, Ont.
813	Lewis, James R.	Williamsville, N.Y.
805	Liley and Winkler	Detroit, Mich.
765	Lymburner Bros. and Webber	Dunnville, Ont.
820	Marshant, F.	Newbury, Ont.
810	Massey, Harold	Windsor, Ont.
814	Massey Oil and Gas Co., Ltd.	Windsor, Ont.
819	McCarter, Charles S.	Jarvis, Ont.
774	McCutcheon, Thomas J.	Dunnville, Ont.
879	McGuigan, Virgil G.	Cedar Springs, Ont.
794	McKillop, Wm.	Hepworth, Ont.
785	Medina Natural Gas Co., Ltd.	Chatham, Ont.

TABLE XII—OPERATORS LICENSED TO LEASE AND PROSPECT FOR NATURAL GAS, 1935—*Continued*

License No.	Name	Address
754	Neath, Charles	Chatham. Ont.
821	Nichols, N. J	Strathroy, Ont.
780	Patterson, W. C	Jamestown, N.Y.
796	Patterson, F. L	Detroit, Mich.
871	Perdue, Jack	Chatham, Ont.
776	Rawlings, George H	Chatham, Ont.
777	Reicheld, Fred W	Jarvis, Ont.
775	Reicheld, O. E	Fisherville, Ont.
783	River Valley Natural Gas Syndicate	Toronto, Ont.
793	Roberts, J. R	Windsor, Ont.
795	Rockton Oil and Gas Syndicate	Dundas, Ont.
802	Rodgers, Alex	Tillsonburg, Ont.
752	Sadlier, L	Chatham, Ont.
801	Savage, Louis	Detroit, Mich.
772	Schollenberger, Christian	Wallacetown, Ont.
797	Schollenberger, Theresa	Wallacetown, Ont.
753	Scullard, Fred B	Chatham, Ont.
815	Sibbitt, Robert A	Ottawa, Ont.
767	Smith, E. W	Toronto, Ont.
788	Smith, Harry B	Windsor, Ont.
789	Smith, Luke	Oakville, Ont.
757	Smith, Robert H	Lowbanks, Ont.
784	Stanley, W. E	Toronto, Ont.
817	Stewart, Elgin Russell	Jarvis, Ont.
764	Sullivan, George F	Sarnia, Ont.
799	Waller, C. W	Toronto, Ont.
770	Welland County Gas Syndicate	Stevensville, Ont.
818	Wood, D. H	Port Huron, Mich.
768	Woodhouse, Henry	Toronto, Ont.

TABLE XIII—OPERATORS LICENSED TO DRILL OR BORE FOR NATURAL GAS, 1935

License No.	Name	Address
663	Ajax Oil and Gas Co., Ltd	Toronto, Ont.
669	Allen, A. J	Dunnville, Ont.
648	British Petroleum Co., Ltd	Hamilton, Ont.
610	Culver, W. H., Jr	Dunnville, Ont.
611	Culver, W. H., Jr	Dunnville, Ont.
612	Culver, W. H., Jr	Dunnville, Ont.
683	Cole, W. J	Petrolia, Ont.
613	Dawson, Ralph	Merlin, Ont.
677	Demaray, Clarence	Kerwood, Ont.
740	Emerson, Harry L	Dunnville, Ont.
679	Gough, N. E	Toronto, Ont.
658	Gregory, Geo. F	Petrolia, Ont.
659	Gregory, Geo. F	Petrolia, Ont.
617	Heal, Andrew A	Petrolia, Ont.
650	High Grade Natural Gas Co., Ltd	Chatham, Ont.
652	Hockley Valley Oil Co., Ltd	Windsor, Ont.
608	Holmes, A. B	Toronto, Ont.
645	Hoover, A. E	Selkirk, Ont.
646	Hoover, A. E	Selkirk, Ont.
647	Hoover, A. E	Selkirk, Ont.
682	Hoover, A. E	Selkirk, Ont.

TABLE XIII—OPERATORS LICENSED TO DRILL OR BORE FOR NATURAL GAS, 1935—*Continued*

License No.	Name	Address
633	House, Charles C.	Stevensville, Ont.
665	Howlett, Fred W., and Sons	Petrolia, Ont.
661	Hussey, W. J.	Petrolia, Ont.
639	Jackson, Percy L.	Dunnville, Ont.
640	Jackson, Percy L.	Dunnville, Ont.
641	Jackson, Percy L.	Dunnville, Ont.
642	Jackson, Percy L.	Dunnville, Ont.
643	Jackson, Percy L.	Dunnville, Ont.
644	Jackson, Percy L.	Dunnville, Ont.
616	Jasperson, Bon	Kingsville, Ont.
670	Kells, Ernest E.	Petrolia, Ont.
637	Kiser Bros.	Chatham, Ont.
638	Kiser Bros.	Chatham, Ont.
629	Lauer, D. G.	Tillsonburg, Ont.
630	Lauer, D. G.	Tillsonburg, Ont.
673	Lewis, James R.	Williamsville, Ont.
738	Lincoln Gas Co., Ltd.	Toronto, Ont.
624	Lymburner Bros. and Webber	Dunnville, Ont.
680	Marshant, F.	Newbury, Ont.
631	McCutcheon, Thomas J.	Dunnville, Ont.
632	McCutcheon, Thomas J.	Dunnville, Ont.
678	McCutcheon, Thomas J.	Dunnville, Ont.
676	McGaffey, Roy	Bothwell, Ont.
625	McKechnie, S.	Dunnville, Ont.
626	McKechnie, S.	Dunnville, Ont.
627	McKechnie, S.	Dunnville, Ont.
628	McKechnie, S.	Dunnville, Ont.
651	McKillop, Wm.	Hepworth, Ont.
744	McLister, J. J.	Dunnville, Ont.
671	McMaster, R., and Son	Echo Place, Ont.
657	McNinch, S. E.	Canborough, Ont.
681	McRitchie, J. A.	Bothwell, Ont.
605	Nicholls, Jack	Pelee Island, Ont.
606	Pelee Island Petroleum Syndicate, Inc.	Detroit, Mich.
666	Pelee Island Petroleum Syndicate, Inc.	Detroit, Mich.
609	Perkins, J. E.	Dunnville, Ont.
742	Port Colborne-Welland Natural Gas and Oil Co., Ltd.	Port Colborne, Ont.
672	Rawson, W. J.	Petrolia, Ont.
675	Ricker, Arthur	Canborough, Ont.
660	Rockton Oil and Gas Syndicate	Dundas, Ont.
674	Sibbitt, Robert A.	Ottawa, Ont.
653	Simpson, C. A.	Simcoe, Ont.
615	Smith, Robert H.	Lowbanks, Ont.
662	Stewart, Elgin	Jarvis, Ont.
634	Stover, F. H., and Son	Chatham, Ont.
635	Stover, F. H., and Son	Chatham, Ont.
607	Stubble, H. H.	Merlin, Ont.
664	Stubble, H. H.	Merlin, Ont.
748	Sundy, Basil K.	Tillsonburg, Ont.
604	Union Gas Company of Canada, Ltd.	Chatham, Ont.
649	Walker, Geoffrey C.	Port Franks, Ont.
614	Walter Gas Syndicate	Buffalo, N.Y.
667	Wardell, Jacob L.	Cayuga, Ont.
621	Willits, G. E. and D. E.	Bothwell, Ont.
622	Willits, G. E. and D. E.	Bothwell, Ont.
623	Willits, G. E. and D. E.	Bothwell, Ont.
636	Wright, David	Sarnia, Ont.

TABLE XIV—OPERATORS LICENSED TO PRODUCE NATURAL GAS, 1935

License No.	Name	Address
774	Acme Gas and Oil Co., Ltd.	Toronto, Ont.
765	Ajax Oil and Gas Co., Ltd.	Toronto, Ont.
925	Aloka Oil Co., Ltd.	Toronto, Ont.
751	Amity Gas and Oil Co., Ltd.	Lowbanks, Ont.
786	Aragain Gold and Natural Gas Syndicate	Toronto, Ont.
789	Beacon Natural Gas Syndicate	Waterloo, Ont.
770	Broadway Gas Syndicate	Jarvis, Ont.
906	Buck, C. S.	Port Rowan, Ont.
801	Burchell Natural Gas Syndicate	Brussels, Ont.
743	Canadian Natural Gas Syndicate	Simcoe, Ont.
899	Canfield Gas Syndicate	Detroit, Mich.
736	Canfield Natural Gas Co., Ltd.	Canfield, Ont.
787	Central Pipe Line Co., Ltd.	Chatham, Ont.
760	Central Seneca Gas Syndicate	Cayuga, Ont.
779	Colonial Natural Gas and Oil Co., Ltd.	Hamilton, Ont.
889	Columbia Natural Gas and Oil Co., Ltd.	Hamilton, Ont.
781	Continental Gas Corporation, Ltd.	Toronto, Ont.
742	Dawson, Ralph	Merlin, Ont.
928	Delhi Gas Syndicate	Cayuga, Ont.
778	Domestic Gas Syndicate	Toronto, Ont.
741	Dominion Natural Gas Co., Ltd.	Buffalo, N.Y.
875	Emerald Gas Syndicate	Toronto, Ont.
877	Emerson, Harry L.	Dunnville, Ont.
795	Empire Natural Gas, Ltd.	Toronto, Ont.
887	Erie Gas, Ltd.	Toronto, Ont.
914	Esmond Avery and Associates Syndicate	Detroit, Mich.
879	Fisherville Gas Co.	Fisherville, Ont.
908	Firelite Gas and Oil Co., Ltd.	Toronto, Ont.
935	Gasfinders and Producers, Ltd.	Toronto, Ont.
800	Gas Producers Syndicate	Chatham, Ont.
754	Gifford, Arthur, and Son	Cayuga, Ont.
897	Glenny, Daniel	Dunnville, Ont.
737	Grand River Gas and Oil Syndicate	Canfield, Ont.
869	Grand River Natural Gas and Oil Syndicate	Cayuga, Ont.
755	Grimsby Natural Gas Co., Ltd.	Grimsby, Ont.
757	Haldimand Gas Syndicate	Cayuga, Ont.
762	Haldimand Natural Gas Syndicate	Stevensville, Ont.
916	Hartzell, Stone, Thurber, Hartzell and Avery, Minnicog Gas Co.	Detroit, Mich.
788	Highbank Oil, Ltd.	Chatham, Ont.
748	Hope Gas Syndicate	St. Catharines, Ont.
764	House and Harris	Stevensville, Ont.
799	Ideal Gas Syndicate	Fisherville, Ont.
775	Industrial Natural Gas Co., Ltd.	Port Robinson, Ont.
747	Jasperson, Bon	Kingsville, Ont.
863	Kelly Gas and Oil Syndicate	Toronto, Ont.
932	Knight, J. W.	Detroit, Mich.
933	Ladd, C. H.	Detroit, Mich.
753	Lincoln Gas Co., Ltd.	Toronto, Ont.
834	Lindsay, W. B., Estate	Edmonton, Alta.
752	Lymburner Bros. and Webber	Dunnville, Ont.
885	Lynn Valley Gas and Oil, Ltd.	Waterloo, Ont.
929	McKechnie and Hussey	Dunnville, Ont.
867	Melrose Gas and Oil Syndicate	Toronto, Ont.
803	Middleton-Norfolk Gas Co., Ltd.	Stratford, Ont.
749	Midwal Oil and Gas Co., Ltd.	Fisherville, Ont.
883	Mohawk Gas and Oil Syndicate	Hamilton, Ont.
847	Monarch Gas and Oil Syndicate	Fisherville, Ont.
912	Mutual Natural Gas Syndicate	Toronto, Ont.
895	National Gas Syndicate	Dunnville, Ont.
791	Niagara Natural Gas Co., Ltd.	Buffalo, N.Y.
871	Niece, Hosea, and Son	Lowbanks, Ont.
768	Norhal Gas and Oil, Ltd.	Hamilton, Ont.
734	North Cayuga Gas Syndicate	North Cayuga, Ont.
910	Nottawa Oil and Gas Co., Ltd.	Toronto, Ont.

TABLE XIV—OPERATORS LICENSED TO PRODUCE NATURAL GAS, 1935—*Continued*

License No.	Name	Address
900	Olga Gas, Ltd.	Toronto, Ont.
776	Patterson, W. C.	Jamestown, N.Y.
738	Petrol Oil and Gas Co., Ltd.	Toronto, Ont.
893	Port Colborne-Welland Natural Gas and Oil Co., Ltd.	Port Colborne, Ont.
931	Premier Oils, Ltd.	Toronto, Ont.
904	Prairie Gas and Oil Co., Ltd.	Toronto, Ont.
756	Provincial Natural Gas and Fuel Co. of Ontario, Ltd.	Fort Erie North, Ont.
758	Rainham Gas Syndicate	Cayuga, Ont.
769	Reicheld, Fred W.	Jarvis, Ont.
918	Ricker, Arthur	Canborough, Ont.
861	Riley, J. V.	Simcoe, Ont.
773	Rowe, E. P.	Toronto, Ont.
750	Salina Gas Co., Ltd.	Chatham, Ont.
923	Sarnia Oil and Gas Co., Ltd.	Sarnia, Ont.
761	Selected Natural Gas and Oil Syndicate	Toronto, Ont.
882	Security Oil and Gas Co., Ltd.	Windsor, Ont.
767	Sherbrooke Gas Syndicate	Lowbanks, Ont.
745	Smith, Robert H.	Lowbanks, Ont.
746	Southern Ontario Gas Co., Ltd.	Buffalo, N.Y.
855	Springvale Gas and Oil Co., Ltd.	Hagersville, Ont.
771	Standard Gas and Oil Syndicate	Fisherville, Ont.
884	Sterling Gas Co., Ltd.	Guelph, Ont.
739	Stevensville Natural Gas and Fuel Co.	Stevensville, Ont.
802	Stewart, Elgin Russell	Jarvis, Ont.
880	Stover and Rawlings	Chatham, Ont.
920	Stromwell Syndicate	Tillsonburg, Ont.
766	Superior Gas Syndicate	Fisherville, Ont.
772	Sweets Corners Gas Syndicate	Fisherville, Ont.
891	Tillsonburg Natural Gas and Oil Co., Ltd.	Toronto, Ont.
735	Union Gas Co. of Canada, Ltd.	Chatham, Ont.
902	Vacuum Gas and Oil Co., Ltd.	Toronto, Ont.
759	Walpole Gas Syndicate	Cayuga, Ont.
763	Welland County Gas Syndicate	Stevensville, Ont.
865	Western Ontario Natural Gas Co., Ltd.	Dunnville, Ont.
744	Walter Gas Syndicate, Ltd.	Buffalo, N.Y.
740	Yager, J. J.	Selkirk, Ont.
796	York Natural Gas Syndicate	Toronto, Ont.

TABLE XV—OPERATORS LICENSED TO DISTRIBUTE NATURAL GAS, 1935

License No.	Name	Address
466	Brantford Gas Co.	Buffalo, N.Y.
464	Canfield Natural Gas Co., Ltd.	Canfield, Ont.
474	Central Pipe Line Co., Ltd.	Chatham, Ont.
465	Dominion Natural Gas Co., Ltd.	Buffalo, N.Y.
491	Fisherville Gas Co.	Fisherville, Ont.
487	Fonthill-Ridgeville Gas Co., Ltd.	Portland, Ind.
497	Leamington, Town of	Leamington, Ont.
472	Lincoln Gas Co., Ltd.	Toronto, Ont.
467	Manufacturers Natural Gas Co., Ltd.	Buffalo, N.Y.
469	Oil Springs Oil and Gas Co., Ltd.	Oil Springs, Ont.
492	Port Colborne-Welland Natural Gas and Oil Co., Ltd.	Port Colborne, Ont.
471	Provincial Natural Gas and Fuel Co. of Ontario, Ltd.	Fort Erie North, Ont.
470	Southern Ontario Gas Co., Ltd.	Buffalo, N.Y.
494	Springvale Gas and Oil Co., Ltd.	Hagersville, Ont.
468	United Gas and Fuel Co. of Hamilton, Ltd.	Hamilton, Ont.
462	Union Gas Co. of Canada, Ltd.	Chatham, Ont.
463	Windsor Gas Co., Ltd.	Windsor, Ont.

TABLE XVI—OPERATORS LICENSED TO OPERATE PIPE LINES, 1935

License No.	Name	Address
102	Central Pipe Line Co., Ltd.	Chatham, Ont.
100	Dominion Natural Gas Co., Ltd.	Buffalo, N.Y.
101	Southern Ontario Gas Co., Ltd.	Buffalo, N.Y.
99	Union Gas Co. of Canada, Ltd.	Chatham, Ont.

Logs of Wells

The logs of oil and gas wells drilled in Ontario in 1935, as given by the drillers, are shown on the pages following. It will be noted that the production of gas wells is not given. This decision is the result of protests from several companies who were doing exploratory work and who felt that the publication of the results of this work would adversely affect them. All information concerning water and gas horizons are given, which should be sufficient to indicate the sources of oil and gas to those familiar with the gas fields of the province.

Samples of drill-cuttings from representative wells throughout the province are available to the public.

ABBREVIATIONS

B.F.	Broken front.
Con.	Concession.
E.	East.
E. ½	East half.
E. ¼	East quarter.
E.D.	East division.
E.F.C.	East of Fairchild Creek.
E.S.C.R.	East of Stoney Creek Road.
F.C.	Front concession.
N.	North.
N. ½	North half.
N.E.	Northeast.
N.E. ½	Northeast half.
N.E. ¼	Northeast quarter.
N.F.R.	North of Forks Road.
N.R.	Niagara River Survey.
N.T.R.	North of Talbot Road.
N.W.	Northwest.
N.W. ¼	Northwest quarter.
Pt.	Part.
R.R.	River range.
S.	South.
S. ½	South half.
S.E. ½	Southeast half.
S.E. ¼	Southeast quarter.
S.F.R.	South of Forks Road.
S.R.R.	South of River Range.
S.T.R.	South of Talbot Road.
S.W. ¼	Southwest quarter.
Tp.	Township.
W. ½	West half.
W.F.C.	West of Fairchild creek.

Brant County

DARROCH AND YOUNG

H. Hamilton No. 1, lot 18, con. III, W.F.C., Onondaga tp.

Completed June 18, 1935.
Producing gas well.
Rock pressure: 146 lbs.

Formation	Thickness, ft.
Surface	111
Shale	39
Niagara	256
Shale	46
Clinton	24
Red Medina	35
Grey shale	65
White Medina	10
Red shale	22
Total depth	608

Gas at 456 and 583 feet.
Fresh water at 100 and 114 feet.

PORT COLBORNE-WELLAND NATURAL GAS AND OIL CO., LTD.

A. Allen No. 1, lot 23, con. III, E.F.C., Onondaga tp.

Completed June 27, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	51
Lime and shale	33
Niagara	264
Rochester shale	25
Clinton	31
Red Medina	22
Grey shale	52
White Medina	12
Red shale	35
Total depth	525

Fresh water at 48 feet; sulphur water at 165 feet.

PORT COLBORNE-WELLAND NATURAL GAS AND OIL CO., LTD.

J. Douglas and Son No. 2, lot 81, R.R., Onondaga tp.

Completed January 5, 1935.
Producing gas well.
Rock pressure: 185 lbs.

Formation	Thickness, ft.
Surface	63
Lime and shale	47
Niagara	270
Rochester shale	21
Clinton	35
Red Medina	27
Grey shale	45
White Medina	12
Red shale	74
Total depth	594

Gas at 519 feet.
Fresh water at 60 feet; sulphur water at 120 feet.

PORT COLBORNE-WELLAND NATURAL GAS AND OIL CO., LTD.

J. Douglas and Son No. 3, lot 79, R.R., Onondaga tp.

Completed June 5, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	53
Lime and shale	42
Niagara	249
Rochester shale	25
Clinton	31
Red Medina	25
Grey shale	50
White Medina	12
Red shale	3
Total depth	490

Fresh water at 50 feet; sulphur water at 130 feet.

PORT COLBORNE-WELLAND NATURAL GAS AND OIL CO., LTD.

J. A. Douglas No. 2, lot 77, R.R., Onondaga tp.

Completed July 19, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	61
Lime and shale	44
Niagara	261
Rochester shale	38
Clinton	28
Red Medina	22
Grey shale	52
White Medina	12
Red shale	3
Total depth	521

Fresh water at 65 feet; sulphur water at 350 feet.

PORT COLBORNE-WELLAND NATURAL GAS AND OIL CO., LTD.

W. Douglas No. 1, lot 75, R.R., Onondaga tp.

Completed August 22, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	62
Lime and shale	53
Niagara	240
Rochester shale	57
Clinton	27
Red Medina	27
Grey shale	50
White Medina	12
Red shale	4
Total depth	532

Fresh water at 60 feet; sulphur water at 115 feet.

PORT COLBORNE-WELLAND NATURAL GAS AND OIL CO., LTD.

W. A. Douglas No. 1, lot 76, R.R., Onondaga tp.

Completed August 3, 1935.
Producing gas well.
Rock pressure: 200 lbs.

Formation	Thickness, ft.
Surface	61
Lime and shale	44
Niagara	256
Rochester shale	39
Clinton	30
Red Medina	26
Grey shale	52
White Medina	13
Red shale	75
Total depth	596

Gas at 405 and 518 feet.
Fresh water at 48 and 60 feet; sulphur water at 210 feet.

PORT COLBORNE-WELLAND NATURAL GAS AND OIL CO., LTD.

O. Ferris No. 1, lot 82, R.R., Onondaga tp.

Completed October 8, 1935.
Producing gas well.
Rock pressure: 185 lbs.

Formation	Thickness, ft.
Surface	30
Lime and shale	50
Niagara	240
Rochester shale	55
Clinton	31
Red Medina	26
Grey shale	52
White Medina	11
Red shale	70
Total depth	565

Gas at 495 feet.
Fresh water at 70 feet; sulphur water at 180 feet.

PORT COLBORNE-WELLAND NATURAL GAS AND OIL CO., LTD.

G. Vanderlip No. 1, lot 64, R.R., Onondaga tp.

Completed September 20, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	75
Lime and shale	20
Niagara	240
Rochester shale	47
Clinton	27
Red Medina	23
Grey shale	58
White Medina	8
Red shale	3
Total depth	501

AJAX OIL AND GAS CO., LTD.

L. Bomberry No. 1, lot 18, con. VI, Tuscarora tp.

Completed June 29, 1935.
Producing gas well.
Rock pressure: 182 lbs.

Formation	Thickness, ft.
Surface	39
Salina	49
Guelph and Niagara	290
Rochester	53
Clinton	33
Red Medina	18
Cabot Head	60
White Medina	10
Red shale	50
Total depth	602

Gas at 433, 548, and 550 feet.
Fresh water at 48 feet; sulphur water at 76 feet.

AJAX OIL AND GAS CO., LTD.

L. Bomberry No. 2, lot 18, con. VI, Tuscarora tp.

Completed July 26, 1935.
Producing gas well.
Rock pressure: 174 lbs.

Formation	Thickness, ft.
Surface	39
Salina	39
Guelph and Niagara	292
Rochester	50
Clinton	31
Red Medina	19
Cabot Head	61
White Medina	10
Red shale	50
Total depth	591

Gas at 422, 536, and 540 feet.
Sulphur water at 73 feet.

AJAX OIL AND GAS CO., LTD.

S. and R. Bomberry No. 3, lot 20, con. VI, Tuscarora tp.

Completed August 23, 1935.
Producing gas well.
Rock pressure: 180 lbs.

Formation	Thickness, ft.
Surface	50
Salina	60
Guelph and Niagara	265
Rochester	50
Clinton	31
Red Medina	22
Cabot Head	56
White Medina	10
Red shale	1
Total depth	545

Gas at 427, 455, and 543 feet.
Sulphur water at 84 feet.

AJAX OIL AND GAS CO., LTD.

E. Franklin and G. Doxtater No. 1, lot 15, con. VI, Tuscarora tp.

Completed September 23, 1935.
Producing gas well.
Rock pressure: 221 lbs.

Formation	Thickness, ft.
Surface	55
Salina	33
Guelph and Niagara	292
Rochester	51
Clinton	29
Red Medina	22
Cabot Head	60
White Medina	12
Red shale	50
Total depth	604

Gas at 433, 452, 543, and 550 feet.
Fresh water at 47 feet; sulphur water at 74 feet.

AJAX OIL AND GAS CO., LTD.

E. Franklin and G. Doxtater No. 2, lot 15, con. VI, Tuscarora tp.

Completed October 19, 1935.
Producing gas well.
Rock pressure: 220 lbs.

Formation	Thickness, ft.
Surface	42
Salina	47
Guelph and Niagara	289
Rochester	50
Clinton	30
Red Medina	16
Cabot Head	66
White Medina	12
Red shale	50
Total depth	602

Gas at 430, 448, 541, and 546 feet.
Sulphur water at 87 feet.

PETROL OIL AND GAS CO., LTD.

F. Loft No. 1, lot 1, con. VI, Tuscarora tp.

Completed December 28, 1935.
Producing gas well.
Rock pressure: 225 lbs.

Formation	Thickness, ft.
Surface	54
Salina	126
Guelph and Niagara	246
Rochester	53
Clinton	13
Red Medina	35
Cabot Head	58
White Medina	10
Queenston	50
Total depth	645

Gas at 485 and 590 feet.
Sulphur water at 210 feet.

Bruce County

NOTTAWA OIL AND GAS CO., LTD.

Binns No. 1, lot 1, con. IX, Amabel tp.

Completed November 1, 1935.
Producing gas well.

Formation	Thickness, ft.
Sand	21
Brown lime	124
White lime	47
Green shale	12
Red shale	61
Blue shale	47
Lime	39
Blue shale	19
Red shale	160
Hudson	477
Utica	37
Trenton	635
Potsdam	3
Basil sandy beds	35
Total depth	1,725

Gas at 1,423 and 1,430 feet.

NOTTAWA OIL AND GAS CO., LTD.

G. Cupsky No. 1, lot 1, con. IX, Amabel tp.

Completed June 1, 1935.
Producing gas well.

Formation	Thickness, ft.
Sand	11
Brown lime	49
White and brown lime	80
White lime	50
Green shale	15
Red shale	55
Blue shale	50
Lime	40
Red and blue shale	178
Hudson	487
Utica	37
Trenton	445
Total depth	1,487

Gas at 1,407, 1,412, and 1,422 feet.

NOTTAWA OIL AND GAS CO., LTD.

P. Doubt No. 1, lot 6, con. VIII, Amabel tp.

Completed November 16, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	40
Dolomite	45
Brown lime	37
White lime	114
Green shale	10
Red shale	50
Blue shale	55
Brown lime	26
Red and green shale	55
Red and blue shale	158
Hudson shale	475
Utica formation	27
Trenton lime	605
Potsdam	22
Broken granite	9
Total depth	1,728

Fresh water at 40 feet.

NOTTAWA OIL AND GAS CO., LTD.

J. Goetz No. 1, lot 1, con. IX, Amabel tp.

Completed August, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	16
Brown lime	124
White lime	55
Green shale	16
Red shale	47
Blue shale	60
Lime	32
Blue shale	30
Red and blue shale	148
Hudson	490
Utica	34
Trenton	398
Total depth	1,450

Gas at 1,426 feet.

NOTTAWA OIL AND GAS CO., LTD.

Hillis No. 1, lot 4, con. VII, Amabel tp.

Completed October 19, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	31
Hard lime	41
Brown lime	93
White lime	50
Green shale	12
Red shale	47
Blue shale	66
White lime	45
Red and blue shale	155
Hudson	470
Utica	52
Trenton	414
Total depth	1,476

Show of gas at 1,435 feet.

NOTTAWA OIL AND GAS CO., LTD.

R. Kinch No. 1, lot 6, con. IX, Amabel tp.

Completed August 23, 1935.
Dry hole.

Formation	Thickness, ft.
Sand	3
Top lime	205
Green shale	14
Red shale	35
Blue shale	63
Brown lime	20
Red shale	65
Blue shale	65
Grey shale	70
Hudson	475
Utica	35
Trenton	382
Total depth	1,432

Fresh water at 55, 125, and 190 feet.

NOTTAWA OIL AND GAS CO., LTD.

C. W. Sinclair No. 1, lot 3, con. IX, Amabel tp.

Completed November 7, 1935.
Producing gas well.
Rock pressure: 150 lbs.

Formation	Thickness, ft.
Sand	21
Top lime	192
Green shale	14
Red shale	43
Blue shale	60
Brown lime	44
Blue shale	21
Red shale	68
Grey shale	75
Hudson	475
Utica	33
Trenton	394
Total depth	1,440

Gas at 1,409 feet.
Fresh water at 70 feet.

Carleton County

R. A. SIBBITT

Davidson No. 1, lot 9, con. II, Gloucester tp.

Completed October 2, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	62
Grey dolomite (Beekmantown)	188
Light-grey sandstone	40
Grey sandstone (Potsdam)	180
Pre-Cambrian feldspar and mica schist	20
Total depth	490

Fresh water at 52, 79, and 245 feet.

Elgin County

DARKE, VASS, ET AL

J. McIntyre No. 1, lot 2, B.F., Aldborough tp.

Completed March 22, 1935.
Small producing oil well.

Formation	Thickness, ft.
Clay	68
Hardpan	144
Soap	7
Lime	11
Soap	18
Dark lime	6
Hard soap	3
Brown lime	1½
Grey lime	171½
Total depth	420

Oil at 224, 273, 345 to 355, 385 to 390, and 408 to 410 feet.

DARKE, VASS, ET AL

J. McIntyre No. 2, lot 2, B.F., Aldborough tp.

Completed May 28, 1935.
Well plugged and abandoned.

Formation	Thickness, ft.
Gravel	8
Clay	14
Hardpan	152
Lime	11
Soap	20
Dark lime	9
Grey lime	186
Total depth	405

Trace of oil at 235 to 240, 250 to 260, and 300 to 330 feet.

CANADIAN NATURAL GAS SYNDICATE

S. Williams No. 1, lot 25, N. ½, con. VIII, Bayham tp.

Completed July 31, 1935.
Producing gas well.
Rock pressure: 560 lbs.

Formation	Thickness, ft.
Surface	223
Lime and shale	175
Flint	130
Lime and shale	388
Niagara	312
Shale	51
Clinton	35
Red Medina	10
Shale	30
Total depth	1,354

Gas at 1,298 feet.
Sulphur water at 225 feet.

CANADIAN NATURAL GAS SYNDICATE

C. E. Wilson No. 2, lot 23, con. VIII, Bayham tp.

Completed December 16, 1935.
Producing gas well.
Rock pressure: 600 lbs.

Formation	Thickness, ft.
Surface	251
Lime and shale	188
Flint	125
Lime and shale	372
Guelph lime	40
Niagara lime	267
Rochester shale	49
Clinton sand	27
Red Medina sand	12
Blue shale	29
Total depth	1,360

Gas at 1,325, 1,329, 1,337, and 1,330 feet.
Fresh water at 259 feet; sulphur water at 976 feet.

CANFIELD NATURAL GAS SYNDICATE

C. E. Wilson No. 1, lot 23, con. VIII, Bayham tp.

Completed October 26, 1935.
Producing gas well.
Rock pressure: 600 lbs.

Formation	Thickness, ft.
Surface	20
Sand and gravel	228
Lime and shale	187
Flint	125
Lime and shale	372
Guelph lime	43
Niagara lime	270
Rochester shale	50
Clinton sand	27
Red Medina sand	7
Red shale	20
Total depth	1,349

Gas at 1,313, 1,317, 1,319, and 1,322 feet.
Fresh water at 300 feet; sulphur water at 980 feet.

R. L. PATTINSON

N. H. Gray No. 2, lot 27, con. IX, Bayham tp.

Completed October 25, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	91
Clay	67
Brown lime	178
Flint	96
Brown lime	49
Slate, lime, and gypsum	100
Grey lime	65
Lime and gypsum	210
Niagara lime	7
Total depth	863

Sulphur water at 856 feet.
Show of gas at 163, 856, and 863 feet.

R. L. PATTINSON

S. Williams No. 2, lot 25, con. VIII, Bayham tp.

Completed December 14, 1935.
Producing gas well.
Rock pressure: 560 lbs.

Formation	Thickness, ft.
Surface	170
Clay	30
Gravel	20
Grey lime	14
Brown lime	185
Flint	100
Brown lime	80
Lime and gypsum	345
Niagara	285
Shale	50
Clinton	13
Thorold sand	19
Red shale	32
Total depth	1,344

Gas at 1,298, 1,303, 1,308, and 1,312 feet.
Fresh water at 140 feet; sulphur water at 330 feet.

E. P. ROWE

L. Alton No. 1, lot 26, con. VIII, Bayham tp.

Completed April 8, 1935.
Producing gas well.
Rock pressure: 560 lbs.

Formation	Thickness, ft.
Clay	30
Quicksand	150
Clay	30
Gravel	12
Brown lime	178
Flint	120
Brown lime	60
Shale and gypsum	355
Niagara	295
Shale	50
Clinton	15
Thorold sand	10
Red shale	25
Total depth	1,330

Gas at 1,295 feet.
Fresh water at 215 feet; sulphur water at 360 and 960 feet.

E. P. Rowe

L. Alton No. 2, lot 26, con. VIII, Bayham tp.

Completed March 25, 1935.
Producing gas well.
Rock pressure: 550 lbs.

Formation	Thickness, ft.
Quicksand	185
Clay	10
Gravel	10
Brown lime	190
Flint	125
Brown lime	40
Lime and gypsum	165
Lime, shale, and gypsum	191
Niagara	296
Blue shale	55
Clinton	19
Thorold sand	10
Red Medina	10
Blue shale	15
Total depth	1,321

Gas at 1,286 to 1,296 feet.
Sulphur gas at 350 and 940 feet.
Show of oil at 360 feet.
Fresh water at 205 feet; sulphur water at 345 and 916 feet.

E. P. Rowe

J. Ball No. 1, lot 26, S. ½, con. VIII, Bayham tp.

Completed June 15, 1935.
Producing gas well.
Rock pressure: 580 lbs.

Formation	Thickness, ft.
Surface	118
Grey lime	62
Brown lime	110
Flint	105
Grey lime	45
Lime, shale, and gypsum	115
Brown and blue lime	283
Niagara	286
Blue shale	55
Clinton	15
Thorold sand	20
Red Medina	15
Blue shale	15
Total depth	1,244

Gas at 1,194 feet.
Sulphur water at 120 feet.

E. P. Rowe

A. C. Wilson No. 2, lot 27, con. VIII, Bayham tp.

Completed February 9, 1935.
Producing gas well.
Rock pressure: 590 lbs.

Formation	Thickness, ft.
Quicksand	100
Clay	15
Gravel	21
Grey lime	74
Brown lime	105
Flint	100
Brown lime	135
Shale and gypsum	291
Niagara	299
Blue shale	48
Clinton lime	19
Thorold sand	10
Red Medina	14
Blue shale	15
Total depth	1,246

Gas at 1,207 to 1,217 feet; sulphur gas at 1,002 feet.
Sulphur water at 205 feet.

Lakeside Oil and Gas Co., Ltd.

C. Schollenberger No. 1, lot 8, con. IX, Dunwich tp

Completed April 24, 1935.
Dry hole.

Formation	Thickness, ft.
Sand	60
Clay	68
Gravel	4
Hardpan	28
Gravel	10
Sand	10
Hardpan	70
Upper soap	30
Middle lime	20
Lower soap	35
Dark streak	5
Lower dark lime	130
Lower light lime	45
Sand	10
Total depth	525

Fresh water at 150 feet.

Lakeside Oil and Gas Co., Ltd.

C. Schollenberger No. 2, lot 8, con. IX, Dunwich tp.

Completed May 2, 1935.
Dry hole.

Formation	Thickness, ft.
Clay	6
Boulders	2
Mild hardpan	37
Stiff hardpan	25
Gravel	38
Hardpan	48
Upper soapstone	65
Middle lime	15
Lower soapstone	17
Dark streak	2
Lower lime	12
Total depth	267

Lakeside Oil and Gas Co., Ltd.

C. Schollenberger No. 3, lot 8, con. X, Dunwich tp.

Completed May 15, 1935.
Dry hole.

Formation	Thickness, ft.
Clay	50
Hardpan	25
Gravel	10
Hardpan	110
Gravel	10
Hardpan	30
Upper soapstone	10
Middle lime	15
Lower soap	16
Dark streak	4
Lower lime	25
Total depth	305

Essex County

Bon Jasperson

S. E. Ferris No. 1, lot 8, con. I, Gosfield South tp.

Completed November 8, 1935.
Producing gas well.
Rock pressure: 325 lbs.

Formation	Thickness, ft.
Quicksand	45
Brown lime	220
Grey lime	10
Hard brown and grey lime	130
Grey lime and gypsum	10
Grey lime	15
Hard brown lime	30
Grey lime	90
Hard brown lime	135
Grey and brown lime	135
Hard brown and grey lime	60
Grey and brown lime	15
Hard brown lime	17
White lime	2
Total depth	914

Gas at 610, 810, 820, and 898 feet.
Mineral water at 45 feet.

BON JASPERSON

A. J. Gunning No. 1, lot 9, N.E. pt., con. I, E.D., Gosfield South tp.

Completed April 27, 1935.
Producing gas well.
Rock pressure: 300 lbs.

Formation	Thickness, ft.
Surface	125
Brown lime	335
Grey lime and gypsum	17
Grey lime	478
Total depth	955

Gas at 665, 715, 862, 865, 870, 875, 920, and 931 feet.
Fresh water at 126 feet; mineral water at 225 and 375 feet; salt water at 955 feet.

BON JASPERSON

A. Simmers Estate No. 1, lot 8, con. I, Gosfield South tp.

Completed August 10, 1935.
Producing gas well.
Rock pressure: 300 lbs.

Formation	Thickness, ft.
Surface	55
No samples kept	375
Hard grey and brown lime	20
Medium grey lime	110
Hard brown and grey lime	120
Medium grey lime	10
Hard brown lime	5
Medium grey and brown lime	135
Hard brown and grey lime	45
Hard brown and white lime	20
Medium grey and brown lime	28
Total depth	923

Gas at 640, 828, and 920 feet.
Fresh water at 55 feet.

Grey County

NOTTAWA OIL AND GAS CO., LTD.

A. Barfoot No. 1, lot 11, con. VII, Keppel tp.

Completed March, 1935.
Producing gas well.

Formation	Thickness, ft.
Surface	11
Brown lime	79
White lime	66
Green shale	14
Red shale	58
Blue shale	60
Blue lime	38
Red shale	136
Hudson formation	490
Utica	56
Trenton formation	621
Potsdam	8
Total depth	1,517

Gas at 1,358 and 1,378 feet.
Salt water at 1,609 feet.

NOTTAWA OIL AND GAS CO., LTD.

A. Cunningham No. 1, Village of Hepworth, Keppel tp.

Completed June 25, 1935.
Dry hole.

Formation	Thickness, ft.
Sand	21
Top lime	191
Green shale	14
Red shale	43
Blue shale	60
Brown lime	44
Blue shale	21
Red shale	68
Grey shale	70
Hudson	477
Utica	33
Trenton	480
Total depth	1,522

Haldimand County

BEN NATURAL GAS CO., LTD.

S. Bartlett No. 1, lot 9, con. II, Canborough tp.

Completed August 9, 1935.
Producing gas well.
Rock pressure: 90 lbs.

Formation	Thickness, ft.
Surface	73
Shale	120
Niagara	200
Grey lime	18
Rochester shale	18
Clinton	31
Red Medina	37
Grey shale	60
White Medina	10
Red shale	20
Total depth	587

Gas at 460 and 567 feet.
Fresh water at 76 feet.

BEN NATURAL GAS CO., LTD.

S. Bartlett No. 2, lot 9, con. II, Canborough tp.

Completed August 29, 1935.
Producing gas well.
Rock pressure: 100 lbs.

Formation	Thickness, ft.
Surface	58
Shale	119
Niagara	200
Grey lime	15
Rochester shale	28
Clinton	35
Red Medina	35
Grey shale	60
White Medina	14
Red shale	20
Total depth	584

Gas at 564 feet.
Fresh water at 62 feet.

BEN NATURAL GAS CO., LTD.

J. Calvert No. 1, lot 10, N.E. ½, con. II, Canborough tp.

Completed September 24, 1935.
Producing gas well.
Rock pressure: 90 lbs.

Formation	Thickness, ft.
Surface	57
Shale	119
Niagara	200
Grey lime	15
Rochester shale	28
Clinton	35
Red Medina	35
Grey shale	60
White Medina	14
Red shale	20
Total depth	583

Gas at 420 to 440 and 550 to 560 feet.

BEN NATURAL GAS CO., LTD.

A. Swayzie No. 1, lot 9, con. II, Canborough tp.

Completed June 22, 1935.
Producing gas well.
Rock pressure: 95 lbs.

Formation	Thickness, ft.
Surface	61
Shale	124
Niagara	200
Grey lime	15
Rochester shale	23
Clinton	32
Red Medina	35
Grey shale	55
White Medina	10
Red shale	5
Total depth	560

Gas at 490 and 555 feet.
Fresh water at 64 feet.

BURCHELL NATURAL GAS AND OIL SYNDICATE

J. N. Allen No. 1, lot 16, S. ½, con. II, Canborough tp.

Completed April 23, 1935.
Producing gas well.
Rock pressure: 120 lbs.

Formation	Thickness, ft.
Surface	36
Lime and shale	122
Niagara	220
Shale	54
Clinton	27
Red Medina	40
Shale	56
White Medina	14
Red shale	35
Total depth	604

Fresh water at 36 feet; black water at 158 feet.

BURCHELL NATURAL GAS AND OIL SYNDICATE

J. N. Allen No. 2, lot 16, con. II, Canborough tp.

Completed May 10, 1935.
Producing gas well.
Rock pressure: 125 lbs.

Formation	Thickness, ft.
Surface	40
Lime and shale	117
Niagara	220
Shale	57
Clinton	28
Red Medina	38
Grey shale	58
White Medina	15
Red shale	35
Total depth	608

Gas at 450 and 560 feet.
Fresh water at 45 feet; black water at 210 feet.

BURCHELL NATURAL GAS AND OIL SYNDICATE

J. N. Allen No. 3, lot 15, con. II, S.T.R., Canborough tp.

Completed May 29, 1935.
Producing gas well.
Rock pressure: 125 lbs.

Formation	Thickness, ft.
Surface	55
Lime and shale	125
Niagara	210
Shale	56
Clinton	30
Red Medina	48
Grey shale	52
White Medina	14
Red shale	35
Total depth	625

Gas at 466, 496, and 588 feet.
Fresh water at 57 feet; black water at 320 feet.

BURCHELL NATURAL GAS AND OIL SYNDICATE

J. N. Allen No. 4, lot 16, con. II, Canborough tp.

Completed October 2, 1935.
Producing gas well.
Rock pressure: 125 lbs.

Formation	Thickness, ft.
Surface	41
Lime and shale	145
Niagara	200
Shale	55
Clinton	30
Red Medina	40
Grey shale	57
White Medina	12
Red shale	35
Total depth	615

Gas at 491 and 575 feet.
Fresh water at 70 feet; sulphur water at 90 feet; black water at 350 feet.

COLONIAL NATURAL GAS CO., LTD.

S. Zarebski No. 1, lot 3, con. III, Canborough tp.

Completed August 2, 1935.
Producing gas well.
Rock pressure: 200 lbs.

Formation	Thickness, ft.
Surface	58
Lime and shale	204
Niagara	220
Shale	57
Clinton	32
Red Medina	38
Shale	56
White Medina	14
Red shale	50
Total depth	729

Gas at 566 feet.
Fresh water at 55 feet.

HARRY L. EMERSON

H. L. Emerson No. 1, lots 5 and 6, con. I, Canborough tp.

Completed May 27, 1935.
Producing gas well.
Rock pressure: 115 lbs.

Formation	Thickness, ft.
Surface	70
Lime and shale	18
Niagara	275
Shale	44
Clinton	29
Red Medina	35
Shale	49
White Medina	11
Red shale	50
Total depth	581

Sulphur water at 55 feet.

HARRY L. EMERSON

H. L. Emerson No. 2, lots 5 and 6, con. I, Canborough tp.

Completed July 3, 1935.
Producing gas well.
Rock pressure: 125 lbs.

Formation	Thickness, ft.
Surface	82
Lime and shale	18
Niagara	273
Shale	45
Clinton	30
Red Medina	35
Shale	48
White Medina	9
Red shale	50
Total depth	590

Gas at 450 to 470 feet and 535 feet.
Sulphur water at 60 feet.

ARTHUR RICKER

A. Ricker No. 2, lot 10, con. I, Canborough tp.

Completed February 20, 1935.
Producing gas well.
Rock pressure: 132 lbs.

Formation	Thickness, ft.
Surface	74
Lime and shale	71
Niagara	195
Rochester shale	38
Clinton	35
Red Medina	40
Grey shale	45
White Medina	10
Red shale	42
Total depth	550

Black water at 160 feet.

ARTHUR RICKER

A. Ricker No. 3, lot 9, con. I, Canborough tp.

Completed August 15, 1935.
Producing gas well.
Rock pressure: 120 lbs.

Formation	Thickness, ft.
Surface	46
Lime and shale	105
Niagara	224
Shale	50
Clinton	42
Red Medina	37
Grey shale	65
White Medina	14
Red shale	42
Total depth	625

Fresh water at 46 feet; black water at 165 feet.

WESTERN ONTARIO NATURAL GAS CO., LTD.

H. Hamilton No. 4, lot 9, con. II, Earl tract, Dunn t p

Completed December 23, 1935.
Producing gas well.
Rock pressure: 370 lbs.

Formation	Thickness, ft.
Surface	9
Flint	30
Hard lime	40
Lime and shale	349
Niagara lime	225
Shale	55
Clinton	36
Red Medina	40
Grey shale	52
White Medina	17
Red shale	22
Total depth	875

Gas at 713, 756, and 850 feet.
Fresh water at 75 feet; salt water at 500 feet.

AMITY NATURAL GAS CO., LTD.

C. Waines No. 1, lot 8, E. pt., con. III C., Moulton tp.

Completed January 18, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	95
Lime and shale	117
Niagara	220
Shale	62
Clinton	33
Red Medina	37
Shale	60
White Medina	10
Red shale	2
Total depth	636

Sulphur water at 98 feet.

JOHN S. BROOKES

J. S. Brookes No. 1, Town of Dunnville, Moulton tp.

Completed November 13, 1935.
Producing gas well.
Rock pressure: 175 lbs.

Formation	Thickness, ft.
Surface	83
Lime and shale	270
Niagara	200
Shale	55
Clinton	32
Red Medina	35
Grey shale	62
White Medina	10
Red shale	50
Total depth	797

Gas at 626, 655, and 742 feet.
Fresh water at 84 feet; sulphur water at 120 feet; black water at 400 feet.

CANADIAN NATURAL GAS SYNDICATE

H. B. Etherington No. 1, lot 20, W. ½, S.F.R., Moulton tp.

Completed April 30, 1935.
Producing gas well.
Rock pressure: 210 lbs.

Formation	Thickness, ft.
Surface	90
Lime and shale	180
Niagara	220
Shale	64
Clinton	30
Red Medina	35
Shale	55
White Medina	10
Red shale	50
Total depth	734

Gas at 606 feet.
Fresh water at 88 feet.

CANADIAN NATURAL GAS SYNDICATE

H. B. Etherington No. 2, lot 20, W. ½, S.F.R., Moulton tp.

Completed May 30, 1935.
Producing gas well.
Rock pressure: 280 lbs.

Formation	Thickness, ft.
Surface	88
Lime and shale	180
Niagara	220
Shale	60
Clinton	29
Red Medina	36
Shale	53
White Medina	10
Red shale	50
Total depth	726

Gas at 597 feet.
Fresh water at 100 feet.

CANADIAN NATURAL GAS SYNDICATE

J. Melick No. 1, lots 21 and 22, S. pt., N.F.R., Moulton tp.

Completed March 4, 1935.
Producing gas well.
Rock pressure: 200 lbs.

Formation	Thickness, ft.
Surface	96
Lime and shale	184
Niagara	220
Shale	61
Clinton	30
Red Medina	34
Shale	43
White Medina	10
Red shale	50
Total depth	728

Gas at 608 and 676 feet.
Sulphur water at 100 feet.

CANADIAN NATURAL GAS SYNDICATE

J. Melick No. 2, lots 21 and 22, S. pt., N.F.R., Moulton tp.

Completed April 2, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	73
Lime and shale	187
Niagara	220
Shale	63
Clinton	30
Red Medina	37
Shale	58
White Medina	12
Red shale	1
Total depth	681

Sulphur water at 73 feet.

DOMESTIC NATURAL GAS SYNDICATE No. 2

R. Root No. 1, lot 2, range I, Grand river, Moulton tp.

Completed December 27, 1935.
Producing gas well.
Rock pressure: 165 lbs.

Formation	Thickness, ft.
Surface	84
Lime and shale	231
Niagara lime	200
Blue shale	57
Clinton	31
Red Medina	33
Grey shale	61
White Medina	16
Red shale	98
Total depth	811

Gas at 575 and 701 feet.
Fresh water at 85 feet; sulphur water at 450 feet.

PERCY L. JACKSON

D. Gunning No. 1, lot 1, N.W. ¼, range II, Grand river, Moulton tp.

Completed June 8, 1935.
Producing gas well.
Rock pressure: 100 lbs.

Formation	Thickness, ft.
Surface	86
Brown lime	139
Shale	87
Niagara	213
Blue shale	41
Clinton	22
Red Medina	40
Grey shale	62
White Medina	12
Red shale	92
Total depth	794

Gas at 580 and 692 feet.
Fresh water at 85 feet; black water at 340 feet.

S. MCKECHNIE

S. McKechnie No. 1, lot 21, Town of Dunnville, Moulton tp.

Completed October 4, 1935.
Producing gas well.
Rock pressure: 150 lbs.

Formation	Thickness, ft.
Surface	79
Lime and shale	232
Niagara	230
Shale	55
Clinton	28
Red Medina	42
Shale	63
White Medina	12
Red shale	50
Total depth	791

Gas at 600, 642, 651, 733, and 739 feet.
Fresh water at 79 and 175 feet; black water at 510 feet.

SMITH AND EHDE

M. Honsinger No. 1, lot 6, gore A, Moulton tp.

Completed September 3, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	107
Lime and shale	101
Niagara	220
Shale	57
Clinton	33
Red Medina	36
Shale	56
White Medina	14
Red shale	2
Total depth	626

Fresh water at 107 feet; black water at 300 feet.

SMITH AND EHDE

M. Honsinger No. 2, lot 6, gore A, Moulton tp.

Completed October 2, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	122
Lime and shale	88
Niagara	220
Shale	61
Clinton	30
Red Medina	36
Shale	55
White Medina	15
Red shale	2
Total depth	629

Fresh water at 122 feet; black water at 285 feet.

SMITH AND EHDE

M. Honsinger No. 3, lot 6, gore A, Moulton tp.

Completed October 24, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	118
Lime and shale	90
Niagara	220
Shale	60
Clinton	33
Red Medina	35
Shale	55
White Medina	15
Red shale	2
Total depth	628

Fresh water at 117 feet; black water at 320 feet.

SMITH AND EHDE

W. Neff No. 1, lot 7, W. ½, N.F.R. Moulton tp.

Completed November 23, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	118
Lime and shale	110
Niagara	220
Shale	65
Clinton	34
Red Medina	34
Shale	56
White Medina	12
Red shale	5
Total depth	654

Fresh water at 120 feet; black water at 350 feet.

SMITH AND EHDE

W. Neff No. 2, lot 7, W. ½, N.F.R., Moulton tp.

Completed December 20, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	120
Lime and shale	95
Niagara	220
Shale	61
Clinton	35
Red Medina	34
Shale	58
White Medina	12
Red shale	1
Total depth	636

Fresh water at 119 feet; black water at 345 feet.

STROMWELL GAS SYNDICATE

L. McCallum No. 3, lot 14, con. II, Moulton tp.

Completed October 19, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	146
Lime and shale	223
Niagara	220
Shale	42
Clinton	32
Red Medina	44
Grey shale	55
White Medina	12
Total depth	774

Fresh water at 150 feet.

CANFIELD GAS SYNDICATE

Biggam No. 1, lot 12, S. ½, con. II, North Cayuga tp

Completed June 15, 1935.
Producing gas well.
Rock pressure: 578 lbs.

Formation	Thickness, ft.
Surface	58
Lime and shale	240
Niagara	225
Shale	55
Clinton rock	30
Red Medina	40
Grey shale	52
White Medina	15
Red shale	50
Total depth	765

Gas at 636 and 727 feet.
Fresh water at 58 feet; salt water at 430 feet.

CANFIELD GAS SYNDICATE

A. Burke No. 1, lot 14, N.W. ½ of N. ½, con. II, North Cayuga tp.

Completed February 22, 1935.
Producing gas well.
Rock pressure: 270 lbs.

Formation	Thickness, ft.
Surface	49
Lime and shale	256
Niagara	225
Shale	56
Clinton	30
Red Medina	40
Grey shale	52
White Medina	18
Red shale	44
Total depth	770

Gas at 591 feet.
Fresh water at 60 feet; salt water at 400 feet.

CANFIELD GAS SYNDICATE

T. Gifford No. 1, lot 12, con. III, North Cayuga tp.

Completed September 13, 1935.
Producing gas well.
Rock pressure: 270 lbs.

Formation	Thickness, ft.
Surface	71
Lime and shale	231
Niagara	225
Shale	55
Clinton rock	30
Red Medina	40
Grey shale	52
White Medina	18
Red shale	48
Total depth	770

Gas at 719 feet.
Fresh water at 78 feet.

CANFIELD GAS SYNDICATE

R. McDonald No. 1, lot 13, N. ½, con. II, S.T.R. North Cayuga tp.

Completed May 20, 1935.
Producing gas well.
Rock pressure: 290 lbs.

Formation	Thickness, ft.
Surface	49
Lime and shale	251
Niagara	225
Shale	56
Clinton rock	30
Red Medina	40
Grey shale	51
White Medina	18
Red shale	50
Total depth	770

Gas at 586, 629, and 718 feet.
Fresh water at 60 feet; salt water at 430 feet.

CANFIELD GAS SYNDICATE

C. Morris No. 1, lot 14, S. ½ of N.E. ½, con. II, North Cayuga tp.

Completed March 20, 1935.
Producing gas well.
Rock pressure: 260 lbs.

Formation	Thickness, ft.
Surface	44
Lime and shale	257
Niagara	225
Shale	56
Clinton rock	30
Red Medina	40
Grey shale	52
White Medina	18
Red shale	48
Total depth	770

Gas at 511 feet.
Fresh water at 50 feet; salt water at 430 feet.

CANFIELD GAS SYNDICATE

M. Murphy No. 1, lot 15, N. pt., con. II, S.T.R., North Cayuga tp.

Completed January 29, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	57
Lime and shale	247
Niagara	225
Shale	56
Clinton rock	30
Red Medina	40
Grey shale	52
White Medina	16
Red shale	5
Total depth	728

Fresh water at 60 feet; salt water at 400 feet.

CANFIELD GAS SYNDICATE

R. Murphy No. 1, lot 12, N. ½, con. III, S.T.R., North Cayuga tp.

Completed August 17, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	63
Lime and shale	240
Niagara	225
Shale	55
Clinton rock	30
Red Medina	40
Grey shale	52
White Medina	18
Red shale	3
Total depth	726

Fresh water at 65 feet; salt water at 450 feet.

CANFIELD GAS SYNDICATE

R. Murphy No. 1, lot 13, N. ½, con. III, S.T.R., North Cayuga tp.

Completed July 18, 1935.
Producing gas well.
Rock pressure: 300 lbs.

Formation	Thickness, ft.
Surface	74
Lime and shale	234
Niagara	225
Shale	55
Clinton	30
Red Medina	40
Grey shale	52
White Medina	18
Red shale	42
Total depth	770

Gas at 593, 602, 636, and 726 feet.
Fresh water at 75 feet; salt water at 450 feet.

CANFIELD GAS SYNDICATE

W. Vickers No. 1, lot 16, N. pt., con. II, North Cayuga tp.

Completed October 29, 1935.
Producing gas well.
Rock pressure: 270 lbs.

Formation	Thickness, ft.
Surface	66
Lime and shale	253
Niagara	225
Shale	56
Clinton rock	30
Red Medina	40
Grey shale	52
White Medina	18
Red shale	30
Total depth	770

Gas at 610 to 620 and 640 to 650 feet.
Fresh water at 120 feet.

CANFIELD GAS SYNDICATE

W. Vickers No. 2, lot 16, N. pt., con. II, North Cayuga tp.

Completed November 22, 1935.
Producing gas well.
Rock pressure: 250 lbs.

Formation	Thickness, ft.
Surface	65
Lime and shale	254
Niagara	225
Shale	56
Clinton rock	30
Red Medina	40
Grey shale	52
White Medina	18
Red shale	30
Total depth	770

Gas at 610 to 620 and 640 to 650 feet.
Fresh water at 85 feet.

CONSOLIDATED NATURAL GAS CO., LTD.

J. T. Armstrong No. 1, lot 49, con. I, N.T.R., North Cayuga tp.

Completed November 2, 1935.
Producing gas well.
Rock pressure: 300 lbs.

Formation	Thickness, ft.
Surface	4
Sandstone	10
Broken lime	27
Lime and shale	350
Niagara	225
Shale	55
Clinton	28
Red Medina	32
Shale	65
White Medina	12
Red shale	6
Total depth	823

Gas at 690, 700, and 713 feet.
Fresh water at 120 feet; sulphur water at 175 feet.

DOMESTIC NATURAL GAS SYNDICATE

P. McFarlin No. 1, lot 29, con. I, N.T.R., North Cayuga tp.

Completed October 4, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	51
Lime and shale	226
Niagara	225
Shale	55
Clinton	24
Red Medina	39
Grey shale	59
White Medina	12
Red shale	5
Total depth	696

Fresh water at 60 feet and 100 feet.

DOMESTIC NATURAL GAS SYNDICATE

J. Mehlenbacher No. 1, lot 28, con. I, S.T.R., North Cayuga tp.

Completed September 9, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	54
Lime and shale	221
Niagara	225
Shale	54
Clinton	24
Red Medina	43
Grey shale	60
White Medina	12
Red shale	1
Total depth	694

Fresh water at 44 and 65 feet; sulphur water at 300 feet.

DUNNVILLE DETROIT GAS SYNDICATE

T. McDonald No. 1, lot 12, N. ½, con. II, S.T.R., North Cayuga tp.

Completed December 24, 1935.
Producing gas well.
Rock pressure: 260 lbs.

Formation	Thickness, ft.
Surface	62
Lime and shale	233
Niagara	225
Shale	56
Clinton	30
Red Medina	40
Grey shale	52
White Medina	19
Red shale	51
Total depth	768

Gas at 580 to 600, 616 to 636, and 705 to 715 feet.
Fresh water at 65 feet.

ESMOND AVERY AND ASSOCIATES

B. Carter No. 1, lot 12, S. ½, con. I, S.T.R., North Cayuga tp.

Completed January 3, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	57
Lime and shale	198
Niagara	233
Shale	55
Clinton	25
Red Medina	42
Shale	60
White Medina	10
Red shale	2
Total depth	682

Fresh water at 60 feet.

ESMOND AVERY AND ASSOCIATES
B. Carter No. 2, lot 12, S. ½, con. I, S.T.R., *North* Cayuga tp.

Completed February 9, 1935.
Producing gas well.
Rock pressure: 220 lbs.

Formation	Thickness, ft.
Surface	57
Lime and shale	200
Niagara	224
Shale	54
Clinton	31
Red Medina	40
Shale	60
White Medina	10
Red shale	50
Total depth	726

Gas at 538, 564, and 671 feet.
Fresh water at 56 feet.

ESMOND AVERY AND ASSOCIATES
W. Haines No. 1, lot 10, N. ½, con. I, S.T.R., North Cayuga tp.

Completed March 5, 1935.
Producing gas well.
Rock pressure: 230 lbs.

Formation	Thickness, ft.
Surface	63
Lime and shale	190
Niagara	225
Shale	53
Clinton	27
Red Medina	43
Shale	60
White Medina	10
Red shale	52
Total depth	723

Gas at 554 and 666 feet.
Fresh water at 64 feet.

ESMOND AVERY AND ASSOCIATES
W. Haines No. 2, lot 10, N. ½, con. II, S.T.R., North Cayuga tp.

Completed March 26, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	53
Lime and shale	202
Niagara	231
Shale	43
Clinton	26
Red Medina	42
Shale	60
White Medina	10
Red shale	4
Total depth	671

Fresh water at 50 feet.

ESMOND AVERY AND ASSOCIATES
W. Haines No. 3, lot 10, N. ½, con. II, S.T.R., North Cayuga tp.

Completed April 29, 1935.
Producing gas well.
Rock pressure: 200 lbs.

Formation	Thickness, ft.
Surface	59
Lime and shale	176
Niagara	225
Shale	49
Clinton	29
Red Medina	42
Shale	60
White Medina	10
Red shale	50
Total depth	700

Gas at 531 and 655 feet.
Fresh water at 60 feet.

GRAND RIVER NATURAL GAS SYNDICATE
C. Donnelly No. 1, lot 22, con. II, S.T.R., North Cayuga tp.

Completed August 13, 1935.
Producing gas well.
Rock pressure: 215 lbs.

Formation	Thickness, ft.
Surface	56
Lime and shale	258
Niagara	200
White lime	50
Rochester shale	33
Clinton	25
Red Medina	35
Blue shale	65
White Medina	10
Red shale	2
Total depth	734

Gas at 602 and 637 feet.
Fresh water at 60 feet.

GRAND RIVER NATURAL GAS SYNDICATE
J. Donnelly No. 2, lot 22, con. II, S.T.R., North Cayuga tp.

Completed September 14, 1935.
Producing gas well.
Rock pressure: 215 lbs.

Formation	Thickness, ft.
Surface	56
Lime and shale	257
Niagara	200
White lime	50
Rochester shale	33
Clinton	27
Red Medina	33
Blue shale	65
White Medina	10
Red shale	2
Total depth	733

Gas at 623 feet.
Fresh water at 60 feet.

GRAND RIVER NATURAL GAS SYNDICATE
T. Donnelly No. 2, lot 23, con. II, S.T.R., North Cayuga tp.

Completed October 27, 1935.
Producing gas well.
Rock pressure: 185 lbs.

Formation	Thickness, ft.
Surface	44
Lime and shale	259
Niagara	200
White lime	50
Shale	25
Clinton	25
Red Medina	33
Blue shale	65
White Medina	10
Red shale	27
Total depth	738

Gas at 586 feet.
Fresh water at 60 feet.

GRAND RIVER NATURAL GAS SYNDICATE
H. Walton No. 3, lots 15 and 16, con. III, S.R.R., North Cayuga tp.

Completed July 9, 1936.
Producing gas well.
Rock pressure: 250 lbs.

Formation	Thickness, ft.
Surface	38
Lime and shale	256
Niagara	200
White lime	50
Shale	38
Clinton	25
Red Medina	35
Blue shale	63
White Medina	10
Red shale	2
Total depth	717

Gas at 606 and 626 feet.
Fresh water at 90 feet.

PERCY L. JACKSON
A. Riley No. 1, lot 35, con. I, N.T.R., North Cayuga tp.
Completed June 26, 1935.
Producing gas well.
Rock pressure: 200 lbs.

Formation	Thickness, ft.
Surface	15
Lime and shale	220
Niagara	230
Shale	55
Clinton	24
Red Medina	40
Grey shale	50
White Medina	12
Red shale	1
Total depth	647

Gas at 546, 557, and 566 feet.
Fresh water at 25 feet.

MIDFIELD NATURAL GAS CO., LTD.
J. Clarke No. 2, lot 52, N. ½, con. I, North Cayuga tp.
Completed December 9, 1935.
Producing gas well.
Rock pressure: 340 lbs.

Formation	Thickness, ft.
Surface	6
Flint	12
Lime and shale	377
Niagara	225
Rochester shale	85
Clinton	23
Red Medina	27
Grey shale	59
White Medina	12
Red shale	10
Total depth	836

Gas at 709 and 736 feet.
Fresh water at 40 feet.

NORTH CAYUGA GAS SYNDICATE
J. Glenny No. 1, Huff tract, North Cayuga tp.
Completed September 28, 1935.
Producing gas well.
Rock pressure: 255 lbs.

Formation	Thickness, ft.
Surface	49
Lime and shale	247
Niagara	230
Shale	55
Clinton	27
Red Medina	40
Grey shale	50
White Medina	17
Red shale	25
Total depth	740

Gas at 590 to 600 and 608 to 648 feet.
Fresh water at 51 and 90 feet; salt water at 425 feet.

NORTH CAYUGA GAS SYNDICATE
J. Glenny No. 2, Huff tract, North Cayuga tp.
Completed October 14, 1935.
Producing gas well.
Rock pressure: 240 lbs.

Formation	Thickness, ft.
Surface	48
Lime and shale	252
Niagara	230
Shale	55
Clinton	27
Red Medina	40
Grey shale	52
White Medina	18
Red shale	25
Total depth	747

Gas at 590 to 600, 620 to 640, and 710 to 720 feet.
Fresh water at 110 feet; salt water at 425 feet.

CONSOLIDATED NATURAL GAS CO., LTD.
G. Ridely No. 4, lot 16, con. V, Oneida tp.
Completed June 6, 1935.
Producing gas well.
Rock pressure: 160 lbs.

Formation	Thickness, ft.
Surface	10
Broken lime	20
Lime and shale	170
Niagara	223
Shale	56
Clinton	26
Red Medina	27
Shale	59
White Medina	12
Red shale	3
Total depth	606

Gas at 502 feet.
Fresh water at 35 feet.

CONSOLIDATED NATURAL GAS CO., LTD.
G. Ridely No. 5, lot 16, con. V, Oneida tp.
Completed July 17, 1935.
Producing gas well.
Rock pressure: 160 lbs.

Formation	Thickness, ft.
Surface	28
Lime and shale	173
Niagara	228
Shale	54
Clinton	23
Red Medina	25
Shale	64
White Medina	12
Red shale	5
Total depth	612

Gas at 502 and 507 feet.
Fresh water at 35 feet.

CONSOLIDATED NATURAL GAS CO., LTD.
G. Ridely No. 6, lot 16, con. V, Oneida tp.
Completed August 2, 1935.
Producing gas well.
Rock pressure: 155 lbs.

Formation	Thickness, ft.
Surface	42
Lime and shale	173
Niagara	225
Shale	52
Clinton	25
Red Medina	27
Shale	63
White Medina	14
Red shale	4
Total depth	625

Gas at 510 and 530 feet.
Fresh water at 60 feet.

CONSOLIDATED NATURAL GAS CO., LTD.
E. Smelser No. 1, lot 15, con. IV, Oneida tp.
Completed September 5, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	39
Lime and shale	168
Niagara	226
Shale	56
Clinton	28
Red Medina	25
Shale	65
White Medina	12
Red shale	3
Total depth	622

Fresh water at 55 feet.

CONSOLIDATED NATURAL GAS CO., LTD.

E. Smelser No. 2, lot 15, S. pt., con. IV, Oneida tp.

Completed September 30, 1935.
Producing gas well.
Rock pressure: 155 lbs.

Formation	Thickness, ft.
Surface	39
Lime and shale	166
Niagara	226
Shale	57
Clinton	29
Red Medina	27
Shale	65
White Medina	13
Red shale	5
Total depth	627

Gas at 508 feet.
Fresh water at 46 feet.

W. H. CULVER, JR.

P. La Fortune No. 1, lot 18, con. V, Oneida tp.

Completed August 22, 1935.
Producing gas well.
Rock pressure: 245 lbs.

Formation	Thickness, ft.
Surface	40
Lime and shale	180
Niagara	233
Shale	50
Clinton	22
Red Medina	35
Grey shale	55
White Medina	10
Red shale	35
Total depth	660

Gas at 506, 510, and 517 feet.
Fresh water at 50 feet.

W. H. CULVER, JR.

P. La Fortune No. 2, lot 18, con. V, Oneida tp.

Completed September 3, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	50
Lime and shale	190
Niagara	225
Shale	50
Clinton	25
Red Medina	35
Grey shale	60
White Medina	10
Red shale	2
Total depth	647

Sulphur water at 75 feet.

W. H. CULVER, JR.

P. La Fortune No. 3, lot 18, con. V, Oneida tp.

Completed October 30, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	60
Lime and shale	140
Niagara	270
Shale	51
Clinton	23
Red Medina	20
Grey shale	65
White Medina	10
Red shale	5
Total depth	644

Sulphur water at 67 feet.

W. H. CULVER, JR.

P. La Fortune No. 4, lot 18, con. V, Oneida tp.

Completed December 9, 1935.
Producing gas well.
Rock pressure: 225 lbs.

Formation	Thickness, ft.
Surface	30
Lime and shale	176
Niagara	235
Shale	50
Clinton	20
Red Medina	35
Grey shale	65
White Medina	10
Red shale	20
Total depth	641

Gas at 499 and 620 feet.
Fresh water at 40 feet.

GASFINDERS GAS CO., LTD.

A. Hunter No. 1, lot 18, con. II, Oneida tp.

Completed April 26, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	81
Lime and shale	240
Niagara	250
Shale	50
Clinton	24
Red Medina	33
Grey shale	60
White Medina	10
Red shale	25
Total depth	773

Fresh water at 90 feet; sulphur water at 125 feet; black water at 300 feet.

GASFINDERS GAS CO., LTD.

A. T. Lang No. 2, pt. Andross block, Oneida tp.

Completed January 31, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	38
Lime and shale	175
Niagara	200
Shale	47
Clinton	20
Red Medina	32
Grey shale	55
White Medina	12
Red shale	4
Total depth	583

Fresh water at 55 feet; sulphur water at 95 feet; black water at 300 feet.

GASFINDERS GAS CO., LTD.

D. Smith No. 1, lot 18, con. IV, Oneida tp.

Completed February 23, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	77
Lime and shale	240
Niagara	250
Shale	50
Clinton	24
Red Medina	20
Grey shale	70
White Medina	11
Red shale	3
Total depth	745

Fresh water at 60 feet.

PERCY L. JACKSON

G. Ferguson No. 1, lot 75, R.R., Oneida tp.

Completed April 24, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	12
Broken lime	28
Lime and shale	200
Niagara	225
Shale	65
Clinton	25
Red Medina	40
Grey shale	50
White Medina	15
Red shale	3
Total depth	663

Fresh water at 38 feet.

PERCY L. JACKSON

G. Ferguson No. 2, lot 75, R.R., Oneida tp.

Completed May 23, 1935.
Producing gas well.
Rock pressure: 200 lbs.

Formation	Thickness, ft.
Surface	25
Lime and shale	215
Niagara	210
Shale	58
Clinton	25
Red Medina	40
Grey shale	55
White Medina	12
Red shale	1
Total depth	641

Gas at 515 and 520 feet.
Fresh water at 40 feet; sulphur water at 150 feet.

PERCY L. JACKSON

I. Ferguson No. 1, lot 77, R.R., Oneida tp.

Completed July 25, 1935.
Producing gas well.
Rock pressure: 200 lbs.

Formation	Thickness, ft.
Surface	42
Lime and shale	218
Niagara	215
Shale	55
Clinton	24
Red Medina	40
Grey shale	60
White Medina	14
Red shale	92
Total depth	760

Gas at 542 and 552 feet.
Fresh water at 60 feet.

LYNN VALLEY GAS SYNDICATE

W. Stark No. 1, lot 19, con. II, Oneida tp.

Completed January 30, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	70
Lime and shale	265
Niagara	225
Rochester shale	53
Clinton	24
Red Medina	35
Grey shale	57
White Medina	18
Red shale	3
Total depth	750

Fresh water at 90 feet.

LYNN VALLEY GAS SYNDICATE

W. Stark No. 2, lot 19, con. II, Oneida tp.

Completed March 15, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	40
Broken lime	32
Lime and shale	263
Niagara	225
Rochester shale	53
Clinton	27
Red Medina	37
Grey shale	55
White Medina	18
Total depth	750

Black water at 90 feet.

RIVER VALLEY NATURAL GAS SYNDICATE

C. Gailing No. 1, lot 21, con. III, Oneida tp.

Completed December 14, 1935.
Producing gas well.
Rock pressure: 350 lbs.

Formation	Thickness, ft.
Surface	12
Hardpan	78
Lime and shale	275
Niagara	220
Shale	36
Clinton	25
Red Medina	30
Shale	64
White Medina	20
Red shale	15
Total depth	795

Gas at 655 and 765 feet.
Fresh water at 97 feet; black water at 200 feet.

RIVER VALLEY NATURAL GAS SYNDICATE

J. Stark No. 1, lot 23, S. ½, con. III, Oneida tp.

Completed March 27, 1935.
Producing gas well.
Rock pressure: 300 lbs.

Formation	Thickness, ft.
Surface	7
Lime and gypsum	96
Lime and shale	267
Niagara	225
Shale	53
Clinton	29
Red Medina	32
Grey shale	59
White Medina	18
Total depth	786

Gas at 675 feet.
Fresh water at 77 feet; black water at 136 feet.

RIVER VALLEY NATURAL GAS SYNDICATE

R. W. Smith No. 1, lot 22, con. III, Oneida tp.

Completed January 29, 1935.
Producing gas well.
Rock pressure: 310 lbs.

Formation	Thickness, ft.
Surface	15
Broken lime	75
Lime and shale	270
Niagara	224
Shale	54
Clinton	28
Red Medina	32
Grey shale	58
White Medina	18
Red shale	35
Total depth	817

Gas at 668 and 780 feet.
Fresh water at 77 feet; sulphur water at 140 feet.

RIVER VALLEY NATURAL GAS SYNDICATE

R. W. Smith No. 2, lot 21, con. III, Oneida tp.

Completed February 23, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	12
Broken lime	81
Shale and lime	272
Niagara	220
Shale	59
Clinton	27
Red Medina	40
Grey shale	55
White Medina	19
Total depth	785

Fresh water at 77 feet; black water at 140 feet.

RIVER VALLEY NATURAL GAS SYNDICATE

R. Smith No. 3, lot 22, con. III, Oneida tp.

Completed May 11, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	6
Broken lime	91
Lime and shale	283
Niagara	225
Shale	50
Clinton	21
Red Medina	32
Grey shale	58
White Medina	18
Total depth	792

Fresh water at 93 feet; black water at 145 feet.

YORK NATURAL GAS SYNDICATE

O. Peart No. 1, pt. Anderson block, Oneida tp.

Completed July 8, 1935.
Producing gas well.
Rock pressure: 260 lbs.

Formation	Thickness, ft.
Surface	25
Lime and shale	165
Niagara	225
Shale	50
Clinton	22
Red Medina	35
Shale	55
White Medina	15
Red shale	1
Total depth	593

Gas at 487 and 492 feet.
Fresh water at 58 feet.

YORK NATURAL GAS SYNDICATE

O. Peart No. 2, pt. Anderson block, Oneida tp.

Completed July 25, 1936.
Dry hole.

Formation	Thickness, ft.
Surface	25
Lime and shale	178
Niagara	225
Shale	50
Clinton	22
Red Medina	35
Grey shale	59
White Medina	19
Red shale	1
Total depth	614

Fresh water at 60 feet.

YORK NATURAL GAS SYNDICATE

B. Pettit No. 1, pt. Anderson block, Oneida tp.

Completed September 17, 1935.
Producing gas well.
Rock pressure: 190 lbs.

Formation	Thickness, ft.
Surface	40
Lime and shale	135
Niagara	225
Shale	50
Clinton	22
Red Medina	35
Grey shale	60
White Medina	15
Red shale	40
Total depth	622

Fresh water at 50 feet.

YORK NATURAL GAS SYNDICATE

B. Pettit No. 2, pt. Anderson block, Oneida tp.

Completed September 27, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	37
Lime and shale	139
Niagara	225
Shale	50
Clinton	22
Red Medina	35
Grey shale	60
White Medina	15
Red shale	2
Total depth	585

Fresh water at 32 feet.

YORK NATURAL GAS SYNDICATE

B. Pettit No. 3, pt. Anderson block, Oneida tp.

Completed October 10, 1935.
Producing gas well.
Rock pressure: 200 lbs.

Formation	Thickness, ft.
Surface	60
Lime and shale	135
Niagara	225
Shale	50
Clinton	28
Red Medina	35
Shale	60
White Medina	10
Red shale	2
Total depth	605

Gas at 473 to 479 feet.
Fresh water at 75 feet.

DOMESTIC NATURAL GAS SYNDICATE

I. Stadder No. 1, lot 3, con. I, Rainham tp.

Completed September 23, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	8
Broken lime	4
Flint	98
Lime and shale	398
Niagara	252
Shale	53
Clinton	27
Red Medina	45
Grey shale	62
White Medina	12
Red shale	4
Total depth	963

Fresh water at 80 feet.

DOMESTIC NATURAL GAS CO., LTD.

Wm. Stadder No. 2, lot 16, con. II, Rainham tp.

Completed November 27, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	18
Flint	42
Lime and shale	375
Niagara lime	235
Shale	57
Clinton	27
Red Medina	38
Grey shale	58
White Medina	13
Red shale	32
Total depth	895

Fresh water at 55 feet; sulphur water at 330 feet; black water at 645 feet.

DOMESTIC NATURAL GAS SYNDICATE

Wm. Stadder No. 1, lot 16, con. II, Rainham tp.

Completed November 7, 1935.
Producing gas well.
Rock pressure: 325 lbs.

Formation	Thickness, ft.
Surface	16
Flint	50
Lime and shale	374
Niagara lime	230
Rochester shale	55
Clinton	30
Red Medina	40
Grey shale	55
White Medina	13
Red shale	9
Total depth	872

Gas at 737 and 763 feet.
Fresh water at 60 feet; black water at 220 feet; sulphur water at 590 feet.

HALDIMAND GAS AND OIL SYNDICATE

J. Winger No. 2, lot 5, S.W. ¼, con. IV, Rainham tp.

Completed November 27, 1935.
Producing gas well.
Rock pressure: 350 lbs.

Formation	Thickness, ft.
Surface	10
Flint	100
Lime and shale	340
Niagara	210
White lime	55
Rochester shale	38
Clinton	28
Red Medina	30
Red shale	14
Grey shale	50
White Medina	18
Red shale	1
Total depth	894

Gas at 761, 787, and 803 feet.
Fresh water at 60 feet.

IDEAL GAS SYNDICATE

J. Rhora No. 1, lot 1, E. ½, con. IV, Rainham tp.

Completed July 25, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	25
Flint	94
Lime and shale	362
Niagara	236
Shale	58
Clinton	25
Red Medina	43
Shale	60
White Medina	10
Total depth	913

Fresh water at 83 feet.

IDEAL GAS SYNDICATE

J. Rhora No. 2, lot 1, E. ½, con. IV, Rainham tp.

Completed August 20, 1935.
Producing gas well.
Rock pressure: 335 lbs.

Formation	Thickness, ft.
Surface	18
Flint	101
Lime and shale	367
Niagara	230
Shale	56
Clinton	25
Red Medina	46
Shale	60
White Medina	10
Red shale	50
Total depth	963

Gas at 804 and 910 feet.
Fresh water at 82 feet.

IDEAL GAS SYNDICATE

J. Rhora No. 3, lot 1, E. ½, con. IV, Rainham tp.

Completed September 20, 1935.
Producing gas well.
Rock pressure: 350 lbs.

Formation	Thickness, ft.
Surface	19
Flint	105
Lime and shale	360
Niagara	249
Shale	64
Clinton	28
Red Medina	44
Shale	60
White Medina	10
Red shale	3
Total depth	942

Gas at 842 and 853 feet.
Fresh water at 70 feet.

IDEAL GAS SYNDICATE

J. Rhora No. 4, lot 1, con. IV, Rainham tp.

Completed October 15, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	8
Flint	116
Lime and shale	354
Niagara	247
Shale	52
Clinton	27
Red Medina	45
Shale	60
White Medina	10
Red shale	3
Total depth	922

Fresh water at 65 feet.

IDEAL GAS SYNDICATE

J. Rhora No. 5, lot 1, con. IV, Rainham tp.

Completed November 16, 1935.
Producing gas well.
Rock pressure: 330 lbs.

Formation	Thickness, ft.
Surface	8
Flint	126
Lime and shale	360
Niagara	245
Shale	56
Clinton	26
Red Medina	45
Shale	60
White Medina	10
Red shale	25
Total depth	962

Gas at 817 feet.
Fresh water at 85 feet.

IDEAL GAS SYNDICATE

J. Rhora No. 6, lot 1, con. IV, Rainham tp.

Completed December 24, 1935.
Producing gas well.
Rock pressure: 321 lbs.

Formation	Thickness, ft.
Surface	6
Flint	127
Lime and shale	360
Niagara	240
Shale	62
Clinton	27
Red Medina	42
Shale	60
White Medina	10
Red shale	30
Total depth	964

Gas at 805 and 929 feet.

LADD AND KNIGHT

Nafel and Best No. 1, lot 7, con. IV, Rainham tp.

Completed October 17, 1935.
Producing gas well.
Rock pressure: 365 lbs.

Formation	Thickness, ft.
Surface	18
Flint	90
Lime and shale	349
Niagara	220
Shale	63
White Medina	9
Red shale	8
Total depth	889

Fresh water at 55 feet; black water at 85 and 457 feet.

LADD AND KNIGHT

O. Reicheld No. 2, lot 6, N. ½, con. IV, Rainham tp.

Completed December 16, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	18
Flint	90
Lime and shale	357
Niagara	225
Shale	58
Clinton	28
Red Medina	45
Shale	60
White Medina	10
Red shale	5
Total depth	896

Fresh water at 52 feet; black water at 375 feet.

L. P. MYTINGER

F. Nablo No. 1, lot 7, con. IV, Rainham tp.

Completed October 9, 1935.
Producing gas well.
Rock pressure: 385 lbs.

Formation	Thickness, ft.
Surface	14
Flint	85
Lime and shale	351
Niagara	240
Shale	55
Clinton	27
Red Medina	49
Grey shale	50
White Medina	10
Red shale	10
Total depth	891

Gas at 787 and 898 feet.
Sulphur water at 78 feet.

L. P. MYTINGER

F. Nablo No. 2, lot 7, con. IV, Rainham tp.

Completed November 8, 1935.
Producing gas well.
Rock pressure: 365 lbs.

Formation	Thickness, ft.
Surface	17
Flint	85
Lime and shale	353
Niagara	240
Shale	58
Clinton	26
Red Medina	47
Grey shale	55
White Medina	10
Red shale	5
Total depth	896

Gas at 763 and 797 feet.
Sulphur water at 68 feet.

L. P. MYTINGER

F. Nablo No. 3, lot 7, con. IV, Rainham tp.

Completed December 24, 1935.
Producing gas well.
Rock pressure: 360 lbs.

Formation	Thickness, ft.
Surface	18
Flint	90
Lime and shale	352
Niagara	240
Shale	57
Clinton	27
Red Medina	47
Grey shale	53
White Medina	10
Red shale	5
Total depth	899

Gas at 773, 781, and 809 feet.
Sulphur water at 61 feet.

W. C. PATTERSON

G. Bier No. 2, lot 1, con. VII, Rainham tp.

Completed December 3, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	18
Flint	67
Shale and lime	339
Niagara	262
Shale	49
Clinton	25
Red Medina	36
Grey shale	58
White Medina	15
Red shale	1
Total depth	870

Fresh water at 33 feet; sulphur water at 425 feet.

W. C. PATTERSON

P. Bier No. 2, lot 2, con. VI, Rainham tp.

Completed September 20, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	27
Flint	57
Lime and shale	360
Niagara	264
Shale	47
Clinton	28
Red Medina	39
Shale	54
White Medina	16
Red shale	1
Total depth	893

Fresh water at 50 feet; sulphur water at 472 feet.

W. C. PATTERSON

G. Fess No. 1, lot 3, con. VI, Rainham tp.

Completed March 7, 1935.
Producing gas well.
Rock pressure: 450 lbs.

Formation	Thickness, ft.
Surface	18
Flint	62
Lime and shale	356
Niagara	262
Shale	44
Clinton	24
Red Medina	40
Grey shale	56
White Medina	16
Red shale	3
Total depth	881

Fresh water at 40 feet; sulphur water at 440 feet.

W. C. PATTERSON

G. Fess No. 2, lot 3, con. VI, Rainham tp.

Completed April 12, 1935.
Producing gas well.
Rock pressure: 400 lbs.

Formation	Thickness, ft.
Surface	11
Flint	60
Lime and shale	369
Niagara	260
Shale	44
Clinton	27
Red Medina	40
Grey shale	56
White Medina	15
Red shale	2
Total depth	884

Fresh water at 36 feet; sulphur water at 437 feet.

W. C. PATTERSON

G. Fess No. 3, Lot 3, con. VI, Rainham tp.

Completed May 1, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	16
Flint	58
Lime and shale	366
Niagara	259
Shale	40
Clinton	27
Red Medina	35
Grey shale	56
White Medina	14
Red shale	1
Total depth	872

Fresh water at 35 feet; sulphur water at 420 feet.

W. C. PATTERSON

W. Reicheld No. 1, lot 3, con. VI, Rainham tp.

Completed June 12, 1935.
Producing gas well.
Rock pressure: 440 lbs.

Formation	Thickness, ft.
Surface	23
Flint	59
Lime and shale	356
Niagara	260
Shale	42
Clinton	30
Red Medina	37
Grey shale	57
White Medina	16
Red shale	3
Total depth	883

Fresh water at 40 feet; sulphur water at 432 feet.

W. C. PATTERSON

W. Reicheld No. 2, lot 3, N. ½, con. VI, Rainham tp.

Completed August 7, 1935.
Producing gas well.
Rock pressure: 450 lbs.

Formation	Thickness, ft.
Surface	22
Flint	62
Lime and shale	357
Niagara	261
Shale	50
Clinton	29
Red Medina	40
Grey shale	53
White Medina	15
Red shale	2
Total depth	891

Gas at 776, 781, and 788 feet.
Fresh water at 47 feet; sulphur water at 463 feet.

W. C. PATTERSON

W. Reicheld No. 3, lot 3, con. VI, Rainham tp.

Completed August 29, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	12
Flint	72
Lime and shale	359
Niagara	262
Shale	50
Clinton	33
Red Medina	40
Shale	54
White Medina	15
Red shale	1
Total depth	898

Fresh water at 55 feet; sulphur water at 470 feet.

W. C. PATTERSON

A. Riddell No. 1, lot 3, con. VII, Rainham tp.

Completed November 1, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	31
Flint	53
Shale and lime	341
Niagara	260
Shale	46
Clinton	27
Red Medina	37
Grey shale	56
White Medina	14
Red shale	2
Total depth	867

Fresh water at 37 feet; sulphur water at 430 feet.

W. C. PATTERSON

G. Roth No. 1, lot 4, con. VII, Rainham tp.

Completed January 12, 1935.
Producing gas well.
Rock pressure: 450 lbs.

Formation	Thickness, ft.
Surface	19
Flint	65
Lime and shale	360
Niagara	260
Shale	40
Clinton	24
Red Medina	35
Grey shale	50
White Medina	15
Red shale	1
Total depth	869

Fresh water at 40 feet; sulphur water at 430 feet.

W. C. Patterson

E. Schier No. 1, lot 4, con. VII, Rainham tp.

Completed January 31, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	16
Flint	67
Lime and shale	347
Niagara	260
Shale	40
Clinton	28
Red Medina	37
Grey shale	55
White Medina	15
Red shale	2
Total depth	757

Fresh water at 35 feet; sulphur water at 425 feet.

W. C. Patterson

S. Schumaker No. 1, lot 5, S.E. ½, con. VI, Rainham tp.

Completed January 24, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	10
Flint	65
Lime and shale	370
Niagara	236
Shale	61
Clinton	28
Red Medina	42
Grey shale	60
White Medina	15
Red shale	5
Total depth	892

Sulphur water at 75 feet.

W. C. Patterson

G. Winger No. 1, lot 8, con. VI, Rainham tp.

Completed July 17, 1935.
Producing gas well.
Rock pressure: 410 lbs.

Formation	Thickness, ft.
Surface	12
Flint	73
Shale and lime	340
Niagara	258
Shale	42
Clinton	27
Red Medina	40
Grey shale	59
White Medina	24
Red shale	32
Total depth	907

Gas at 749, 754, and 870 feet.

Central Seneca Gas Syndicate

J. Hanson No. 6, lot 18, con. IV, E.S.C.R., Seneca tp.

Completed January 15, 1935.
Producing gas well.
Rock pressure: 100 lbs.

Formation	Thickness, ft.
Surface	79
Lime and shale	70
Niagara	215
Rochester shale	45
Clinton	27
Red Medina sand	21
Red Medina shale	18
Grey shale	51
White Medina	10
Red shale	37
Total depth	573

Gas at 429 and 530 feet.
Fresh water at 83 feet.

Central Seneca Gas Syndicate

E. Harrison No. 3, lot 19, N. ½, con. IV, E.S.C.R., Seneca tp.

Completed January 30, 1935.
Producing gas well.
Rock pressure: 90 lbs.

Formation	Thickness, ft.
Surface	75
Lime and shale	81
Niagara	216
Rochester shale	45
Clinton	22
Red Medina	19
Red shale	20
Grey shale	55
White Medina	9
Red shale	49
Total depth	591

Gas at 541 feet.
Fresh water at 78 feet.

Central Seneca Gas Syndicate

F. Harrison No. 1, lot 16, N. ½, con. IV, E.S.C.R., Seneca tp.

Completed February 27, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	68
Lime and shale	75
Niagara	221
Rochester shale	33
Clinton	24
Red Medina sand	21
Red Medina shale	16
Grey shale	61
White Medina	8
Red shale	23
Total depth	550

Show of gas at 399 and 522 feet.
Fresh water at 72 feet.

Domestic Natural Gas Syndicate

W. J. Cummings No. 3, lot 16, con. IV, Seneca tp.

Completed July 18, 1935.
Producing gas well.
Rock pressure: 110 lbs.

Formation	Thickness, ft.
Surface	59
Lime and shale	80
Niagara	232
Shale	48
Clinton	30
Red Medina	40
Blue shale	70
White Medina	12
Red shale	55
Total depth	626

Gas at 440 and 564 feet.
Fresh water at 60 feet.

Domestic Natural Gas Syndicate

R. Edwards No. 2, lot 15, con. III, Seneca tp.

Completed August 6, 1935.
Producing gas well.
Rock pressure: 110 lbs.

Formation	Thickness, ft.
Surface	82
Lime and shale	80
Niagara	232
Shale	54
Clinton	30
Blue shale	65
White Medina	14
Total depth	557

Gas at 580 feet.
Fresh water at 79 feet.

DOMESTIC NATURAL GAS SYNDICATE
R. Kerr No. 3, lots 18 and 19, con. IV, Seneca tp.
Completed February 1, 1935.
Producing gas well.
Rock pressure: 210 lbs.

Formation	Thickness, ft.
Surface	67
Lime and gypsum	70
Niagara	240
Shale	45
Clinton	26
Red Medina	38
Blue shale	70
White Medina	14
Red shale	35
Total depth	605

Fresh water at 67 feet; sulphur water at 215 feet.

DOMESTIC NATURAL GAS SYNDICATE
R. Kerr No. 4, lots 18 and 19, con. IV, Seneca tp.
Completed March 4, 1935.
Producing gas well.
Rock pressure: 210 lbs.

Formation	Thickness, ft.
Surface	78
Lime and gypsum	67
Niagara lime	240
Shale	42
Clinton	26
Red Medina	30
Blue shale	70
White Medina	15
Red shale	50
Total depth	618

Gas at 430 and 559 feet.
Fresh water at 79 feet; black water at 315 feet.

DOMESTIC NATURAL GAS SYNDICATE
R. Kerr No. 5, lots 18 and 19, con. IV, Seneca tp.
Completed April 1, 1935.
Producing gas well.
Rock pressure: 210 lbs.

Formation	Thickness, ft.
Surface	79
Lime and gypsum	67
Niagara lime	240
Shale	42
Clinton	26
Red Medina	30
Blue shale	75
White Medina	15
Red shale	53
Total depth	627

Gas at 448 and 571 feet.
Fresh water at 81 feet; sulphur water at 220 feet.

DOMESTIC NATURAL GAS SYNDICATE
R. Kerr No. 6, lots 18 and 19, con. IV, Seneca tp.
Completed April 23, 1935.
Producing gas well.
Rock pressure: 200 lbs.

Formation	Thickness, ft.
Surface	72
Lime and gypsum	68
Niagara lime	239
Shale	42
Clinton	28
Red Medina	29
Blue shale	75
White Medina	16
Red shale	55
Total depth	624

Gas at 441 and 563 feet.
Fresh water at 93 feet; sulphur water at 225 feet.

DOMESTIC NATURAL GAS SYNDICATE
R. Kerr No. 7, lots 18 and 19, con. IV, Seneca tp.
Completed August 27, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	51
Lime and gypsum	77
Niagara lime	250
Shale	50
Clinton	32
Red Medina	35
Blue shale	70
White Medina	14
Red shale	5
Total depth	584

Fresh water at 52 feet; sulphur water at 210 feet.

DOMESTIC NATURAL GAS SYNDICATE
R. Kerr No. 8, lots 18 and 19, con. IV, Seneca tp.
Completed September 24, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	69
Lime and gypsum	77
Niagara	250
Shale	50
Clinton	30
Red Medina	30
Blue shale	65
White Medina	12
Red shale	7
Total depth	590

Fresh water at 52 feet.

DOMESTIC NATURAL GAS SYNDICATE
H. Parker No. 1, Lot 15, S. ½, con. IV, Seneca tp.
Completed May 22, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	60
Lime and shale	80
Niagara	232
Shale	48
Clinton	20
Red Medina	43
Blue shale	70
White Medina	14
Red shale	3
Total depth	570

Fresh water at 70 feet; sulphur water at 280 feet.

DOMESTIC NATURAL GAS SYNDICATE
H. Parker No. 2, lot 15, S. ½, con. IV, Seneca tp.
Completed June 26, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	54
Lime and shale	74
Niagara	238
Shale	47
Clinton	28
Red Medina	38
Blue shale	78
White Medina	13
Red shale	8
Total depth	578

Fresh water at 57 feet; sulphur water at 260 feet.

DOMESTIC NATURAL GAS SYNDICATE

W. Tomlinson No. 1, lot 13, con. IV, Seneca tp.

Completed July 13, 1935.
Producing gas well.
Rock pressure: 110 lbs.

Formation	Thickness, ft.
Surface	57
Lime and shale	85
Niagara	214
Shale	47
Clinton	29
Red Medina	43
Blue shale	67
White Medina	11
Red shale	55
Total depth	608

Gas at 421, 443, and 451 feet.
Fresh water at 63 feet.

DOMESTIC NATURAL GAS SYNDICATE

W. Tomlinson No. 2, lot 13, con. IV, Seneca tp.

Completed August 5, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	60
Lime and shale	83
Niagara	220
Shale	46
Clinton	25
Red Medina	35
Blue shale	68
White Medina	14
Total depth	551

Fresh water at 68 feet; sulphur water at 290 feet.

NATIONAL GAS SYNDICATE

M. Shaw No. 2, lot 14, con. III, Seneca tp.

Completed January 22, 1935.
Producing gas well.
Rock pressure: 125 lbs.

Formation	Thickness, ft.
Surface	76
Lime and shale	104
Niagara	230
Shale	43
Clinton	25
Red Medina	38
Grey shale	48
White Medina	17
Red shale	35
Total depth	616

Gas at 493, 515, and 580 feet.
Fresh water at 80 feet.

NATIONAL GAS SYNDICATE

T. Singer No. 2, lot 16, S.½, con. II, Seneca tp.

Completed February 15, 1936.
Producing gas well.
Rock pressure: 125 lbs.

Formation	Thickness, ft.
Surface	90
Lime and shale	89
Niagara	228
Shale	48
Clinton	29
Red Medina	40
Grey shale	55
White Medina	17
Red shale	34
Total depth	630

Gas at 470 and 590 feet.
Fresh water at 94 feet.

YORK NATURAL GAS SYNDICATE

H. J. and E. A. Hannah No. 1, lot 1, Young tract, Seneca tp.

Completed May 14, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	84
Lime and shale	95
Niagara	250
Shale	50
Clinton	25
Red Medina	35
Shale	67
White Medina	15
Red shale	3
Total depth	625

Show of gas at 505 feet.
Fresh water at 100 feet.

YORK NATURAL GAS SYNDICATE

R. Warring No. 1, lot 1, Young tract, Seneca tp.

Completed March 30, 1935.
Producing gas well.
Rock pressure: 135 lbs.

Formation	Thickness, ft.
Surface	94
Brown lime	96
Niagara	250
Shale	50
Clinton	27
Red Medina	34
Shale	60
White Medina	15
Red shale	32
Total depth	658

Gas at 498 to 502, and 542 to 616 feet.
Fresh water at 100 feet.

YORK NATURAL GAS SYNDICATE

R. Warring No. 2, lot 1, Young tract, Seneca tp.

Completed April 10, 1935.
Producing gas well.
Rock pressure: 240 lbs.

Formation	Thickness, ft.
Surface	85
Brown lime	105
Niagara	250
Shale	50
Clinton	25
Red Medina	35
Shale	60
White Medina	15
Red shale	36
Total depth	661

Gas at 505 to 515 and 615 to 625 feet.
Fresh water at 100 feet.

YORK NATURAL GAS SYNDICATE

R. Warring No. 3, lot 1, Young tract, Seneca tp.

Completed April 26, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	93
Lime and shale	97
Niagara	250
Shale	55
Clinton	25
Red Medina	35
Shale	55
White Medina	10
Red shale	5
Total depth	625

Show of gas at 520 feet.
Fresh water at 100 feet.

CANFIELD GAS SYNDICATE

J. Fradenburgh No. 1, Fradenburgh tract, South Cayuga tp.

Completed January 12, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	48
Lime and shale	259
Niagara	225
Shale	56
Clinton	27
Red Medina	40
Grey shale	53
White Medina	16
Red shale	5
Total depth	729

Fresh water at 49 feet; salt water at 400 feet.

DUFFERIN OIL AND GAS SYNDICATE

W. Wilson No. 1, lot 28, S. ½, con. IV, South Cayuga tp.

Completed August 30, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	14
Lime and shale	397
Niagara	201
White lime	16
Shale	69
Clinton	30
Red Medina	36
Shale	60
White Medina	18
Red shale	4
Total depth	845

Sulphur water at 65 feet.

RIVER VALLEY NATURAL GAS SYNDICATE

W. Pridmore No. 1, lot 22, con. IV, South Cayuga tp.

Completed March 2, 1935.
Producing gas well.
Rock pressure: 165 lbs.

Formation	Thickness, ft.
Surface	19
Flint	19
Lime and shale	315
Niagara	277
Shale and lime	51
Shale	22
Clinton	32
Red Medina	37
Blue shale	59
White Medina	11
Pocket	2
Total depth	844

Gas at 733 feet.
Fresh water at 92 feet.

BEACON NATURAL GAS SYNDICATE

H. Butcher No. 2, lot 2, S.W. ¼, con. III, Walpole tp.

Completed April 30, 1935.
Producing gas well.
Rock pressure: 420 lbs.

Formation	Thickness, ft.
Surface	47
Flint	148
Lime and shale	370
Niagara limestone	270
Shale	42
Clinton	27
Red Medina	46
Grey shale	55
White Medina	10
Red Medina	50
Total depth	1,065

Gas at 913 and 1,013 feet.
Black water at 195 feet.

BROADWAY GAS SYNDICATE

C. Bacher No. 3, lot 20, N. ½, con. VI, Walpole tp.

Completed November 14, 1935.
Producing gas well.
Rock pressure: 400 lbs.

Formation	Thickness, ft.
Surface	25
Flint	110
Lime and shale	340
Niagara	268
Rochester shale	38
Clinton	28
Red Medina	22
Red shale	14
Grey shale	57
White Medina	8
Red shale	1
Total depth	911

Gas at 811, 817, and 825 feet.
Fresh water at 70 feet.

BROADWAY GAS SYNDICATE

G. Bartlett No. 1, lot 19, S. ½ of N. ½, con. VI, Walpole tp.

Completed January 15, 1935.
Producing gas well.
Rock pressure: 450 lbs.

Formation	Thickness, ft.
Surface	13
Flint	107
Lime and shale	343
Niagara	257
Rochester shale	66
Clinton	28
Red Medina sand	25
Red Medina shale	17
Grey shale	54
White Medina	12
Red shale	4
Total depth	926

Gas at 801 and 826 feet.
Fresh water at 65 feet.

BROADWAY GAS SYNDICATE

G. Bartlett No. 2, lot 19, S. ½ of N. ½, con. VI, Walpole tp.

Completed September 30, 1935.
Producing gas well.
Rock pressure: 405 lbs.

Formation	Thickness, ft.
Surface	25
Flint	105
Lime and shale	350
Niagara	271
Rochester shale	37
Clinton	27
Red Medina	43
Grey shale	52
White Medina	12
Red shale	3
Total depth	925

Gas at 806, 821, 827, and 833 feet.
Fresh water at 60 feet.

BROADWAY GAS SYNDICATE

G. Bartlett No. 3, lot 19, S. ½ of N. ½, con. VI, Walpole tp.

Completed October 22, 1935.
Producing gas well.
Rock pressure: 410 lbs.

Formation	Thickness, ft.
Surface	26
Flint	110
Lime and shale	344
Niagara	271
Rochester shale	36
Clinton	28
Red Medina	44
Grey shale	56
White Medina	12
Red shale	3
Total depth	930

Gas at 821 and 827 feet.
Fresh water at 45 feet.

DELHI GAS SYNDICATE

C. Buck No. 1, lot 6, S. ½, con. IV, Walpole tp.

Completed June 4, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	23
Flint	127
Lime and shale	370
Niagara	285
Rochester shale	40
Clinton	25
Red Medina sand	26
Red Medina shale	10
Grey shale	60
White Medina	12
Red shale	3
Total depth	981

Fresh water at 110 feet.

DELHI GAS SYNDICATE

W. Craddock No. 1, lot 5, S.E. ¼, con. IV, Walpole tp.

Completed February 18, 1935.
Producing gas well.
Rock pressure: 485 lbs.

Formation	Thickness, ft.
Surface	33
Flint	132
Lime and shale	380
Niagara	210
White lime	66
Rochester shale	29
Clinton	22
Red Medina	50
Grey shale	54
White Medina	14
Total depth	990

Gas at 890 feet.
Fresh water at 100 feet.

DELHI GAS SYNDICATE

W. Craddock No. 2, lot 5, S.E. ¼, con. IV, Walpole tp.

Completed February 26, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	25
Flint	165
Lime and shale	355
Niagara	270
Rochester shale	48
Clinton	25
Red Medina sand	18
Red Medina shale	22
Grey shale	57
White Medina	14
Red shale	4
Total depth	1,003

Fresh water at 50 and 150 feet.

DELHI GAS SYNDICATE

W. Craddock No. 3, lot 5, S.E. ¼, con. IV, Walpole tp.

Completed March 18, 1935.
Producing gas well.
Rock pressure: 465 lbs.

Formation	Thickness, ft.
Surface	34
Flint	131
Lime and shale	380
Niagara	210
White lime	61
Rochester shale	25
Clinton	27
Red Medina sand	45
Grey shale	54
White Medina	14
Total depth	991

Gas at 896 and 941 feet.
Fresh water at 110 feet.

DELHI GAS SYNDICATE

W. Doughty No. 1, lot 7, N.E. ¼ of N. ½, con. IV, Walpole tp.

Completed April 25, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	46
Flint	94
Lime and shale	375
Niagara	266
Rochester shale	54
Clinton	24
Red Medina sand	8
Red Medina shale	19
Grey shale	79
White Medina	8
Red shale	4
Total depth	977

Fresh water at 60 feet.

DOMESTIC NATURAL GAS SYNDICATE

T. McNeill No. 1, lot 5, con. VII, Walpole tp.

Completed July 16, 1935.
Producing gas well.
Rock pressure: 375 lbs.

Formation	Thickness, ft.
Surface	19
Flint	93
Lime and shale	379
Niagara	256
Shale	53
Clinton	32
Red Medina	45
Grey shale	43
White Medina	13
Red shale	37
Total depth	970

Gas at 810, 856, and 920 feet.
Fresh water at 30 feet; sulphur water at 80 feet.

DOMESTIC NATURAL GAS SYNDICATE No. 2

Wm. Sanders No. 1, lot 5, con. VII, Walpole tp.

Completed August 19, 1935.
Producing gas well.
Rock pressure: 375 lbs.

Formation	Thickness, ft.
Surface	20
Flint	74
Lime and shale	381
Niagara	285
Shale	53
Clinton	30
Red Medina	46
Grey shale	50
White Medina	12
Red shale	4
Total depth	955

Gas at 869 feet.
Fresh water at 125 feet; sulphur water at 400 feet.

DOMESTIC NATURAL GAS SYNDICATE No. 2

Wm. Sanders No. 2, lot 5, con. VII, Walpole tp.

Completed November 30, 1935.
Producing gas well.
Rock pressure: 370 lbs.

Formation	Thickness, ft.
Surface	10
Flint	74
White sand	15
Lime and shale	391
Niagara	291
Shale	36
Clinton	30
Red Medina	47
Grey shale	46
White Medina	12
Red shale	50
Total depth	1,002

Gas at 870 feet.
Oil at 945 feet.
Fresh water at 50 feet; sulphur water at 420 feet.

GASFINDERS GAS COMPANY

C. Devine No. 1, lot 13, con. VIII, Walpole tp.

Completed February 16, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	11
Flint	64
White sand	15
Lime and shale	369
Niagara	255
Guelph lime	20
Shale	51
Clinton	32
Red Medina	33
Shale	50
White Medina	12
Red shale	7
Total depth	917

Black water at 90 feet.

KELLY GAS SYNDICATE

G. Schweyer No. 1, lot 20, S.E. ¼, con. V, Walpole tp.

Completed October 10, 1935.
Producing gas well.
Rock pressure: 390 lbs.

Formation	Thickness, ft.
Surface	23
Flint	104
Lime and shale	375
Niagara	242
Rochester shale	57
Clinton	23
Red Medina	28
Red shale	27
Grey shale	58
White Medina	9
Red shale	1
Total depth	937

Gas at 850 feet.
Fresh water at 59 feet.

KELLY GAS SYNDICATE

G. Schweyer No. 2, lot 20, S.E. ¼, con. V, Walpole tp.

Completed November 7, 1935.
Producing gas well.
Rock pressure: 380 lbs.

Formation	Thickness, ft.
Surface	13
Flint	104
Lime and shale	385
Niagara	250
Rochester shale	58
Clinton	23
Red Medina	29
Red shale	17
Grey shale	57
White Medina	9
Red shale	4
Total depth	949

Gas at 853 feet.
Fresh water at 60 feet.

KELLY GAS SYNDICATE

M. Wilkins No. 2, lot 21, N. ½, con. VI, Walpole tp.

Completed May 14, 1936.
Producing gas well.
Rock pressure: 430 lbs.

Formation	Thickness, ft.
Surface	12
Flint	98
Lime and shale	350
Niagara	262
Rochester shale	57
Clinton	24
Red Medina	35
Red shale	10
Grey shale	52
White Medina	12
Red shale	3
Total depth	915

Gas at 811, 818, and 828 feet.
Fresh water at 59 feet.

KELLY GAS SYNDICATE

M. Wilkins No. 3, lot 21, N. ½, con. VI, Walpole tp.

Completed June 11, 1935.
Producing gas well.
Rock pressure: 445 lbs.

Formation	Thickness, ft.
Surface	16
Flint	104
Lime and shale	346
Niagara	255
Rochester shale	61
Clinton	25
Red Medina	33
Red shale	9
Grey shale	63
White Medina	9
Red shale	3
Total depth	924

Gas at 786, 822, and 829 feet.
Fresh water at 75 feet.

KELLY GAS SYNDICATE

M. Wilkins No. 4, lot 21, N. ½, con. VI, Walpole tp.

Completed July 3, 1935.
Producing gas well.
Rock pressure: 460 lbs.

Formation	Thickness, ft.
Surface	18
Flint	96
Lime and shale	347
Niagara	258
Rochester shale	56
Clinton	32
Red Medina	29
Red shale	16
Grey shale	56
White Medina	3
Red shale	4
Total depth	915

Gas at 793 feet.
Fresh water at 38 feet.

KELLY GAS SYNDICATE

M. Wilkins No. 5, lot 21, N. ½, con. VI, Walpole tp.

Completed July 26, 1935.
Producing gas well.
Rock pressure: 415 lbs.

Formation	Thickness, ft.
Surface	21
Flint	97
Lime and shale	354
Niagara	260
Rochester shale	57
Clinton	25
Red Medina	29
Red shale	17
Grey shale	60
White Medina	4
Red shale	2
Total depth	926

Gas at 810 feet.
Fresh water at 83 feet.

KELLY GAS SYNDICATE

M. Wilkins No. 6, lot 21, N. ½, con. VI, Walpole tp.

Completed August 17, 1935.
Producing gas well.
Rock pressure: 400 lbs.

Formation	Thickness, ft.
Surface	13
Flint	90
Lime and shale	358
Niagara	253
Rochester shale	60
Clinton	24
Red Medina	26
Red shale	18
Grey shale	57
White Medina	7
Red shale	1
Total depth	907

Gas at 794 and 820 feet.
Fresh water at 22 feet.

LADD AND KNIGHT

W. Addison No. 1, lot 16, S.E. ¼, con. VIII, Walpole tp.

Completed December 24, 1935.
Producing gas well.
Rock pressure: 320 lbs.

Formation	Thickness, ft.
Surface	18
Flint	90
Lime and shale	380
Niagara	200
Grey lime	35
Rochester shale	50
Clinton	28
Red Medina	39
Grey shale	55
White Medina	15
Red shale	5
Total depth	915

Sulphur water at 80 feet; black water at 220 and 500 feet.

LADD AND KNIGHT

R. Butler No. 1, lot 8, N. ½, con. VII, Walpole tp.

Completed November 22, 1935.
Producing gas well.
Rock pressure: 450 lbs.

Formation	Thickness, ft.
Surface	23
Flint	79
Lime and shale	380
Niagara	266
Shale	51
Clinton	28
Red Medina	30
Grey shale	56
White Medina	12
Red shale	5
Total depth	930

Fresh water at 65 feet; black water at 170 feet.

LADD AND KNIGHT

G. Dossar No. 1, lot 6, W. ½, con. VIII, Walpole tp.

Completed October 17, 1935.
Producing gas well.
Rock pressure: 455 lbs.

Formation	Thickness, ft.
Surface	18
Flint	75
Lime and shale	389
Niagara	276
Shale	52
Clinton	24
Red Medina	44
Grey shale	55
White Medina	17
Red shale	50
Total depth	1,000

Gas at 818, 935, and 942 feet.
Fresh water at 62 feet.

LADD AND KNIGHT

J. Wodham No. 1, lot 5, S.W. ¼, con. VIII, Walpole tp.

Completed September 7, 1935.
Producing gas well.
Rock pressure: 455 lbs.

Formation	Thickness, ft.
Surface	20
Flint	76
Lime and shale	389
Niagara	274
Shale	51
Clinton	30
Red Medina	46
Grey shale	42
White Medina	14
Red shale	50
Total depth	992

Gas at 860 and 935 feet.
Fresh water at 45 feet.

LYMBURNER BROS. AND WEBBER

A. Dennis No. 2, lot 24, con. IV, Walpole tp.

Completed July 1, 1935.
Producing gas well.
Rock pressure: 365 lbs.

Formation	Thickness, ft.
Surface	7
Flint	135
Lime and shale	355
Niagara	251
Shale	59
Clinton	27
Red Medina	41
Shale	60
White Medina	10
Red shale	50
Total depth	995

Gas at 900 and 951 feet.
Fresh water at 60 feet.

LYMBURNER BROS. AND WEBBER

C. Gee No. 3, lot 24, con. IV, Walpole tp.

Completed June 5, 1935.
Producing gas well.
Rock pressure: 405 lbs.

Formation	Thickness, ft.
Surface	7
Flint	126
Lime and shale	355
Niagara	253
Shale	60
Clinton	26
Red Medina	50
Shale	59
White Medina	10
Red shale	1
Total depth	947

Gas at 837 and 887 to 900 feet.
Sulphur water at 644 feet.

McCARTER AND ALLEN

C. S. McCarter No. 1, lot 3, E. ½, con. VII, Walpole tp.

Completed November 23, 1935.
Producing gas well.
Rock pressure: 365 lbs.

Formation	Thickness, ft.
Surface	12
Flint	93
Lime and shale	368
Niagara	205
Rochester shale	20
Guelph lime	24
Shale	45
Clinton	32
Red Medina	58
Grey shale	65
White Medina	18
Red shale	102
Total depth	1,042

Gas at 772, 809, and 936 feet.
Fresh water at 75 feet; sulphur water at 425 feet.

MONARCH GAS SYNDICATE

F. P. House No. 4, lot 23, con. VI, Walpole tp.

Completed January 14, 1935.
Producing gas well.
Rock pressure: 435 lbs.

Formation	Thickness, ft.
Surface	9
Flint	90
Lime and shale	351
Niagara	210
White lime	55
Rochester shale	42
Clinton	24
Red Medina	47
Grey shale	50
White Medina	12
Red shale	2
Total depth	892

Gas at 807 feet.
Fresh water at 18 feet.

MONARCH GAS SYNDICATE

F. P. House No. 5, lot 23, con. VI, Walpole tp.

Completed September 13, 1935.
Producing gas well.
Rock pressure: 485 lbs.

Formation	Thickness, ft.
Surface	24
Flint	90
Lime and shale	353
Niagara	260
Rochester shale	46
Clinton	25
Red Medina	50
Grey shale	55
White Medina	7
Red shale	2
Total depth	912

Gas at 793 feet.
Fresh water at 575 feet.

OTTERVILLE NATURAL GAS SYNDICATE

A. Evans No. 1, lot 4, con. I, Walpole tp.

Completed March 2, 1935.
Producing gas well.
Rock pressure: 318 lbs.

Formation	Thickness, ft.
Surface	20
Flint	158
Shale	362
Niagara	273
Shale	50
Clinton	27
Red Medina	55
Shale	56
White Medina	12
Total depth	1,013

Gas at 878 and 905 feet.
Fresh water at 60 feet; black water at 100 feet.

OTTERVILLE NATURAL GAS SYNDICATE

A. B. Hoover No. 2, lot 5, con. I, Walpole tp.

Completed January 21, 1935.
Producing gas well.
Rock pressure: 312 lbs.

Formation	Thickness, ft.
Surface	9
Flint	165
Lime, gypsum, and shale	340
Niagara lime	215
Shale	53
Clinton	25
Red Medina	52
Shale	66
White Medina	12
Red shale	9
Total depth	1,006

Gas at 864 and 894 feet.
Fresh water at 9 feet; black water at 78 feet; sulphur water at 585 feet.

OTTERVILLE NATURAL GAS SYNDICATE

A. B. Hoover No. 3, lot 5, con. I, Walpole tp.

Completed March 12, 1935.
Producing gas well.
Rock pressure: 335 lbs.

Formation	Thickness, ft.
Surface	18
Flint	138
Lime and shale	354
Niagara	288
Shale	52
Clinton	21
Red Medina	53
Shale	68
White Medina	11
Red shale	4
Total depth	1,007

Gas at 921 and 995 feet.
Fresh water at 14 feet; sulphur water at 63 feet; black water at 540 feet.

W. C. PATTERSON

H. Bradley No. 1, lot 10, con. V, Walpole tp.

Completed August 12, 1935.
Producing gas well.
Rock pressure: 520 lbs.

Formation	Thickness, ft.
Surface	14
Flint	90
Lime and shale	376
Niagara	285
Shale	33
Clinton	30
Red Medina	40
Shale	57
White Medina	11
Red shale	4
Total depth	940

Fresh water at 80 feet; black water at 460 feet.

W. C. PATTERSON

H. Bradley No. 2, lot 10, con. V, Walpole tp.

Completed October 4, 1935.
Producing gas well.
Rock pressure: 525 lbs.

Formation	Thickness, ft.
Surface	24
Flint	114
Lime and shale	362
Niagara	280
Shale	36
Clinton	25
Red Medina	33
Shale	66
White Medina	13
Red shale	40
Total depth	993

Gas at 850, 856, and 948 feet.
Fresh water at 87 feet.

W. C. Patterson

H. Bradley No. 3, lot 10, con. V, Walpole tp.

Completed December 6, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	30
Flint	90
Lime and shale	385
Niagara	274
Shale	37
Clinton	28
Red Medina	31
Shale	60
White Medina	20
Shale	3
Total depth	958

Fresh water at 76 feet.

W. C. Patterson

J. Carpenter No. 1, lot 3, con. IV, Walpole tp.

Completed March 12, 1935.
Producing gas well.
Rock pressure: 350 lbs.

Formation	Thickness, ft.
Surface	14
Flint	150
Lime and shale	356
Niagara	278
Shale	45
Clinton	25
Red Medina	35
Grey shale	23
Total depth	926

Sulphur water at 70 feet.

W. C. Patterson

J. Carpenter No. 2, lot 3, E. ½, con. IV, Walpole tp.

Completed June 15, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	20
Flint	147
Lime and shale	391
Niagara	263
Shale	20
Clinton	33
Red Medina	35
Shale	55
White Medina	15
Red shale	4
Total depth	983

Fresh water at 54 feet.

W. C. Patterson

A. Evans No. 1, lot 5, con. II, Walpole tp.

Completed October 8, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	7
Flint	143
Lime and shale	354
Niagara	300
Shale	35
Clinton	27
Red Medina	35
Shale	60
White Medina	18
Red shale	5
Total depth	984

Fresh water at 41 feet.

W. C. Patterson

P. Ionson No. 1, lot 10, con. VI, Walpole tp.

Completed July 13, 1935.
Producing gas well.
Rock pressure: 415 lbs.

Formation	Thickness, ft.
Surface	26
Flint	94
Lime and shale	375
Niagara	286
Shale	32
Clinton	28
Red Medina	33
Shale	63
White Medina	15
Red shale	4
Total depth	956

Fresh water at 68 feet; black water at 495 feet.

W. C. Patterson

P. Ionson No. 2, lot 10, con. VI, Walpole tp.

Completed September 7, 1935.
Producing gas well.
Rock pressure: 475 lbs.

Formation	Thickness, ft.
Surface	20
Flint	100
Lime and shale	371
Niagara	283
Shale	36
Clinton	28
Red Medina	41
Shale	56
White Medina	16
Red shale	51
Total depth	1,002

Gas at 827, 846, and 944 feet.
Fresh water at 18 feet; black water at 491 feet.

W. C. Patterson

B. Kindry No. 2, lot 6, con. III, Walpole tp.

Completed June 19, 1935.
Producing gas well.
Rock pressure: 350 lbs.

Formation	Thickness, ft.
Surface	14
Flint	140
Lime and shale	371
Niagara	280
Shale	45
Clinton	30
Red Medina	35
Shale	60
White Medina	15
Red shale	5
Total depth	995

Sulphur water at 90 feet.

W. C. Patterson

B. Kindry No. 3, lot 6, con. III, Walpole tp.

Completed August 1, 1935.
Producing gas well.
Rock pressure: 300 lbs.

Formation	Thickness, ft.
Surface	8
Flint	142
Lime and shale	350
Niagara	300
Shale	40
Clinton	27
Red Medina	40
Shale	60
White Medina	11
Red shale	5
Total depth	983

Black water at 80 feet.

W. C. PATTERSON

B. Kindry No. 4, lot 6, con. III, Walpole tp.

Completed August 31, 1935.
Producing gas well.
Rock pressure: 325 lbs.

Formation	Thickness, ft.
Surface	6
Flint	142
Lime and shale	352
Niagara	300
Shale	50
Clinton	27
Red Medina	35
Shale	60
White Medina	10
Red shale	48
Total depth	1,030

Black water at 80 and 490 feet.

W. C. PATTERSON

E. Mackey No. 1, lot 21, con. IV, Walpole tp.

Completed January 24, 1935.
Producing gas well.
Rock pressure: 275 lbs.

Formation	Thickness, ft.
Surface	10
Flint	120
Brown lime	398
Niagara	250
Shale	40
Clinton	26
Red Medina	40
Shale	60
White Medina	17
Red shale	5
Total depth	966

Fresh water at 80 feet; black water at 528 feet.

W. C. PATTERSON

E. Mackey No. 2, lot 21, con. IV, Walpole tp.

Completed December 7, 1935.
Producing gas well.
Rock pressure: 275 lbs.

Formation	Thickness, ft.
Surface	12
Flint	138
Lime and shale	360
Niagara	272
Shale	40
Clinton	27
Red Medina	40
Shale	60
White Medina	12
Red shale	4
Total depth	965

Black water at 90 feet.

W. C. PATTERSON

E. Miller No. 1, lot 2, con. IV, Walpole tp.

Completed May 10, 1935.
Producing gas well.
Rock pressure: 320 lbs.

Formation	Thickness, ft.
Surface	32
Flint	152
Lime and shale	359
Niagara	290
Shale	25
Clinton	26
Red Medina	28
Grey shale	74
White Medina	7
Red shale	3
Total depth	996

Clear water at 55 feet.

W. C. PATTERSON

G. Saunders No. 1, lot 5, con. III, Walpole tp.

Completed March 16, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	30
Flint	135
Lime and shale	375
Niagara	287
Shale	27
Clinton	25
Red Medina	35
Shale	60
White Medina	16
Red shale	5
Total depth	995

Black water at 165 feet.

W. C. PATTERSON

G. Saunders No. 2, lot 5, con. IV, Walpole tp.

Completed May 2, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	26
Flint	130
Lime and shale	377
Niagara	278
Shale	36
Clinton	25
Red Medina	40
Shale	60
White Medina	13
Red shale	5
Total depth	990

Fresh water at 60 feet; sulphur water at 156 feet.

FRED REICHELD

W. Hunt No. 1, lot 3, con. V, Walpole tp.

Completed May 10, 1935.
Producing gas well.
Rock pressure: 435 lbs.

Formation	Thickness, ft.
Surface	20
Flint	160
Lime and shale	350
Niagara	265
Shale	44
Clinton	29
Red Medina	42
Grey shale	55
White Medina	10
Red shale	40
Total depth	1,015

Gas at 841, 851, 867, 872, and 973 feet.
Fresh water at 60 and 155 feet.

FRED REICHELD

W. Hunt No. 2, lot 3, con. V, Walpole tp.

Completed August 7, 1935.
Producing gas well.
Rock pressure: 485 lbs.

Formation	Thickness, ft.
Surface	44
Flint	150
Lime and shale	343
Niagara	264
Shale	41
Clinton	28
Red Medina	42
Grey shale	60
White Medina	10
Red shale	2
Total depth	984

Gas at 844, 859, and 888 feet.
Sulphur water at 140 feet.

FRED REICHELD

D. Parkinson No. 1, lot 4, con. V, Walpole tp.

Completed August 22, 1935.
Producing gas well.
Rock pressure: 500 lbs.

Formation	Thickness, ft.
Surface	29
Flint	160
Lime and shale	351
Niagara	268
Shale	40
Clinton	27
Red Medina	40
Grey shale	60
White Medina	12
Red shale	40
Total depth	1,027

Gas at 850, 875, 881, and 986 feet.
Fresh water at 65 feet.

FRED REICHELD

D. Parkinson No. 2, lot 4, con. V, Walpole tp.

Completed July 2, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	31
Flint	160
Lime and shale	347
Niagara	262
Shale	45
Clinton	28
Red Medina	42
Shale	55
White Medina	10
Red shale	5
Total depth	985

Sulphur water at 150 feet.

FRED REICHELD

F. Reicheld No. 4, lot 10, con. V, Walpole tp.

Completed January 30, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	8
Flint	135
Lime and shale	342
Niagara	260
Shale	48
Clinton	28
Red Medina	40
Grey shale	60
White Medina	13
Red shale	3
Total depth	937

FRED REICHELD

F. Reicheld No. 5, lot 10, con. IV, Walpole tp.

Completed September 4, 1935.
Producing gas well.
Rock pressure: 505 lbs.

Formation	Thickness, ft.
Surface	22
Flint	125
Lime and shale	343
Niagara	269
Shale	57
Clinton	27
Red Medina	38
Grey shale	55
White Medina	10
Red shale	50
Total depth	996

Gas at 818, 831, and 943 feet.
Fresh water at 42 feet.

FRED REICHELD

F. Saunders No. 1, lot 3, con. V, Walpole tp.

Completed June 4, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	25
Flint	160
Lime and shale	350
Niagara	261
Shale	44
Clinton	28
Red Medina	38
Grey shale	53
White Medina	10
Red shale	2
Total depth	971

Sulphur water at 85 feet.

SANDUSK GAS AND OIL SYNDICATE

C. Doherty No. 1, lot 13, W. ½, con. VI, Walpole tp.

Completed April 19, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	26
Flint	140
Lime and shale	321
Niagara	270
Shale	51
Clinton	27
Red Medina	42
Grey shale	55
White Medina	14
Red shale	2
Total depth	948

Fresh water at 57 feet; black water at 70 feet.

SANDUSK GAS AND OIL SYNDICATE

C. Doherty No. 2, lot 13, W. ½, con. VI, Walpole tp.

Completed May 22, 1935.
Producing gas well.
Rock pressure: 478 lbs.

Formation	Thickness, ft.
Surface	11
Flint	104
Lime and shale	374
Niagara	270
Shale	52
Clinton	28
Red Medina	42
Grey shale	55
White Medina	12
Red shale	3
Total depth	951

Gas at 831, 836, 844, and 863 feet.
Sulphur water at 72 feet.

SANDUSK GAS AND OIL SYNDICATE

C. Doherty No. 3, lot 13, W. ½, con. VI, Walpole tp.

Completed July 9, 1935.
Producing gas well.
Rock pressure: 500 lbs.

Formation	Thickness, ft.
Surface	20
Flint	107
Lime and shale	363
Niagara	285
Shale	49
Clinton	28
Red Medina	42
Grey shale	46
White Medina	14
Red shale	1
Total depth	955

Gas at 853 and 868 feet.
Black water at 97 feet.

SANDUSK GAS AND OIL SYNDICATE

G. Duxbury No. 1, lot 18, con. IV, Walpole tp.

Completed September 26, 1935.
Producing gas well.
Rock pressure: 235 lbs.

Formation	Thickness, ft.
Flint	100
Lime and shale	344
Niagara	283
Shale	53
Clinton	29
Red Medina	43
Grey shale	55
White Medina	14
Red shale	1
Total depth	922

Gas at 816, 818, 843, 857, and 864 feet.
Black water at 595 feet.

SANDUSK GAS AND OIL COMPANY

G. Duxbury No. 2, lot 18, con. IV, Walpole tp.

Completed November 1, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	29
Flint	100
Lime and shale	351
Niagara	275
Shale	53
Clinton	29
Red Medina	45
Grey shale	55
White Medina	14
Red shale	2
Total depth	953

Fresh water at 32 feet.

ELGIN STEWART

A. Stewart No. 1, lot 18, con. V, Walpole tp.

Completed April 17, 1935.
Producing gas well.
Rock pressure: 280 lbs.

Formation	Thickness, ft.
Surface	9
Flint	91
Salt and pepper rock	45
Shale	355
Niagara	240
Guelph lime	30
Rochester shale	60
Clinton	32
Red Medina	47
Grey shale	65
White Medina	13
Red shale	3
Total depth	980

Gas at 824 and 879 feet.
Sulphur water at 205 feet.

WALPOLE GAS SYNDICATE

W. McBurney No. 5, lot 18, S. ½, con. VII, Walpole tp.

Completed July 20, 1935.
Producing gas well.
Rock pressure: 395 lbs.

Formation	Thickness, ft.
Surface	10
Flint	80
Lime and shale	357
Niagara	288
Rochester shale	52
Clinton	25
Red Medina	22
Red shale	15
Grey shale	59
White Medina	14
Red shale	4
Total depth	926

Gas at 820 and 830 feet.
Fresh water at 50 feet.

WALPOLE GAS SYNDICATE

A. Porter No. 3, lot 17, S. ½, con. VII, Walpole tp.

Completed August 17, 1935.
Producing gas well.
Rock pressure: 400 lbs.

Formation	Thickness, ft.
Surface	12
Flint	83
Lime and shale	350
Niagara	283
Clinton	31
Red Medina	6
Red shale	34
Grey shale	51
White Medina	12
Red shale	4
Total depth	916

Gas at 798 and 808 feet.
Fresh water at 105 feet.

WALPOLE GAS SYNDICATE

A. Porter No. 4, lot 17, S. ½, con. VII, Walpole tp.

Completed September 6, 1935.
Producing gas well.
Rock pressure: 390 lbs.

Formation	Thickness, ft.
Surface	13
Flint	110
Lime and shale	357
Niagara	272
White lime	52
Clinton	24
Red Medina	38
Red shale	38
Grey shale	60
White Medina	12
Red shale	3
Total depth	924

Gas at 772 and 921 feet.
Fresh water at 85 feet.

Kent County

TERRY AND SONS

Terry and Sons, No. 1, City of Chatham, Chatham tp.

Completed May 21, 1935.
Dry hole.

Formation	Thickness, ft.
Clay and quag	64
Black shale	31
Black, and blue and grey shale	55
Upper soap	162
Middle lime	11
Lower soap	23
Dark shell	3
Lower lime	88
Sand	23
Lime	37
Total depth	497

Show of gas at 364 feet.
Oil at 406 feet; pumped 60 barrels and then went dry.
Fresh water at 62 feet; salt water at 437 to 440, 445 to 460, and 470 to 475 feet.

UNION GAS CO. OF CANADA, LTD.

O. Dudley No. 1, lot 5, con. XIII, Chatham tp,
Completed November 12, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	70
Hamilton	370
Grey, and brown and grey lime	85
Blue and grey lime	10
Brown and grey lime	5
Grey and brown lime	80
Brown, and grey and brown lime	75
Dark-brown lime	70
Brown and grey lime	45
Sharp grey lime	140
Brown and grey lime	140
Blue lime and gypsum	35
Brown lime	10
Blue lime and gypsum	15
Brown lime	20
Blue lime	80
Brown, and blue and brown lime	50
Brown and grey lime	20
Blue lime	10
Brown, and brown and grey lime	55
Blue and grey lime	35
Blue and brown lime	185
Brown and brown and grey lime	105
Blue lime	5
Brown and grey lime	160
Rochester blue shale	30
Red and blue shale	90
Grey-white limestone	20
Total depth	2,015

Fresh water at 70 feet: sulphur water at 515 feet.

AJAX OIL AND GAS CO., LTD.

H. Sterling No. 1, lot 1, E. ½ of W. ½, con. IV, Dover East tp.
Completed April 9, 1935.
Producing gas well.
Rock pressure: 870 lbs.

Formation	Thickness, ft.
Surface	75
Hamilton shale	198
Lime	540
Sharp lime	90
Grey and brown lime	597
Salt	35
Brown and grey lime	390
White lime	45
Rochester shale	20
Red Medina	55
Grey shale	30
Lime and shells	4
Manitoulin dolomite	71
Red and grey shale	250
Grey shale and shells	90
Grey shale	270
Brown shale	144
Shells	6
Black shale	10
Trenton lime	210
Total depth	3,130

Gas at 3,038, 3,047, 3,063, 3,082 to 3,086, 3,100 to 3,110, and 3,115 to 3,120 feet.
Fresh water at 40 feet; salt water at 415 to 440 and 1,045 feet; brown water at 2,960 feet.

AJAX OIL AND GAS CO., LTD.

J. Antaya No. 2, lot 1, con. III, Dover East tp.
Completed November 9, 1935.
Producing gas well.
Rock pressure: 665 lbs.

Formation	Thickness, ft.
Surface	75
Soap	115
Soap and lime	87
Middle lime	18
Grey lime	185
Light-brown lime	15
Brown lime	325
Grey lime	10
Brown lime	286
Grey lime	109
Brown lime	155
Blue lime	75
Brown lime	40
Brown lime and salt	40
Brown lime	320
White lime	105
Blue shale	30
Red and blue shale	120
Blue shale	10
White Medina	40
Red shale	165
Blue shale	390
Brown shale	189
Trenton	205
Total depth	3,109

Gas at 2,940, 2,949, 2,972, 2,980, and 2,985 feet.
Water at 440 and 715 feet; salt water at 1,920, 3,023 to 3,237, and 3,109 feet.

CENTRAL PIPE LINE CO., LTD.

J. Sterling No. 1, lot 1, con. IV, Dover East tp.
Completed February 14, 1935.
Producing gas well.
Rock pressure: 810 lbs.

Formation	Thickness, ft.
Surface	76
Hamilton	201
Lime	485
Hard lime	325
Grey lime	493
Brown lime	63
Grey lime	110
Brown lime	111
Grey lime	128
Red Medina	26
Red shale	22
Grey shale	30
Lime and shale	46
Hard and sharp grey lime	56
Queenston	110
Lime shells and shale	182
Grey shale	220
Utica	241
Total depth	3,025

Gas at 2,989 feet.
Sulphur water at 433 feet.

CENTRAL PIPE LINE CO., LTD.

J. Sterling No. 2, lot 1, con. III, Dover East tp.

Completed August 27, 1935.
Producing gas well.
Rock pressure: 810 lbs.

Formation	Thickness, ft.
Surface	76
Hamilton	209
Lime	740
Brown lime	19
Lime	457
Salt and lime	48
Lime	419
Blue shale	23
Grey lime	5
Grey lime and grey shale	6
Red shale	13
Red Medina	29
Blue and red shale	12
Blue shale	14
Blue and red shale	38
Blue shale	14
White Medina	45
Queenston	137
Blue shale	156
Hard grey lime	75
Grey shale and shells	51
Blue shale	129
Utica	195
Trenton	159
Total depth	3,069

Gas at 2,940, 3,000, 3,015, 3,045, and 3,064 feet.
Fresh water at 68 and 478 to 571 feet; salt water at 612, 853, 1,025 to 1,088, and 1,774 to 2,916 feet.

KNIGHT, DOBIE, STOVER, AND RAWLINGS

P. Jubenville No. 3, lot 3, F.C., Dover East tp.

Completed May 1, 1935.
Producing gas well.
Rock pressure: 1,175 lbs.

Formation	Thickness, ft.
Surface	87
Hamilton shale and lime	158
Top of Onondaga, 245 feet.	
Bottom of Niagara, 1,850 feet.	
Top of Trenton, 2,780 feet.	
Shaley band at 380 feet in Trenton	5
Trenton lime	38
Total depth, 3,203 feet.	

Gas at 2,886 to 2,890, 2,905 to 2,911, and 2,911 to 2,917 feet.
Sulphur water at 400 and 700 to 1,050 feet; salt water at 1,525 feet.

LADD AND KNIGHT

J. Antaya No. 1, lot 1, con. IV, Dover East tp.

Completed June 15, 1935.
Producing gas well.
Rock pressure: 810 lbs.

Formation	Thickness, ft.
Surface	76
Hamilton	211
Big lime	229
Brown lime	44
Lime	26
Sharp grey lime	154
Grey-brown lime	986
Blue shale	25
Clinton	10
Red Medina	10
Blue and red shale	113
White Medina	40
Blue and red shale	278
Blue lime	18
Blue shale	323
Utica	117
Trenton	395
Total depth	3,309

Gas at 3,023 feet.
Sulphur water at 445 feet; salt water at 790 feet.

MIDWAL OIL AND GAS CO., LTD., ET AL.

C. Peltier No. 1, lot 5, con. III, Dover East tp.

Completed August 1, 1935.
Producing gas well.
Rock pressure: Not taken.

Formation	Thickness, ft.
Surface	79
Hamilton	228
Onondaga lime	113
Hard brown and grey lime	315
Brown and grey lime	264
Brown lime and gypsum	61
Grey and brown lime	55
Blue lime	70
Brown lime	140
Grey and brown lime	110
Brown lime	185
Grey and brown lime	9
Brown lime	156
Brown and grey lime	75
Rochester blue shale	28
Clinton	34
Cabot Head	84
Manitoulin dolomite	45
Red shale	611
Utica blue shale	143
Trenton lime	410
Blue shale	5
Trenton lime	45
Total depth	3,265

Gas at 1,549, 1,574, 1,610, and 3,240 feet.
Fresh water at 79 feet; sulphur water at 437 and 452 feet; salt water at 1,620 feet.

PRAIRIE GAS AND OIL CO., LTD.

M. Stephens No. 2, lot 2, con. III, Dover East tp.

Completed January 21, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	102
Hamilton shale and lime	148
Onondaga	175
Brown lime	275
Gritty brown lime	220
Brown lime	115
Blue and grey lime	430
Salt	30
Salt and lime shells	20
Brown and grey lime	265
Niagara lime	140[1]
Red and blue shale	35
Red and grey shale	60
Blue shale	343
Hard shell	12
Blue shale	305[1]
Brown and black shale	176
Trenton lime	379
Shale and lime	2
Trenton lime	494
Potsdam sandstone	5
Total depth	3,731

Show of gas at 3,581 feet.
[1]The log is not reliable between 1,920 and 2,675 feet.

PRAIRIE GAS AND OIL CO., LTD.

M. Stephens No. 3, lot 2, con. III, Dover East tp.

Completed April 18, 1935.
Producing gas and oil well.

Formation	Thickness, ft.
Surface	75
Hamilton shale and lime	190
Onondaga	120
White lime	175
Gypsum	2
White lime	38
Brown lime	360
Brown and blue lime	690
Niagara	305
Rochester	25
Red shale	125
White Medina	45
Queenston	270
Blue shale	385
Utica	102
Trenton	374
Blue shale	11
Total depth	3,292

Gas at 2,940, 3,085, 3,112, and 3,277 feet.
Oil at 3,280 to 3,292 feet.
Fresh water at 42 feet.

E. P. ROWE

V. Duphette No. 1, lot 2, W. ½, con. IV, Dover East tp.

Completed September 21, 1935.
Producing gas and oil well.
Rock pressure: 825 lbs.

Formation	Thickness, ft.
Clay	65
Gravel	8
Soap	157
Middle lime	20
Soap	35
Guelph lime	65
Lime	1,285
Niagara lime	325
Blue shale	30
Clinton	4
Red shale	56
Light-grey shale	20
Grey shale	30
White Medina	150
Red shale	10
Pink shale	50
Brown shale	150
Pink shale	210
Brown shale	230
Trenton lime	375
Total depth	3,275

Gas at 3,023, 3,050, 3,090, 3,095, and 3,100 feet.
Oil at 3,100 feet.
Fresh water at 70 feet; salt water at 560, 735, and 3,262 feet.

PRAIRIE GAS AND OIL CO., LTD.

M. Stephens No. 4, lot 2, con. III, Dover East tp.

Completed August 16, 1935.
Producing gas well.
Rock pressure: 850 lbs.

Formation	Thickness, ft.
Surface	89
Hamilton shale and lime	191
Onondaga lime	140
Detroit River, Salina, and Guelph:	
Sharp sand	80
Brown and grey lime	1,140
Niagara	315
Rochester shale	30
Clinton	4
Cabot Head	116
Manitoulin dolomite	48
Queenston and Hudson River:	
Red and pink shale	147
Brown shale	150
Blue shale	325
Utica brown shale	117
Trenton	382
Blue shale	4
Trenton	37
Total depth	3,315

Fresh water at 85 feet; black water at 435 feet; brackish water at 1,925 feet.
Gas at 3,029 feet.

CENTRAL PIPE LINE CO., LTD.

G. Jubenville No. 4, lot 1, con. II, Dover West tp.

Completed December 20, 1935.
Producing gas well.

Formation	Thickness, ft.
Surface	83
Lime and soap	222
Brown lime	132
Lime	125
Lime and gypsum	11
Lime	247
Sharp lime	122
Lime	1,049
Lime and blue shale	36
Red shale	29
Blue shale	46
Shale and shell	33
Lime	12
White Medina	41
Red shale	142
Blue shale	124
Blue shells	18
Lime shells	36
Blue shale	282
Brown shale	107
Brown lime and shale	3
Trenton	514
Total depth	3,414

Gas at 2,950, 2,985, 3,062, and 3,161 to 3,172 feet.
Show of oil at 3,342 feet.
Fresh water at 75 and 169 feet; sulphur water at 200 and 255 feet; salt water at 304 and 1,933 feet.

F. W. KEHLET

J. Downie No. 1, lot 26, W. ½, con. XIV, Orford tp.

Completed March 16, 1935.
Dry hole.

Formation	Thickness, ft.
Sand	10
Clay	57
Hardpan and stones	114
Top rock	7
Soap	37
Dark shell	9
Soap streak	1
Lower lime	178
Water sand	2
Total depth	445

Show of gas at 317 to 322 feet.
Salt water at 445 feet.

F. W. KEHLET

J. Ross No. 1, lot 23, con. XV, Orford tp.

Completed February 10, 1935.
Producing oil well.

Formation	Thickness, ft.
Sand	10
Clay	60
Hardpan and boulders	80
Pipe clay	10
Soapstone	43
Dark streak and soap	7
Lower lime	125
Brown lime	7
Light lime	13
Total depth	415

Oil at 294 to 300, 332 to 351, and 395 to 400 feet.
Fresh water at 205, 263, and 395 feet.

L. G. KURTZ

H. Bloom No. 1, lot 26, con. XIV, Orford tp.

Completed March 28, 1935.
Small producing oil well.

Formation	Thickness, ft.
Sand	4
Clay	54
Hardpan and boulders	96
Soapstone	91
Dark streak	6
Lower lime	185
Total depth	436

Oil at 165, 245 to 251, and 321 to 328 feet.
Salt water at 421 feet.

L. G. KURTZ

H. Bloom No. 2, lot 26, con. XIV, Orford tp.

Completed April 12, 1935.
Dry hole.

Formation	Thickness, ft.
Sand	5
Clay	55
Hardpan	90
Upper soap	62
Middle lime	8
Lower soap	25
Dark streak	5
Lower lime	185
Total depth	435

Small show of oil at 318 to 324 feet.
Salt water at 425 feet.

L. G. KURTZ

H. Bloom No. 3, lot 26, con. XIV, Orford tp.

Completed April 26, 1935.
Small producing oil well.

Formation	Thickness, ft.
Sand	5
Clay	60
Hardpan and gravel	86
Upper soap	60
Middle lime	11
Lower soap	19
Dark streak	9
Lower lime	152
Total depth	402

Small flow of oil at 275 to 280 feet; mud and oil at 315 feet.
Fresh water at 100 feet.

L. G. KURTZ

H. Bloom No. 4, lot 26, con. XIV, Orford tp.

Completed July 6, 1935.
Small producing oil well.

Formation	Thickness, ft.
Sand	12
Clay	53
Hardpan and gravel	70
Upper soap	77
Middle lime	10
Lower soap	24
Dark streak	5
Lower lime	183
Water sand	4
Total depth	438

Show of gas at 155 and 282 feet.
Water at 384 to 406 feet.

GAS PRODUCERS SYNDICATE

G. L. Pardo No. 3, lot 140, N.T.R., Raleigh tp.

Completed February 24, 1935.
Producing gas well.
Rock pressure: 675 lbs.

Formation	Thickness, ft.
Surface	190
Soap	135
Grey lime	60
Brown lime	175
Brown and white lime	135
Grey lime	23
Brown and white lime	42
Grey lime	65
Brown lime	155
Gypsum and lime	20
Blue lime	5
Brown lime	25
Blue and brown lime	310
Salt	30
Brown lime	67
Brown and grey lime	101
Total depth	1,538

Gas at 1,400, 1,406, 1,411 to 1,414, 1,455, 1,460, 1,476, 1,489, 1,502, 1,510, and 1,539 feet.
Sulphur water at 535 feet; sulphur and salt water at 585 and 796 feet.

J. PERDUE

Sullivan No. 1, lot 1, con. I, Raleigh tp.

Completed August 17, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	90
Upper soap	10
Lime	6
Soap	28
Middle lime	14
Lower soap	32
Dark streak	3
Lower lime	147
Sand	4
Total depth	334

Small show of oil at 185 feet.
Salt water at 330 feet.

E. P. Rowe

L. Bruette No. 1, lot 5, con. I, Raleigh tp.

Completed October 1, 1935.
Producing oil well.

Formation	Thickness, ft.
Surface	80
Lime shell	5
Soap	155
Middle lime	15
Soap	29
Grey lime	10
Light-brown lime	127
Sharp grey lime	29
White lime	10
Sharp grey lime	10
Grey lime	75
Lime and gypsum	195
Sharp brown lime	165
Lime and gypsum	515
Salt	65
Brown lime	45
Shale and lime	130
Brown lime	210
Grey lime	37
Blue shale	26
Clinton lime	2
Red shale	31
Blue shale	74
White Medina	60
Red shale	150
Blue shale	400
Brown shale	208
Trenton lime	392
Blue shale	4
Trenton lime	32
Total depth	3,286

Show of oil at 445 feet; oil at 3,261 feet.
Fresh water at 80 feet; black water at 450, 465, and 1,670 feet.

Union Gas Co. of Canada, Ltd.

J. D. Benedict No. 1, lot 140, N.T.R., Raleigh tp.

Completed February 18, 1935.
Producing gas well.
Rock pressure: 665 lbs.

Formation	Thickness, ft.
Surface	175
Hamilton shale and lime	140
Grey lime	245
Light-brown lime	10
Dark-brown and black lime	10
Light-brown lime	20
Sharp grey lime	220
Grey and brown lime	145
Grey lime and gypsum	10
Brown, and blue and brown lime	185
Blue lime	40
Blue, and brown and blue lime	50
Salt	35
Brown lime	115
Grey lime	40
Total depth	1,540

Gas at 1,403, 1,410, 1,418, and 1,497 to 1,540 feet.
Sulphur water at 550, 585, and 790 feet.

Union Gas Co. of Canada, Ltd.

J. Clayton No. 2, lot 17, con. XV, Raleigh tp.

Completed November 15, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	223
Hamilton shale and lime	73
Brown and grey lime	334
Sharp grey lime	210
Grey and brown lime	155
Blue lime	5
Grey lime	60
Blue lime	100
Brown, and brown and blue lime	70
Brown lime	60
Grey and blue lime	70
Blue and brown lime	45
Brown lime	50
Grey lime	157
Total depth	1,612

Gas at 1,430 feet; show of gas at 1,530 feet.
Sulphur water at 470 feet; salt water at 1,585 and 1,612 feet.

Union Gas Company of Canada, Ltd.

S. W. Russell No. 1, lot 17, con. XIII, Raleigh tp.

Completed June 20, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	175
Hamilton shale and lime	132
Grey lime	243
Brown lime	50
Grey lime	30
Sharp grey lime	200
Grey lime	90
Brown lime	90
Grey and brown lime	95
Blue lime	75
Brown and grey lime	50
Blue and brown lime	25
Brown lime	60
Blue, and blue and brown lime	115
Grey and brown lime	195
Brown lime	155
Grey lime	40
Total depth	1,820

Show of gas at 1,515 feet.
Sulphur water at 335, 555, and 585 feet; salt water at 1,590 and 1,750 feet.

Union Gas Company of Canada, Ltd.

S. W. Russell No. 2, lot 18, con. XIV, Raleigh tp.

Completed September 4, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	170
Hamilton shale and lime	103
Grey lime	237
Brown lime	70
Sharp grey lime	195
Brown lime	55
Grey lime	80
Grey lime and gypsum	45
Blue, and blue and grey lime	100
Brown, and blue and brown lime	250
Salt	130
Brown lime	75
Grey lime	60
Brown lime	25
Grey lime	10
Brown lime	215
Grey lime	18
Total depth	1,838

Show of gas at 285, 1,085, 1,105, and 1,605 feet.
Sulphur water at 420, 440, and 740 feet; salt water at 1,650 and 1,838 feet.

LADD AND ZEIGEN

Jones No. 1, lot 169, N.T.R., Tilbury East tp.

Completed January 30, 1935.
Producing gas well.
Rock pressure: 240 lbs.

Formation	Thickness, ft.
Surface	146
Soapstone	76
Shell	3
Soapstone	56
Grey lime	254
Brown lime	22
Grey lime and gypsum	18
Sharp lime	110
Brown lime	18
Grey lime and gypsum	48
Grey lime	58
Grey lime and gypsum	120
Brown lime	6
Grey lime	12
Brown lime and gypsum	12
Brown lime	41
Grey lime and gypsum	15
Brown lime	45
Grey lime	80
Grey lime and gypsum	15
Grey lime	65
Brown lime	45
Brown lime and gypsum	24
Brown lime	23
Grey lime	49
Brown lime	30
Grey lime	10
Total depth	1,401

Gas at 1,220 and 1,322 feet.
Fresh water at 135 feet; black water at 665 feet; salt water at 1,361, 1,391, and 1,401 feet.

LADD AND ZEIGEN

Mifflin No. 2, lot 7, con. XIV, Tilbury East tp.

Completed July 23, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	125
Top lime	5
Shale	9
Upper soap	68
Middle lime	8
Lower soap	63
Lower lime	127
Brown lime	33
Grey lime	57
Brown lime	105
Grey lime	27
Sharp lime	119
Grey lime	42
Brown lime	37
Grey lime	23
Brown lime	6
Grey lime	96
Lime and gypsum	61
Brown lime	6
Grey and brown lime	6
Lime and gypsum	39
Brown lime	47
Lime and gypsum	51
Grey lime	80
Brown lime	40
Grey lime	60
Brown lime	25
Grey lime	18
Total depth	1,303

Gas at 1,282 and 1,403 feet.
Fresh water at 126 feet; salt water at 435 feet; black water at 635 feet.

JACK PERDUE

R. C. Church No. 1, lot 1, R.R., Tilbury East tp.

Completed August 26, 1935.
Dry hole.

Formation	Thickness, ft.
Loam	5
Quag	35
Mild hardpan	51
Sand	5
Upper soap	53
Middle lime	12
Lower soap	37
Lower lime	81
Total depth	279

Fresh water at 91 feet; salt water at 275 feet.

CHRYSLER AND LULLER

Humphrey No. 1, lot 8, con. V, Zone tp.

Completed December 18, 1935.
Dry hole.

Formation	Thickness, ft.
Sand	15
Quag	10
Clay	33
Hardpan	2
Black shale	87
Top lime	40
Upper soap	145
Middle lime	10
Lower soap	18
Dark streak	2
Lower lime	133
Sharp sand	3
Total depth	498

Show of gas at 71 feet.
Fresh water at 68 feet; salt water at 498 feet.

J. VONBERG

H. Brewer No. 1, lot 19, con. VIII, Zone tp.

Completed December 12, 1935.
Small producing oil well.

Formation	Thickness, ft.
Top sand	17
Clay	38
Gravel	146
Dark streak	3
Soapstone	2
Soft lime	7
Grey hard lime	77
Dark lime	77
Light lime	18
Total depth	385

Oil at 213 and 367 to 385 feet.
Fresh water at 55 feet; salt water at 290 feet.

C. R. WALKER

Buchanan No. 1, lot 8, con. VI, Zone tp.

Completed September 17, 1935.
Dry hole.

Formation	Thickness, ft.
Sand	21
Quag	5
Clay	36
Hardpan	26
Black shale	34
Top lime	40
Upper soap	149
Middle lime	9
Lower soap	22
Dark streak	3
Lower lime	130
Sharp sand	10
Total depth	485

Fresh water at 120 feet; salt water at 378 feet.

G. E. AND D. E. Willits

Corlet No. 1, lot 9, con. III, Zone tp.

Completed July 31, 1935.
Dry hole.

Formation	Thickness, ft.
Sand	10
Quag	5
Clay	40
Hardpan	32
Black shale	53
Top lime	38
Upper soap	137
Middle lime	10
Lower soap	20
Dark streak	5
Lower lime	70
Total depth	420

Fresh water at 65 feet.

G. E. AND D. E. Willits

R. Jones No. 1, lot 5, con. V, Zone tp.

Completed September 10, 1935.
Dry hole.

Formation	Thickness, ft.
Sand	12
Clay	33
Hardpan	120
Upper soap	30
Middle lime	12
Lower soap	23
Dark streak	9
Soap streak	3
Lower lime	158
Total depth	400

Small show of oil at 235 feet.
Salt water at 255 feet.

G. E. AND D. E. Willits

Lutz No. 1, lot 14, R.R., Zone tp.

Completed June 24, 1935.
Small producing oil well.

Formation	Thickness, ft.
Sand	18
Clay	44
Hardpan and gravel	103
Soap	46
Dark streak	10
Lower lime	164
Oil rock	27
Total depth	412

Oil at 190 to 194, 220 to 225, 231 to 236, 290 to 295, 310 to 315, and 385 to 395 feet.

G. E. AND D. E. Willits

M. Mercer No. 1, lot 4, con. V, Zone tp.

Completed September 28, 1935.
Dry hole.

Formation	Thickness, ft.
Sand	15
Clay	21
Hardpan	139
Upper soap	49
Middle lime	8
Lower soap	24
Dark streak	3
Lower lime	137
Sharp lime	14
Sand	6
Total depth	420

Show of gas at 36 feet.
Salt water at 414 feet.

Lambton County

GEORGE SULLIVAN ET AL.

Lot 9, con. C, Kettle Point Indian Reservation, Bosanquet tp.

Completed May 24, 1935.
Small show of gas.

Formation	Thickness, ft.
Surface	9
Huron shale	12
Hamilton shale	365
Dark streak	4
Ondondaga lime	113
Total depth	503

Show of gas at 390 and 453 feet.
Salt water at 34 feet, dark salt water at 501 feet.

BROOKEFIELD OIL AND GAS CO., LTD.

F. Atcheson No. 3, lot 23, con. XIII, Brooke tp.

Completed February, 1935.
Dry hole.

Formation	Thickness, ft.
Clay	57
Hardpan	3
Black shale	22
Blue shale	5
Lime and soap	98
Soap	115
Middle lime	20
Lower soap	32
Big lime	82
Total depth	434

Show of gas at 400 to 405 feet.
Show of oil at 352 to 354 and 365 to 372 feet.
Fresh water at 57 to 60 feet; salt water at 432 feet.

BROOKEFIELD OIL AND GAS CO., LTD.

T. Scott No. 1, lot 22, con. XIII, Brooke tp.

Completed March 15, 1935.
Small producing oil well.

Formation	Thickness, ft.
Clay	61
Black shale	27
Top rock	3
Grey shale	74
Top soap	130
Middle lime	23
Lower soap	26
Big lime	117
Total depth	461

Oil at 416 to 418, 422, and 454 to 457 feet.

EMPIRE GOLD CO., LTD.

R. Powell No. 1, lot 25, con. XIII, Brooke tp.

Completed March 1935.
Dry hole.

Formation	Thickness, ft.
Surface	55
Black shale	25
Grey lime and soap	85
Soap	135
Lime	18
Lower soap	33
Lower lime	54
Total depth	405

Show of oil at 354 feet.
Fresh water at 55 feet; salt water at 405 feet.

GUBB AND RUSSELL

F. Braithwaite No. 2, lot 9, con. II, Brooke tp.

Completed September 21, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	52
Top rock	80
Upper soap	132
Middle lime	21
Lower soap	25
Big lime	90
Total depth	400

Fresh water at 52 feet; salt water at 400 feet.

GUBB AND RUSSELL

F. Braithwaite No. 3, lot 9, con. II, Brooke tp.

Completed October 8, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	52
Black shale	13
Top rock	70
Upper soap	139
Middle lime	10
Lower soap	32
Big lime	40
Total depth	365

Fresh water at 58 feet.

GUBB AND RUSSELL

H. Wilcox No. 1, lot 10, pt. of W.½, con. II, Brooke tp.

Completed May 15, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	58
Top rock	73
Soapstone	134
Middle lime	19
Lower soap	27
Big lime	145
Total depth	456

Fresh water at 57 feet; salt water at 455 feet.

LILEY AND WINKLER

W. Cambell No. 1, lot 8, con. II, Brooke tp.

Completed May 22, 1935.
Producing oil well.

Formation	Thickness, ft.
Surface	58
Top rock	71
Top soap	135
Middle lime	21
Lower soap	27
Big lime	88
Total depth	400

Oil at 332 feet.
Fresh water at 59 feet.

LILEY AND WINKLER

W. Cambell No. 2, lot 8, con. II, Brooke tp.

Completed June 19, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	59
Black shale	16
Top rock	15
Top soap	136
Middle lime	21
Lower soap	27
Big lime	37
Total depth	351

Fresh water at 58 feet.

SCIENTIFIC OIL AND GAS SYNDICATE

R. Serson No. 2, lot 27, con. XII, Brooke tp.

Completed October 8, 1935.
Producing gas well.
Small show of oil.

Formation	Thickness, ft.
Surface clay	52
Hardpan	13
Black shale	11
Grey shale	7
Lime	4
Lime and soap	43
Hard grey lime	10
Lime and soap	18
Hard grey lime	3
Soap	125
Soapy lime	4
Middle lime	25
Lower soap	23
Dark lime	8
Lower lime	107
Total depth	453

Gas at 160 feet.
Show of oil at 401 and 452 feet.
Fresh water at 55 feet; salt water at 401 to 452 feet; black water at 453 feet.

BERT WILSON

J. Lewis No. 2, lot 27, con. XII, Brooke tp.

Completed April 13, 1935.
Dry hole.

Formation	Thickness, ft.
Clay	30
Sand	30
Gravel	15
Grey shale	5
Top rock	80
Top soap	128
Middle lime	26
Lower soap	19
Grey lime	12
Big lime	120
Total depth	465

Salt water at 150 feet.

LEO WILSON ET AL.

R. Serson No. 1, lot 27, con. XII, Brooke tp.

Completed March 22, 1935.
Producing gas well.
Small oil yield.

Formation	Thickness, ft.
Clay	52
Black gravel	16
Grey shale	27
Soap	30
Hard lime	3
Soap	22
Lime	4
Soap	133
Middle lime	21
Soap	21
Dark lime	8
Big lime	128
Total depth	475

Gas at 95 feet.
Oil at 348 feet.
Sulphur water at 68 to 80 feet; brackish water at 400 to 405 feet; dark salt water at 450 to 475 feet.

GUBB AND RUSSELL

W. T. Weese No. 1, lot 22, N. ½, con. III, Dawn tp.
Completed December 9, 1935.
Dry hole.

Formation	Thickness, ft
Clay	62
Black shale	298
Top rock	55
Top soap	130
Middle lime	13
Lower soap	42
Onondaga	365
Hard grey lime	105
Hard brown and grey lime	80
Total depth	1,150

Fresh water at 62 feet; sulphur water at 725 feet.

ERNEST KELLS

E. Kells No. 1, Town of Petrolia, Enniskillen tp.
Completed August 30, 1936.
Producing oil well.

Formation	Thickness, ft.
Surface	94
Limestone	50
Upper soap	120
Limestone	16
Lower soap	45
Limestone	139
Total depth	464

Oil at 266, 280, 338, and 460 feet.
Fresh water at 93, 338, and 390 feet.

OLGA GAS AND OIL CO., LTD.

J. H. Coleman No. 1, lot 18, con. VI, Euphemia tp.
Completed August, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	50
Top rock	22
Soap and shell	142
Middle lime	11
Lower soap	20
Dark streak	7
Soap	3
Lower lime	159
Total depth	414

Show of oil at 348 feet.
Fresh water at 50 feet; salt water at 348 feet.

OLGA GAS AND OIL CO., LTD.

D. Ferguson No. 1, lot 19, con. VI, Euphemia tp.
Completed September, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	60
Hardpan	9
Top rock	32
Soap	99
Shell	4
Soap	38
Middle lime	11
Lower soap	20
Dark streak	5
Soap	1
Lower lime	59
Total depth	338

Show of oil at 287 feet.

OLGA GAS AND OIL CO., LTD.

C. McDonald No. 1, lot 17, con. VIII, Euphemia tp.
Completed July, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	78
Top rock	24
Soapstone and shell	70
Hard soap	38
Shell	6
Soap	22
Middle lime	15
Lower soap	19
Dark streak	5
Soap	1
Lower lime	119
Sandstone	4
Total depth	401

Show of oil and gas at 295 feet.
Fresh water at 79 feet; salt water at 397 to 401 feet.

F. L. PATTERSON ET AL.

A. Bruce No. 1, lot 4, con. IX, Moore tp.
Completed April 17, 1935.
Small producing oil well.

Formation	Thickness, ft.
Surface	145
Top rock	47
Top soap	133
Middle lime	12
Lower soap	45
Lower lime	392
Total depth	465

Oil at 392, 400, and 420 feet.
Fresh water at 172 feet.

F. L. PATTERSON ET AL.

A. Bruce No. 2, lot 4, con. IX, Moore tp.
Completed April 24, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	152
Top rock	63
Top soap	115
Middle lime	12
Lower soap	43
Lower lime	70
Total depth	455

Show of oil at 395 and 410 feet.
Fresh water at 171 feet.

F. L. PATTERSON ET AL.

A. Glover No. 1, lot 4, con. X, Moore tp.
Completed May 11, 1935.
Small producing oil well.

Formation	Thickness, ft.
Surface	145
Hardpan	5
Top rock	62
Top soap	120
Middle lime	13
Lower soap	50
Lower lime	69
Total depth	464

Oil at 422 feet.
Fresh water at 176 feet.

ALEXANDER GARDINER

D. McDonald No. 1, lot 5, W. ½, con. I, Plympton tp.

Completed July 24, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	163
Top rock	50
Top soap	140
Middle lime	15
Lower soap	45
Lower lime	72
Total depth	485

Fresh water at 167 feet.

F. L. MERRITT ET AL.

A. J. Garnon No. 1, lot 26, con. XIV, Plympton tp.

Completed July 13, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	73
Hardpan	3
Black shale	45
Top rock	84
Hard soap	30
Lime	10
Top soap	130
Middle lime	4
Lower soap	66
Lower lime	88
Total depth	533

Fresh water at 73 to 80 feet.
Black salty water at 531 to 533 feet.

WM. P. REDDICK

W. P. Reddick No. 1, lot 4, E. ¼, con. II, Plympton tp.

Completed August 28, 1935.
Small producing gas well.

Formation	Thickness, ft.
Brown clay	10
Blue clay	144
Top rock	40
Middle lime	15
Lower soap	50
Lower lime	55
Total depth	470

Gas at 435 and 460 feet.
Oil at 464 feet, but not pumped.

BERT WILSON, G. SULLIVAN, ET AL.

J. Cooper No. 1, lot 17, S. ½ of W. ½, con. III N. Warwick tp.

Completed January 5, 1935.
Dry hole.

Formation	Thickness, ft.
Clay	56
Gravel	2
Hamilton lime	68
Lime and soap	34
Lime	23
Soap	17
Lime	12
Soap	68
Lime	10
Soap	25
Lime	5
Soap	22
Middle lime	16
Lower soap	40
Onondaga lime	114
Total depth	512

Show of oil at 435 to 440, 495 to 500, and 505 to 510 feet.
Sulphur water at 64 feet.

BERT WILSON, G. SULLIVAN, ET AL.

W. Hall No. 1, lot 23, con. III N., Warwick tp.

Completed February 1, 1935.
Dry hole.

Formation	Thickness. ft.
Clay	67
Hamilton lime	50
Soap	8
Lime	35
Grey shale	21
Lime	14
Soap	85
Lime	2
Soap	8
Lime	15
Soap	15
Lime	23
Soap	17
Lime	10
Soap	10
Onondaga lime	110
Total depth	500

Show of oil at 400 to 405, 435 to 437, and 470 to 475 feet.
Sulphur water at 70 to 80 feet.

Lincoln County

LINCOLN GAS CO., LTD.

M. Lymburner No. 2, lot 1, con. III, Caistor tp.

Completed April 2, 1935.
Producing gas well.
Rock pressure: 130 lbs.

Formation	Thickness, ft.
Surface	73
Lime and shale	24
Niagara	220
Shale	37
Clinton	35
Red Medina	40
Shale	60
White Medina	10
Red shale	50
Total depth	549

Gas at 400 and 495 feet.

LINCOLN GAS CO., LTD.

Neigarth No. 1, lot 1, con. III, Caistor tp.

Completed February 21, 1935.
Producing gas well.
Rock pressure: 125 lbs.

Formation	Thickness, ft.
Surface	72
Lime and shale	25
Niagara	220
Shale	37
Clinton	26
Red Medina	39
Shale	60
White Medina	10
Red shale	50
Total depth	539

Gas at 397 and 489 feet.

LINCOLN GAS CO., LTD.

Neigarth No. 2, lot 1, con. III, Caistor tp.

Completed September 10, 1935.
Producing gas well.
Rock pressure: 125 lbs.

Formation	Thickness, ft.
Surface	77
Lime and shale	25
Niagara	208
Shale	35
Clinton	38
Red Medina	40
Shale	60
White Medina	10
Red shale	50
Total depth	543

Gas at 488 feet.
Sulphur water at 40 feet.

LINCOLN GAS CO., LTD.

Neigarth No. 3, lot 1, con. III, Caistor tp.

Completed October 20, 1935.
Producing gas well.
Rock pressure: 125 lbs.

Formation	Thickness, ft.
Surface	65
Lime and shale	15
Niagara	205
Shale	53
Clinton	28
Red Medina	29
Shale	57
White Medina	18
Red shale	50
Total depth	520

Gas at 358, 390, and 465 feet.
Sulphur water at 15 feet.

LINCOLN GAS CO., LTD.

L. Vaughn No. 1, lot 5, S. ½, con. I, Gainsborough tp.

Completed November 27, 1935.
Producing gas well.
Rock pressure: 125 lbs.

Formation	Thickness, ft.
Surface	80
Lime and shale	25
Niagara	203
Shale	47
Clinton	27
Red Medina	32
Shale	54
White Medina	15
Red shale	50
Total depth	533

Gas at 360 to 370 and 470 to 475 feet.
Sulphur water at 50 feet.

Middlesex County

J. H. GAUL

H. Anderson No. 1, lot 24, con. I, North Dorchester tp.

Completed July 22, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	158
Grey lime	42
Grey and brown lime	200
Brown lime and gypsum	50
Grey lime	170
Grey and brown lime	75
Blue shale	105
Lime and gypsum	25
Hard brown lime	195
Grey lime and gypsum	30
Brown lime	50
Guelph lime	27
Niagara lime	203
Blue shale	48
Clinton sand	10
Blue shale	17
Total depth	1,405

Gas at 1,055 and 1,102 feet; gas blew down rapidly.
Fresh water at 30 and 200 feet; sulphur water at 680 feet.

IRWIN CARROTHERS AND C. DEMARAY

W. L. McDonald No. 1, lot 11, con. V, Metcalfe tp.

Completed July 8, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	110
Petrolia (upper soap)	118
Widder (middle lime)	21
Olentangy (lower soap)	20
Dark hard lime	5
Mud vein	2
Onondaga (lower lime).	
Total depth	276

Fresh water at 85 to 90 feet.

CLARENCE DEMARAY

Wm. McIntyre No. 1, lot 11, con. IV, Metcalfe tp.

Completed October 30, 1935.
Dry hole.

Formation	Thickness, ft.
Clay	110
Sand	3
Hardpan	23
Soap	102
Middle lime	25
Lower soap	20
Lime	98
Total depth	391

Fresh water at 113 feet; black water at 385 feet.

FRED W. CRAFT

M. Armstrong No. 1, lot 17, con. IV, Mosa tp.

Completed January 19, 1935.
Dry hole.

Formation	Thickness, ft.
Sand	8
Clay	67
Hardpan and gravel	60
Upper soap	115
Middle lime	12
Lower soap	17
Dark streak	7
Lower lime	104
White sharp lime	15
Dark lime	28
Total depth	433

Fresh water at 80 feet; salt water at 428 feet.

DOMINION PETROLEUM CO., LTD.

J. Walker No. 19, lot 6, N. ½, con. VI, Mosa tp.

Completed November 1, 1935.
Dry hole.

Formation	Thickness, ft.
Drift	77
Hardpan	3
Soap	82
Lime	5
Soap	45
Lime	15
Shale	23
Lime (mostly dolomite)	150
Total depth	400

Fresh water at 77 and 140 feet.

L. P. MYTINGER ET AL.

H. Gould No. 3, lot 13, con. II, Mosa tp.

Completed October 1,1935.
Small producing oil well.

Formation	Thickness, ft.
Clay	70
Broken formation	45
Soap	140
Middle lime	20
Lower soap	19
Lower lime	106
Total depth	400

Oil at 315 and 355 feet.
Fresh water at 60 feet; salt water at 355 feet.

SLOAN AND ZOOK

N. Gillies No. 1, lot 6, con. VII, Mosa tp.

Completed October 30, 1935.
Dry hole.

Formation	Thickness, ft.
Clay	20
Quag	10
Clay	25
Sand	20
Hardpan	10
Upper soap	142
Middle lime	15
Lower soap	23
Dark streak	3
Lower lime	117
Grey and brown lime	6
Light-grey lime	9
Total depth	400

SLOAN AND ZOOK

P. McTavish No. 1, lot 6, con. VII, Mosa tp.

Completed November 15, 1935.
Dry hole.

Formation	Thickness, ft.
Clay	30
Quag	37
Hardpan	22
Top rock	45
Upper soap	153
Middle lime	10
Lower soap	27
Dark streak	16
Lower lime	98
Total depth	439

Fresh water at 30 and 130 feet.

SLOAN AND ZOOK

D. J. Mitchell No. 1, lot 7, con. V, Mosa tp.

Completed November 25, 1935.
Dry hole.

Formation	Thickness, ft.
Clay	75
Hardpan	10
Top rock	20
Upper soap	144
Middle lime	15
Lower soap	20
Dark streak	4
Lower lime	125
Sharp lime	10
Total depth	423

Fresh water at 75 feet.

BERT WILSON ET AL.

D. McIntyre No. 1, lot 1, con. XI, Mosa tp.

Completed November 15, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	22
Grey shale	26
Black shale	47
Lime and shale	55
Soap	10
Lime	8
Soap	134
Middle lime	18
Soap	24
Dark lime	6
Grey lime	15
Total depth	465

Fresh water at 16 feet; salt water at 462 feet.

Norfolk County

MIDDLETON NORFOLK GAS CO., LTD.

V. McDonald No. 2, lot 5, con. III, N.T.R., Middleton tp.

Completed February 23, 1935.
Producing gas well.
Rock pressure: 365 lbs.

Formation	Thickness, ft.
Surface	201
Lime and shale	167
Flint	122
Brown lime and shale	408
Niagara	5
Total depth	903

Gas at 900 feet.
Sulphur water at 900 feet.

MIDWAL OIL AND GAS CO., LTD.

W. Kelly No. 1, lot 2, S. pt., con. III, N.T.R., Middleton tp.

Completed March 21, 1935.
Dry hole.

Formation	Thickness, ft.
Clay	60
Quicksand	100
Clay and hardpan	34
Grey lime	110
Flint	125
Shale	175
Brown lime	286
Niagara lime	317
Blue shale	45
Clinton	28
Red Medina	2
Total depth	1,282

Sulphur gas at 915 feet.
Fresh water at 65 feet; sulphur water at 200 feet.

E. P. ROWE

C. D. Coyle No. 3, lot d, N.W. pt., con. II, N.T.R., Middleton tp.

Completed February 6, 1935.
Producing gas well.
Rock pressure: 550 lbs.

Formation	Thickness, ft.
Quicksand	140
Clay and gravel	38
Brown lime	145
Flint	125
Shale and gypsum	430
Niagara	295
Blue shale	55
Clinton lime	23
Pink shale	2
Thorold sand	4
Red Medina	15
Blue shale	10
Total depth	1,282

Gas at 1,253 and 1,257 feet.
Fresh water at 165 feet; sulphur water at 245 feet.

EMPIRE NATURAL GAS, LTD.

M. and A. Hazen No. 1, lot 16, con. I, South Walsingham tp.

Completed April 30, 1935.
Producing gas well.
Rock pressure: 400 lbs.

Formation	Thickness, ft.
Surface	305
Lime and shale	170
Flint	135
Lime and shale	345
Niagara	279
Shale	56
Clinton	34
Red Medina	17
Shale	28
Total depth	1,369

Gas at 1,303 feet.
Fresh water at 300 feet.

EMPIRE NATURAL GAS, LTD.

C. Leighfield No. 1, lot 12, con. B, South Walsingham tp.

Completed November 22, 1935.
Producing gas well.
Rock pressure: 600 lbs.

Formation	Thickness, ft.
Surface	298
Lime and shale	177
Flint	125
Lime and shale	370
Niagara	268
Shale	65
Clinton	28
Red Medina	22
Grey shale	40
Total depth	1,393

Gas at 1,310 and 1,348 feet.
Sulphur water at 300 feet.

EMPIRE NATURAL GAS, LTD.

H. Mudford No. 2, lot 17, con. I, South Walsingham tp.

Completed February 24, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	305
Lime and shale	170
Flint	130
Lime and shale	365
Niagara	276
Shale	52
Clinton	27
Red Medina	10
Grey shale	104
White Medina	15
Red shale	4
Total depth	1,458

Fresh water at 305 feet.

ALOKA OIL CO., LTD.

F. Smith No. 1, lot 6, con. III, Woodhouse tp.

Completed April 26, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	47
Limestone	25
Flint	140
Brown lime	38
Lime and shale	354
Niagara lime	280
Blue shale	57
Clinton	35
Red Medina	17
Blue shale	90
White lime	15
Red shale	4
Total depth	1,104

Show of gas at 978 feet.

BURCHELL NATURAL GAS AND OIL SYNDICATE

N. Brown No. 1, lot 22, con. VI, Woodhouse tp.

Completed July 12, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	42
Flint	130
Lime and shale	427
Niagara	225
Shale	53
Clinton	32
Red Medina	30
Grey shale	58
White Medina	12
Red shale	3
Total depth	1,012

Fresh water at 78 feet; black water at 647 feet.

BURCHELL NATURAL GAS AND OIL SYNDICATE

W. Ferris No. 1, lot 20, S. ½, con. VI, Woodhouse tp.

Completed June 21, 1935.
Producing gas well.
Rock pressure: 500 lbs.

Formation	Thickness, ft.
Surface	10
Flint	160
Lime and shale	420
Niagara	210
Shale	47
Clinton	17
Red Medina	45
Grey shale	60
White Medina	15
Red shale	25
Total depth	1,009

Gas at 859, 879, and 979 feet.
Sulphur water at 60 and 300 feet; black water at 400 feet.

BURCHELL GAS AND OIL SYNDICATE

W. Ferris No. 2, lot 22, con. VI, Woodhouse tp.

Completed July 25, 1935.
Producing gas well.
Rock pressure: 500 lbs.

Formation	Thickness, ft.
Surface	31
Flint	160
Lime and shale	380
Niagara	210
Shale	59
Clinton	38
Red Medina	32
Grey shale	55
White Medina	12
Red shale	27
Total depth	1,004

Gas at 900 feet.
Fresh water at 60 feet; sulphur water at 160 feet; black water at 400 feet.

BURCHELL NATURAL GAS AND OIL SYNDICATE

W. Ferris No. 3, lot 22, con. VI, Woodhouse tp.

Completed September 2, 1935.
Producing gas well.
Rock pressure: 500 lbs.

Formation	Thickness, ft.
Surface	24
Flint	160
Lime and shale	350
Niagara	250
Shale	50
Clinton	32
Red Medina	38
Grey shale	50
White Medina	12
Red shale	3
Total depth	969

Fresh water at 60 feet; sulphur water at 90 feet; black water at 500 feet.

WALTER GAS SYNDICATE

C. Blow No. 2, lot 12, con. VI, Woodhouse tp.

Completed March 2, 1935.
Producing gas well.
Rock pressure: 385 lbs.

Formation	Thickness, ft.
Surface	65
Flint	110
Lime and shale	385
Niagara	320
Rochester shale	33
Clinton	28
Red Medina	25
Blue shale	65
White Medina	11
Red shale	12
Total depth	1,054

Gas at 922 and 941 feet.
Sulphur water at 143 feet.

WALTER GAS SYNDICATE

J. Walker No. 1, lot 12, con. VI, Woodhouse tp.

Completed November 11, 1935.
Producing gas well.
Rock pressure: 385 lbs.

Formation	Thickness, ft.
Surface	57
Flint	105
Lime and shale	388
Niagara lime	319
Rochester shale	41
Clinton sand	34
Red Medina	16
Blue shale	66
White Medina	9
Red shale	2
Total depth	1,037

Gas at 914 and 960 feet.
Fresh water at 72 feet, sulphur water at 143 feet.

Oxford County

ALOKA OIL AND GAS CO., LTD.

C. C. Hawkins No. 1, lot 23, N.W. ¼, con. XII Dereham tp.

Completed September 13, 1935.
Producing gas well.
Rock pressure: 450 lbs.

Formation	Thickness, ft.
Surface	166
Lime and shale	24
Brown and grey lime	110
Lime and shale	85
Flint	35
Brown and grey lime	65
Lime and shale	45
Shale and gypsum	160
Lime and shale	20
Brown lime	55
Shale	30
Lime and shale	45
Brown lime	10
Lime and shale	40
Guelph	15
Total depth	905

Sulphur water at 166 feet.

ALOKA OIL AND GAS CO., LTD.

C. C. Hawkins No. 2, lot 23, con. XII, Dereham tp.

Completed December 6, 1935.
Producing gas well.
Rock pressure: 465 lbs.

Formation	Thickness, ft.
Surface	164
Lime and shale	21
Brown lime	55
Grey lime	45
Brown lime	15
Lime and shale	80
Flint	70
Brown lime	30
Lime and shale	50
Shale and gypsum	170
Lime and shale	55
Shale	30
Lime and shale	50
Brown lime	10
Lime and shale	45
Grey lime	27
Total depth	917

Gas at 900 to 915 feet.
Sulphur water at 168 and 430 feet.

Welland County

HALDIMAND NATURAL GAS SYNDICATE

W. Reinhart No. 1, lot 3, N. ½, con. II, N.R., Bertie tp.

Completed September 10, 1935.
Producing gas well.
Rock pressure: 75 lbs.

Formation	Thickness, ft.
Surface	106
Salina	214
Guelph and Niagara	210
Rochester	100
Clinton	32
Red Medina	75
Manitoulin	10
White Medina	30
Queenston	45
Total depth	822

Gas at 712 and 760 feet.
Fresh water at 35 feet.

WELLAND COUNTY GAS SYNDICATE

J. G. Morningstar No. 1, lot 16, con. VIII, N.R., Bertie tp.

Completed August 15, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	16
Salina	210
Guelph and Niagara	220
Rochester	108
Clinton	32
Red Medina	65
Manitoulin	27
White Medina	25
Queenston	5
Total depth	708

WESTERN ONTARIO NATURAL GAS CO., LTD.

J. Lampman No. 1, lot 38, con. VI, Wainfleet tp.

Completed September 3, 1935.
Producing gas well.
Rock pressure: 235 lbs.

Formation	Thickness, ft.
Surface	114
Lime and shale	79
Niagara	225
Shale	55
Clinton	30
Red Medina	40
Grey shale	48
White Medina	17
Red shale	24
Total depth	632

Gas at 596 to 606 feet.
Fresh water at 115 feet; salt water at 210 feet.

WESTERN ONTARIO NATURAL GAS CO., LTD.

W. Ricker No. 1, lot 37, N. ½, con. VI, Wainfleet tp.

Completed September 30, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	114
Lime and shale	53
Niagara	225
Shale	55
Clinton	29
Red Medina	40
Grey shale	52
White Medina	17
Red shale	15
Total depth	600

Fresh water at 115 feet; salt water at 190 feet.

WESTERN ONTARIO NATURAL GAS CO., LTD.

P. Shefley No. 1, lot 39, con. V, Wainfleet tp.

Completed August 10, 1935.
Producing gas well.
Rock pressure: 235 lbs.

Formation	Thickness, ft.
Surface	121
Lime and shale	79
Niagara	225
Shale	60
Clinton	30
Red Medina	45
Grey shale	53
White Medina	17
Red shale	10
Total depth	640

Gas at 616 and 638 feet.
Fresh water at 122 feet; salt water at 215 feet.

MINING CLAIMS MART

G. Ortt No. 1, lot 1, con. IV, Willoughby tp.

Completed June 22, 1935.
Producing gas well.
Rock pressure: 165 lbs.

Formation	Thickness, ft.
Surface	50
Lime and shale	163
Niagara	215
Shale	60
Clinton	36
Red Medina	74
Shale	20
White Medina	15
Red shale	50
Total depth	683

Gas at 548 feet.
Fresh water at 60 feet.

F. A. SCHWEGLER

F. A. Schwegler No. 1, lot 15, B.F., N.R., Willoughby tp.

Completed June 4, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	22
Salina	191
Guelph and Niagara	210
Rochester	97
Clinton	32
Red Medina	70
Manitoulin	20
White Medina	23
Total depth	665

Fresh water at 35 feet.

F. A. SCHWEGLER

F. A. Schwegler No. 2, lot 15, B.F., N.R. Willoughby tp.

Completed July 20, 1935.
Dry hole.

Formation	Thickness, ft.
Surface	16
Salina	210
Guelph and Niagara	220
Rochester	108
Clinton	32
Red Medina	65
Formation—*Continued*	
Manitoulin and White Medina	52
Queenston	6
Total depth	709

Fresh water at 40 feet.

Wentworth County

C. A. HEWITT

C. A. Hewitt No. 1, lot 31, con. IX, Binbrook tp.

Completed October 25, 1935.
Producing gas well.
Rock pressure: 70 lbs.

Formation	Thickness, ft.
Surface	47
Lime and gypsum	12
Niagara lime	243
Shale	30
Clinton	28
Red Medina	43
Blue shale	60
White Medina	12
Red shale	40
Total depth	515

Gas at 470 feet.
Fresh water at 50 feet.

SECURITY OIL AND GAS CO., LTD.

Logan No. 1, lot 15, con. VIII, Glanford tp.

Completed August 14, 1935.
Producing gas well.
Rock pressure: 50 lbs.

Formation	Thickness, ft.
Surface	55
Lime and shale	25
Niagara	228
Lime and shale	48
Clinton	22
Blue shale	24
Red Medina	10
Shale	26
White Medina	14
Red shale	48
Total depth	500

Gas at 446 feet.
Fresh water at 60 feet; sulphur water at 221 feet.

SECURITY OIL AND GAS CO., LTD.

Logan No. 2, lot 15, con. VIII, Glanford tp.

Completed September 10, 1935.
Producing gas well.
Rock pressure: 50 lbs.

Formation	Thickness, ft.
Surface	45
Lime and shale	35
Niagara	228
Lime and shale	48
Clinton	24
Blue shale	24
Red Medina	10
Shale	27
White Medina	15
Red shale	48
Total depth	504

Gas at 450 feet.
Fresh water at 80 feet; sulphur water at 221 feet.

PETROLEUM IN 1935

By R. B. Harkness

General

The year 1935 is the fifth consecutive year of increase in crude oil production in Ontario. The total increase over the lowest year (1930) is 32 per cent., and there has been only one new discovery. The production for 1935 is 165,040 barrels, an increase of 23,655 barrels over 1934. To equal this year's production it is necessary to go back fourteen years, at which time there were 1,400 more producing wells than at present, the price for oil at the refinery was $2.67, and the Dominion Government paid a bounty of 52½ cents per barrel, a total of $1.09½ above to-day's prices.

The greatest increase is in the Bothwell field where, without increasing the production area but simply by opening old wells shut down and abandoned possibly thirty years ago, the production has been brought back to the level of 1911-12. Two new fields have been brought into production since these years, the Dover and the Dawn; but the chief increase came in the old fields that had been in operation from fifty to seventy years.

Undoubtedly the psychological effect of falling price was one of the main reasons for the annual decline in production. In 1921 the price of steel pipe was at its peak and the price of oil had dropped about $1.25 per barrel; operators felt that they could not afford to buy new pipe and fittings at such prices in the face of a falling market. The fields were very old, and on the basis of the history of all oil fields seemed due for abandonment. Old wells had been patched up by using equipment from still older wells, and naturally water troubles increased; it required all the knowledge and courage of the then Inspector of Oil Wells, John Scott, to ferret out the source of the many troubles and insist on repairs being made. This was made more difficult on account of the many absentee owners. However, he and the more courageous operators kept the fields alive; those who lost courage sold out to others. Many of these purchasers were young men who had returned after having had a world-wide experience, and who applied their knowledge to good effect. About this time the electric motor superseded the gasoline and natural gas engine. The old-type gas engine was subject to many troubles both night and day, and particularly in winter, whereas the electric motor is dependable at all times. As the price of steel pipe declined, replacements increased. It had been practically a universal practice to pump groups of wells on a property into one central tank; the new operators who measured individual wells discovered that many were not producing enough oil to pay for the cost of pumping; these were abandoned. No doubt as this practice increases, many more unprofitable wells will be abandoned.

Following the success obtained in the Michigan oil fields of pumping hydrochloric acid into oil wells where the oil horizon was limestone and thereby enlarging the many channels by which the oil reached the bottom of the well, some tests of this method were made in Petrolia and Oil Springs but without complete success, chiefly owing to the faulty equipment, particularly casing packers, which are mostly "home-made" and designed to resist pressure only from above. These failed to retain the pressure exerted on the acid, and it was found impossible to force the acid into the rock. Some benefit resulted in the thorough cleaning of the limestone walls of the well, much of the accumulated paraffin, scale, and other sediment always present in old oil wells being removed.

The work mentioned in last year's report[1] of cleaning out and recasing, and in some cases redrilling, old wells in the Bothwell field was continued in 1935 with remarkable success. Practically the whole area, which was opened up after the discovery of oil on the Thames by Lick in 1865 but which has lain idle for many years, has been treated in this manner.

Activity in Brooke township has ceased, following the disappointing results from the wells, which had a high initial production. From a total of 36 wells, representing an estimated investment of $50,000 in wells and equipment, a total of 2,063 barrels of oil was produced, having a value of $4,371.

Activity in the Dover field extended across the Thames river into Raleigh township, where a well was drilled that had an initial production of 20 barrels per day. This well has a very small quantity of gas, which is not sufficient to make the oil flow to the surface. Although the well is in Raleigh township, it has been included in the Dover field, since it is actually an extension of that field and not of the old Raleigh field, which lies six miles to the south. This well and two others produced over 13,000 barrels.

Not all of the Dawn oil wells are operated continuously; some of them produce gas as well as oil, and the oil production for the year depends on the continuity of operation. The increase and decrease in annual production does not in any way indicate additional producing wells or failure of the present wells.

Fourteen drilling rigs, described as "shallow-well rigs," were in use during the year, representing a capital investment of $30,200. These drilled a total footage of 29,612 feet. The employees numbered 23, and they received $11,950 in wages. These figures are included in the totals for the crude petroleum industry shown at the bottom of Table I.

TABLE I—OIL PRODUCED IN ONTARIO BY FIELDS, 1927–1935

Field	1928	1929	1930	1931	1932	1933	1934	1935
	bbls.	bbls.	bbls.	bbls.	bbls.	bbls.	bbls.	bbls.
Petrolia and Enniskillen	60,547	56,284	55,130	57,515	58,871	57,298	57,938	59,282
Oil Springs	35,653	30,737	29,160	30,792	31,438	31,343	29,863	31,646
Moore tp.	2,148	1,230	1,576	3,739	3,272	2,192	2,963	3,263
Sarnia tp.	1,221	749	1,149	1,466	1,227	2,181	825	870
Plympton tp.	371	315	296	296	274	211	202	237
Bothwell	24,255	23,236	21,176	18,024	19,460	22,935	32,133	34,715
Tilbury East tp.	736	138	149	.....	.....	.....	.....	.....
Dover tp.	773	715	457	891	453	763	558	13,117
Raleigh tp.	.....	.....	.....	.....	.....	239	264	195
Onondaga tp.	186	243	231	34	543	946	601	431
Mosa tp.	7,268	6,851	7,166	8,517	8,429	8,168	9,031	8,788
Thamesville	1,006	427	447	462	534	847	614	428
Euphemia tp.	.....	.....	.....	121	496	510	189	(1)
Dunwich tp.	.....	148	365	507	285	346	283	408
Brooke tp.	.....	52	.....	.....	.....	.....	1,941	122
Dawn tp.	.....	.....	.....	.....	5,061	8,079	3,980	11,538
Total	134,164	121,125	117,302	122,364	130,343	136,058	141,385	165,040
Value	$249,981	$253,678	$235,746	$219,993	$247,468	$253,486	$299,874	$346,156
Average price	$1.86	$2.09	$2.00	$1.80	$1.89	$1.86	$2.12	$2.10

[1]Included in Dawn township.

The capital employed in producing crude petroleum is $1,040,436; the number of employees, 221; and the wages paid, $127,862. This information is furnished by the Dominion Bureau of Statistics, Ottawa.

[1]Ont. Dept. Mines, Vol. XLIV, pt. 5, 1935, p. 67.

TABLE II—OIL WELLS AND THEIR PRODUCTION, 1935

Field	Wells			Wells drilled		Production[1]		Gain or loss in 1935	
	Operating	Not operating	Abandoned	Producing	Dry			Gain	Loss
						bbls.	gals.	bbls.	bbls.
Petrolia and Enniskillen	736	768	11	1	.....	59,281	20	1,344	.....
Oil Springs	876	148	3	.....	.....	31,646	17	1,784	.....
Moore tp	55	39	1	.....	3	3,263	31	301	.....
Sarnia tp	72	31	.....	.....	.....	870	19	45	.....
Plympton tp	24	8	.....	1	3	236	32	35	.....
Bothwell	220	70	5	6	9	34,714	17	2,582	.....
Dover tp	2	.....	.....	.....	.....	13,117	1	12,559	.....
Raleigh tp	1	6	.....	1	1	195	.....	.....	69
Onondaga	13	23	1	.....	.....	430	26	.....	170
Mosa	89	41	3	2	5	8,787	22	.....	243
Thamesville	2	22	.....	.....	.....	428	5	.....	186
Euphemia and Dawn tps	13	112	.....	.....	3	11,537	24	7,368	.....
Dunwich tp	3	96	.....	.....	3	408	3	125	.....
Brooke tp	3	11	7	1	10	122	11	.....	1,819
Tilbury East tp	.....	1	.....	.....	1	.....	.....	.....	.....
Bosanquet tp	.....	2	.....	.....	1	.....	.....	.....	.....
Nottawasaga tp	.....	.....	1	.....	.....	.....	.....	.....	.....
Other fields	.....	.....	.....	.....	[2]8	.....	.....	.....	.....
Total	2,109	1,378	32	12	47	165,040	18	26,143	2,487
								Net gain	23,655

[1]Production figures from the Imperial Oil Company.

[2]Two in Metcalfe, 1 in Mono, 1 in Nassagaweya, 2 in Warwick, 1 in Gloucester, and 1 in the city of Chatham.

Petroleum Refining

Seven petroleum refineries were in operation in Ontario in 1935, as listed below:—

PETROLEUM REFINERIES, 1935

Company	Location of refinery	Head office address
British American Oil Co., Ltd.	Foot of Cherry St., Toronto	Royal Bank Bldg., Toronto.
Burlington Refineries, Ltd.	Burlington St. E., Hamilton	70 Brant St., Hamilton.
Canadian Oil Companies, Ltd.	Petrolia	12 Strachan Ave., Toronto.
Goodrich Refining Co., Ltd.	Scarborough	3509 Danforth Ave., Toronto.
Imperial Oil Refineries, Ltd.	Sarnia	Sarnia.
Lloyds Refinery	Port Credit	Port Credit.
McColl-Frontenac Oil Co., Ltd.	Foot of Cherry St., Toronto	Royal Bank Bldg., Montreal, Que.

The total capacity of these refineries is 39,900 barrels.

A comparison of refining operations over a 6-year period is given in Table III. The figures in this table, together with those in Table IV, represent the consumption of petroleum products in Ontario, as nearly as it can be arrived at. Along the eastern and western boundaries of Ontario, there is some interprovincial trade, viz. imports from Montreal and exports to Manitoba. It is not known where the balance of trade lies, but it will not be sufficient to seriously affect the total.

A comparison of the past five years shows that conditions are gradually coming back towards the peak years of 1930 and 1931. The increase in the production of cracked gasoline is very marked.

TABLE III—PETROLEUM REFINING OPERATIONS, 1930–1935[1]

Schedule	Unit of measure	1930	1931	1932	1933	1934	1935
Imported crude distilled	Gallons[2]	343,372,124	364,871,253	327,524,704	314,058,338	307,717,332	331,461,390
	Value	$23,273,547	$17,035,028	$19,197,691	$14,904,715	$16,110,251	$16,624,472
Imported crude oil distilled not in its natural state	Gallons	.....	.....	1,669,675	14,815,049	27,871,946	1,629,805
	Value	.....	.....	$51,092	$966,409	$1,723,943	$140,091
Canadian crude distilled	Gallons	3,944,969	4,382,806	4,704,609	4,823,639	4,289,702	6,321,891
	Value	$264,008	$261,334	$290,752	$299,793	$274,888	$408,366
Percentage of total	.....	1.13	1.19	1.43	1.45	1.26	1.87
Total value of crude	.....	$23,537,555	$17,296,362	$19,539,535	$16,170,917	$18,109,082	$17,172,929
PRODUCTS							
Gasoline: Straight run	Gallons	97,806,121	95,934,920	61,297,731	89,429,293	81,307,756	85,698,897
	Selling value	$12,334,586	$9,886,611	$6,378,577	$7,793,607	$6,231,050	$6,439,916
By cracking process	Gallons	84,496,056	100,120,768	109,519,770	70,519,864	71,949,582	93,901,122
	Selling value	$11,066,369	$10,544,926	$10,673,010	$5,736,708	$4,754,529	$6,745,372
Kerosene	Gallons	17,973,730	14,656,833	18,666,252	26,499,830	14,208,236	10,424,545
	Selling value	$1,980,546	$1,397,607	$1,736,164	$2,022,408	$1,109,504	$814,344
Lubricating oil	Gallons	16,451,717	13,963,545	14,187,555	16,299,872	17,638,490	16,785,539
	Selling value	$2,756,579	$2,445,410	$3,476,341	$2,854,787	$3,695,083	$3,342,280
Engine distillate and naphtha	Gallons	4,272,751	3,652,973	6,098,784	8,384,517	6,636,041	[3]12,570,944
	Selling value	$504,206	$327,717	$573,585	$490,728	$340,237	$736,449
Gas oil	Gallons	80,742,218	101,370,904	85,233,170	37,860,532	50,461,106	42,526,709
	Selling value	$3,792,757	$3,627,041	$3,550,598	$1,874,878	$2,795,217	$1,742,684
Fuel oils	Gallons				55,394,540	58,918,615	55,133,960
	Selling value				$2,112,522	$2,716,951	$2,416,004
Tar	Gallons	101,750	902,000	.....	.....	130,641	12,132,400
	Selling value	$8,140	$9,020	.....	.....	$49,977	$48,529
Grease	Pounds	13,468,964	8,814,022	8,751,758	8,342,446	8,571,927	9,898,844
	Selling value	$268,509	$171,036	$492,339	$357,316	$509,271	$459,595
Paraffin wax and candles	Pounds	10,153,924	10,097,478	9,196,156	8,978,068	10,656,115	11,237,665
	Selling value	$453,601	$368,686	$417,386	$355,323	$476,928	$434,921
Petroleum coke	Short tons	56,946	54,223	62,836	62,601	49,011	53,845
	Value	$316,180	$285,051	$328,067	$344,686	$268,821	$320,004
Still gas	M cu. ft.	1,551,334	2,128,739	1,942,741	1,574,451	1,498,379	2,122,091
	Value	$421,500	$505,156	$410,222	$306,984	$281,524	$468,765
Asphalt	Gallons	6,029,624	8,778,452	6,885,142	6,494,707	7,946,775	6,977,781
	Selling value	$285,460	$318,005	$555,654	$524,532	$712,468	$600,229
Miscellaneous	Value	$291,404	$219,900	$222,545	$50,498	$56,971	$95,350
Total value of refined products	.....	$34,479,837	$30,106,166	$28,814,438	$24,824,977	$23,998,621	$24,664,342
Employees	Average No.	2,449	1,984	1,937	2,036	2,047	2,012
	Wages paid	$3,760,870	$2,840,794	$2,764,208	$2,752,718	$2,637,213	$2,970,360
Capital invested	.....	$26,761,273	$25,282,459	$25,732,687	$22,947,812	$23,579,481	$21,367,847

[1]*Information furnished by the Dominion Bureau of Statistics, Ottawa.*
[2]Gallons refer to Imperial gallons.
[3]Of this, 8,567,840 Imperial gallons, valued at $452,774, was sold as engine and tractor fuel.

Petroleum Imported into Ontario

Table IV gives a comparative statement of imports of crude and refined petroleum for the past two years. There is a 13 per cent. gain in the crude petroleum imported and a 20 per cent. loss in gallonage of refined petroleum imported. This loss is distributed through all products except lubricating oil, which shows an increase. A comparison of this table with Table II shows a healthy growth in the refining industry in Ontario.

TABLE IV—PETROLEUM AND REFINED PRODUCTS IMPORTED IN 1934 AND 1935

Import	1934		1935	
	Imperial gallons	Value	Imperial gallons	Value
CRUDE PETROLEUM:				
Petroleum, 0.790 specific gravity or heavier, for refining	244,801,477	$7,498,528	281,043,063	$8,747,729
REFINED PETROLEUM:				
For use in concentrating ores	12,580	$7,108	11,699	$7,229
Gasoline lighter than 0.669 specific gravity (casing head)	5,973,610	259,232	3,486,281	195,037
Gasoline lighter than 0.8235 specific gravity	4,400,803	358,682	2,981,688	257,556
Gas oils, other than naphtha and gasoline, between 0.8235 and 0.775 specific gravity	114,807	6,680	6,522	446
Kerosene and illuminating oils	1,027,834	58,162	651,106	40,903
Fuel oil, 0.8235 specific gravity and heavier	1,294,661	64,805	887,666	53,941
Engine distillate lighter than 0.8235 specific gravity	17,014	1,531	39,236	3,368
Lubricating oils, consisting wholly or in part of petroleum, costing less than 25 cents a gallon	3,244,580	446,492	5,024,000	684,371
Lubricating oils, all other	1,539,299	545,508	1,228,315	509,367
All other oils	237,401	67,412	362,654	79,864
Total	17,862,598	$1,815,612	14,679,167	$1,832,082
PETROLEUM PRODUCTS:				
Axle grease ..... lbs.	2,020,461	$85,122	2,414,844	$104,275
Vaseline, toilet and medicinal petroleum	.....	128,501	.....	134,296
Paraffin wax ..... lbs.	682,259	37,779	867,461	40,300
Paraffin wax candles ..... lbs.	104,939	21,525	137,442	25,026
Other petroleum products lighter than 0.8235 specific gravity ..... gals.	1,631,722	120,936	1,408,600	118,808
Total	.....	$393,863	.....	$422,705
Total value	.....	$9,708,003	.....	$11,002,516
Total net value of petroleum and refined products imported[1]	$9,708,003		$11,002,516	
Duty paid on the above, calculated on the existing tariff schedule	474,213		462,703	
Sales tax at 6 per cent	610,933		689,513	
Freight, approximately	805,000		900,000	
Total value delivered in Ontario	$11,598,149		$13,054,732	

[1]These statistics are furnished through the courtesy of the Department of Customs and Excise.

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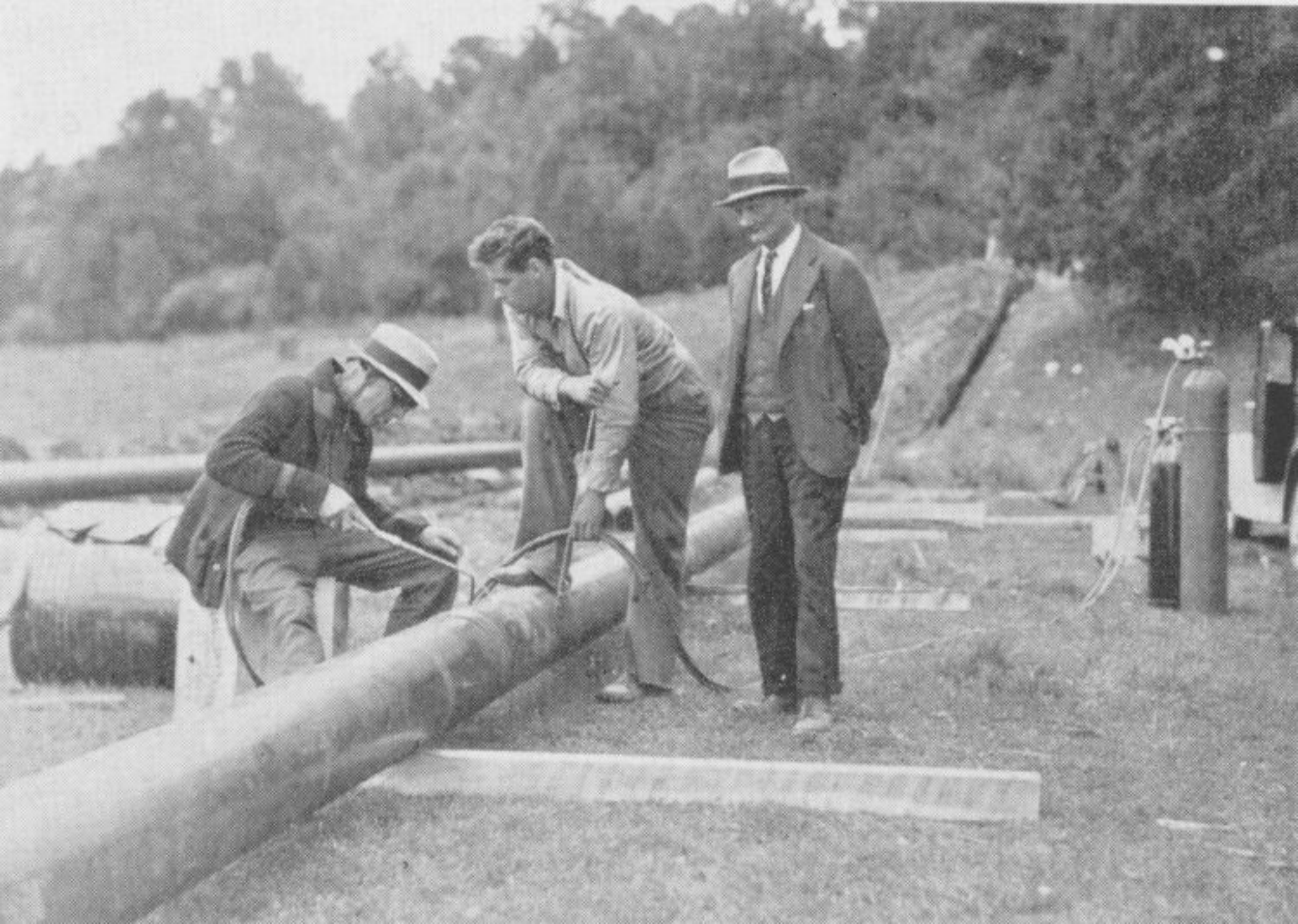
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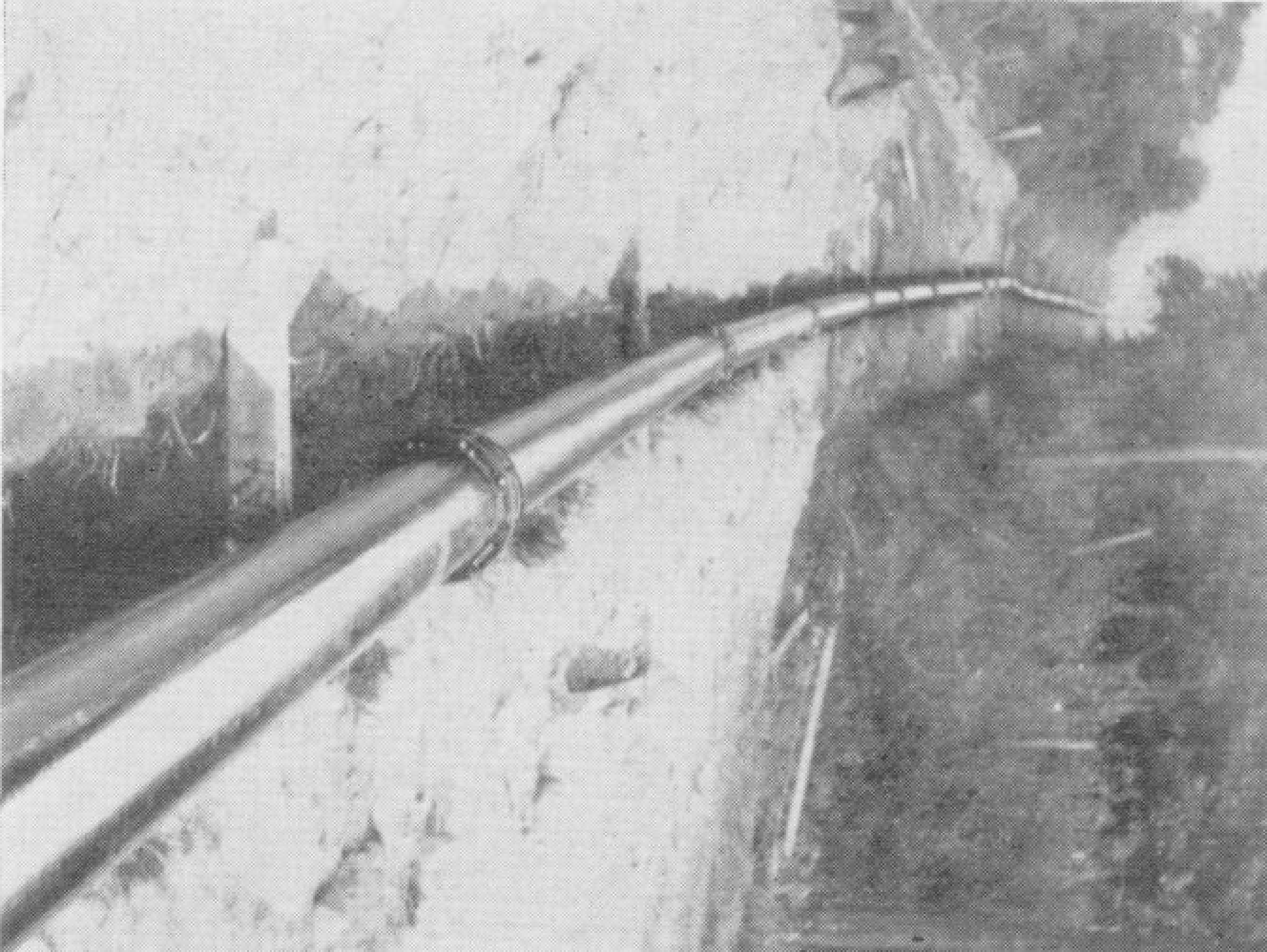
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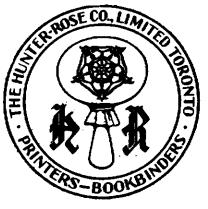

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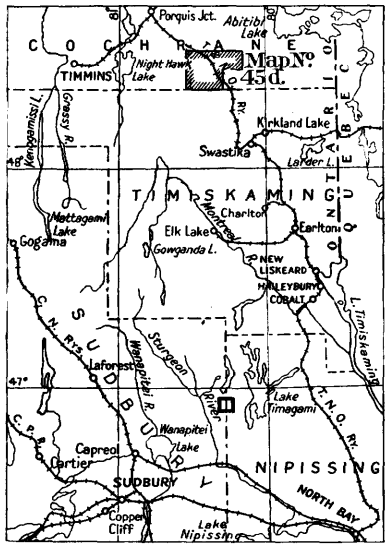
Map No. 45d—Ramore Area, District of Cochrane, Ontario. Scale, ¾ mile to the inch.
Map No. 45e—Burntbush River Area, District of Cochrane, Ontario. Scale, 2 miles to the inch.

Geology and Ore Deposits of the Ramore Area

By E. S. Moore

INTRODUCTION

The Ramore area, comprising the townships of Bowman, Hislop, Guibord, McCann, and Playfair, in the district of Cochrane, lies between north latitude 48° 21′ and 48° 33′ and west longitude 80° 8′ and 80° 33′. The village of Ramore is situated in Playfair township, on the Temiskaming and Northern Ontario railway, and serves as a centre for prospecting and mining activities



Key map showing the locations of the Ramore and Afton-Scholes areas. The latter is the small heavily outlined square near Lake Timagami. Scale, 60 miles to the inch.

for the greater part of the area. The Ferguson highway passes through the village, and since it is in a large farming community, roads lead out from it in nearly all directions. Many of these roads have been gravelled, but where this has not been done they are almost impassable in wet weather because the soil is mostly clay.

The situation of this area is of special interest to mining men because it lies between the two great gold camps, Porcupine and Kirkland Lake, about 30 miles northwest of Swastika. Gold is widely distributed, and consideration of the number of occurrences of this metal in connection with the relatively small number of rock exposures over large sections of the area leads to conjectures about the possibility of there being many more hidden deposits. It may be that the gold-bearing formations, on account of their quartz content, are more

resistant to erosion than others and therefore produce more outcrops. Nevertheless, it seems probable that many are concealed beneath the heavy mantle of drift and stratified clay, silt, and sand that covers the greater part of Hislop, Guibord, and Bowman townships and large sections of Playfair and McCann.

Gold was discovered in the Ramore area at a very early date in the history of gold mining in Northern Ontario, and much effort has been expended in attempts to develop producing mines on the large number of claims staked,



View of Ramore, which is situated on a plain of clay lake-beds. In the background is Lava Flow hill in Cook township.

but these efforts met with little success until quite recently. During 1935 the Ross mine of Hollinger Consolidated Gold Mines, Limited, in Hislop township, came into production, and the Vimy mine in the same township operated a mill for a short time. Hollinger has proved considerable ore reserves, and the development of this property has stimulated renewed interest in the whole area.

Acknowledgments

The writer is greatly indebted to many persons for favours received while in the field. Through the kindness of Mr. John Knox, general manager of Hollinger Consolidated Gold Mines, and Mr. John Caty, manager of the company's mine in Hislop township, accommodation was generously provided at the mine camp. They and other members of the staff of the company gave freely much information relating to their property. The staff of McIntyre-Porcupine Gold Mines, Limited, also furnished plans and information relating to properties in which the company is interested. The writer regrets that it is impossible to make individual acknowledgments to all of those from whom aid in some form was received.

The three assistants on the field party, B. T. Wilson, J. D. Bateman, and E. F. Hartwick, performed their share of the work in a very efficient manner. Special credit is given to Mr. Wilson for work done after the writer left Ramore to investigate the Afton-Scholes area. He was responsible for completing the mapping of parts of McCann and Guibord townships.

Previous Work

It is stated by Wright[1] that gold was discovered in Playfair township by land surveyors, in 1905, and that claims were staked the following year by a prospector named Frederick Mobbs and several others. This is believed to have been one of the earliest discoveries of gold in Northern Ontario. By 1908 discoveries had been made and claims staked in some of the other townships in this region.

The earliest geological work done in the Ramore area was probably that of Kay,[2] who descended the Watabeag river and passed through McCann township.

In 1920 Wright mapped the Black River area,[3] and in 1921 the townships of McCann and Playfair and others to the south.[4] His geological map,[5] covering McCann township in some detail and Playfair in a general way, and his reports on the geology of these and adjacent townships have been of great service in the present work.

As early as 1911 Burrows[6] mapped Munro and a small part of Guibord township. In 1915, Hopkins' map and report on "The Beatty-Munro Gold Area"[7] appeared. These maps and reports were a great aid in the geological work in those sections of the Ramore area contiguous to the Beatty-Munro area. The numerous gold discoveries made in the latter area and the great interest which they created among prospectors in the region surrounding Matheson has had much influence on prospecting in the Ramore area. This is particularly true of the discovery of the Croesus mine, the fabulously rich but small deposit in Munro township. Several properties in the southern part of Munro, on which considerable work has been done, contained veins that in some cases extended across the township boundary into Guibord. The Gold Pyramid Mining Company, for example, was operating a small mill in 1911 on a property in Guibord which adjoined that of Munro Mines on the north. The Detroit New Ontario property along the south boundary of Munro also produced some gold from a small stamp mill, which closed down in 1911.

Near the southeast corner of Hislop township, in a farming section, a small outcrop containing much quartz and pyrite had attracted the attention of prospectors on more than one occasion. No commercial ore, however, was found until a prospector, Frank Tremblay, sampled another section of the exposure and found good values. He staked the claims which were later known as the Brennan-David and are now called the Ross mine. The Hollinger took an option on the property and did much trenching and drilling in the autumn of 1933. In 1934 shaft-sinking was commenced.

Topography

When the Ramore area is viewed from the top of a high hill, it has the appearance of a large basin almost surrounded by ridges of hills. Considerable sections of the basin are almost perfectly flat because they are underlain by stratified clay and silt deposited in a bay of Lake Ojibway, a large glacial lake

[1]D. G. H. Wright, "Geology of the Watabeag Area," Ont. Dept. Mines, Vol. XXXI, pt. 7, 1922, p. 19.

[2]Geo. F. Kay, "The Abitibi Region," Ont. Bur. Mines, Vol. XIII, pt. 1, 1904, pp. 104-134.

[3]D. G. H. Wright, "The Black River Area," Ont. Dept. Mines, Vol. XXX, pt. 6, 1921, pp. 27-62.

[4]D. G. H. Wright, "Geology of the Watabeag Area," Ont. Dept. Mines, Vol. XXXI, pt. 7, 1922.

[5]No. 31d.

[6]A. G. Burrows, Ont. Bur. Mines, Map No. 21c, 1912.

[7]P. E. Hopkins, Ont. Bur. Mines, Vol. XXIV, pt. 1, 1915, pp. 171-184.

which lay between the height-of-land to the south and the ice front to the north and covered the area known as the "clay belt." The clay furnishes good farming land, and large sections of the area are tilled. The lake did not cover the higher hills, and distinct boulder and gravel beaches may be seen in lot 9, concession II, Bowman township. Here two beaches, one about 40 feet above the other, occur on the north flank of the large hill in the southwestern part of the township. The lower beach is estimated to lie from 70 to 75 feet above the lowlands.

The lowlands, before they are cleared, are swampy, and covered with an almost impenetrable growth of alders. Large sections of Guibord township are occupied by extensive swamps, and this township is particularly difficult to traverse, except in the rocky and sand plain sections. The northeastern part of the township is covered by sand, which represents the sediments deposited near the northeast shore of the bay of the old lake. The southwestern part of McCann township is also largely occupied by a sand plain, and there is another stretching south and east from Talbock lake in Playfair township.

Rising above the clay lands are ridges and hillocks of terminal moraine consisting of large boulders, gravel, and sand. These are particularly striking in Bowman township, south of Matheson. A little west of the Matheson cemetery there is a very deep, dry kettle in the moraine. In wet weather rivulets run into it, and the water readily drains out through the gravel at the bottom.

Hills and knolls of rock, large and small, protrude through the lake beds, and the larger hills stand as conspicuous monadnocks, rising to several hundred feet above the lowlands. The average altitude of the clay lands is about 950 feet. The altitude of Ramore is 944 feet, and of Matheson 861 feet. The highest point in the whole area is Kempis mountain, on the boundary between Playfair and Cook townships. This hill rises about 400 feet above the railroad at its base. The next highest points are two hills in lots 10 and 12, concession I, Bowman township. On the hill in lot 10, there is a Geodetic Survey record of 354 feet. Barometer readings indicate that the hill in lot 12 is approximately 350 feet above the valley north of it. On some maps the large hill in the central part of Guibord township has been given an elevation of 300 feet, but this is regarded as much too high, since barometer readings indicate that it is barely 200 feet above the large swamp at its base.

The drainage is all northward, and the largest river in the area is the Black, which is joined by the Watabeag below Matheson. The valley of the Black river is drowned as far up as Matheson by the dam at Iroquois Falls, as is the lower end of the Watabeag. The next largest river in the area is the Pike, which is a tributary of the Black river and drains practically all of the townships of Guibord and Michaud and a considerable part of Cook and Barnet. Wildgoose river, another tributary of the Black, is a stream of considerable size and drains most of the remainder of the Ramore area. The larger streams have cut deep valleys in the stratified lake beds and glacial drift, and where they have reached buried ridges of rock, falls and rapids occur. Where the road to the Ross mine crosses the Black river, the bottom of the valley is estimated to be more than 75 feet below the level of the clay plain on its east side. When the glacier that covered the Hudson Bay basin melted and Lake Ojibway drained out, lowering the water to the present level of James bay, the larger rivers in the area began their work of deeply dissecting many sections of the Ramore area. The Black river has long stretches with sluggish current above falls and rapids, where solid rock impedes rapid cutting of the valley, and below them for a considerable distance a canyon-like valley.

GENERAL GEOLOGY

Table of Formations

QUATERNARY	
RECENT:	Alluvium along streams.
PLEISTOCENE:	Glacial drift and stratified gravel, sand, silt, and clay lake beds.
	Great unconformity
PRE-CAMBRIAN	
KEWEENAWAN(?):	Quartz diabase dikes (may be Matachewan).
COBALT SERIES (Gowganda Formation):	Conglomerate, arkose, and greywacké (tillite).
	Unconformity
MATACHEWAN:	Quartz diabase, gabbro, and diorite dikes.
	Intrusive contact
ALGOMAN:	Lamprophyre dikes. Quartz porphyry and feldspar porphyry dikes. Diorite porphyry. Hornblende syenite. Hornblende granite.
	Intrusive contact
TIMISKAMING:	Conglomerate, banded arkose, greywacké, and slate.
	Disconformity
KEEWATIN:	Greenstone, andesite, basalt, diabase, epidiorite, dacite. Hornblende, chlorite, and sericite schists. Rhyolite, felsite, chert, greywacké, slate, tuff, and agglomerate.

Keewatin

The whole of the Ramore area is underlain by Keewatin formations, most of which are buried by drift and lake beds. The Keewatin series are intruded by Algoman and Matachewan rocks, and Timiskaming and Cobalt sediments cover them in a few places.

The Keewatin consists almost entirely of basic and intermediate rocks, there being little acid or sedimentary rock in the series. The basic rocks are of the types found in the Keewatin elsewhere. Andesite is a common type, and there is much basalt and diabase. Amygdaloidal and spherulitic lavas occur, and pillows may be seen in many places. Coarse phases of the basic flows have the appearance of diabase, and some parts of the flows are so coarsely porphyritic that the rock resembles the coarse porphyritic diabase of some of the Matachewan dikes. Such rocks are well exposed in lots 3, 4, and 5, concession III, Playfair township. The band of lavas seen here is a continuation of the one so splendidly exposed in the large hill, in Cook township to the east, on which the lookout tower is situated. Wright[1] has given a good description of the rocks in this hill, which he called "Lava Flow mountain," under the name of "leopard rock." The phenocrysts of altered anorthite have a maximum diameter of an inch or more, and chemical analyses quoted by Wright show that the porphyry approaches anorthosite in composition but is more basic. The phenocrysts are arranged in irregular zones, in some of which the crystals are crowded together, constituting a high percentage of the rock, while in others they are few and scattered. The tops of the flows, of which fourteen, with a total thickness of 7,300 feet, have been distinguished, show typical ropy, fragmental, amygdaloidal,

[1]D. G. H. Wright, Ont. Dept. Mines, Vol. XXX, pt. 6, 1921, pp. 35-42.

and pillow bands. Here, as elsewhere throughout the Ramore area where the tops of flows can be recognized, the formations dip steeply southward.

Associated with the lava flows are coarse-grained intrusions, which are now, for the most part, epidiorites, or secondary diorites derived from the alteration of gabbro or diabase. In these rocks amphiboles have taken the place of the pyroxenes, and the plagioclases are more sodic than the original feldspars. Such rocks may be seen in the southern part of Playfair township, concession I, lots 2, 3, and 4.



Porphyritic Keewatin lava flow, Lava Flow hill, Cook township. This is similar to the lava in Playfair township.

Dacite was observed in a few places. On the property of Hislop Gold Mines, in lot 1, concession IV, Hislop township, some of the veins in the trench at the western end of the outcrop occur in this rock. The rock appears in the field to be a little more acid than the typical greenstone, and in thin section it is found to be medium-grained, with plagioclase as the main constituent. It contains considerable chlorite and sericite, a little carbonate, and disseminated magnetite and pyrite. Another occurrence of similar rock was observed on the McIntyre property, claim L. 24,686, lot 2, concession IV, Hislop township.

In many places, the basic and intermediate lavas have been altered to schists. Chlorite schists are widely distributed in the area. Near the granite contact, in the southern part of Bowman township, there are large bodies of hornblende schist, which has apparently resulted from the contact effects of the granite intrusions, as it is practically confined to this section of the township. The schist is a hard, compact, barren, resistant rock, which forms large hills.

A few small areas of acid lava are found in the Ramore area. The most important are in Hislop township, at the Ross mine, lot 1, concession II, and on the McIntyre property, lots 1 and 2, concession IV. Outcrops were also found on Kempis mountain and in a few other places, but such lavas are comparatively

scarce. The lavas on the McIntyre property are fine grained and pink to red in colour. In thin section some specimens show flow structure, and they are full of microlites of feldspar, stained brown by iron oxide. Phenocrysts of feldspar also occur. The feldspars are orthoclase, albite, and oligoclase. Quartz forms a considerable proportion of the rock and is both primary and introduced. It has been impregnated with pyrite, and a little carbonate and epidote have also been introduced. It is on the rhyolite that most of the drilling and trenching has been done.

Of a number of bands of tuff in the Keewatin series, the most important are on the Hollinger and McIntyre properties in Hislop township. The tuff is mostly of an acid type, probably related to the rhyolite that occurs in its neighbourhood. It is mostly highly altered, sericitized, carbonated, and silicified. On the two properties mentioned it is also greatly impregnated with a green chrome mica, which seems to favour this rock. There is much of this green mica associated with the quartz in the spectacular outcrops in lot 9, concession IV, Guibord township. Here the rock is so schisted and otherwise altered that a definite determination of its original nature is impossible. A more detailed description of the tuff at the Ross mine will be found in a description of that property.

A few small patches of agglomerate occur with the greenstones in several places, but the quantity of this rock is small. In contrast to the tuff, the agglomerate is more commonly associated with the basic rocks of the Keewatin.

Scattered over this area are a few small outcrops of sedimentary rocks associated with the typical rocks of the Keewatin series. These consist of slate and greywacké. They may be later sediments infolded, or they may be local deposits of sediment laid down with the lavas, probably water-laid volcanic ash. An outcrop of dark slate may be seen on the banks of the Black river, near the south end of lot 4, concession I, Hislop township. Greywacké occurs on the same stream, at the rapids in lot 1, concession VI, Bowman township.

Timiskaming

Rocks of the Timiskaming series underlie a large area in the northern part of Guibord township, into which they extend from Munro township. In this area the only sediments are arkose, slate, and greywacké, which are in places distinctly banded like varved clays. In other places the only rock is a thick-bedded arkose, approaching quartzite in some sections, as at the Gold Pyramid mine. These rocks strike from N. 70° W. to N. 45° W. They have been considerably sheared along two lines, the most pronounced shearing being in a direction varying from N. 73° E. to N. 65° E., and the lesser east-west. They dip from 45° to 60° S.W. The contact of the sediments and greenstone is concealed in Guibord township, as a marked depression follows the contact. In Munro township, however, a short distance north of the township boundary, they are in contact, but the sediments dip southwestward, and a short distance from the contact the lava flows dip northeastward. This has given rise to much speculation regarding the age of these sediments. Some geologists have regarded them as Keewatin, or at least as older than the lava flows around the Croesus mine. There is strong evidence, however, that the contact in this place is along a fault and that the sediments are actually Timiskaming in age. There is no conglomerate in the sediments in this locality, but there is conglomerate in this same band of sediments elsewhere. The distinctly banded character of the rocks in places is similar to that of the Timiskaming in many other areas.

At the Talisman mine, lot 7, concession VI, Guibord township, there is a small outcrop of banded arkose, slate, and greywacké, which indicates the extension of the main body of Timiskaming sediments in that direction. They disappear under a great swamp to the southeast. The strike here is N. 80° W. and the dip 70° S. The quartz veins on this property cut the sediments at various angles and conform more or less to the strike of several dikes intruding the banded sediments.

On the north side of Guibord hill, in lot 8, concession IV, Guibord township, there are two small outcrops, one of conglomerate and the other of banded greywacké. The conglomerate contains a variety of angular to well-rounded pebbles and boulders up to 6 inches in diameter. It grades downward into agglomeratic rock, which overlies greenstone. The strike here is east-west, and the dip 68° N. Apparently this outcrop lies on the south limb of a large syncline, as the dip is nearly opposite in direction to that near the north boundary of the township. There is quite a distinct cleavage in the greywacké, which strikes N. 78° E. and dips 88° S.

A few small outcrops of conglomerate are found on the west side of the Pike river in lot 11, concession III, Guibord township. The rock contains a variety of pebbles and boulders, some as much as a foot in diameter. The fragments vary from angular to well-rounded forms. The strike is N. 65° W., and the dip indeterminable. As in the occurrence of this rock last described, it looks as if the conglomerate graded from an agglomerate to a conglomerate with well-rounded fragments; or the rock might have been formed in the sea near a steep shore, which was gradually levelled down. This gradation of coarse, angular fragments upward into conglomerate with rounded pebbles and boulders may also be seen in Playfair township, lot 1, concession VI. The writer has observed the same condition in the Timiskaming in several other areas in Ontario, for example in the Mississagi Forest Reserve, and on the Onaman river.

In Hislop township several outcrops of conglomerate are regarded as Timiskaming, although it must be admitted that it is difficult to be sure of the age of this rock, which is much like the Cobalt conglomerate in many ways. On the Vincent section of the McIntyre property, in lot 2, concession IV, a small wedge of conglomerate grades downward into what may be agglomerate and tuff. Many well-rounded boulders, are found, however, and since the relations here are similar to those in Guibord township this rock should be placed in the Timiskaming. On lot 2, concession I, Hislop township, and on lots 1 and 2, concession VI, Playfair, there are a number of outcrops of distinct conglomerate, which are considered as Timiskaming although in the field they were at first regarded as Cobalt in age. In some of these outcrops the rock is crowded with boulders, varying from angular to well-rounded shapes. There is a great variety of boulders of acid and basic rocks, and there are granite boulders up to 2 feet in diameter. Other parts of the series are almost entirely greywacké, which in places is not easily distinguished from the greenstone lying on the west side of the conglomerate, except where there is some banding in the sediments or where the greenstone contains pillows or spherulites. The strike of the formation varies from north-south to N. 35° W. The dip is indistinct. In some places the shearing planes are practically vertical, and at one point a thin band dips 25° S.W.

The matrix of the conglomerate is a blue greywacké-like material. In thin section it is found to contain particles of a great variety of rocks: greenstone with microlites of feldspar, a very basic rock with grains of olivine altered to serpentine, feldspar porphyry, arkose, etc. Some specimens contain a micrographic intergrowth of quartz and feldspar. When the matrix of this rock is compared

with that of the conglomerate in McCann township, which is regarded as undoubtedly Cobalt in age, it is found that on the whole it is much more indurated and altered, and it appears to be derived from a much older rock. Some of the feldspar porphyry fragments in both rocks are, however, remarkably fresh in appearance.

The correct interpretation of the age relations of this conglomerate is of some importance because of its value in finding the key to the major structural features of the Ramore area. From observations in the field the formation is not cut by the Algoman intrusives in Hislop or Playfair townships, as are the Timiskaming sediments near the north boundary of Guibord. At the north end of lot 1, concession V, Playfair township, the conglomerate is cut by a diabase dike, but owing to the lack of evidence to determine whether this dike is Matachewan or Keweenawan, little help is given in determining whether the conglomerate is Timiskaming.

Algoman Intrusives

The Algoman intrusives in this area, as around Kirkland lake, comprise a considerable variety of rocks. They range in composition from very acid to nearly basic, and it is believed that they have all been derived from a common magma, which must have underlain the whole of the Ramore area in Algoman time. It is impossible to determine the age relations of all the members of the series because they have not been found in contact with one another, except in the case of the syenite and lamprophyre. The latter cuts the former and is, therefore, apparently the youngest of the series of intrusions.

The question may be raised as to whether the Matachewan diabase does not also belong in this series. The occurrence of diabase earlier than the ore and later than the other Algoman intrusives at Kirkland Lake, and the petrographic relations of Haileyburian, Algoman, and Matachewan intrusives, as worked out by Derby[1] in the area lying southwest of Kirkland Lake, seem to point to the possibility of the Algoman having closed with diabase intrusions. The diabases found in the Ramore area, and mapped as Matachewan, so distinctly cut the Algoman acid and intermediate intrusives in many places, that there is no doubt concerning the relative age of these two groups of rocks. The Matachewan diabase also cuts some of the quartz veins, and it is believed that whatever the relation of the diabase to the magma from which the Algoman rocks came, the diabase is later than the period of ore deposition. The diabase, because of its great volume and wide distribution, must have been drawn from a magma reservoir of great dimensions and not from subsidiary magmas produced by local differentiation, such as those that supplied the small basic lamprophyre dikes.

Probably the first of the Algoman series to erupt was the granite. Large bodies of granite occur in Egan township, west of McCann, and in Michaud and Garrison townships, east of the Ramore area. Smaller masses outcrop in McCann, Bowman, and Guibord townships, and a few outcrops were found in the southwestern part of Hislop. It is probable that a hidden connecting link joins the two main bodies under the southern part of Hislop and the northern part of Playfair townships.

Granite and Granodiorite

The granite is on the whole massive and little sheared. It is mostly the hornblende variety and is pink to reddish in colour. Some of the smaller

[1]A. W. Derby, unpublished thesis, University of Toronto, 1934.

intrusions are quite acid in composition and fine grained, approaching aplite; others are comparatively basic and are more nearly granodiorite or quartz monzonite. Several outcrops in Guibord township show the monzonitic phases. In lot 9, concession IV, the rock is slightly porphyritic, and while it contains a considerable amount of quartz this mineral is in smaller proportions than in typical granite. Orthoclase dominates, but plagioclase is abundant. There is little evidence of the presence of ferromagnesian minerals, and if any were originally present they have been replaced by carbonate and sericite. The rock contains a little pyrite. In another outcrop, in the same lot, the rock is a quartz monzonite porphyry, in which plagioclase is the dominant feldspar in quantity, but the larger crystals are orthoclase. There was originally more ferromagnesian mineral in this rock than in the one just described, and it has changed to chlorite. The rock is impregnated with fine-grained pyrite and stained by hematite along the contacts of quartz and feldspar grains.

In lot 3, on the line between concessions II and III, Guibord township, a porphyritic granite occurs. It is more typical of granite in composition than the specimens described and forms larger outcrops. This rock in thin section consists chiefly of microcline, orthoclase, and quartz, and many of the feldspars are well zoned. The ferromagnesian mineral is hornblende. Distinct wedge-shaped crystals of titanite, small, clear crystals of zircon, and a few grains of magnetite are present. The feldspars are partly kaolinized and in most cases are a dirty-grey in colour.

A more sodic phase of the granite was observed in lot 10, concession I, Hislop township. There is a considerable quantity of quartz in the rock, but the feldspars are entirely of the sodic variety. Some of the amphibole is the ordinary green type of hornblende, but there is also blue amphibole with pleochroism resembling that of arfvedsonite—deep-blue to greenish-blue to lavender-blue to greenish-yellow. The extinction angle is too high for arfvedsonite and is closer to that of ordinary hornblende. The blue colour is in many crystals unevenly distributed, being in blotches and zones in the green hornblende. The rock contains also well-formed crystals of titanite and zircon and a few grains of apatite.

It is evident from the descriptions given above that the smaller intrusions of granite in this area vary considerably in composition from the main masses of granite.

Syenite

Hornblende syenite is widely distributed in this area, but it is always in relatively small bodies, such as dikes and plugs. The rock is very commonly porphyritic, and there is no very sharp line in composition between the syenite and feldspar porphyries, which also occur throughout this area in small dikes. Gold occurs in many places with both the syenite and feldspar porphyries.

On the McIntyre property, lot 1, concession IV, Hislop township, a syenite porphyry dike 20 feet wide runs along the contact between carbonated tuff and rhyolite. In thin section the rock is seen to be made up chiefly of orthoclase and albite with a little ankerite. It is impregnated with pyrite and cut by veinlets of this mineral. Visible gold occurs along one side of the dike. A number of irregular dikelets cutting the rhyolite near the dike described consist of rather coarse-grained syenite, which is composed chiefly of orthoclase and microcline with some microperthite. The feldspar is largely microcline. As in many of the other syenite dikes there is practically no ferromagnesian mineral. Carbonate and quartz have been introduced.

A coarse-grained syenite porphyry on lot 8, concession IV, McCann township, consists of orthoclase and microcline feldspars; almost fresh, deep-green hornblende; a considerable amount of titanite; and a little hematite and pyrrhotite. The syenite on the property of Ramore Gold Mines, lot 8, concession III, Playfair township, is a medium-coarse, red, granular syenite highly impregnated with pyrite, which is said to carry values in gold.

Diorite Porphyry

Diorite porphyry was observed in several places in small intrusions resembling plugs. As a rule, it does not form distinct dikes. The rock is grey or greenish-grey in colour and spotted with white to greyish plagioclase phenocrysts, which are considerably kaolinized and sericitized, although in the hand specimen they appear nearly fresh. There are in most specimens a few phenocrysts of orthoclase. The ferromagnesian minerals, when seen in thin section, are now mostly uralite, chlorite, and serpentine. Certain specimens show original hornblende. Some of the intrusions might more properly be described as granodiorites than diorites. Quartz occurs in the matrix of all the specimens, but much of it may have been introduced by hot solutions.

Feldspar Porphyry

There is nothing unusual about the feldspar porphyry dikes, which occur in many parts of the area. They contain orthoclase and plagioclase phenocrysts with very little ferromagnesian material. They appear to have much the same composition as the syenite, but the process of cooling and crystallization has been different. A few of these dikes contain an occasional phenocryst of quartz.

Lamprophyres

A number of dikes occur in this area which in the field are commonly spoken of as lamprophyre, although few of them are really typical of this rock. These dikes are the youngest rocks in the Algoman series. They vary greatly in composition and are dark-grey to brownish in colour and more or less porphyritic in texture. They have an abundance of ferromagnesian constituents and occur only in small irregular dikes, usually near ore deposits. Some of them are highly altered, in which case few of the original minerals remain.

The most typical examples are found on the Bush claims, McIntyre property, lot 1, concession IV, Hislop township. In one of the trenches a dark dike, 6 feet wide, is well exposed for a few yards along its strike. This rock, following Iddings,[1] might be classified as a diabasic lamprophyre, as the lime-soda feldspars are lath-shaped. It has been considerably carbonated, and the long phenocrysts of biotite have lost most of their pleochroism, being greenish and dull and almost altered to chlorite. There are many outlines of what appear to have been hornblende crystals, which have been replaced by carbonate and a little chlorite. Some fairly fresh hornblende crystals remain. A little quartz, which appears to have been introduced into the rock, and many grains of magnetite and very small crystals of bluish apatite are present.

Another dike in the same locality is 5 inches wide and intrudes the syenite. It is porphyritic, and there are a number of outlines of previously existing crystals shaped like those of olivine, but these grains have been replaced by carbonate and sericite, as the rock is almost completely carbonated. A few flakes of

[1]J. P. Iddings, "Igneous Rocks," John Wiley & Sons.

bleached biotite are present. The rock reminds the writer of the picrite lamprophyre in the Michipicoten area.[1]

A specimen of another dike of highly carbonated lamprophyre on the property of Hislop Gold Mines, lot 1, concession IV, Hislop township, was examined in thin section. The greater part of the original constituents has been replaced by quartz and carbonate, but a considerable amount of bleached biotite remains.

In the outcrop at the Talisman mine, lot 7, concession VI, Guibord township, several small, irregular dikes cut the banded sediments. These range in width from a few inches to 8 feet. The dike at the shaft increases from 2 to 8 feet in width within a distance of 10 feet. The dikes cut the sediments in various directions and have no definite trend. The rock is light- to dark-grey in colour and weathers brown, appearing to be more basic than it really is. It is medium- to fine-grained and somewhat porphyritic. In thin sections the rock is found to consist of feldspar, quartz, and much biotite. The groundmass consists of columnar feldspar, chiefly orthoclase, and biotite. The biotite, which constitutes a considerable proportion of the rock, occurs in small flakes of nearly uniform size, which are so bleached that many of them retain very little of their green colour. There is considerable sericite present as a result of alteration.

These dikes are not typical lamprophyre, although several geologists have regarded them as such in the field. They might be regarded as syenitic lamprophyre.

Matachewan

Diabase or gabbro dikes, ranging in width from a few feet to 150 feet, are conspicuous in the Ramore area. They have a marked north-south trend, few of them departing from this direction by as much as 45 degrees. The rock constituting these dikes is usually a coarse, brown-weathering diabase or gabbro. In a few cases it approaches a diorite. In many places it is coarsely porphyritic, with a spotted appearance due to phenocrysts of plagioclase, which reach an inch and more in diameter. The feldspar is rarely fresh and it has taken on a greenish tinge, due to alteration and replacement by fibrous amphibole and other minerals.

The porphyritic diabase resembles some of the coarsely porphyritic lava flows in Playfair and Cook townships, but in most places the two rocks may be distinguished in the field without much difficulty. The diabase dikes strike approximately north-south, whereas the lava flows strike nearly east-west. The course phases of the flows grade upward into finer-grained rock in which ropy structure, breccia, pillows, or amygdules may be found. Some of the dikes in the area are more nearly dark-grey in colour than the majority of the Matachewan dikes. These may be Keweenawan quartz diabase, but there was no means available in the field of distinguishing them with certainty from the Matachewan, since they were not found cutting the Cobalt conglomerate.

Several thin sections of the dike rocks were studied, and it was found that some of them show distinct ophitic texture, while others have little or no such texture and should be regarded as gabbro. Some are highly altered; others quite fresh. The feldspars are sericitized or partly replaced by fibrous amphibole, and chlorite occurs along cleavage lines and cracks. Some of the labradorite has changed to secondary albite. The diopside may be fresh or uralitized, and the ilmenite may or may not be changed to leucoxene. Quartz is present in most

[1]E. S. Moore, Ont. Dept. Mines, Vol. XL, pt. 4, 1931, p. 12.

sections, sometimes in the form of individual grains, but more commonly in micropegmatitic intergrowths.

Rarely is any mineralization associated with these diabases. Small bodies of pyrrhotite may owe their origin to the diabase magma, such as that on the south side of Guibord hill.

Cobalt Series

Gowganda Formation

The few exposures of the Gowganda formation of the Cobalt series occur in the southeastern part of McCann township. The formation consists of conglomerate, arkose, and greywacké. The conglomerate contains a great variety of pebbles and boulders, of which granite boulders, up to 3 feet in diameter, are very conspicuous. In thin sections of the matrix are also many varieties of rock, mostly in very angular fragments, with little evidence of sorting among those of quite different size. Many of the particles of feldspar are quite fresh. A little chlorite and epidote occur in places, but the formation has been but little deformed and on the whole appears younger in many features than the conglomerate mapped as Timiskaming.

Pleistocene

The Pleistocene deposits in this area are of considerable importance. The surface was thoroughly glaciated, and in many places a thick mantle of drift was deposited. The ice during its retreat must have halted for a considerable time in the area because there is much terminal moraine. There are numerous kames, consisting of roughly stratified gravel and sand, mixed with boulders. In the terminal moraine there are a number of kettles, some dry and others occupied by small lakes. These deposits were probably made in the deeper part of a bay of Lake Ojibway. This great lake occupied a large area, now known as the "clay belt," which lay in front of the ice and north of the height-of-land. As the ice melted and retreated northward, the lake grew in front of the glacier, which filled the Hudson Bay basin, and prevented drainage to the Atlantic by way of Hudson strait. Near the shore of the bay stratified gravel and sand were deposited, and a little farther out in deeper water the clay set free by the melting ice and washed in by streams was laid down in varved beds. The large sand plains of the area and the valuable clay-farming lands thus owe their origin to this lake. When the ice finally disappeared and Lake Ojibway drained away through Hudson strait, the moraine was left rising above the low flat lands, and streams began to dissect the whole area.

The drift, and especially the lake beds, conceals large areas of the bed rock, thus making prospecting difficult. The drift and overlying stratified lake beds form a layer that must be over a hundred feet thick in some places. In drilling a short distance from the outcrop at the Ross mine, in Hislop township, the overburden was found to be 45 to 50 feet thick, and a similar thickness was found on part of the McIntyre property to the north of the Ross mine.

There is evidence of at least two glaciers having passed over this area. Striations were found running S. 10° E. and others, more distinct, running S. 25°-30° E. The direction varies a few degrees in different places. A prospector searching for the source of float rock should, therefore, look for it in a direction about N. 30° W. of where the float was found.

STRUCTURAL GEOLOGY

Folding

Wherever it has been possible to distinguish the top from the bottom of a lava flow in the Ramore area, the top is toward the south. The lava flows must have originally overlapped one another from north to south, and whatever folding has occurred since has not changed this condition on a large scale, although local deflections of the flows have occurred, and in some places the strike has changed from almost directly east-west to northwest-southeast or northeast-southwest. In those localities where more intense disturbances have occurred the greenstones are sheared, and it is difficult to distinguish the individual lava flows.

The Timiskaming sediments are a great aid in outlining some of the major structural features that have been developed since they were deposited. In the northwestern part of Guibord township the beds strike N. 65° W. and dip 60° to 70° S.W. On the north side of Guibord hill, some distance farther south, the dip is reversed, indicating that a large syncline underlies the northwest corner of Guibord township and extends N. 65° W. into Beatty and Munro townships. The nose of this syncline apparently swings a little more northward as it extends to the east, because at the Talisman mine the strike is N. 80° W. The Timiskaming rocks probably underlie a large section of the covered area in the northwestern part of Guibord township.

The Timiskaming rocks in lot 11, concession III, Guibord township, in lot 2, concession I, Hislop, and in lots 1 and 2, concession VI, Playfair, indicate that another syncline runs down through this area. The dip southwestward of the pillow lavas in the large greenstone hill in lot 6, concession VI, Hislop, also indicates that this syncline runs across Hislop township in the general direction of a line connecting lot 2, concession I, with lot 7, concession VI. This syncline must be comparatively shallow, however, as greenstone makes its appearance on either side within a short distance from this line. It is probably a subsidiary of the larger syncline in the northwest part of Guibord township. This major folding could not have been very intense because the western syncline is not deep, and the folds are not closely compressed.

In that part of the Ramore area where the Timiskaming rocks do not occur, there are two rather distinct trends to the formations. One is east-west to a little north of east, and the other is in a general northwest-southeast direction. There seems to have been thrusting from the northeast and southwest which gently squeezed up the lavas that originally dipped south into a series of apparent local folds that swing from an east-west to a northwest-southeast direction. In many cases this apparent folding is only indicated by a little schistosity, which is due to squeezing and not to actual twisting around of the lava flows.

The trend of the hidden granite ridge, which, as has been previously suggested in this report, may run under the southern part of Hislop township to connect the bodies of granite to the east and west, would have practically the same trend as the schistosity in the greenstone in the same area.

It is interesting to note that in the vicinity of the Ross mine, where the rocks are more disturbed than anywhere else in the Ramore area, the trend of the formations, which is mostly east-west to N. 70° E. in the southwestern part of Hislop township, changes to north-south and northwest-southeast. In the eastern part of the outcrop at the mine the strike is north-south, and in the western part northwest-southeast. A fault runs between these two sections and

may partly account for the sudden change in strike. A more detailed account of the conditions at the mine will be found under the description of this property.

In addition to the features already mentioned there is, in many places, a shearing running through the greenstones and the Timiskaming sediments at various angles to the strike of the beds. The direction of this shearing may be east-west or vary to N. 65° E. in places. Veins or stringers of quartz often occur in these narrow shear zones, good examples of which may be seen in the greenstone hill on lot 6, concession VI, Hislop township, and in the northwestern part of Guibord.

Faulting

A very distinct fault along the west side of the east ore body in the Ross mine is known as the hanging-wall fault. It strikes north-south and dips from almost vertical to as low as 72° W. It is apparently a normal fault, as the west side is the downthrow side, judging from the striations on the slickensided face. The amount of throw could not be determined, as there are no distinct horizon markers.

In lot 11, concession I, Hislop township, a small fault in a large outcrop of greenstone near the centre of the lot strikes N. 20° W. The horizontal displacement is 20 feet, and the west side has moved northward with respect to the east side. The displacement can be readily recognized from the difference in the lavas on opposite sides of the fracture. The lavas here strike N. 60 E. and dip southeast. Several quartz veins occur in this area, and like the fault they cut the lava flows nearly at right angles.

Several small faults in the south central part of Guibord township strike either a little east or west of north. The displacement is not large. The fault along the contact of the Timiskaming and Keewatin in Munro township strikes S. 65° E. and undoubtedly extends into lot 9, concession VI, Guibord township. This fault must have considerable displacement, but in Guibord township it is entirely concealed.

ECONOMIC GEOLOGY

Gold is the only metal that has been found in economic quantities in this area, where it was discovered in 1905, which was very early in the history of gold discoveries in this part of Ontario. Very small quantities of galena, chalcopyrite, and sphalerite have been found, but these are of little significance. The gold occurs as native gold, or associated with sulphide, which is mostly pyrite. It may occur in small quantities with chalcopyrite. A little tetrahedrite has been reported from the Talisman mine, but pyrite is the dominant sulphide throughout the area. Pyrrhotite occurs on the south side of Guibord hill, near the top, and in a few other places. This mineral is most commonly found in the vicinity of Matachewan diabase intrusions, and may owe its origin to them, but this question has not been satisfactorily settled.

There seems to be no doubt that the source of the gold was in the Algoman magma, as the deposits are closely related to intrusions of this age. Ore deposits have not been found in the Ramore area in close proximity to the larger intrusions of granite, but they occur in or close to syenite and porphyries of the intermediate type. The lamprophyres nearly all occur in the vicinity of gold deposits.

The occurrences of gold that have been attracting most attention lately lie in a zone running northeast across the southern and east-central part of Hislop township. In this zone, which lies between two large areas of granite, there are many intrusions of syenite and porphyry and a few small intrusions of granite.

In it there has also been considerable disturbance in some places, the evidence being well displayed in the outcrop at the Ross mine, where faulting, much fracturing, and a sudden change in strike of the formations may be observed. In Guibord township, lot 9, concession IV, near some small granite intrusions and within the zone mentioned, there is a remarkable display of quartz veins. Large and small veins, lacking continuity for any great distance along the strike, outcrop over an area of several acres. They occur in a green mica and carbonated schist, which is apparently a metamorphosed tuff. Unfortunately this spectacular showing of quartz carries scarcely any gold, although there is a little pyrite present. The quartz is white and barren in appearance and is apparently of the nature of pegmatitic quartz, lacking the other minerals commonly associated with quartz in pegmatites.



Part of a large quartz showing in lot 9, concession IV, Guibord township.
(Photograph by B. T. Wilson.)

On a number of properties on which gold occurs, the country rock contains a large proportion of a green chrome mica. This mineral is abundant in the Ross mine, on the McIntyre property, in the large quartz outcrop mentioned above, and in a number of other places. Much interest is attached to the occurrence of this mica here because of the frequent occurrence of mariposite in gold deposits in other areas. Its presence cannot be regarded as a definite evidence of commercial values in gold, but it owes its origin to hot solutions which came from the same magma as that supplying the gold. The formation of the mica occurred in an early stage of the formation of the gold deposits, because it is cut by stringers of quartz and ankerite and impregnated with auriferous pyrite. The mica often occurs in blotches and small angular bodies, suggesting that it has replaced angular fragments in tuff.

W. W. Moorhouse, of the University of Toronto, studied the mica from the Ross mine in some detail, and the writer is greatly indebted to him for the following information regarding its physical and chemical properties:—

ANALYSES OF MICA FROM THE ROSS MINE AND MARIPOSITE

	No. 1	No. 2
	per cent.	per cent.
SiO_2	56.00	55.35
Al_2O_3	23.52	25.62
Fe_2O_3	3.30	.63
FeO	.51	.92
TiO_2	not determined	.18
Cr_2O_3	.78	.18
MgO	2.12	3.25
CaO	.37	.07
K_2O	7.03	9.29
Na_2O	2.72	.12
H_2O	3.52	4.52
Total	99.87	100.13

Sample No. 1—Green mica from the Ross mine. Analysed by W. W. Moorhouse.
Sample No. 2—Mariposite (green). Analysis given by Hillebrand, Amer. Jour. Sci., Vol. 49, 1895, p. 377.

It is evident from these analyses and a comparison of sample No. 1 with a number of analyses of fuchsite, another green chrome mica, that the composition of the mica from the Ross mine is very much more like that of mariposite than fuchsite. The latter mica is 9 to 10 per cent. lower in silica, the alumina is much higher, and the chromium oxide is several times as high.

The physical properties of the mica from the Ross mine are as follows: biaxial, with a very small axial angle; optical sign, negative; polarization colours, brilliant; index of refraction, 1.624. These correspond fairly closely with the properties assigned to mariposite. They differ in that mariposite has been described as uniaxial and its mean index as 1.63. Since the micas vary so much in composition and it was difficult to obtain a perfect separation of the green mica from the pyrite, quartz, and carbonate with which it is intimately intergrown, it may be safely assumed that the mica is mariposite. Since the green mica found on other properties in this area is similar to that described it is believed that it is all mariposite.

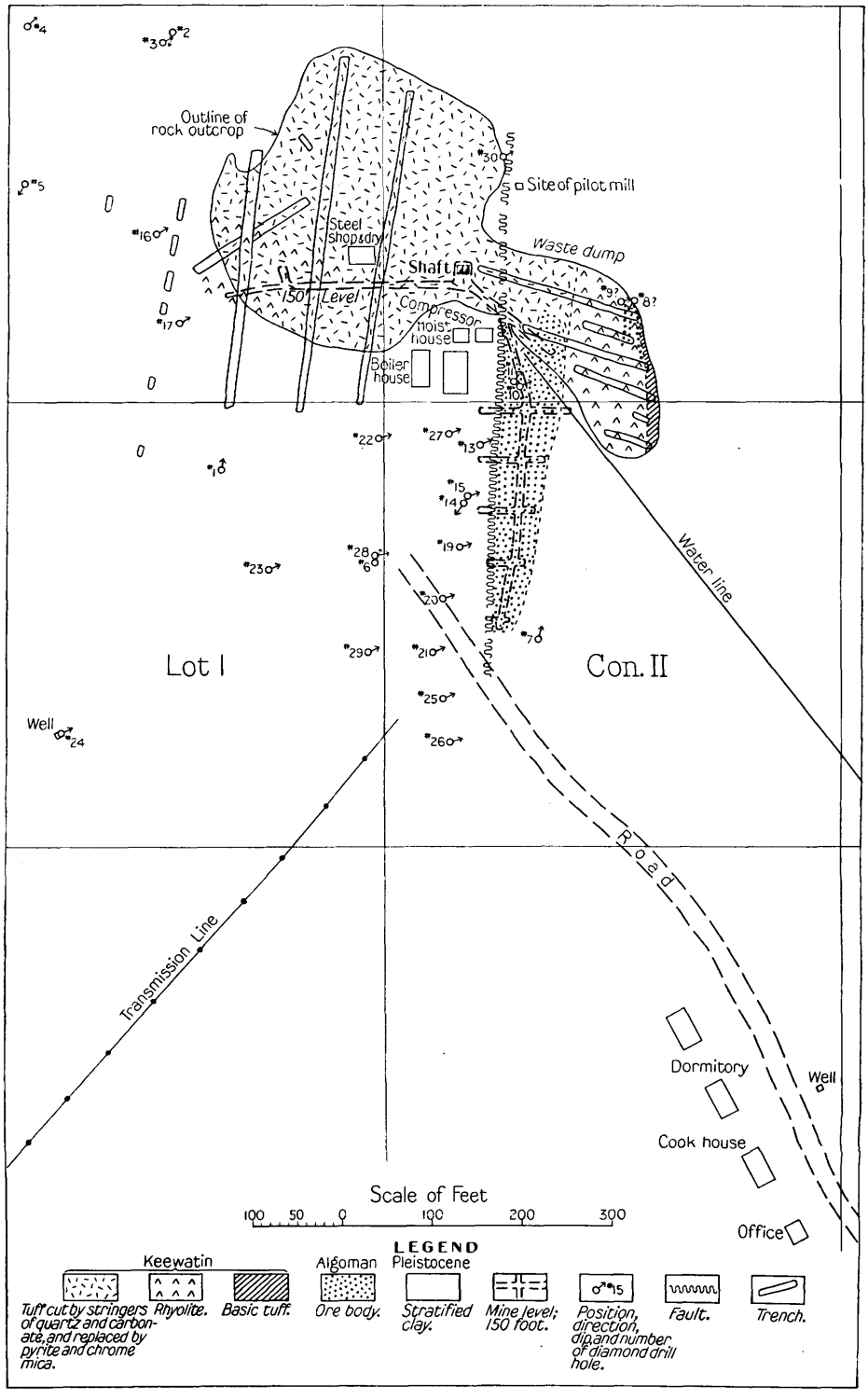
DESCRIPTION OF PROPERTIES

Hislop Township

ROSS MINE

The most important property in the Ramore area at present is the Ross mine, which is owned by Hollinger Consolidated Gold Mines, Limited, and is situated near the north end of lot 1, concession II, Hislop township. The property at the time the writer studied it comprised the north half of lot 1, concession II, and the south third of lot 1, concession III. It was previously known as the Brennan David property.

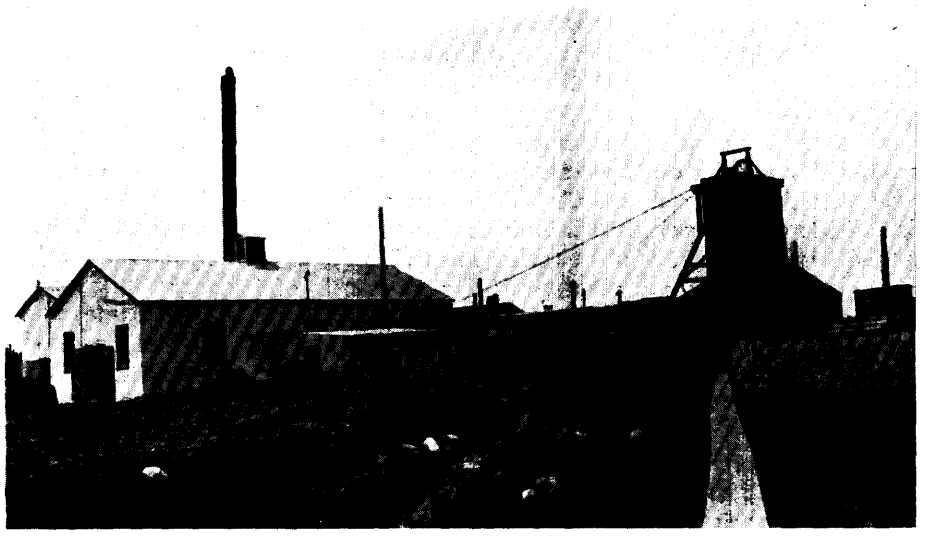
Prospectors had on several occasions examined the outcrop on the Ross farm, but no values of much interest were discovered until Frank Tremblay sampled it in 1933. Sufficient gold was found in assays to justify taking up the property. The Hollinger took an option from Tremblay and his associates in October of the same year and proceeded with development by trenching the outcrop. Diamond-drilling on a large scale followed; and in July, 1934, shaft-



Sketch map showing the surface geology, underground workings, and diamond-drill holes, Ross mine, Hislop township.

sinking commenced. When the shaft reached 150 feet, work on the 1st level was started, and about 1,000 feet of drifting and crosscutting was done to test the accuracy of the diamond-drill results. It was estimated that 115,000 tons of commercial ore had been proved above the 150-foot level in the east ore body. The 3-compartment shaft, which was completed to a depth of 480 feet late in the summer of 1935, provides for three levels, at intervals of 150 feet, and a sump 30 feet deep below the 3rd level.

In the autumn of 1935, a pilot mill with a capacity of about 80 tons per day was built, and it came into operation near the close of the year. This mill has proved to be capable of treating over 100 tons a day.



Shaft, boiler, and hoist houses, Ross mine.

The mine is situated on an outcrop 525 by 350 feet, rising about 15 feet above the surrounding flat clay land. No other rock is exposed within a radius of five-eighths of a mile to the north, 2 miles to the east, a mile to the south, and several miles directly west of the shaft. A short distance from the outcrop, the stratified clay and sand and the underlying drift have a thickness of 45 to 50 feet.

Geology of the Outcrop

The rocks have been so changed by shearing and replacement by mica, silica, carbonate, and pyrite that in many places it is exceedingly difficult to recognize the original rocks and to distinguish one rock from another. Two general types have been recognized, however, by studying a number of thin sections. The first are lava flows of intermediate composition and the second, basic, intermediate, and acid tuff. There is also a band of cherty rock in one section of the outcrop.

For convenience in describing the rocks on the surface they will be discussed in two parts, one east and the other west of the shaft. In the eastern part there is a band of rather basic tuff, with a maximum thickness of 20 feet, running along the east side of the outcrop. It consists chiefly of serpentine and carbonate, a little sericite and chlorite, scattered fragments of plagioclase, and grains of

pyrite. Some of the serpentine appears to have replaced pyroxene. On the west side of this tuff more than 100 feet of lava is found, containing distinct phenocrysts of orthoclase and plagioclase in a very fine grained groundmass. The composition of the rock is apparently close to latite, the extrusive rock corresponding to monzonite, since the feldspars consist of both plagioclase and orthoclase and there is little ferromagnesian mineral. This rock is cut by small veins of quartz and numerous stringers of quartz and carbonate, but any values found in it seem to be rather closely confined to the quartz veins.

West of the lava flow described, the rock is mostly concealed by buildings and the waste rock dump, and its character is difficult to determine, but it is believed to be an acid to intermediate tuff, similar to that in the western section of the outcrop. It is highly impregnated with silica, pyrite, and green mica.

In the western part of the outcrop, a careful study was made of a section along the longest trench, which crosses the outcrop from north to south. In hand specimens, the rock in this trench appears much the same from end to end, except for the relative amounts of quartz, carbonate, pyrite, and mica, and the extent of the shearing and fracturing. In thin sections there is also a marked similarity, except for one specimen taken about 200 feet south of the north end of the trench. Whereas all the other sections indicate that the rock is tuff, this one indicates a porphyritic lava similar to that east of the shaft. There is probably a thin lava flow in the tuff. The tuff is, for the most part, an indefinite rock containing in some places, angular fragments of feldspar and in others what appear to have been similar fragments replaced by silica, carbonate, pyrite, or mica. There are also a few fragments of acid lava or lava similar to that described, but these have in most cases been replaced by the minerals mentioned.

The irregular and patchy replacement lends force to the conclusion that the rock is a tuff.

Near the north end of the trench there is a considerable amount of chalcedony, a fibrous form of silica, in blotches and stringers. Fine-grained pyrite is particularly associated with this mineral. The tuff is cut by countless small stringers of quartz up to 6 inches in width, extending only a few feet along the strike. The larger ones follow the general trend of the schistosity and for the most part dip steeply southward, but the stringers run in all directions and some are nearly horizontal. Some of the tuff is 50 per cent. or more quartz, the remainder being carbonate and sericite. Pyrite impregnates the greater part of the rock, but most of it is in the stringers and associated with the quartz that replaces the tuff. It is mostly rather fine grained, but in a few places it occurs in medium-coarse, cubic crystals. Very small quantities of chalcopyrite, galena, and sphalerite were found. No evidence of the presence of Algoman intrusives was found on the surface.

Underground, on the 150-foot level, some additional information was obtained regarding the character of the formations, although many of the conditions found on the surface are repeated on the 1st level. A sample of rock taken at the west end of the long crosscut running west of the shaft is reddish in colour, resembling some of the rhyolite seen on the McIntyre property north of the mine. It shows in thin section numerous fragments of feldspar, indicating that the rock is either a crushed porphyritic lava flow or a tuff composed of similar material. The distribution of the fragments of feldspar suggest that the rock is a tuff. It contains disseminated pyrite and magnetite and considerable amounts of sericite and carbonate. Another specimen taken a short distance from the end of this crosscut is tuff, largely replaced by a brownish carbonate and silica. In thin

section there is a sort of augen structure, in which the sericite is wrapped around fragments which have been replaced by an indefinite mixture of minerals.

Where the short drift runs off the crosscut near its west end, there is a band, at least 10 feet wide, which consists largely of dark, dense, cherty rock. Similar rock was found in irregular bands in other sections of this crosscut.

The shaft has been sunk in tuff. A specimen taken at a depth of 420 feet is a sericitized rock containing numerous fragments of feldspar with a little quartz and pyrite.

In the crosscut running east from the shaft there is a slightly yellowish green, fine-grained rock resembling the tuff on the surface. It is tight and little fractured and does not contain ore. It is followed by what must have been rather coarse fragmental rock with angular pieces of green mica, which seems to have replaced previously existing fragments of another rock. This is followed by a fragmental rock resembling the basic tuff seen on the surface at the extreme east side of the outcrop.

Near the centre of the drift running south from the shaft, and on its east side, there are a number of quartz eyes in a dense, green, micaceous rock. Some of these eyes are whiter in the centre than around the border, giving them an apparent concentric structure.

Structural Features of the Outcrop

The most prominent structural feature in this outcrop is a fault striking north-south and dipping from 72° W. to nearly vertical. This is known as the hanging-wall fault because it runs along the boundary of the east ore body. It appears in all the west crosscuts from the south drift on the 150-foot level, except No. 5, which had apparently not reached it. It is very distinct in the workings, having in some sections a slickensided face and a little gouge and in most places it is marked by an oxidized zone and a considerable flow of water. On the 450-foot level many tons of oxidized quartz and mud literally flowed out into the drift along the fault, indicating that oxidation has occurred on a large scale to a depth greater than 450 feet. It is unusual to find oxidation occurring to such an extent and depth in the Canadian shield, although at the Keeley mine in South Lorrain, it extended to even greater depth. The extensive underground circulation responsible for the oxidation must have occurred before the glacial epoch, at a time when this area had a higher altitude than at present, because the rocks at 450 feet below the present surface are saturated with water. From the extent of the weathered zone, oxidation will probably be found for a considerable distance below the 450-foot level.

Judging from the striations on the slickensided face this is a normal fault, with the west the downthrow side. The movement of the block appears to have been nearly vertically downward. The rocks for at least 100 feet to the east and for several hundred feet to the west of the fault have been greatly shattered and broken into innumerable blocks of all sizes, and the whole mass is filled with a very complex network of quartz veins and veinlets. Brecciation is quite marked near the fault, and the largest bodies of quartz and carbonate in the mine are in the fault zone. Brecciation extended into both the hanging and foot walls.

There has been some post-ore movement along the fault and on many of the slips seen at the surface and underground. The relations of the larger veins of quartz with the fault underground, and the apparent close relations of the brecciation of the whole mass of rock in the vicinity of the workings with the faulting, indicates, however, that the main fault must have originated at about

the time the ore was deposited. In the workings there are numerous examples of small veins faulted, with a few inches to a foot or more displacement, and the fault fractures are filled with quartz.

Throughout the mine there are many open cracks from which water pours into the workings and which are red with iron oxide. Most of these are cracks that were filled with quartz, carbonate, and pyrite, which have been weathered out, but a few appear to have been formed after the deposition of quartz and carbonate had ceased. In diamond-drilling, water under considerable pressure is sometimes encountered in these openings. The flow for the mine is about 300 gallons per minute. When the bottom of the oxidized zone is passed in mining most of the cracks will be much tighter, and there should be much less water per cubic foot of mine openings.

Section west of shaft Section east of shaft

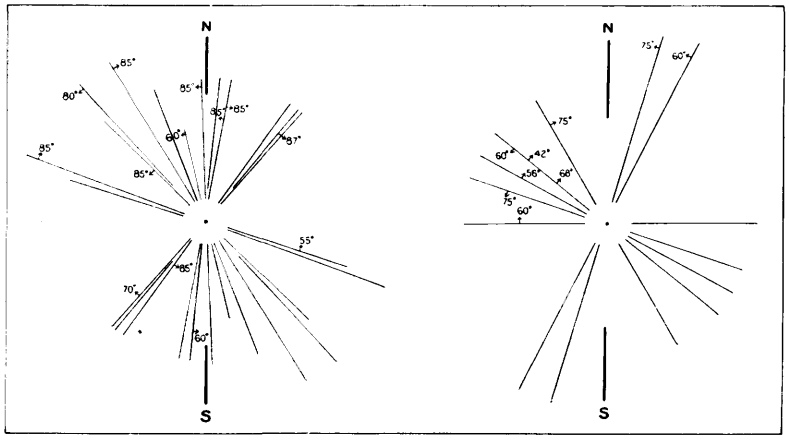


Diagram illustrating the strike and dip of a number of the most prominent joints and slips in the outcrop at the Ross mine, and their direction in relation to the strike of the schistosity and the small quartz veins and larger stringers of quartz and carbonate. The strike of the veins is indicated by the longest lines.

West of the shaft, the strike of the schistosity and the trend of the major quartz stringers are in a general northwest-southeast direction, with a variation in different places from N. 68° W. to N. 30° W. The dip is vertical to 80° N.E. in some cases and southwest in others. East of the shaft the strike is N. 15°-25° E., and the dip of the quartz veins that follow the strike is from 60° to 75° W., indicating a tendency of these to approach the ore body with depth.

As will be seen from the above diagram, there is considerable difference in the direction of the major joints in the two sections of the outcrop, and within each section, although one set in each section corresponds fairly well. The eastern section shows a rather definite tendency of the joints and slips to cut the strike of the formations in the same general direction and at high angles, whereas the western section shows two sets of joints about equally developed, one running in the general direction of the strike and the other cutting it at large angles. The joints show a tendency to lie in directions approaching 45 degrees to the direction of the main fault, and they are more closely related to the fault than to the shearing.

The major fault in this outcrop does not account for the difference in strike in the two sections, because the block has moved after the folding ceased. Apparently there was a twist in the formations in this locality at the time the folding and shearing occurred early in the period of Algoman igneous activity. The formations were disturbed by twisting and shearing without much horizontal displacement by actual faulting. The normal fault occurred later along the line where the formations were weakened by being bent from a direction east of north to one west of north. The presence of the more competent lava flow in the weaker tuff beds seems to have been a factor in the location of the fault, and it developed near the contact of the two formations. The fault no doubt resulted from activity in a magma at depth late in the Algoman period. There are no Algoman intrusions exposed in the outcrop, but typical red feldspar porphyry has been found in small irregular intrusions during the recent mining operations. A little of this rock was found in the west ore body on the 150-foot level and a larger body on the 450-foot level.

Ore Deposits

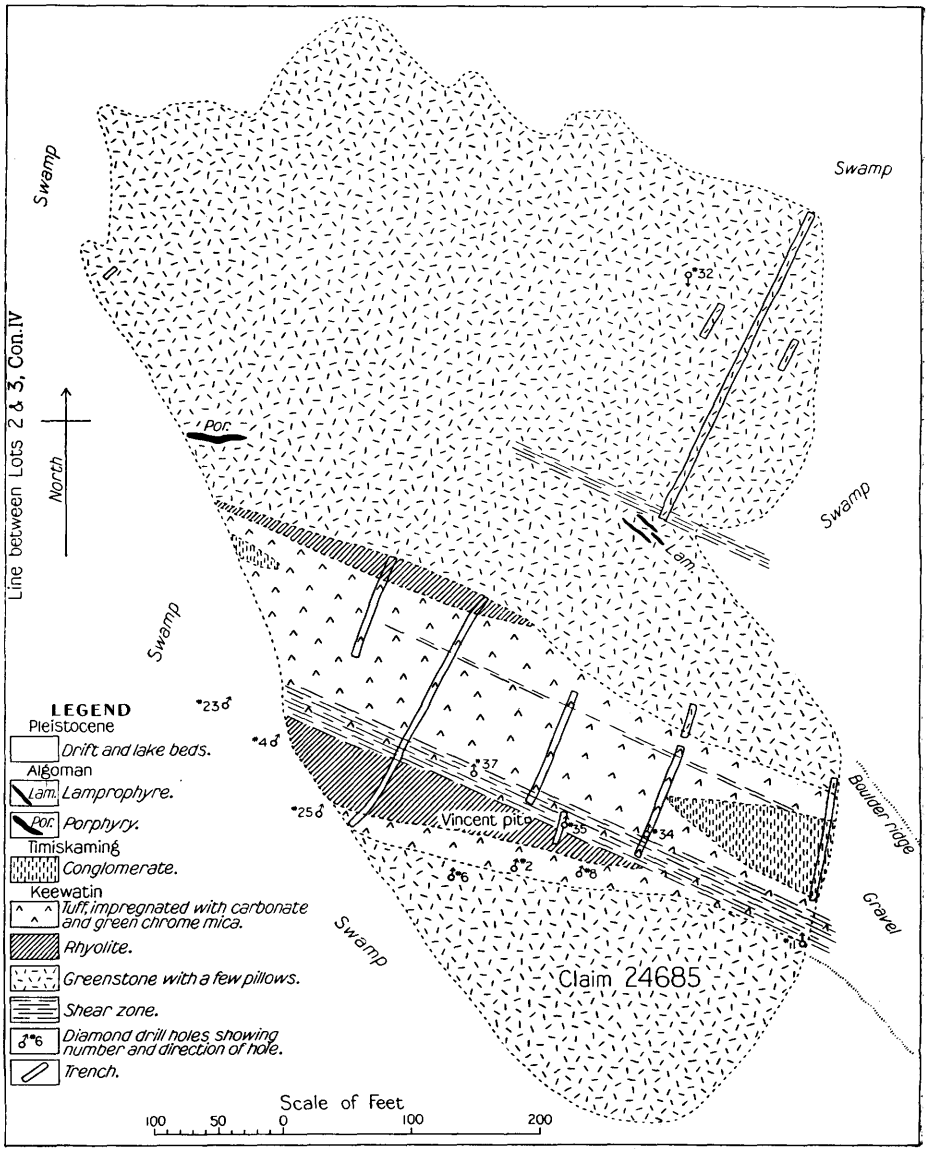
There are two ore bodies on the property, known as the East and West. The East ore body is a lens that has been stoped across a width of 50 feet and developed by drilling and underground workings for a width of 75 feet and a length of 400 feet. It is practically bounded on the west by the major fault described above, and it grades out into waste rock to the east. The ore consists of quartz and carbonate lenses, veins and stringers containing auriferous pyrite, and country rock impregnated with sulphide, and is of much higher grade than that in the West ore body. The carbonate, in some cases at least, is later in origin than the quartz, since stringers of it may be seen cutting veins of quartz. In other cases it seems to be contemporaneous with the quartz. Much of the carbonate is apparently ankerite. There is a considerable amount of pink calcite in the quartz veins near the fault on the 300-foot level. Quartz is the most favourable gangue mineral. On the surface in the eastern section of the outcrop three nearly parallel quartz stringers, 2, 3, and 18 inches wide, have shown some high values.

The West ore body lies west of the main fault and is a stockwork of narrow veins and stringers, mostly in tuff. There are some sections in which quartz is much more abundant than in others, but there is no definite ratio between quartz and ore. The ore body dies out to the east in places where there is abundant quartz and the boundaries are only assay boundaries. On the west side the commercial ore generally ends in a dark, dense lava cut by small stringers of quartz. Small bodies of the same rock occur within the ore body, and these are said to carry values, but apparently they were small enough to be impregnated by the ore-bearing solutions. On the 300-foot level the ore body has been crosscut for nearly 100 feet. This deposit is characterized by considerable chalcopyrite, much more than in the East ore body, and it also carries a little galena. The grade is lower than that of the East ore body. West of the West ore body, several quartz veins, which run practically parallel to the main body, have been drifted on for short distances.

A striking feature of these deposits is the similarity of ore and waste rock. The ore bodies occur mostly in the tuff, which is highly impregnated with quartz, carbonate, mariposite, sericite, and pyrite, the mariposite giving a green shade to much of the rock. When exposed to the air a yellow shade develops by oxidation of the carbonate. Much of the rock taken from the shaft was so highly mineralized that it appeared to be ore, but it ran only a few cents of gold to the ton.

McINTYRE PROPERTY

McIntyre-Porcupine Mines, Limited, took an option on 28 claims lying north of the Hollinger property. Most of these are in Hislop township, but eight lie wholly or partly in the adjoining section of Guibord. There are two



Geological sketch map of part of the Vincent claims, McIntyre property, Hislop township.

properties in Hislop township: the Bush property in lot 1, concession IV, and the Vincent in lot 2, concession IV. There is an outcrop on each of these properties in which gold has been found and on which much drilling and trenching have been done. Thirty-eight diamond-drill holes were bored on or in the neigh-

bourhood of these outcrops, and some holes were later drilled to cover assessment work on adjoining claims in Hislop and Guibord townships, in which the overburden conceals all bed rock. The accompanying geological sketch maps show the drill-holes and trenches on these two outcrops.

In the Vincent outcrop the prevailing rock is greenstone of andesitic character, in places approaching dacite. A few pillows are exposed, but otherwise there is little in the rock to denote its true character. The greenstone has been sheared in several places, and one distinct shear zone runs through it in a direction N. 65° W. Two other shear zones, one quite a minor one, occur near the southwest side of the outcrop and lie parallel to the one mentioned. These are in a different type of rock, as two small wedges of conglomerate and a band of tuff, more acid than the greenstone, occur in this part of the outcrop. The conglomerate is regarded as Timiskaming, as it is similar to some of the outcrops of this formation in other parts of the Ramore area. Well-rounded boulders of different types grade into coarse angular fragments, and these bodies apparently have been infolded in the Keewatin. In the band of tuff a small body of rhyolite shows in the trenches near the southwest corner of the outcrop. In thin section this rock is found to be crowded with phenocrysts of orthoclase, plagioclase, and quartz. The rock is so altered that it is difficult to decide whether this is rhyolite of the Keewatin series or an Algoman intrusion. On the west side of the outcrop, however, a small Algoman porphyry dike appears to be much fresher than the rhyolite, indicating that the rhyolite is extrusive and not intrusive.

The band of tuff is sheared and highly carbonated, and in places it contains a large proportion of mariposite, as does some of the tuff at the Ross mine. Relatively little quartz is seen here, and there is little to suggest a vein or lode deposit except for the large amount of carbonate and pyrite in some zones. So far as can be seen the carbonate and quartz are contemporaneous in age. Three small lamprophyre dikes occur in the outcrop.

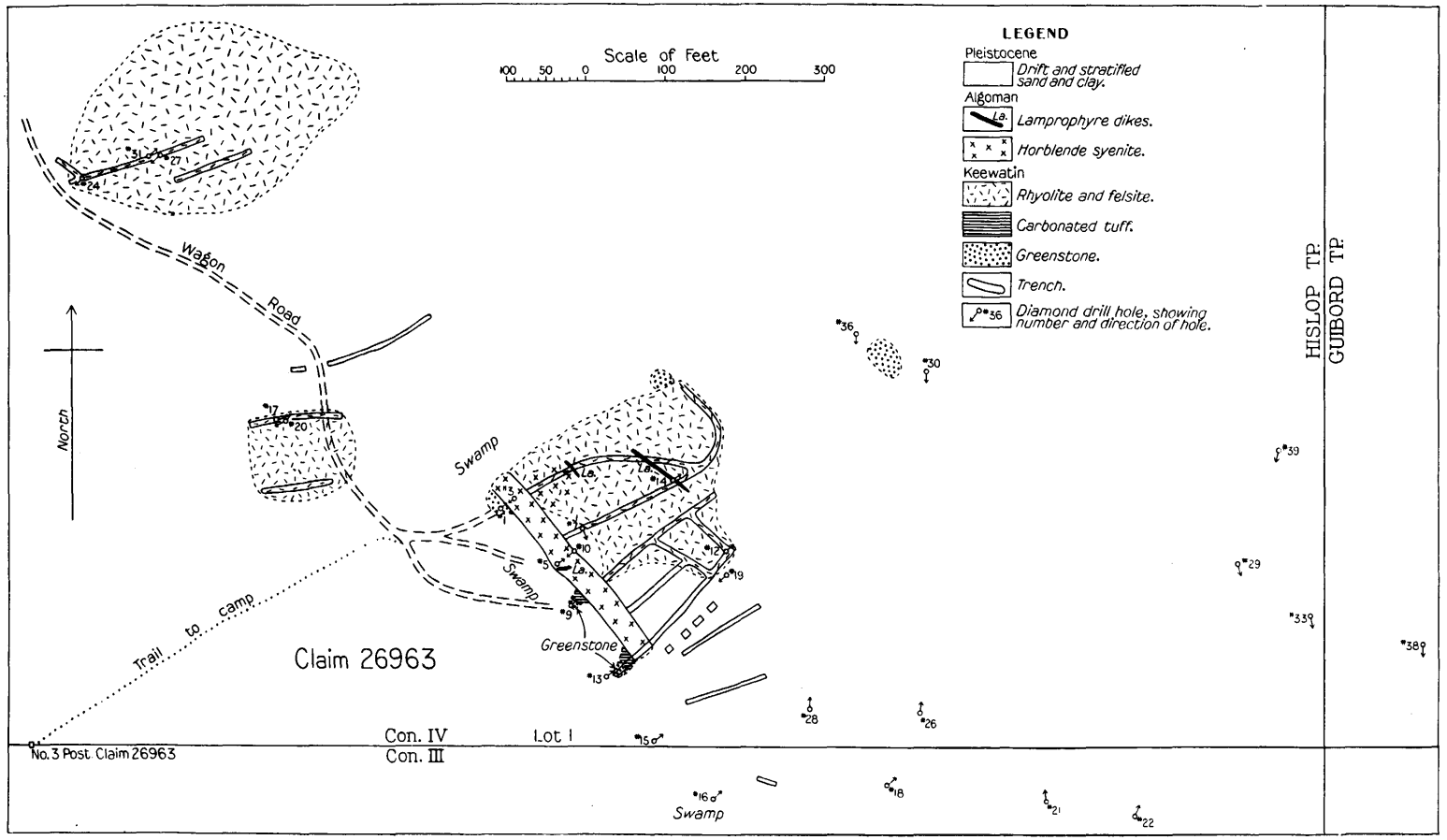
On the main Bush outcrop and on some of the smaller outcrops in its vicinity, the most common rock is reddish, fine-grained, and felsitic. It has the appearance of being highly silicified, and in one place a cherty zone shows injections of a rock consisting of silica with feldspathic streaks running through it.

This felsitic rock proves, from thin sections, to be a fine-grained rhyolite, in some places showing flow structure, as indicated by the arrangement of microlites of feldspar. Some specimens show distinct phenocrysts of feldspar, both orthoclase and oligoclase. The rock has been considerably carbonated by the introduction of ankerite, and large amounts of quartz and pyrite have been introduced.

Running through the main outcrop is a syenite dike about 20 feet wide, striking N. 40° W., at an angle to the schistosity of the rhyolite, which runs N. 70° W. The syenite is coarse-grained and pink to red in colour; it consists almost entirely of feldspar. In the vicinity of this dike, on its northeast side, there are a large number of small, irregular dikes and dikelets of syenite consisting chiefly of microcline. They are offshoots from the main dike and decrease in number away from it.

On the southwest side of the main dike, a narrow band of highly carbonated tuff contains fragments, which in most cases have been replaced by carbonate. This band of tuff lies between the syenite and the greenstone.

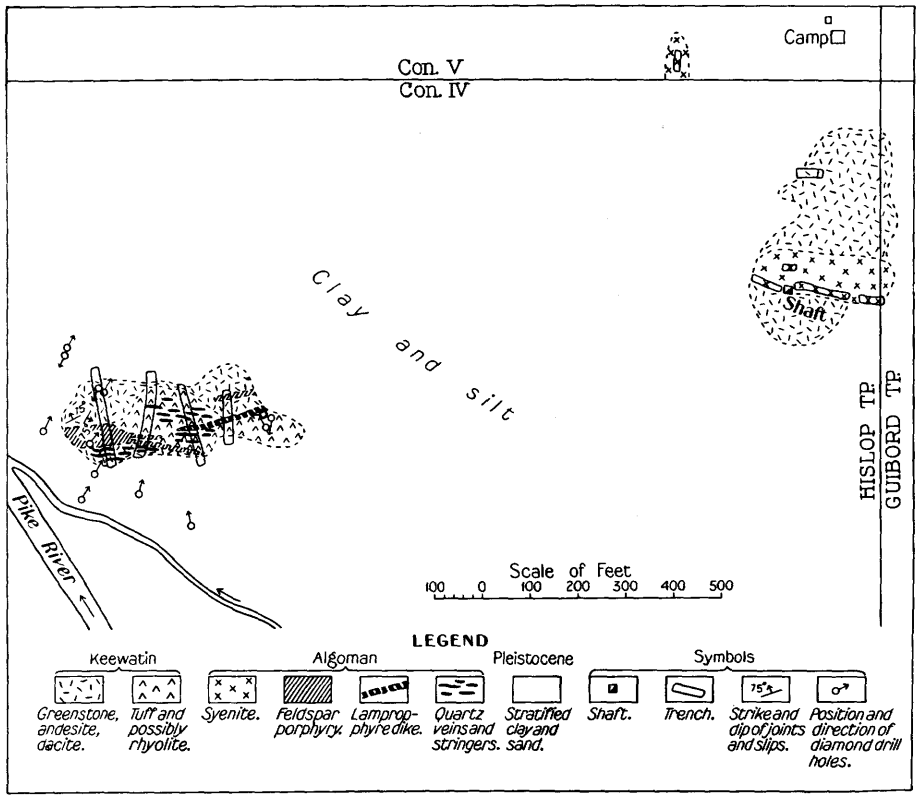
Cutting the rhyolite, and in one case the main syenite dike, are dikes of lamprophyre. One of these is well exposed in the trenches northeast of the syenite dike, where it reaches a width of 6 feet. It is dark-grey, micaceous rock, which from thin sections might be classified as a diabasic lamprophyre because



Geological sketch map of part of the Bush claims, McIntyre property, Hislop township.

of the lath-shaped feldspars. The rock contains phenocrysts of biotite, considerable amounts of hornblende, magnetite, and apatite, and a little quartz, which appears to have been introduced. Considerable alteration to chlorite and replacement by carbonate have occurred.

The lamprophyre dike cutting the syenite dike is 5 inches wide. It has been much altered by replacement by carbonate and sericite and is slightly porphyritic. In thin section it shows outlines of replaced crystals, like those of olivine. The biotite is dull and bleached.

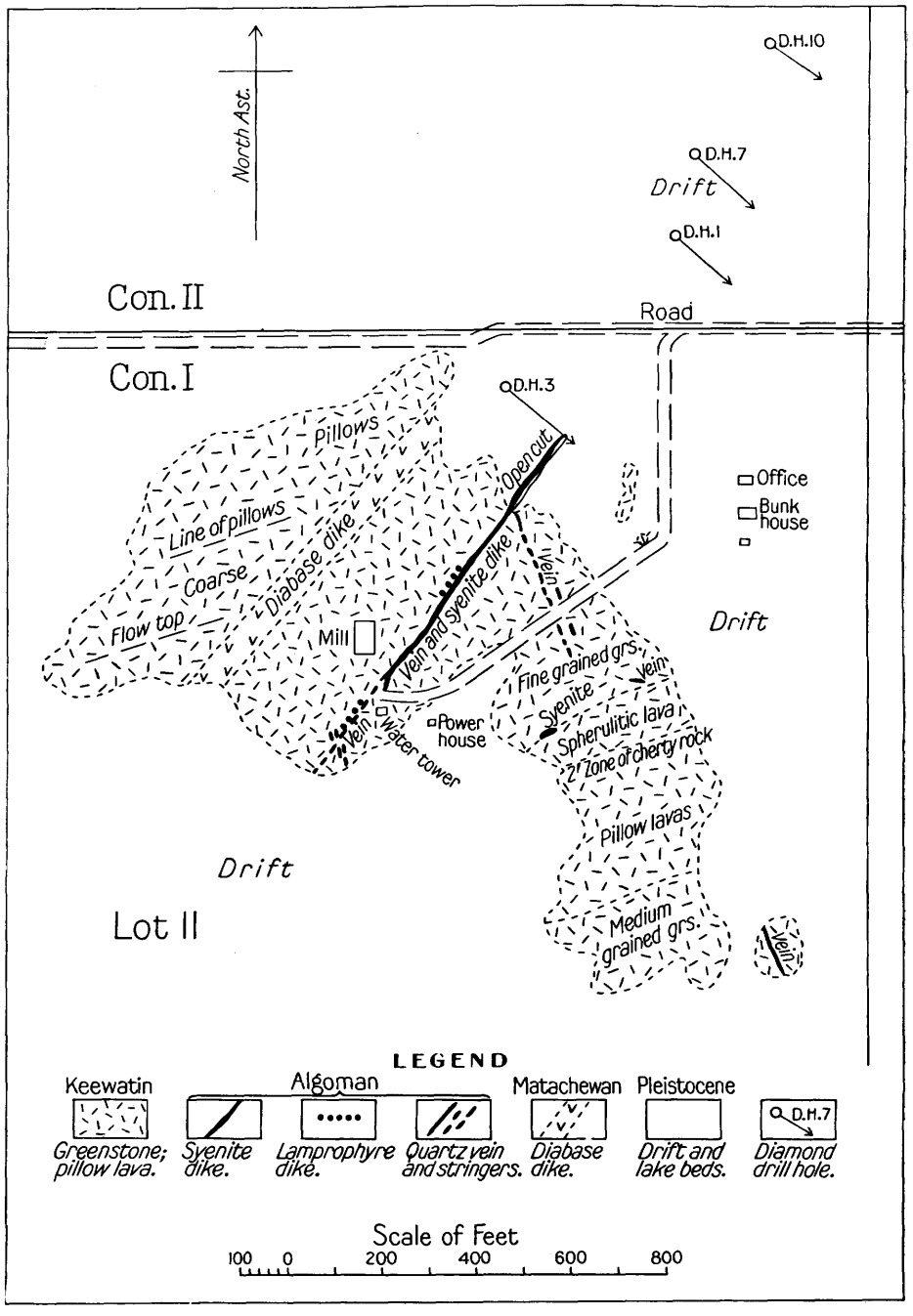


Geological sketch map of part of the property of Hislop Gold Mines, Limited.

The rhyolite in this outcrop is so impregnated with silica, carbonate, and pyrite that it gives the impression that it might be nearly all ore. Native gold was readily found along the contact of the syenite dike and the red rhyolite. Away from the dike the values appear to be spotty and uncertain. The writer has no information regarding what was found in the drill-holes at depth.

HISLOP GOLD MINES, LIMITED

Hislop Gold Mines, Limited, controls the south half of lot 1, concession V, the patented part of the north half of lot 1, concession IV, Hislop township, and two adjoining patented claims in Guibord township. The property lies north of the McIntyre, and the operations are all on the northeast side of the Pike river. Considerable work has been done on the two outcrops on the property.



Geological sketch map of the property of Vimy Gold Mines, Limited, Hislop township.

On the eastern outcrop there is a shaft on a quartz vein, which, judging from the quartz removed from a trench that is now full of water, is 2½ to 3 feet wide on the west side and 6 inches to 1 foot wide in the deep trench on the east side of the shaft. In some sections, the quartz is highly mineralized with chalcopyrite. This vein follows a distinct slip along the contact between syenite and greenstone on the west side of the shaft, but on the east side it swings a little to the northeast, and from there on lies within the syenite. This rock is a biotite syenite, differing from the hornblende variety common in other parts of the Ramore area, and is one of the Algoman intrusives.

According to V. B. Lyle, who kindly furnished information regarding this property, the 2-compartment shaft is about 65 feet deep. It was started on an incline and then changed to the vertical position. As success in finding satisfactory values in gold was not attained, the operations were suspended on this part of the property. The next work of consequence was done on the western outcrop, near the Pike river, where Ventures, Limited, and the Mining Corporation of Canada made a thorough test of the formations by diamond-drilling and trenching. It is said that in all 15 holes were drilled, of which the sites of 13 were found and located on the map. These holes are said to be comparatively shallow, few if any of them exceeding 300 feet in depth.

The geology of the western outcrop is quite complex. In a body of greenstone, some of which is as acid as dacite, quite conspicuous "quartz eyes" are developed. Within this formation is a zone of rock that is probably of tuffaceous origin. It is silicified and carbonated, and in some places is green in colour from an abundance of mariposite. These Keewatin formations are cut by Algoman feldspar porphyry and lamprophyre dikes. In places the formations are cut by narrow quartz veins and a network of quartz stringers. Visible gold was found with some of these stringers, and pyrite occurs with the stringers and impregnates the wall rocks. A series of joints and slips break up the greenstone with the quartz eyes into blocks. The more prominent of these have directions of N. 20° E., with a dip of 75° E., and N. 60° E., with a dip of 75° N.W.

A geophysical survey of the property was made during the summer of 1935 with the object of locating favourable bed rock beneath the heavy mantle of clay and sand that covers the greater part of the property.

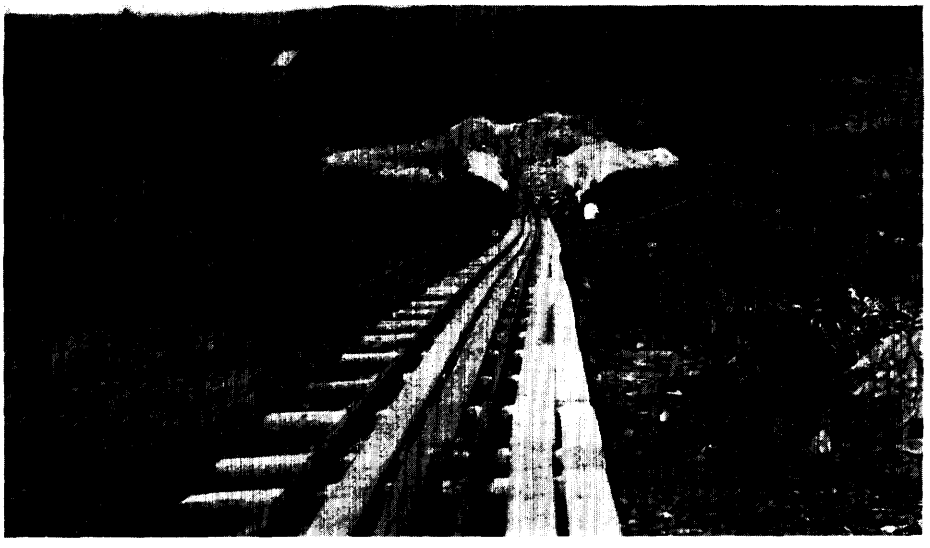
VIMY GOLD MINES, LIMITED

The property controlled by Vimy Gold Mines, Limited, comprises the north half of lot 11, concession I, and the south half of lot 10, concession II, Hislop township. The mine is situated on a hummock of Keewatin pillow lavas, which has been intruded by a large Matachewan diabase dike, a biotite syenite dike, and a lamprophyre dike. The main vein lies along a fracture zone, which is followed for part of its length by the syenite and lamprophyre dikes. The lamprophyre dike lies next to the hanging wall. It is very narrow but appears in several sections of the lode. The syenite dike contains considerable quartz, making it appear to be a granite, but it was not studied under the microscope and the quartz may have been introduced. The dike joins the vein, near the road to the mill, from a direction S. 20° W. At this point it has a width of 5 feet. It pinches to a few inches and swells again to a width of 3 feet.

The vein strikes N. 47° E. and dips 74° N.W. It is uncovered by a trench, which runs practically across the greenstone outcrop, and there is a large pit at the northeast end from which some ore for the mill has been drawn.

At the southwest end, the lode, which here consists of quartz stringers in silicified greenstone, is about 2 feet wide at the surface. About 70 feet from this

point there is a zone about 4 feet wide of quartz stringers running south from the main vein. They dip 63° E. and extend a few feet into the hanging wall. They are unmineralized at the surface. Between this point and the open pit the vein ranges in width from a few inches to about 5 feet. In some sections it is represented by silicified greenstone and in others by a band of quartz stringers in the lamprophyre and syenite dikes; in certain sections a distinct quartz vein occurs. The main pit, spoken of as the open cut, at the northeast end of the trench, was nearly 200 feet long and in places up to 20 feet wide. In this pit a syenite dike, 2 to 3 feet wide, and dikelets of the same rock lie along the hanging-wall side of the lode. This rock and the greenstone are cut by quartz stringers and impregnated with pyrite. A band 8 feet wide is well mineralized with fine pyrite, and a zone 4 feet wide is said to run over $20.00 in gold per ton.[1] In part of the



View showing the open pit and tram to the mill, Vimy mine.

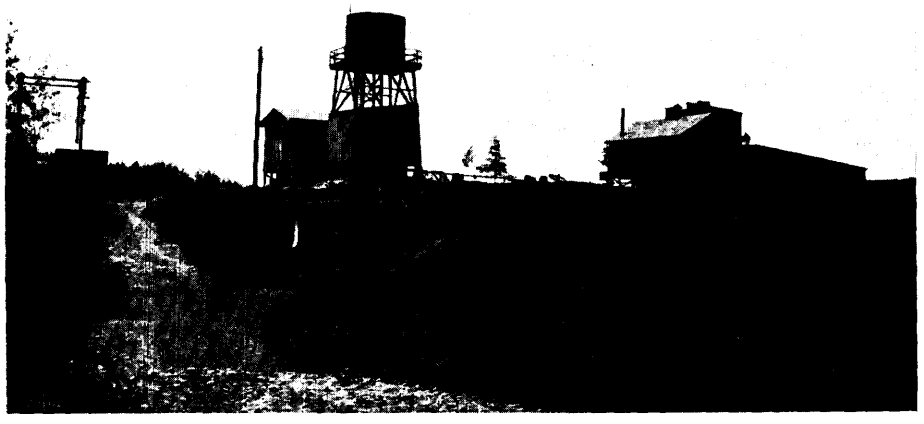
open pit, bed rock had not been reached owing to difficulty with quicksand. From the main vein at the open pit there is a narrow quartz vein running S. 20° E. for 350 feet. This vein dips 60° E. and ranges in width from 2 inches to 1 foot.

A 50-ton mill was completed in July, 1935, and it was intended to supply it with ore from the open pit. Meanwhile a shaft was started near the mill. Difficulty was experienced in finding an adequate water supply for the mill, and a pipe line was laid to a pond in lot 12, concession VI, Playfair township, a mile and a quarter away. Unfortunately, during dry weather this source was sufficient for only two or three days' operation, and the mill was closed down. It was suggested that water might be obtained from a small lake five-eighths of a mile to the southwest in lot 11, concession VI, Playfair township. The gold is in fine-grained pyrite, and in milling the sulphide is floated, necessitating water of suitable type for this purpose. Visible gold is rare in this deposit.

[1]At $35.00 an ounce.

Electric power is available at the mine from the transmission line along the Ferguson highway near Ramore, and electrical equipment has been installed.

About 5,000 feet of diamond-drilling is said to have been done on the Vimy property before plans to operate were completed. In the winter of 1936, Hollinger Consolidated Gold Mines, Limited, drilled three holes on their claims on the Dowson property, in the southeast corner of lot 11, concession II, Hislop township. At the same time they put down a hole near the end of the open pit on the Vimy property. The writer is indebted to Mr. W. C. H. Dowson for information regarding the geological data obtained from the holes on the Dowson property. No. 1 hole was drilled to 250 feet at an angle of 50 degrees. The overburden was 46 feet thick, and the rest of the core was greenstone with dikes and irregular bands of porphyry or syenite and patches and stringers of quartz. In No. 7 hole, which started with a dip of 50 degrees and ended at 322 feet with a dip of



View of the Vimy mine, showing the mill in the background.

45 degrees, there was 65 feet of casing. The solid rock was almost entirely greenstone with a little porphyry and quartz. There was some evidence of breccia with the quartz, and this rock was mineralized with pyrite. No. 10 hole had a depth of 498 feet and a dip of 50 degrees. The casing was 82 feet. Evidence of brecciation, mineralization, and alteration of the greenstone was found, especially between 177 and 181 feet in the hole. Apparently the syenite exposed on the Vimy property occurs in irregular intrusions under the overburden to the northeast, but there is no definite vein in that area.

LOT 10, CONCESSION I

On the Birch farm, north half of lot 10, concession I, Hislop township, Sylvanite Gold Mines, Limited, made a test of the formations by stripping and trenching several outcrops. The bed rock on the property is mainly coarse Keewatin greenstone, which has been intruded in many places by dikes and irregular injections of Algoman feldspar porphyry. A few dikes of granite occur near the south end. Two north-south dikes of Matachewan diabase also cut the outcrops.

In the southern of the two main outcrops a quartz vein 3 to 7 feet wide is crossed by the power line. This vein runs north-south through a feldspar porphyry dike and has been trenched for 4 chains. Unfortunately, it is poorly mineralized, although it contains a little pyrite, galena, and chalcopyrite. To the northwest of this vein, 360 feet along the power line, there is a large trench 12 feet wide and about 200 feet long, with a maximum depth of 6 feet. It runs north-south on a zone of small quartz veins, dikelets of porphyry, and somewhat mineralized greenstone, which is exposed for nearly 500 feet and ends in a mass of rock that is mostly feldspar porphyry cut by stringers of quartz. A series of white quartz veins run north-south through the western part of the outcrop. Much quartz occurs on this property, but it is not well mineralized.

SOUTH HALF, LOT 11, CONCESSION I

On the J. Weir property, south half of lot 11, concession I, Hislop township, there are several quartz veins in granite and greenstone near small intrusions of granite. One vein has a width of from 3 to 10 feet. In places where the vein is narrow, parallel quartz stringers make up a zone about 6 feet in width, which is composed mostly of quartz. At the widest points the quartz is white and very barren in appearance, but a band of dark quartz 2 feet wide occurs near the centre of the 10-foot vein. This quartz is mineralized with pyrite, which is abundant in some places. The greenstone walls are altered a little and contain pyrite in some parts. The vein strikes N. 20° W., dips 70° E., and was traced for a distance of more than 400 feet. The strike of the lava flows is N. 60° E., and they dip southeast. There is some shearing in the direction of the main quartz veins, and a fault with a horizontal displacement of 20 feet runs in the same direction.

In another outcrop to the west, several other quartz veins strike N. 20° W. and have widths up to 3 feet. The quartz is white and little mineralized.

It is interesting to note that the veins on the south half of the lot trend almost at right angles to the main vein on the Vimy property in the north half of the same lot.

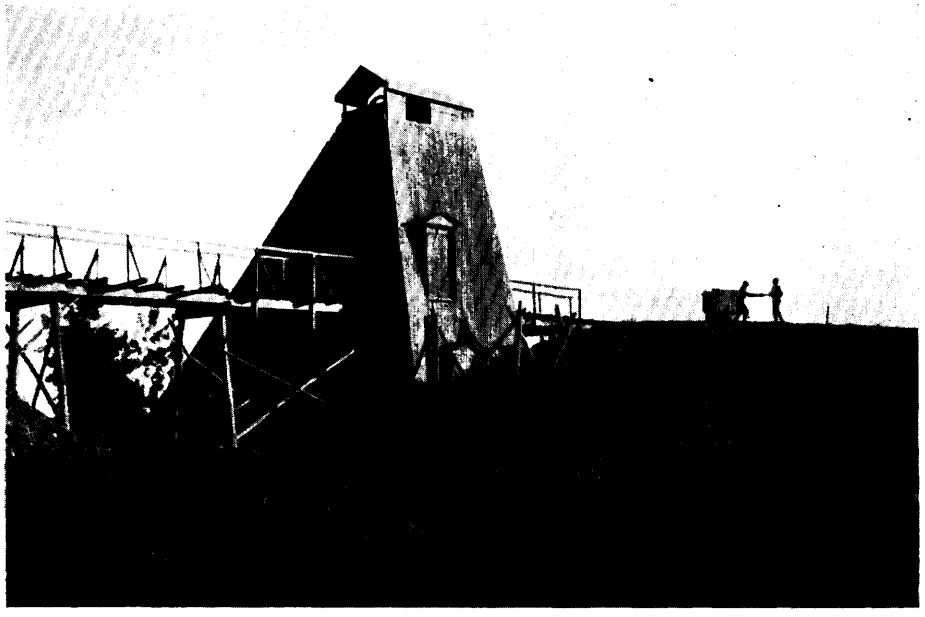
GOLDEN ARROW

The Golden Arrow property comprises claims in the south half of lot 12 and in lot 13, concession I, Hislop township. Much work has been done on the two main outcrops. One of these lies across the line dividing lots 12 and 13, and the other a little south and east of the centre of lot 12. The geology of these outcrops is quite complex. The oldest rock is Keewatin pillow lava, which strikes nearly east-west. The lavas have been intruded by dikes of Matachewan diabase and numerous small bodies of syenite and granite. They have been sheared, and in a number of sections the shear zones are followed by quartz stringers.

A large trench runs east-west across the outcrop that crosses the lot line. East of the line a number of quartz stringers mineralized with pyrite are exposed in the trench. The zone here is 10 feet wide. Another trench follows an oxidized zone in the lavas. West of the line a quartz vein about 1½ feet wide runs N. 80° E. from the west side of the greenstone outcrop and dips 65° N. Associated with this quartz vein are stringers of quartz, making a zone which is 8 to 10 feet wide in places. The quartz carries some pyrite. Near the west edge of the outcrop, quartz stringers are scattered through a zone about 100 feet wide, in which the greenstone has been silicified, carbonated, and slightly sheared. In this zone, sampling has been done on a band 30 feet wide. Very thorough sampling of the Golden Arrow property was done by Hollinger Consolidated

Gold Mines, Limited, in the summer of 1935. Four diamond-drill holes had been drilled near the western edge of the outcrop to test the quartz-bearing zone described above.

The other main outcrop on the property consists largely of coarse- and fine-grained lava flows, cut by small bodies and numerous dikelets of syenite. The eastern part consists of rather massive greenstone, and the western part of the finer-grained rock, which is sheared in a number of zones. A considerable amount of hornblende schist occurs in this section, and the schist has been so twisted that the strike lies in various directions. The syenite and the greenstone near it have been silicified and well mineralized in many places. There is also a considerable amount of chalcopyrite in this outcrop.



Shaft and dump at the Talisman mine, Guibord township.

The showings have been extensively trenched and thoroughly sampled. One trench is from 10 to 14 feet wide and 165 feet long. It is difficult to distinguish any definite ore zone, as the mineralized bands are irregular and in places wide. In one place a channel sample had been taken across a width of 25 feet.

OTHER PROPERTIES

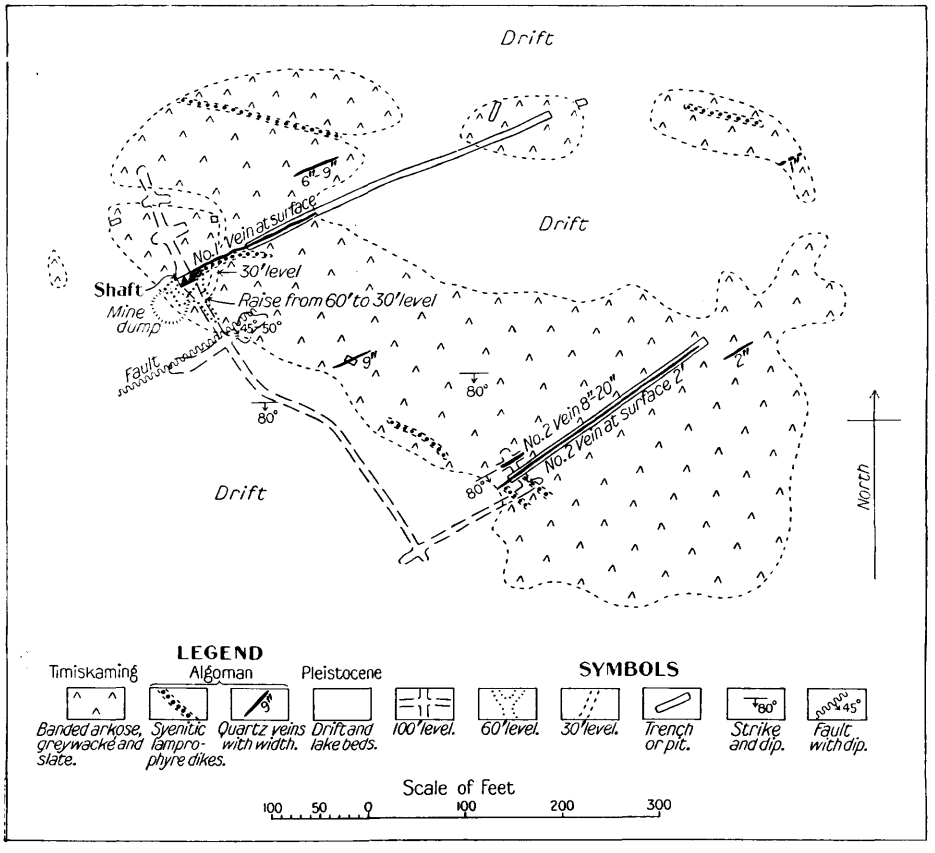
Considerable work has been done on a number of other properties in Hislop township. There is an old shaft in lot 13, concession III, and a shallow new one in lot 9, concession VI. Trenching has been done on a considerable scale in lots 10, 11, and 12, concession II, but there was nothing, at the time the mapping was done, to require a detailed description of these properties.

Guibord Township

TALISMAN MINE

The Talisman property in the south half of lot 7, concession VI, Guibord township, can be readily reached by an automobile road running east from

Matheson. No work was being done on the property in 1935, but during the previous year underground work was carried on from a shaft sunk ten years earlier. M. E. Hurst, of the Ontario Department of Mines, visited the property while it was in operation in 1934, and the writer is indebted to him for the following description of the conditions underground and the plan of the underground workings embodied in the accompanying map of this property.



Sketch map of the surface geology and underground workings, Talisman mine, Guibord township.

During 1923 and 1924, a shaft was sunk near the west end of the No. 1 vein to a depth of 115 feet, and about 500 feet of lateral work was done at the 100-foot level. In 1934 the property was reopened and additional exploratory work was carried out at the 30-foot, 60-foot, and 100-foot levels. The extent of the underground workings in June, 1934, is shown on the accompanying plan.

In the shaft, the No. 1 vein splits into two stringers, one of which pinches out at a depth of 18 feet and the other at a depth of 30 feet. At the 100-foot level crosscuts were driven to the northwest and southeast without encountering the downward extension of the No. 1 vein. A fault, which dips about 45° S., was intersected at a point 75 feet southeast of the shaft. Lateral exploration in the vicinity of the shaft at the 30-foot and 60-foot levels also failed to find the continuation of the No. 1 vein but encountered the fault exposed on the 100-foot level. Later, the southeast crosscut at the 100-foot level was extended to intersect the downward extension of the No. 2 vein. At a point about 370 feet southeast of the shaft a drift was run to the northeast to get beneath the surface exposure of the vein. After drifting 120 feet, a crosscut driven to the northwest intersected the vein at a distance of 37 feet. At this point the vein strikes N. 54° E., dips 80° S., and ranges from 8 to 20 inches in width. It consists of white quartz containing wall-rock inclusions and small amounts of tetrahedrite and chalcopyrite. The walls

are somewhat sheared and contain disseminated pyrite and chalcopyrite. Some drifting is said to have been done on the vein since the property was examined by the writer.

Most of the surface exposure consists of banded arkose, greywacké, and slate of Timiskaming age. The formation strikes east-west, dips from 70° to 80° S., and is cut by several small dikes running in different directions and of no great length. The dikes, which vary greatly in width from point to point, are from 2 to 8 feet wide and have been regarded in the field as lamprophyre, as they are rather dark in colour and rich in biotite. They are slightly porphyritic and weather to a reddish-brown colour on the surface. Thin sections show that they consist largely of orthoclase, biotite, and a little plagioclase. The biotite occurs in blades, which are often bleached from their original green colour. The rock approaches a fine-grained syenite in composition, except for the large amount of biotite present. It might be considered a syenitic lamprophyre.

There are several quartz veins exposed on the surface ranging in width from 1 inch to 2 feet. The veins are roughly parallel to one another and to a small fault found on the 100-foot level, and they cut the banded sediments at a low angle. No. 1 vein near the shaft follows one of the lamprophyre dikes for a short distance at the surface.

OTHER PROPERTIES

Near the top of Guibord hill on the south side there are a number of pits, trenches, and diamond-drill holes on several small bodies of pyrrhotite and pyrite in the greenstone. A quartz vein with a maximum width of 15 inches, strikes N. 20° W., dips 70° N., and runs southward from a pit in which pyrite is exposed. It maintains its strike and dip for 180 feet along a trench. The main sulphide body is somewhat dome-shaped and lies between layers of greenstone. It is about 4 feet thick near the top of the dome, where the body dips 45° S. Much gossan is found at the surface. Part of the pyrite is quite coarse grained. A number of patches of gossan are found on Guibord hill, and pits have been sunk on several of these.

A considerable amount of work has been done on quartz showings along the foot of Guibord hill on the west side, where a number of porphyry and syenite intrusions occur in the greenstone. Work has also been done on and in the vicinity of the big quartz exposure in lot 9, concession IV. This remarkable display of quartz has attracted much attention, but gold values in it are very low. A number of small granite intrusions occur in its neighbourhood.

Work has been done on several other lots in this township, where quartz is found in association with granite, syenite, and porphyry intrusions of Algoman age, such as those in lots 8 and 9, concessions I and II; lots 1 and 6, concession IV; and a number of others.

Apparently no work has been done recently on the Big Pete or the Gold Pyramid near the northwest corner of the township. The latter property is reported to have produced a considerable quantity of gold from shafts and open cuts previous to 1912 but nothing since. The plant has been destroyed by fire. The ore here occurred in quartz veins cutting the Timiskaming sediments.

Playfair Township

Although what is claimed to have been the earliest discovery of gold in this part of Northern Ontario was made in Playfair in 1905, no producing mine has been developed in the township. The first claims in the Ramore area are said to have been staked by a prospector named Frederick Mobbs, after whom the

lake in lot 9, concession III, is named. A number of claims have been tested in this part of the township, and a large amount of work has been done by Ramore Gold Mines and other companies.

RAMORE GOLD MINES, LIMITED

Ramore Gold Mines, Limited, controls claims in lot 8, concession III, on which shafts, drill-holes, and large trenches have been sunk. The concession line at the north end of the lot crosses a large outcrop of coarse greenstone, which in some sections is sheared in zones running east-west; in such zones the greenstone has been altered to hornblendite. The main mass of the rock appears to have been a gabbro, now largely altered to epidiorite. At the southeast corner of the outcrop there is an intrusion of hornblende syenite, and a dike of this rock runs off to the northeast in the greenstone. The syenite is a reddish, medium-grained rock, which has been brecciated and cut by veinlets of quartz. A considerable part of the intrusion is impregnated with pyrite, which is said to contain gold, although the writer has no assays of it. A pit about 20 by 15 feet and 15 feet deep has been sunk in the syenite, and apparently it was intended that this should be timbered and used as a shaft, since timbers were on the ground. The pit was full of water at the time of the writer's visit, as no work was then in progress.

A trench has been cut across the syenite and a diamond-drill hole bored in the swamp just south of the pit. The impregnation of so much of this intrusion by pyrite is interesting, because on no other property in the Ramore area is there a body similar to this. The syenite intrusion contains a horse of greenstone, and both the greenstone and the small syenite dikes are cut by a large dike of porphyritic Matachewan diabase.

About a quarter of a mile south of the workings described, and beyond a swamp, there is a 2-compartment, timbered shaft. It was full of water, but is reported to be about 70 feet deep. The shaft was sunk on an outcrop of greenstone, about 50 feet in diameter, which is cut by dikelets of a very fresh-appearing hornblende syenite. In fractures in the syenite a considerable amount of epidote is found, but there is relatively little quartz or sulphide mineralization. Another diamond-drill hole has been put down near this shaft.

Nearly 600 feet south of the shaft a large outcrop of greenstone, 15 chains long, is cut along the east side by a large Matachewan diabase dike, which runs a little west of north. On the west side it is cut by a dike of syenite, which widens out at the south end so that it is cut by the diabase dike. A swamp lies along the west side of the outcrop.

Deep trenches and pits have been sunk on this exposure, especially along the syenite-greenstone contact, where there are quartz stringers and variable degrees of pyrite mineralization.

LOT 13, CONCESSION IV

What is commonly called the Noranda property, because that company did the work on it, is situated in lot 13, concession IV, Playfair township. Much trenching was done, and a number of diamond-drill holes, from which the casing has been pulled, were sunk on an irregular quartz zone lying along the east side of a large hill of porphyritic Keewatin lavas. The trenches extend along the hill for a distance of about 400 feet. There is no definite vein, but numerous stringers of quartz make up a zone that in one section has been channel-sampled across a width of 15 feet. The dip of the zone seems to vary from nearly vertical to quite flat, and the strike changes rapidly. In some places the zone is well

mineralized, and in others it is practically barren of sulphide. Irregular dikelets of syenite are associated with the quartz.

OTHER PROPERTIES

Work has been done on a number of properties in this township, in addition to those mentioned. Quartz or carbonate veins and impregnations of sulphide near intrusions of porphyry or syenite in greenstone have attracted the attention of many prospectors. The sulphide is usually pyrite, but small quantities of chalcopyrite occur in some of these deposits. A considerable amount of work has been done in lots 7 and 8, concession II, and at several other places.

McCann Township

A large number of claims have been staked in McCann township. Trenching and some shallow diamond-drilling have been done, but no definite ore deposits have been revealed.

Bowman Township

Gold has been reported on a number of properties in Bowman township, and work has been done in several localities, but none of these require a special detailed description.

Geology of the Afton-Scholes Area

By E. S. Moore

INTRODUCTION

Afton and Scholes townships are situated in the southwestern part of the Timagami Forest Reserve, district of Sudbury. Late in the last century, attention was attracted to Afton township by a discovery of gold on Emerald lake, prospectors have from time to time staked claims in the township, but little development work was done until 1915. Recently this area has again aroused interest. The New Golden Rose (Afton) mine is now being developed by the Consolidated Mining and Smelting Company of Canada, Limited, and most of the Afton-Scholes area has been restaked.

The area is not readily accessible, except by air, and airplanes are commonly used for transporting men and materials. The route in summer is by way of Lake Timagami. A boat trip of about 30 miles from Timagami, on the Timiskaming and Northern Ontario railway, brings one to Obabika portage, which is about a mile in length and on which a wagon road has been built. There is a 9-mile trip south on Obabika lake to the Emerald lake portage, which is 1¼ miles long and is also crossed by a wagon road. The New Golden Rose mine is situated on the east shore of Emerald lake about three-quarters of a mile from the portage. Last summer heavy machinery, including a 75 h.p. Diesel engine and compressor, and supplies of all sorts were brought in over this route.

The area can also be reached by canoe by another route from Lake Timagami, via Gull and Eagle Rock lakes, as well as by the Obabika lake route. In taking the latter a small lake and two shorter portages between Obabika and Emerald lakes are used instead of the long portage. A winter road runs from the mine to Chudleigh on the Canadian National railway, near Sudbury.

The writer is greatly indebted, for information and generous hospitality, to the Consolidated Mining and Smelting Company of Canada, especially to W. E. Aitchison, manager of the New Golden Rose mine, and D. C. McKechnie, district mining engineer, and to David Ferguson, of the Taylor-Caswell property. E. Hartwick performed the duties of assistant in a very efficient manner.

Previous Work

Barlow[1] mapped the region around Lake Timagami and covered at least part of this area, but no mention of gold discoveries on Emerald lake was made in his report. Gold had been discovered before 1900, however, being mentioned briefly in other reports of that date,[2] and Miller[3] discussed the discovery in a report made the following year:—

> A few years ago Emerald lake attracted considerable attention from prospectors on account of the reported occurrence of gold on its shores. The gold was said to have been found in the loose state in grains of considerable size, mixed with sand, in a small cave, or so-called "vug," near the water's edge. . . . Rock had been blasted out here at different points, but we saw no signs of the precious metal in the quartz in which the openings had been made. Considerable pyrite, some of which is in well defined cubes, occurs in these openings.

[1] A. E. Barlow, "Report on the Geology and Natural Resources of the Area Included by the Nipissing and Temiscaming Map-sheets," Geol. Surv. Can., Vol. X, 1897, pp. 271-279 I.

[2] "Report of the Survey and Exploration of Northern Ontario, 1900," Ont. Bur. Mines, 1901, pp. 88, 112.

[3] W. G. Miller, "Iron Ores of Nipissing District," Ont. Bur. Mines, Vol. X, 1901, p. 175.

Miller[1] also mentions the occurrence of conglomerate and dolomite on the north side of the southeast bay of Emerald lake and speaks of the dolomite having a striking appearance.

In 1909, the Golden Rose Mining Company was incorporated, with head office at Sudbury and a capital stock of $500,000.[2] Apparently little work was done on the property until 1915, when about eight men were employed during the open season. Trenching, open-cutting, and test-pitting were done, and a 6-foot Hardinge mill and amalgamation plates were installed for the extraction of the gold. Edward J. Townsend was president and manager of the Golden Rose Mining Company at that time.[3] In the following summer some work was done; and in addition to trenching, a shaft was sunk to a depth of 30 feet.[4] The remains of the old mill and a large vault for storing the gold recovered may still be seen on the shore of Emerald lake.

The next record of work done on the property was in 1927. In June of that year, Afton Mines, Limited, was incorporated at Toronto, with a capital stock of $2,000,000. During the summer about 30 men were engaged in deepening the shaft to 100 feet and in crosscutting and drifting. Some diamond-drilling was also done on the hill in the vicinity of the mine.

In the summer of 1934, New Golden Rose Mines, Limited, was organized. The Consolidated Mining and Smelting Company of Canada, Limited, controls 2,000,000 shares of the stock of this company and has undertaken the development of the property. Further drilling was done on the surface to check the former records, and in March, 1935, a start was made in deepening the old shaft to 450 feet. Up to the present time, at least 12 diamond-drill holes have been sunk from the surface, a considerable amount of drilling has been done from the underground workings, and about 1,500 feet of drifting and crosscutting has been completed on the second and third levels.

Topography

This area, like so much of the Timagami region, is very rugged. The relief is due chiefly to remnants of a great diabase sill that at one time covered the whole area. It has been partly removed by erosion, leaving in some places unscalable cliffs, scores of feet high, and large rugged hills that rise several hundred feet above the larger lakes. South of Emerald lake the hills stand nearly 300 feet above the lake.

Where the diabase has been eroded away, exposing the older rocks, the relief is low and there are numerous lakes, the larger ones, like Emerald and Eagle Rock lying in basins that are mostly in the Timiskaming sediments. There are a few small lakes among the diabase hills. The area of older rocks is in many places deeply covered with glacial drift and around the larger lakes with alluvium. The whole area is covered with pine. The red species predominates, but there is a sprinkling of the white variety.

GENERAL GEOLOGY

The Afton-Scholes area may be considered as a low dome, on the surface of which erosion has cut windows through a great sill of Nipissing diabase, exposing rocks of Keewatin, Timiskaming, Algoman, and Cobalt ages. The section of

[1]W. G. Miller, op. cit., p. 176.
[2]Ont. Bur. Mines, Vol. XIX, pt. 1, 1910, p. 48.
[3]Ibid, Vol. XXV, pt. 1, 1916, p. 103.
[4]Ibid, Vol. XXVI, 1917, p. 90.

special interest to prospectors is almost surrounded by diabase, and two large ridges of this rock traverse the area from north to south. Streams have cut gaps through the sill at the north and south ends of the area, exposing the older rocks.

Table of Formations

QUATERNARY	
PLEISTOCENE:	Glacial drift.
PRE-CAMBRIAN	
KEWEENAWAN:	Nipissing diabase sill.
COBALT:	Conglomerate and arkose.
ALGOMAN:	Red and grey feldspar porphyries.
TIMISKAMING:	Conglomerate, quartzite, arkose, greywacké, and a little limestone.
KEEWATIN:	Greenstone and schist, iron formation, and possibly some rhyolite.

Keewatin

The oldest rocks in the area are greenstones, and schists resulting from dynamic metamorphism of basic rocks. These rocks occur in scattered outcrops, separated by drift and Algoman porphyries. Associated with the greenstone is an acid rock, rhyolite or feldspar porphyry, that on the whole appears to be older and more altered than most of the Algoman porphyries. This may be Keewatin, but the heavy mantle of drift that hides the rocks in so many places covers the contacts and prevents a satisfactory determination of the relations between the greenstone and the more acid rocks. Further, some of the Algoman porphyries are so altered that it is difficult to distinguish them from older rocks of similar composition except where they are found cutting rocks younger than the Keewatin.

The Keewatin iron formation is important in this area because most of the gold deposits so far found are located in it. The rock is a typical banded type, in most places consisting of red to nearly black jaspilite. In places hematite and magnetite are almost sufficiently abundant to make a low-grade iron ore. In part of the formation the rock consists almost entirely of laminated chert. The formation is, for the most part, very hard, dense, and impermeable, but there are bands of quite porous granular silica, which on account of its more permeable character permitted the circulation of ore-bearing solutions.

The iron formation is strongly magnetic, and compass work is difficult over the formation in place and over drift containing boulders of this rock. It is impossible to run lines by compass in the vicinity of the outcrops with any degree of accuracy, and there are few surveyed lines in this area that can now be recognized. Many of the claim lines run by compass are far from their proper positions.

There are two main bands of iron formation exposed on the east side of Emerald lake. The New Golden Rose mine is located on one of these, and the other occurs on the large island south of the mine. It is believed that these two bands indicate the limbs of a large syncline with Timiskaming sediments in the centre. The northern band is more or less continuous from Emerald lake eastward to Eagle Rock lake, a distance of 2½ miles. For about half of this distance it is covered by a remnant of the diabase sill and drift. The dip needle indicates its presence beneath the drift in some places, but it may be cut out by Algoman intrusions in others. The formation is in a single band for the greater part of its length, but in the vicinity of the mine there are three bands, the result of duplication by folding.

The south band is well exposed at the west end of the large island in Emerald lake, but 30 chains east from the shore it disappears beneath drift, and a little farther east a remnant of the diabase sill overlies its extension in that direction. On the east side of the ridge of diabase a large mass of Algoman porphyry is exposed, and it has caught up some of the iron formation on the south side of a lake lying between Emerald and Eagle Rock lakes. This exposure of iron formation is regarded as a part of the south band, which was apparently continuous along the south side of the syncline before the injection of the Algoman porphyries. The remnants of the iron formation surrounded by porphyry are greatly distorted and have very complicated structures.

Timiskaming Series

A series of sediments in this area consists of conglomerate, arkose, quartzite, and greywacké. These formations are regarded as Timiskaming for several reasons. The basal formation is a conglomerate that strongly resembles the Timiskaming conglomerate in other areas; it contains large granite boulders, some being as much as 2 feet in diameter, and there is no granite in place in the neighbourhood that could have furnished these boulders; it also contains pebbles and angular fragments of the iron formation, which it is believed to overlie (a shallow syncline of conglomerate lies in the iron formation at the mine). The conglomerate and iron formation are both cut by the Algoman porphyries, and these are overlain by Cobalt sediments, which in turn are intruded by the Nipissing diabase sill.

The distribution of pebbles and boulders in the conglomerate is quite irregular, as the rock gives place within a short distance to greywacké with only scattered pebbles, or none at all. This irregularity in the distribution of the pebbles and boulders makes it more difficult to determine the structure south of the mine than if there were not these rather rapid changes from conglomerate to greywacké in sections of the area where there are only scattered outcrops.

The conglomerate is well exposed near the mine, and a few outcrops may be seen on the south side of the iron formation just east of the mine. A small patch of it occurs on the south side of the iron formation south of a lake between Emerald and Eagle Rock lakes. Outcrops also occur on the south side of the iron formation on the large island, on the north shore of the southeast bay of Emerald lake, and on the west side of Eagle Rock lake. It grades into greywacké and arkose and these rocks may be seen at the south end of Emerald lake and at the south end of a small lake lying about half way between the southern sections of Eagle Rock and Emerald lakes.

The Timiskaming quartzite is an impure type grading into arkose and greywacké. Some of it is rather friable and highly impregnated with pyrite in places, as on the large peninsula jutting out from the east side into the southern part of Emerald lake. In some sections it is a hard, pink rock, as on the east and west shores of Eagle Rock lake, where there are several outcrops. The quartzite is also exposed beneath the edge of the diabase sill on the west side of Emerald lake southwest of the large island.

The small occurrence of limestone, associated with conglomerate, on the north side of the southeast bay of Emerald lake is unusual, as it is entirely crystalline and practically a marble. It is similar to some of the Grenville limestone in southeastern Ontario.

The Timiskaming formations on the whole weather readily and form the basins of the larger lakes in this area.

Algoman Porphyries

In this area are two types of porphyry that are regarded as Algoman. They are both feldspar porphyries, less acid than typical granite in composition but slightly more acid than typical syenite. The phenocrysts are almost entirely feldspars: orthoclase and plagioclase of a composition near oligoclase and albite.

The porphyries occur in dikes, small stocks, and bosses. The largest mass is found around the lake near the trail between the mine and Eagle Rock lake. It is a comparatively fresh pink feldspar porphyry. There are many smaller bodies in the form of dikes and small stocks scattered throughout the area, some of which are pink to reddish and others grey in colour. On the whole the grey porphyry is a little more altered than the red, and some of it appears older. As the two porphyries were never found in contact with one another, their age relations could not be definitely determined, but it is believed that they are of approximately the same age. The grey porphyry probably represents border phases of the reddish type and intrusions that have been influenced by the rocks intruded and by hot solutions where these intrusions are in the vicinity of mineralized formations.

The porphyries are quite similar in composition and other features, except for a slightly larger proportion of sericite, chlorite, epidote, and other secondary minerals in some of the dikes. One intrusion on the point south of the mine, on the north side of the bay separating the large island from the peninsula on which the mine is located, has an unusual structure. In thin section it shows a perlitic or onion-like structure in the matrix. This was not observed in any of the other intrusions.

Cobalt Series

Conglomerate and banded arkose and greywacké of the Cobalt series, which lie immediately beneath the diabase, outcrop in a number of places around the northern part of Emerald lake. These rocks have a dip westward of 15 to 20 degrees, except on the west side of the lake opposite the mine, where they have been disturbed by the intrusion of the diabase. Where the sill has pushed up over some of the sedimentary rock it has so disturbed it that at first glance one is led to believe that the sediments must be part of the Timiskaming. Further study shows, however, that these disturbed rocks are confined to a small area close to the sill.

A small outcrop of Cobalt quartzite was seen along the trail between Emerald and Woods lakes and another on the portage between Obabika and the small lake south of it. Farther north, around Obabika lake, the Cobalt rocks underlie the drift over larger areas.

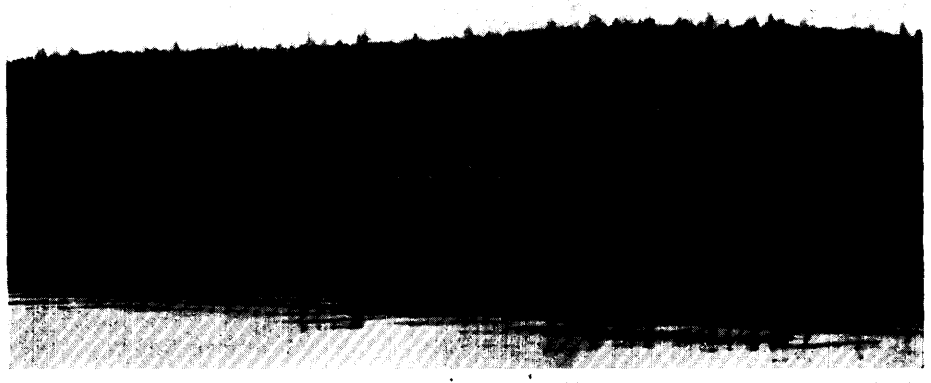
Nipissing Diabase

The Nipissing diabase outcrops in large sections of the Timagami Forest Reserve, where remnants of a great sill remain. The Afton-Scholes area is practically surrounded by this rock, and ridges of it extend from north to south across the area. The rock here is very similar to that in other areas, which has been described in detail. No estimate of the original thickness of the sill is possible in this area because much of the upper part has been removed by erosion. Between 300 and 400 feet remain.

STRUCTURAL GEOLOGY

It is evident that this area was greatly folded at the close of the Timiskaming, and probably the major disturbance accompanied the intrusion of the Algoman rocks. This diastrophism was so great that there is no way of determining whether there was extensive folding after the Keewatin rocks were formed and before the erosion that resulted in the deposition of the Timiskaming. It is probable, however, that there was a period of folding and erosion preceding the deposition of the Timiskaming sediments.

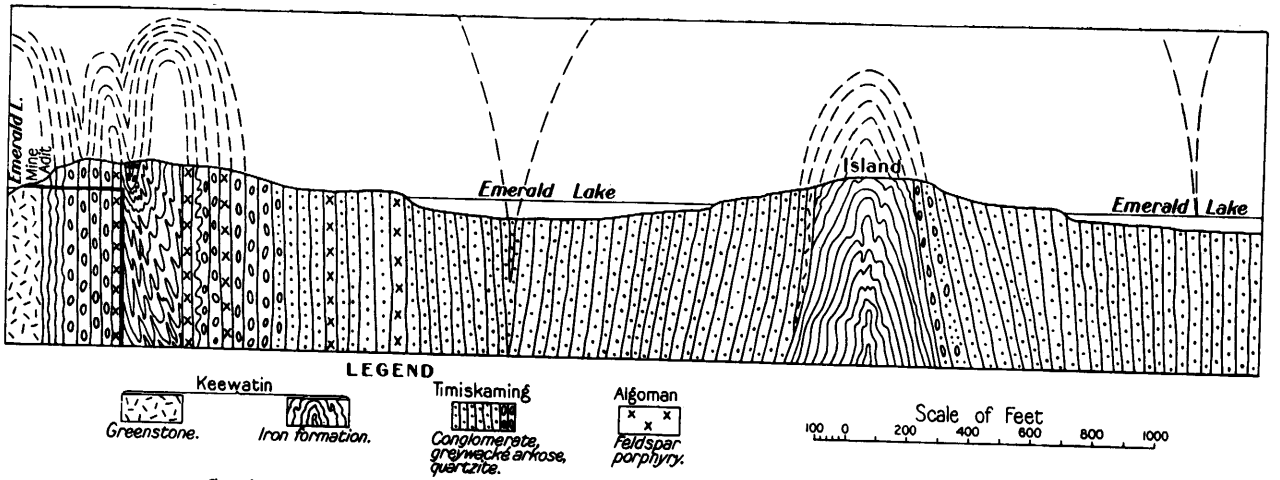
An unconformity is indicated by the Timiskaming rocks lying directly on the greenstone in some places and on the iron formation in others. On the north side of the creek flowing out of Eagle Rock lake the Timiskaming arkose and quartzite are in contact with greenstone. In other places, as near the eastern shore of Emerald lake, these formations appear to be in contact without iron



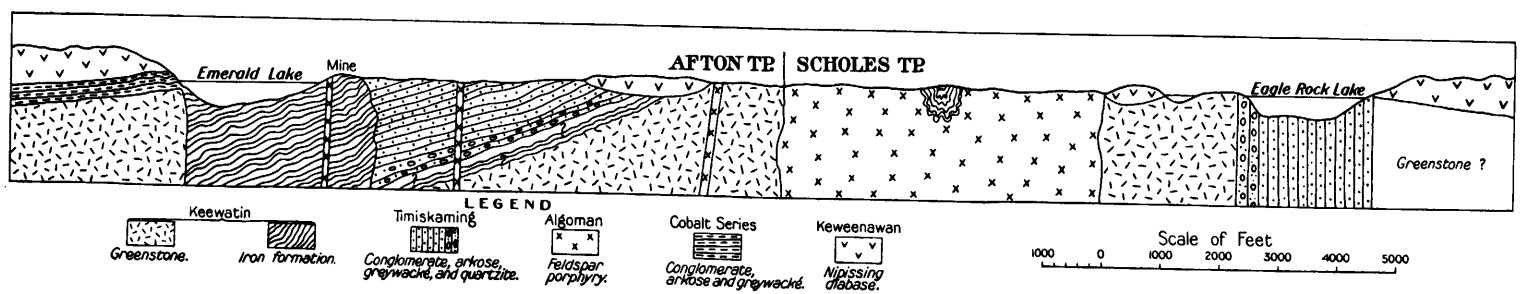
Diabase sill on the west side of Emerald lake. Timiskaming sediments underlie it towards the left-hand and Cobalt sediments near the right-hand end of the photograph.

formation intervening. It must be borne in mind, however, that the iron formation, judging from other regions, tends to occur in isolated bodies and in many cases is not continuous over large areas, as many other sedimentary formations are. Further, in the Afton-Scholes area there is greenstone overlying, as well as underlying, the iron formation, although that overlying is not very thick. The assumption that the Keewatin formations were folded and eroded before the Timiskaming sediments were deposited seems to explain the structural conditions better than any other theory. The iron formation is very hard and resistant, and during the pre-Timiskaming erosion it would be left in anticlinal ridges, which would again be exposed in anticlines after the Timiskaming was folded and eroded. If this assumption is correct the iron formation should be found beneath the syncline between the mine and the large island in Emerald lake.

On the shore of Emerald lake, near the mine, a minor syncline with conglomerate folded down into the iron formation may be distinctly seen. It is



Section running south-southeast from the New Golden Rose mine, showing suggested interpretation of structure.



Generalized east-west section across parts of Afton and Scholes townships.

quite shallow, since the mine workings pass under it, and it pitches westward. This indicates a deepening and widening of the major synclinal structure toward the west and probably improves the possibility of finding ore bodies in that direction.

The occurrence of the two bands of iron formation in this area, and the tendency of these, although they are not continuous, to converge toward the east, near Eagle Rock lake, further suggests that these bands represent the limbs of a large syncline having its axis between the mine and the large island and pitching to the west.

The outcrops of Timiskaming sediments around Eagle Rock lake, between the southern part of this lake and Emerald lake, and around the south end of the latter indicate that another large synclinal structure runs through Eagle Rock lake. This syncline swings around the south end of the greenstone area under the diabase sill to Emerald lake. Along Eagle Rock lake the strike of the formations is roughly north-south, and around the south end of Emerald lake it is north of west. The structure near the north end of this lake is complicated, and there are indications of a fault running through the bed of the lake and roughly parallel to it.

The dip of the Timiskaming sediments is everywhere quite steep, 70 degrees to vertical. The Cobalt sediments, on the other hand, are very little disturbed. It is evident that the folding of the Timiskaming, the intrusion of the Algoman porphyries, and the deposition of gold were all closely associated activities.

ECONOMIC GEOLOGY

Gold Deposits

The gold deposits in this area are mostly confined to the banded iron formation where it is intruded by Algoman porphyries. A discovery in the southern part of the area has been reported since the writer left the field, but information on the nature of the rocks in which the gold occurs is not available. This occurrence is apparently not in the iron formation. A well-mineralized band of arkose and impure quartzite in the Timiskaming series has recently been uncovered on the east side of the outlet of Eagle Rock lake. The band is at least 8 feet wide and is mineralized with pyrite, which carries some gold.

This area is of special interest, since it adds another example to the rapidly increasing number of gold deposits occurring in a formation that was formerly regarded by prospectors as unpromising for the occurrence of gold. Much of the formation is too impervious to permit the ready injection of ore-bearing solutions, but there are zones of more porous silica that have permitted the penetration of solutions, and the brittleness of the rock has aided brecciation during folding, thus favouring deposition of ore. The iron formation is tremendously contorted and greatly brecciated in some places in the vicinity of Algoman intrusions. In these localities solutions that have risen later from the magma that produced the porphyries have formed the ore deposits. On the Afton property the ore deposits are all in the iron formation near dikes of porphyry. On the large island in Emerald lake neither porphyry intrusions nor ore deposits were found.

The ore deposits have the form of lenses and veins in the iron formation, often lying alongside of porphyry dikes. These lenses consist in some cases of quartz and a little ankerite, which have replaced the iron formation, and in others of iron formation impregnated with quartz and pyrite. Some fairly

distinct quartz veins have been found, besides large lenses of massive sulphide. Stringers of quartz in some cases serve as a guide from one lens to another. In the heavy sulphide bodies a striking feature is the coarseness of the pyrite. Crystals of pyrite an inch or more in diameter have particles of native gold distributed among them, a feature that is unusual because, as a rule, such coarse pyrite is not as favourable for gold as the finer-grained type. The metallic gangue is practically all pyrite, but a little chalcopyrite occurs. Tellurides occur sparingly. In a sample from the workings of the New Golden Rose mine, a speck of a dark mineral grown on a crystal of gold has been identified by J. E. Thomson, of the University of Toronto, as a telluride, apparently of a bismuth type, and he has also identified altaite in gold specimens from the southern part of the area. The ore can be easily treated, as over 80 per cent. of the gold is said to amalgamate with mercury.

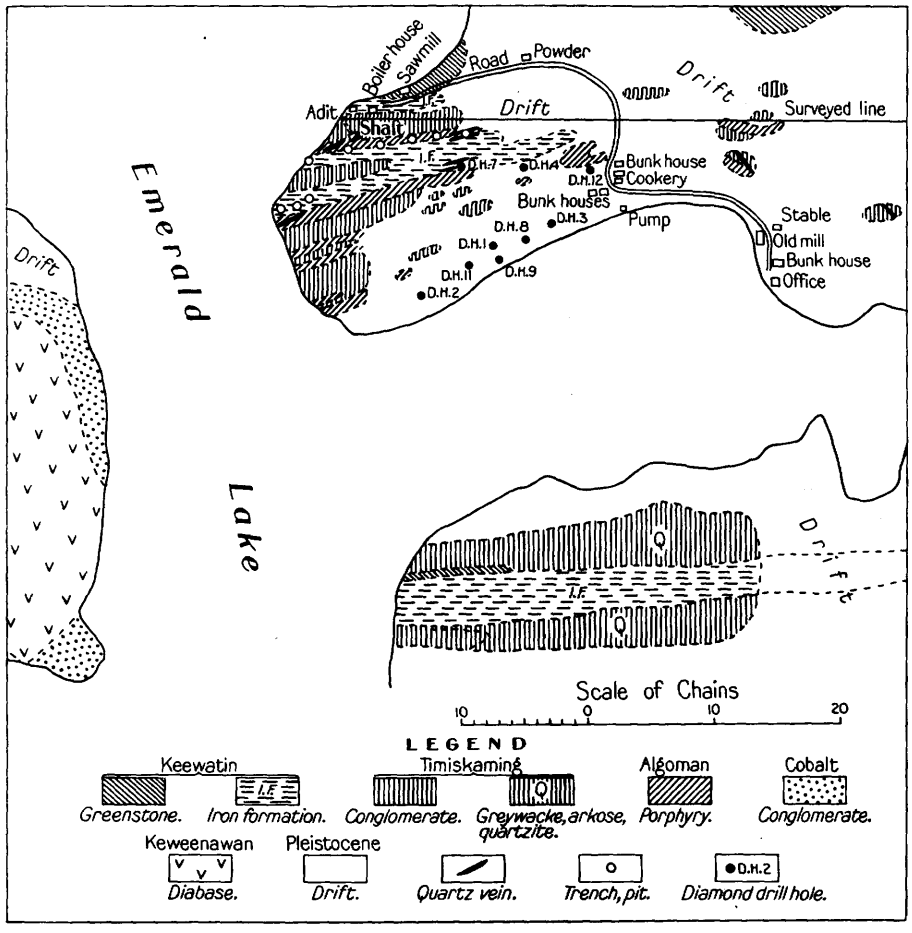


Boiler-house and machine shop at the New Golden Rose mine. The adit entrance is near the lower right-hand corner. The hill is iron formation.

New Golden Rose Mine

The New Golden Rose (Afton) mine is situated on a peninsula jutting out into the northern part of Emerald lake on the east side. It was near the present mine that the first discovery of gold in this area was made toward the close of the last century. The gold was found at the water's edge in a small cavity in rather porous and friable silica of the iron formation. In 1915-16, considerable surface work was done by the Golden Rose Mining Company, and some gold was extracted in the small amalgamation mill from the ore taken from the pits and trenches. In 1927, work was resumed when Afton Mines, Limited, took over the property and sank a shaft. An adit, 240 feet long, runs from near the water's edge into a hill of iron formation and conglomerate, and the shaft descends from it, the collar being about 85 feet below the top of the hill. The shaft is small, and if the mine should develop into one of large production a new shaft would be necessary to handle the ore. The Consolidated Mining and Smelting Company completed the present shaft during the summer of 1935 to a depth of 450 feet, with three levels. In 1936 a raise was driven through to the surface and a 200-ton mill was under construction.

A porphyry dike ranging in width from 6 inches to 20 feet runs along the contact of the conglomerate and iron formation, and the ore lenses lie in the iron formation near this dike. The jaspilite is very hard to drill, and on this account in some places the drift has been run in the porphyry or the conglomerate. The lenses of ore, consisting of quartz and pyrite, occur scattered along the strike of the formations, and diamond-drilling from underground has located mineralized zones at various places across the strike of the iron formation There are



Sketch map showing the geology in the vicinity of the New Golden Rose mine.

some nearly flat veins that appear to cut across the iron formation between the porphyry dikes, and the attitude of these seems to have been controlled to some extent by the folds in the formation. Three bands of the iron formation are found near the mine, owing to duplication by folding, and in the bottoms of synclines and on the tops of anticlines the beds will have low dips. The jaspilite has been greatly contorted and fractured during folding, which made conditions more favourable for the deposition of ore. The synclines of conglomerate pitch westward under the lake, and in the writer's opinion the duplication of the beds, with consequent greater width of the iron formation to the west, as compared to the narrow single band to the east, should increase the possibilities of ore

occurrences beneath the lake. Twelve diamond-drill holes have been sunk on the hill, mostly east of the shaft, and these indicate the occurrence of mineralized zones in close association with porphyry dikes in the iron formation. Four of these holes have been drilled by the company now operating the property.

The values in the mineralized zones are not uniform and vary from a small fraction of an ounce to over an ounce in gold.

The company was employing about 70 men, including wood-cutters, in their development work during the summer of 1935. Toward the end of the summer, a 75 h.p. Diesel engine and compressor were installed to supplement the steam and gasoline compressors and to cut down on the consumption of wood fuel. A relatively high consumption of air is necessary for drilling the hard iron formation.

The Consolidated Mining and Smelting Company controls 45 claims in this area and holds an option on others.

Taylor-Caswell Property

A block of claims known as the Taylor-Caswell property is situated to the east of the New Golden Rose property and runs west from the northern part of Eagle Rock lake. A large amount of work has been done on these claims under the direction of David Ferguson, to whom the writer is indebted for information regarding the results accomplished. In two localities much trenching and test-pitting on the iron formation has exposed mineralized zones. One of these localities is on the south side of the lake lying along the trail running from the New Golden Rose mine to Eagle Rock lake. Here a number of large pits and trenches expose bodies of highly disturbed cherty iron formation caught up in the Algoman porphyry. The iron formation is cut by quartz stringers and impregnated with quartz and pyrite. Apparently only low values in gold have been found.

A short distance west of the portage between Eagle Rock and Greenrod lake, a large trench, nearly a chain in length, has been dug in the iron formation along an intrusion of porphyry. In the trench an irregular quartz vein and jaspilite impregnated with quartz are well mineralized with pyrite carrying some gold. A short distance away another quartz vein carrying some chalcopyrite was seen. These occurrences indicate the close relationship of mineralization and porphyry intrusions in the iron formation.

Other Parts of the Area

The whole Afton-Scholes area has been staked and some work has been done in a number of places, but in most cases little of interest has been found, except in the recent discovery, previously mentioned, near the south boundary of the area. Here in the winter of 1934-35, two diamond-drill holes were sunk in the Timiskaming quartzite and greywacké on the peninsula on the east side of Emerald lake south of the large island. The formations in this locality are highly impregnated with pyrite over considerable areas, but no information has been disclosed regarding gold values found.

It is quite possible that some of the Timiskaming sediments, where intruded by porphyry, may contain ore deposits, and they are worthy of consideration by the prospector. The schisted greenstones should also be favourable prospecting ground, although the exposures of these rocks are not large and so far nothing of special interest has been found in them.

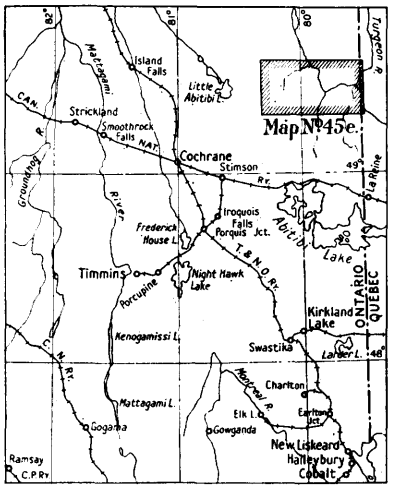
Geology of the Burntbush River Area

By Robert Thomson

INTRODUCTION

The Burntbush River area lies about thirty-five miles north of Lake Abitibi in the district of Cochrane. It extends from the Ontario-Quebec boundary some thirty miles west to the townships of Bragg and Tweed, and from the townships of Seguin, Kenning, Singer, and Clive north to Speight's line.

The writer's work in the Burntbush River area, covering a period of about three months in 1934, was primarily to determine if prospecting might be carried on in the area with some likelihood of success. The work accomplished included the survey and mapping of most of the topographical features and a reconnaissance geological survey. A small amount of prospecting had been carried out in preceding years.



Key map showing the location of the Burntbush River area. Scale, 70 miles to the inch.

Previous Work

Hopkins[1] in 1917 made a reconnaissance along the Patten river. Tanton[2] reported on the northwestern part of Quebec. The western part of his map includes the lower part of the Burntbush river and the Patten river.

Means of Access and Travel Routes

The Canadian National Railways furnish the only available railway transportation close to the area, by the line running from Cochrane eastward into Quebec. The easiest route into the area, and the one available at all times of the year, begins at La Sarre, Quebec. From La Sarre a road leads north 16 miles to a fire-ranger's camp on the Turgeon river. This road is suitable for

[1]P. E. Hopkins, "Notes on Lake Abitibi Area," Ont. Bur. Mines, Vol. XXVII, pt. 1, 1918, pp. 200-214.

[2]T. L. Tanton, "The Harricanaw-Turgeon Basin, Northern Quebec," Geol. Surv. Can., Mem. 109, 1919.

wagon and to some extent for motor traffic. Vehicles can be hired at La Sarre. The Turgeon river is navigable by canoe to the mouth of the Burntbush river. Ten portages (kept in good repair by fire rangers and none more than a quarter of a mile long) are encountered along the route; an outboard motor, nevertheless, can be used to advantage over this stretch. The trip from La Sarre to the mouth of the Burntbush river generally takes from two to three days.

Other routes into the area are by way of La Reine (Okikodosik) and the Patten river and by way of the Kabika (Mud) river. The Kabika River route goes from Mace on the C.N.R., by way of Lake Abitibi to Forks creek, and about 1½ miles up Forks creek. From here the portage over to the Kabika river is



View up the Mikwam river from the third portage above the mouth.

4½ miles. Kabika river as far down as the forks shown on the Burntbush River map (No. 45e) is likely to be "bad going," owing to shallowness and log jams. The use of this route is thus restricted to periods of high water; at any time it is very poor and uncertain compared with the Turgeon river route.

The La Reine–Patten Rivers route is not used at present. The water is shallow, and the portages are long; the one at the head of Patten river is 6 miles in length. This route is not recommended.

Most parts of the Burntbush River area can be reached from canoe routes. The amount of water in the river makes a material difference in the ease with which travelling can be done. High water is assured in the early spring and fall of the year. Some of the portages marked on the accompanying map may be avoided by poling, lining, or wading up the rapids. The portages were in good condition in the summer of 1934, but there is no permanent agency to keep them cut out. Numerous boulders in the rivers are hard on canoes.

The Burntbush river, from the Turgeon river to Speight's line is suitable for canoe travel at all seasons of the year, but from the Turgeon river to the Kabika river, rocks obstruct the passage in low water. The Kabika river, from its mouth up to the forks, is easily navigated by canoe at all seasons. The Mikwam river is navigable at all seasons all the way to Bateman lake. The route from Bateman lake to the Kabika river through Payntouk lake is unsuitable for canoes at all seasons.

A trail runs north from Payntouk lake to the Mikwam river near the second rapid above its mouth, and continues on the other side of the river to a small lake about 2 miles north. The trail, originally well cut, is impaired by a subsequent burn and much deadfall but is still useful (1934).

From Springer lake a portage leads to Wasicho lake, and from there Two Peak lake is easily reached. Although the divide between the Burntbush River system and the Abitibi River system has been crossed, the creek draining Wasicho



View of the hills west of Two Peak lake from the outlet of the lake.

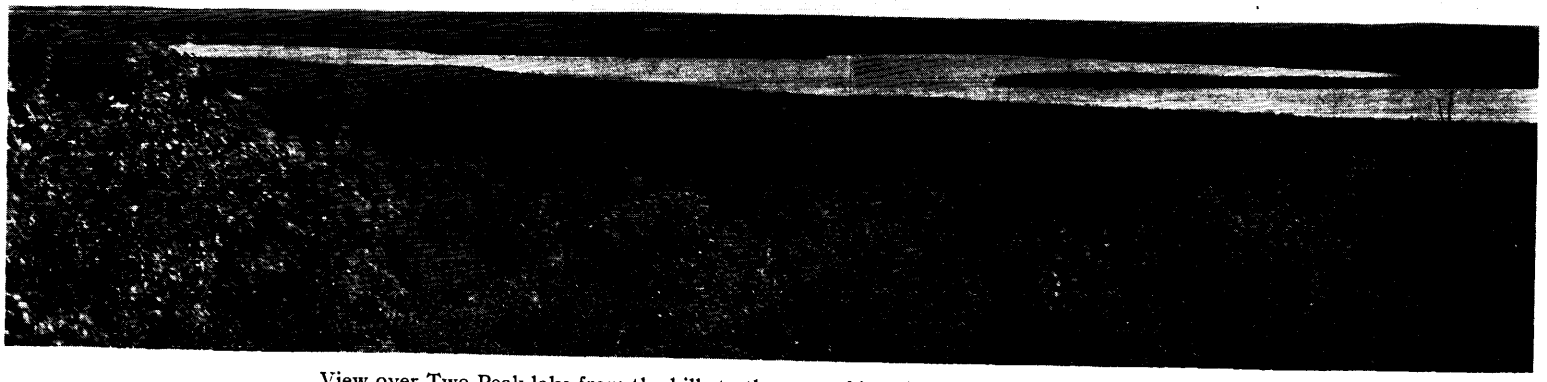
lake is too small and choked with logs to permit canoe travel farther down the latter system.

During the field season of 1934, the writer unsuccessfully sought routes through to the Abitibi River system. Two routes were reported later by local Indians. It was stated that a portage about a mile long, which starts at the tiny lake about a mile from the mouth of the creek running into the Mikwam river between Mikwam lake and Kanitama lake, lies on the route to Little Abitibi lake. Another route to Little Abitibi lake through the Burntbush River area was said to start from the west branch of the Kabika river and to run by way of Lowbush river. It is stated to be a poor route in low water.

A canoe route to James bay by way of the Turgeon and Detour rivers is shown on map No. 25A, Ontario Department of Surveys. Local Indians told the writer of another route up the Burntbush river.

Topography and Drainage

The usually gentle undulating surface of the area is broken by three rock hills, which rise several hundred feet above the surrounding country. West of Two Peak lake a hill of basic volcanic rock (see photograph above) rises about



View over Two Peak lake from the hills to the west of it. (Photograph by J. C. Sproule.)

400 feet above the general surface and affords an excellent view (see photograph opposite) of the surrounding country. Apart from such hills the only noteworthy topographic elevations are ridges of unconsolidated glacial material, which sometimes rise 35 feet, e.g. the eskers in the vicinity of Magiskan lake. In places, as along the Burntbush river from Kabika river north for several miles and along the Kabika river from its mouth to where it crosses the township line, the banks are steep and rise about 20 feet above water level. A jackpine-covered sand plain, with an east-west width of some 3 miles, lies in the east central part of Bragg township.

As shown on the accompanying map, outcrops are scarce and usually very small. Most of the ground is covered with moss, except on sandy ridges. The moss-covered surface in places grades into muskeg with small trees or no trees, although this type is not extensive. Occasional undrained ponds are found away from the drainage system.

In the eastern part of the area lakes are few and small; in the western part, however, they are rather abundant, although for the most part shallow. The lakes and rivers are rimmed with unconsolidated glacial material; rarely are there any rock outcrops among them. The Burntbush river above the Kabika river has the dark-coloured water so characteristic of muskeg areas in Northern Ontario. The light-coloured muddy water of the Kabika river contrasts sharply with the dark muskeg water of the Burntbush river at their junction.

The water level in the rivers is subject to considerable changes during the seasons. When the ice goes out in spring there is an abrupt rise. Ice scars on the trees along the river bank up to heights of 15 feet attest to the seasonal high level of the water.

The area drains into James bay, for the most part by way of the Turgeon and Harricanaw rivers, but the western part is drained by the Abitibi river.

The lakes owe their origin to slight original depression in the unconsolidated glacial deposits, to dams of glacial material across depressed parts of the surface, and to the southward tilting of the general surface following the recession of the ice.

The rivers have cut their courses to bed rock only at a few rapids; most of the rapids are caused by accumulations of boulders.

Climate

The dates of the opening up and of freezing up of the rivers are of importance to anyone travelling in the area. Jos. Berube, independent trader at the mouth of the Burntbush river, kindly supplied the following information:—

	First open water	Freeze-up
1930	May 4	November 6
1931	April 25	December 2
1932	May 6	November 13
1933	May 2	October 28
1934	May 5	.....

Tanton[1] has described the climate in the Harricanaw-Turgeon Rivers basin, of which the Burntbush River area is a part. As stated there, the climate is unfavourable to agriculture. During 1934, frost was experienced in June and September but not in July or August. Mr. Berube has been able to grow potatoes, beets, carrots, and some other vegetables at his trading station.

[1]T. L. Tanton, op. cit., p. 4.

Natural Resources

Timber

Johnston and Sharpe[1] have reported on the timber resources of this part of the province. As they show, a considerable part of the Burntbush River area is "burn." From the west boundary a belt of burn runs southeastward, between Magiskan lake and Bateman lake, to a point beyond the Kabika river. Small areas of unburned timber are found in it.

Spruce is the most abundant tree, although locally other kinds may be plentiful. Trees seen in the area include spruce, balsam, balsam poplar, aspen poplar, birch, jackpine, tamarac, and cedar.

Agriculture

The rigorous climate, combined with the distance from markets and lack of transportation facilities, make the area unfavourable for agriculture, although in most places the soil is quite suitable and there is little rock outcropping.

Game, Fur-bearing Animals, Fish

Moose are the most plentiful large animals in the area. Deer are rare. Black bear are fairly common. A half a dozen beaver colonies were seen by the writer's party. Muskrat and fox were also seen. Other animals reported to occur in the area are: otter, mink, marten, weasel, wolf, skunk. Rabbits and squirrels are common.

Pike and pickerel may be caught at many of the rapids in the rivers.

An independent fur trader, Jos. Berube, maintains (1934) a trading post at the mouth of the Burntbush river, but usually carries only a limited amount of supplies.

With the exception of itinerant trappers the area is uninhabited. Trapping, the only industry carried on at present, furnishes a precarious livelihood for a few people, including some Indians.

Acknowledgments

The writer is indebted to a number of persons who furnished information on the area. C. W. Knight very kindly allowed the use of maps and reports of the Cyril Knight Prospecting Company, prepared by C. F. Rice and J. D. Bateman from prospecting work done during 1931, 1932, and 1933. J. R. Brayley, Toronto, and A. V. Dukes, Mace, contributed helpful information on the area. A small-scale map of the area sketched from an airplane by Karl Springer was of material assistance.

During the field season the writer was ably assisted by J. C. Sproule, M. F. Teskey, and J. D. Bateman.

GENERAL GEOLOGY

Table of Formations

QUATERNARY	
RECENT:	Muskeg, alluvium.
PLEISTOCENE:	Glacial deposits.

[1]R. N. Johnston and J. F. Sharpe, "Report of the James Bay Forest Survey-Moose River Lower Basin," Department of Lands and Forests, Ontario, 1922.

PRE-CAMBRIAN	
KEWEENAWAN or PRE-COBALT:	Diabase dikes.
ALGOMAN(?):	Batholithic granite intrusives.
TIMISKAMING(?)	Chlorite schist, greywacké, arkose. Conglomerate.
KEEWATIN:	Andesite, including some minor basic intrusives and some intimately related sediments. Rhyolite, feldspar porphyry, quartz porphyry. Flow breccia. Biotite schist, feldspar gneiss. Hornblende schist and amphibolite.

Keewatin

The name Keewatin is applied to the predominantly volcanic group, the oldest rocks known in the area. The contacts are difficult to trace, owing to the large amount of drift covering the area. From the few scattered outcrops tentative contacts have been drawn on the accompanying map. The Keewatin in the Burntbush River area is a tongue extending westward from a much more extensive area in Quebec. A smaller body is exposed at the south edge of the area along the Kabika river. The rocks dip at high angles and in places are altered to schists.

Rock types include basic lavas, such as andesite or greenstone; acid lavas, such as rhyolite; quartz porphyry and feldspar porphyry; volcanic sediments, such as tuffs, jaspilite, and schists, whose original nature is uncertain, biotite schists with garnet or staurolite, hornblende and chlorite schists.

Acid Volcanics

Acid volcanics outcrop in many places along the lower part of the Burntbush river (below the Kabika river). Tanton[1] has mentioned the occurrence of quartz porphyry and agglomerate here. The outcrops appear to be restricted to the river bank; farther inland is muskeg.

On the lapsed claims on the east side of the Burntbush river, acid lavas are exposed. With the fine-grained rhyolites containing small quartz eyes are green- and white-weathering tuffs. Quartz, feldspar, and quartz-feldspar porphyries appear to have intrusive contacts with the other volcanics. These dikes are probably nearly contemporaneous with the lavas and in places appear to grade into them. Rhyolite outcrops about 2 miles north of Wasicho lake and feldspar porphyry about half a mile north of the rhyolite.

Thin sections of the acid lavas show phenocrysts of quartz and albite occurring singly or together in a microcrystalline groundmass. Biotite is the usual dark mineral. Carbonate is a common alteration product in the rock and is abundant in places. White mica is also a common secondary mineral. The original biotite is often altered to chlorite. In places shearing has tended to destroy the phenocrysts.

Basic Lavas

Andesitic lava forms extensive outcrops west of Two Peak lake and west of the Patten river. It also occurs along the Kabika river and near Rube lake. The greenish rock is fine- to medium-grained. Pillow structure is common, and amygdules can be made out in a few places. The flows have a nearly vertical attitude, as shown by the occasional sediment lying between them. In thin section secondary hornblende is the most abundant mineral. The plagioclase ranges in composition from andesine to albite.

[1]T. L. Tanton, op. cit., pp. 24, 28.

Hornblende schists occurring east of the second rapid on the Mikwam river are believed to be altered basic lavas. The greenstone along the Kabika river (near the south boundary of the area) contains abundant carbonate.

Sedimentary Rocks Associated with the Volcanics

Associated with the volcanic rocks, in places clearly between successive flows, are minor amounts of cherty rock, bearing magnetite. These rocks are banded, and the banding is often brecciated and closely folded. Red jaspilite containing small amounts of magnetite and pyrite occurs on the portage between the Burntbush river and Rube lake.

Banded magnetite and quartz-feldspar gneiss, associated with biotite schist, are found on the south side of the second rapid in Mikwam river. The total width is less than a yard; the width of the contorted banding is from a quarter of an inch to paper thin.

Interbanded chert, garnetiferous chlorite schist, and biotite schist up to a width of 15 feet lie between andesite flows on the west side of the hills near Two Peak lake.

Schists

Biotite schist outcrops near the second rapid on the Mikwam river and along the Burntbush river up to 4 miles below the Mikwam river. In them quartz-feldspar dikelets and quartz veins are of common occurrence. The biotite flakes are less than a millimetre in diameter. In places hornblende is abundant.

The origin of the rock is uncertain; in places the banding suggests a sedimentary origin. The metamorphism is probably due to the proximity of the schists to the large granite mass to the north. T. L. Tanton[1] has described biotite schists in adjoining parts of Quebec and concluded that they were altered tuffs. Schists which he describes on the Turgeon river about 4 miles below Corset island[2] are similar to those seen by the present writer.

A highly metamorphosed dull-grey mica schist occurs about a quarter of a mile north of mile-post IV, east line, Bragg township, and about half a mile east of this. The mica is in very fine flakes. Garnet and staurolite crystals up to one-third of an inch in diameter are developed in places. Finely banded, contorted chert beds up to a width of 2 feet are associated with the schists.

Timiskaming(?) Sediments

Sedimentary rocks other than those clearly interbedded with lava flows are exposed in five places in the area. Of these, four are sufficiently in line to suggest that they may form a more or less continuous band. The localities are described as follows:—

East Side of the Burntbush River at the Lapsed Claims

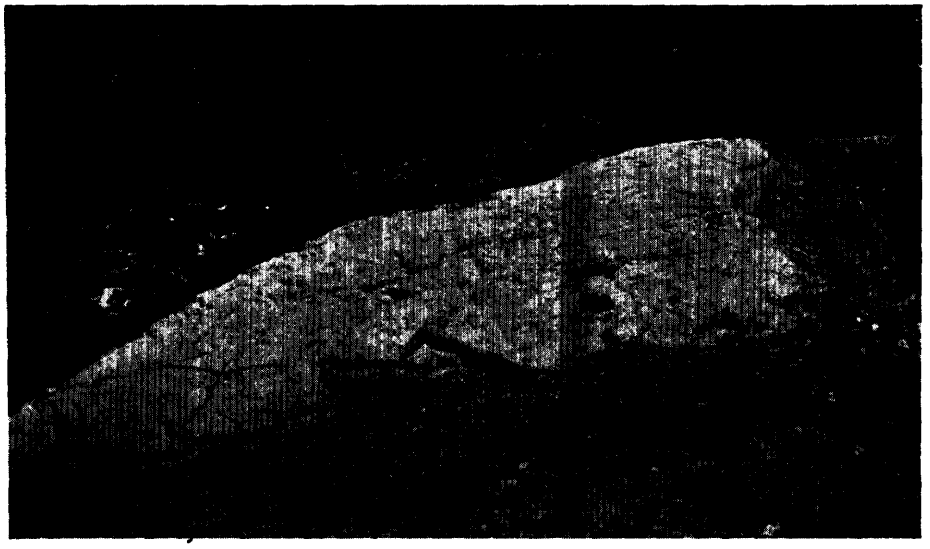
About 100 yards from the north end of the portage on the east side of the Burntbush river at the lapsed claims is a puzzling exposure which may be a metamorphosed conglomerate or a volcanic breccia. In a matrix, which if occurring alone would be called feldspar porphyry, are fragments of acid volcanic rock similar to that occurring in the claims to the north. The fragments have a maximum length of 5 inches and vary in shape from rounded to irregular, with re-entrant angles. They are of rhyolite, quartz porphyry, and feldspar porphyry (resembling the matrix). Under the microscope the matrix shows well-shaped

[1]T. L. Tanton, op. cit., pp. 26, 27.
[2]Ibid., p. 27.

feldspar crystals (for the most part albite) in a microcrystalline groundmass. The feldspar crystals are not clastic grains; in places they have been broken by shearing.

This rock, which is dark-grey and fine-grained, is in sharp contact with altered sediments, now chloritic schist, which show fine banding. Exposures continue south for a hundred yards along the river bank. Irregular discontinuous quartz veins and lenses occur in the schist. In places shearing has broken these veins into irregular fragments.

Feldspar porphyry lies south of the chlorite schist in a band 100 yards wide, with the south contact sharp against chlorite schist, whose outcrop extends some 4 yards farther. These exposures are seen during low water only. The feldspar porphyry is believed to be a dike or sill.



Light-coloured quartz porphyry in sharp contact with green contorted schists on abandoned claims east of the Burntbush river.

West Side of the Burntbush River

Sediments altered to a contorted chlorite schist are exposed on the west side of the Burntbush river, and about three-quarters of a mile from it. The schist is exposed over a width of 40 yards and contains small irregular quartz veins. Some pyrite occurs in the schist. A small amount of stripping has been done. About 150 yards south are two or three low outcrops in which lenticular, rounded, or irregular fragments, for the most part less than 6 inches long, occur in a greenish sheared chloritic matrix. The fragments are of rhyolite, quartz porphyry, feldspar porphyry, chert, and andesite. A few appear to be of acid plutonic rock. The angular shape of the fragments is shown in the photograph above.

Near Porphyry Lake

On the south side of the lake immediately north of Porphyry lake, well-bedded greywacké containing a few fragments occurs. A sub-rounded granite boulder, 5 inches long, in a fine-grained, dark greywacké matrix, is one of the few instances of fragments of plutonic igneous rock found in the sediments.

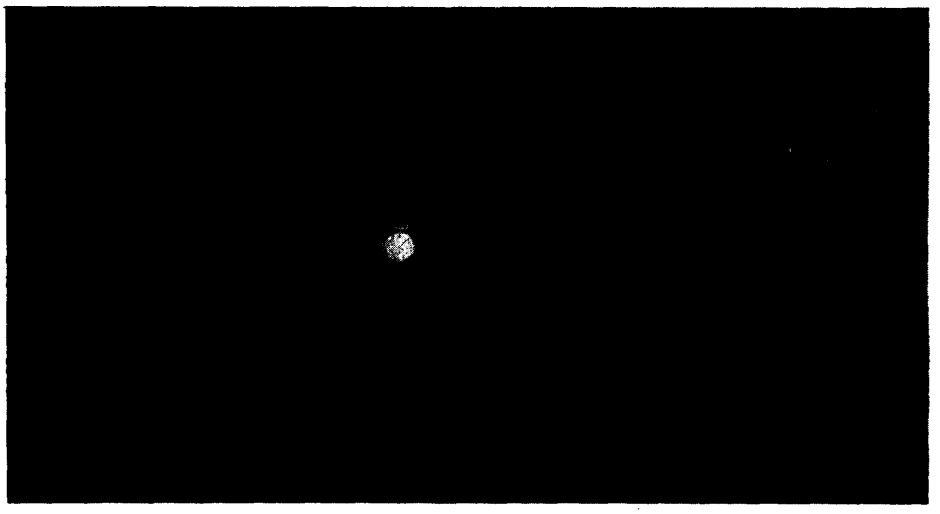
Schisted greywacké containing angular to sub-rounded fragments occurs in several outcrops in the area south to Porphyry lake. Feldspar crystals have developed in the greywacké in places, giving the rock a resemblance to feldspar porphyry. An outcrop of sheared feldspar porphyry occurs at the west end of Porphyry lake.

North of Wasicho Lake

About 2 miles north of Wasicho lake is a rock hill about 20 feet high and 150 yards square. Sub-rounded to irregular fragments, for the most part under 6 inches, occur in varied amount in a dark greywacké matrix.

Bragg Township

Nearly vertical greywacké and arkose, exposed over a width of 40 feet, outcrops in Bragg township. The strike is about S. 50° E. Poor cross-bedding



Conglomerate, about three-quarters of a mile west of the Burntbush river opposite the abandoned claims.

indicates that the top of the beds is toward the west. Since no other outcrops, except intrusive diabase, were found within 2 miles, the relations of these sediments to others in the Burntbush River area is unknown.

Summary

The origin and significance of these sediments is not clear to the writer. Two hypotheses may be presented: (1) that they represent a period of sedimentation during Keewatin time, or (2) that they were laid down after the conclusion of most of the volcanic activity and after some considerable erosion of the Keewatin had taken place, i.e. that they are Timiskaming in age.

The sediments in general are highly metamorphosed. Originally they were not well sorted, and in them secondary minerals are commonly developed. Thus in places the abundant secondary feldspar gives them the appearance of igneous rocks. The irregular to angular shape, with re-entrant angles, of many fragments suggests that the coarser fragmental rocks may be agglomerates, somewhat water-worn. The chloritic schists are altered tuffs of water-laid volcanic

ash. In view of the occurrence in places of a few pebbles of plutonic igneous rock, the writer has mapped them as conglomerate and considers that they are probably of Timiskaming age.

Batholithic Intrusives

As shown on accompanying map a large part of the Burntbush River area is underlain by plutonic igneous rocks of acid composition. Only approximate contacts could be drawn, owing to the scarcity of outcrops. The granites lie north and south of the main belt of volcanics. With the exception of a large outcrop hill southwest of Payntouk lake, only small scattered outcrops of granite were found. Small granitic dikes were found cutting through the volcanic group in places as, for example, near Two Peak lake. It seems reasonable to believe that they are offshoots from the underlying batholith.

Along the Mikwam river are several outcrops of granite. It is fresh, coarse-grained, usually non-gneissic and often porphyritic, with microcline crystals up to three-quarters of an inch in length. The phenocrysts usually make up about 5 per cent. of the rock but are locally much more abundant. The granite in the vicinity of Two Peak lake is quite similar. The pink granite of the large hill southwest of Payntouk lake is non-porphyritic and often gneissic; otherwise it is similar to those mentioned above. The average mineral composition, estimated from five thin sections, is as follows: oligoclase, 47 per cent.; microcline, 35 per cent.; quartz, 13 per cent.; and biotite (with minor amounts of hornblende), 5 per cent. Myrmekite is of rather common occurrence. The thin sections show the rock to be granodiorite, but in view of the limited exposures from which specimens were collected the writer prefers to describe it under the more general name "granite," which is probably more descriptive of the whole body.

A grey biotite granite exposed along the Kabika river is of varied composition, particularly as to dark materials. A thin section of a light-coloured phase has the following composition: oligoclase, 55 per cent.; microcline, 25 per cent.; quartz, 18 per cent.; biotite, 2 per cent.

Some feldspar porphyry dikes in the Timiskaming(?) sediments may be closely related to the batholithic intrusives. The porphyry on the Burntbush river near the lapsed claims has been mentioned in connection wih the sediments there. The intrusive relation seems definite. Lithologically similar porphyry is exposed at the west end of Porphyry lake in a small outcrop. An unaltered dike of grey feldspar porphyry cuts the conglomerate about 2 miles north of Wasicho lake. The dike here is 5 feet wide but pinches out.

The porphyry is of varied colour, from reddish to grey, and shows abundant feldspar crystals (for the most part albite) in a fine-grained matrix.

The Patten River Intrusives

Along the Patten river from the first portage to the mile portage, several outcrops of plutonic igneous rocks are exposed. Hopkins[1] mentions the altered quartz gabbro occurring at the first falls above the river mouth. The rock is cut by small, fine-grained acidic dikes and a few quartz veins; it contains inclusions of andesite, sometimes showing pillow structure. Similar andesites outcrop abundantly a short distance to the west. The gabbro varies in composition and texture over short distances. A common type is made up of white

[1]P. E. Hopkins, op. cit., p. 209.

feldspar crystals, up to a quarter of an inch in length, and dark-green hornblende in about equal amounts. In places where quartz occurs abundantly, the rock is somewhat coarser in grain and has well-shaped hornblende crystals. Over small areas feldspar crystals, up to half an inch in diameter, are accompanied by quartz, and the two are present in larger amount than the dark minerals. The inclusions seem to furnish a partial explanation of the variation in rock types. In places the edges of the inclusions are sharp; in others they are gradational. In some of them are developed patches of feldspar, giving a rock similar in appearance to the matrix of the inclusions and suggesting that they represent an incomplete stage in the eventual disappearance of the inclusions.

Farther south along the Patten river quartz-poor biotite granite is exposed. The quartz gabbro appears to be a phase of the granite.

Age and Contact Effects

Wherever granite was found in contact with rocks of the volcanic group it was clearly intrusive. No evidence of more than one period of granitic intrusion was found.

Coarse amphibolite, presumably developed from basic igneous rocks, such as andesite, are found in a few places at and near the contacts of the large granite masses, e.g. at the south end of Mikwam lake. A wide contact zone between granite and amphibolite rock is exposed along the north boundary of Clive township. This type of contact is probably prevalent throughout the area, but owing to the drift covering was not observed elsewhere. In places granite is enriched with hornblende, the enrichment being often shown in parts of a hand specimen. It is probably due to the assimilation of parts of the basic igneous rock by the granite.

The emplacement of the granite masses is intimately related to the structural disturbance of the volcanic group. It seems reasonable to suppose that the general alteration of the volcanic group is related to the changed conditions of heat, pressure, and circulating fluids brought about during the consolidation of the batholithic masses.

Diabase Dikes

The youngest consolidated rock in the area is diabase. In all 9 dikes were found within the area. The largest of these is 185 feet wide. One crossing the hills west of Two Peak lake is exposed at short intervals over a length of 4½ miles. A north-south trend appears to be characteristic. Most of them strike within 10 degrees of true north, and none vary over 25 degrees from it. No appreciable differential movement of the dike walls was found. The dikes have a slightly greater tendency to outcrop than the other rocks of the area. They appear to be of no economic significance.

In the hand specimen the diabase is an unaltered, fine- to medium-grained, dark rock. A thin section showed it to be nearly fresh quartz diabase. Plagioclase phenocrysts occur in 3 of the 9 dikes, but are abundant in one only. The dike about half a mile north of Magiskan lake is cut by small aplite stringers. In places, as on Snare lake, the diabase contains enough magnetite or other magnetic mineral to affect the compass needle in the immediate vicinity.

Two groups of petrographically similar diabase (or gabbro) dikes are spread widely throughout Northern Ontario and adjacent parts of Quebec. The older is pre-Cobalt in age; the younger, Keweenawan. Cooke, James, and Mawdsley[1]

[1]H. C. Cooke, W. F. James, and J. B. Mawdsley, "Geology and Ore Deposits of Rouyn-Harricanaw Region, Quebec," Geol. Surv. Can., Mem. 166, 1931, p. 143.

state that the post-Cobalt diabase intrusions appear to diminish north of latitude 47° 54′. As the Burntbush River area is considerably north of this, the dikes there would, in keeping with this idea, be pre-Cobalt in age.

PLEISTOCENE GEOLOGY AND PHYSIOGRAPHY

Bed Rock Surface

From pre-Cambrian to Pleistocene times, processes of erosion are the only activities which have left a record in the area. The three rock hills previously mentioned appear to be erosion remnants. From the top of the hill west of Two Peak lake a view of the other two hills in the area and other more distant hills may be had. These appear to have somewhat similar summit levels, which suggest that they are remnants of an old erosion surface. This erosion surface had been cut into prior to glaciation to give the present bed rock surface, though possibly it was modified slightly by subsequent glaciation.

Glaciation

In Pleistocene time the area was completely covered by continental glaciers. No evidence of more than one period of glaciation was found. The direction of ice advance as shown by glacial striae was about S. 15° E. A further indication of the direction of ice movement is the presence of fossiliferous Paleozoic limestone pebbles and boulders in the drift. Such Paleozoic limestones outcrop southwest of James bay. Only a few boulders of such limestone are found on the lower part of the Burntbush river, but they are quite common along the lake shores in the western part of the area.

Glacial Deposits

Practically the entire region is covered by a mantle of boulder clay, through which few and scattered outcrops of bed rock project. The clay commonly contains only a few small pebbles,but there are occasional moraines with numerous large boulders; indeed, most of the rapids in the rivers are caused by such accumulations. Examples are the irregular ridges southwest of Two Peak lake and the low piles of large boulders a mile and a half west of Magiskan lake.

Kames and eskers, occasionally as high as 35 feet, are abundant in the western part of the area. Two eskers which partly cross Magiskan lake give it a peculiar outline. Small sandy plains are found throughout the area. They are easily distinguished by the growth of jackpine on them. One fairly extensive sand plain with frequent boulders occurs in the east central part of Bragg township, as shown on the accompanying map.

Varved clay was found in only one place, on the Kabika river, 1½ miles above its mouth. Here, about 3 feet of silty varved clay overlies boulder clay, which, as usual, contains a few small boulders. In the course of the work the writer looked for varved clay exposures, as carefully as the muskeg covering would permit, in an attempt to find the northern limit of the great post-glacial lake in which the stratified clays of the clay belt have been deposited. Since no extensive stratified clays and no beaches around any of the hills were found, the writer concludes that the post-glacial lake (Lake Barlow-Ojibway) had been drained before the ice front had receded as far north as the Burntbush River area.

Drainage System

On the complete withdrawal of the ice from Northern Ontario, the surface had a much more pronounced tilt to the north than at present; a discussion of this phase of glacial recession is given by Cooke, James, and Mawdsley.[1] On this northerly sloping surface the new drainage system originated. The direction of flow of individual rivers would be influenced by minor irregularities in the surface. No evidences of pre-glacial erosion channels were found by the writer in the Burntbush River area. As the new rivers were developing, the northerly gradient was reduced by a rising of the northern part. The smaller streams were backed up and finally diverted laterally into those larger rivers that had the ability to cut through the rising barricade. This and the usual development of rivers appear to have modified to some extent the drainage system in the area. A series of changes in keeping with this explanation may possibly have taken place as follows. Three rivers originally flowed northward through the area: (1) the Turgeon, with its tributary the Patten; (2) a river made up of the present Kabika river and the Burntbush above its junction with the Kabika; (3) a river now represented by the chain of shallow lakes and creeks in the western part of the area. The most westerly river was diverted into the next one to the east, and this into the Turgeon river.

The glacier left behind a wide, more or less flat, poorly drained area, lined with a mantle of impervious boulder clay, overlain locally by sand, gravel, and boulders. Such conditions were ideal for the development of the extensive muskeg flats that now cover the region.

ECONOMIC GEOLOGY

Any area of volcanic rock in Northern Ontario that has been sheared and intruded by granite may be considered to have some merit as a field for prospecting. To this extent the Burntbush River area is worth attention, and access is not difficult. The important adverse factor, however, is the small area of exposed rock, which makes a difficult and expensive task of establishing either the presence or absence of workable mineral deposits. Gold is the valuable mineral most likely to be found, but up to the present it has not been discovered in encouraging quantities.

Some claims were staked by the Cyril Knight Prospecting Company on the east side of the Burntbush river, at the second long rapid about 4 miles above the Kabika river. A small amount of trenching and stripping was done during parts of 1931, 1932, and 1933, but the claims have since been allowed to lapse. Much of the area staked is drift-covered. Exposed rock consists largely of acid lava. Possibly some of the acid porphyritic rocks are intrusive and related to the granite, but if so they are lithologically very similar to others known to be flow rocks.

In places the rocks have been changed to schists and contain contorted quartz veins, which in places have been bent, broken, and pulled apart. These veins appear to be barren of gold, as shown by panning and assays. Trenching and stripping have been done principally on shear zones containing quartz-carbonate veinlets in altered acid rock, both containing pyrite. The trend is about E. 10° S. The shear zones stand out more markedly where they intersect light-coloured massive rock than in the darker-coloured, more highly schisted

[1]Op. cit., pp. 150-157.

rock. At the place where most of the work was done, a 6-foot zone, as described above, is bordered by fine-grained, massive rhyolite with disseminated fine-grained pyrite. The highest assay result obtained by C. F. Rice and J. D. Bateman (for the Cyril Knight Prospecting Company) was $2.00 per ton in gold.[1] A grab sample collected by the writer yielded no gold.

Quartz veins intersect the volcanics west of Two Peak lake but appear quite barren. About 2½ miles north of Wasicho lake, a 1½-foot quartz vein with abundant coarse pyrite cuts andesite, also containing pyrite. A grab sample yielded no gold. About 2 miles north of the same lake an outcrop of conglomerate contains a few small quartz veins and some slight impregnation of fine-grained pyrite. A grab sample of the pyritized rock yielded a trace of gold.

Hopkins[2] states that gold has been reported along the Patten river in narrow quartz veins. At the second rapid, just below the fall on the Patten river, a small amount of trenching has been done in recent years on a small rusty-weathering shear zone with some quartz. It does not appear to be of economic importance.

[1]At $35 an ounce.
[2]P. E. Hopkins, op. cit., p. 209.

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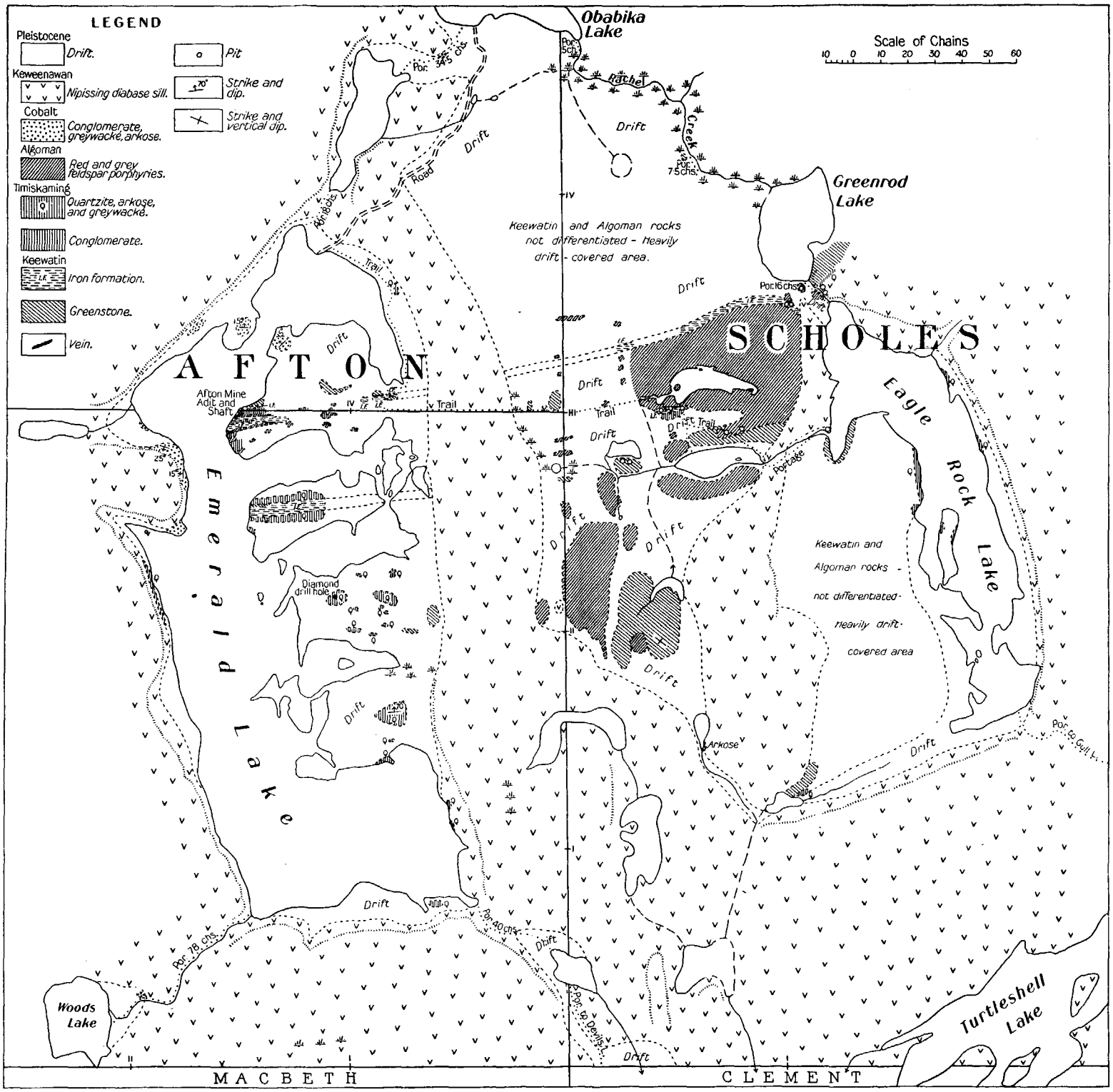
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GEOLOGICAL SKETCH MAP OF A PART OF AFTON AND SCHOLES TOWNSHIPS.



























PROVINCE OF ONTARIO
DEPARTMENT OF MINES

HON. PAUL LEDUC, *Minister of Mines* T. F. SUTHERLAND, *Deputy Minister*

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COLOURED TOPOGRAPHICAL MAP

(In pocket at back of report)

Map No. 45f—Lake Iroquois and Related Ice Front at the Time of the Rome Outlet. Scale, 5 miles to the inch.

Lake Iroquois

By A. P. Coleman

Introduction

The Pleistocene formations of the region around Lake Ontario have been studied by the writer during recent summers, special attention being devoted to the Iroquois beach because of its economic importance and theoretic interest, and the part of this ancient shore line within the province of Ontario has been mapped in detail. During most of the time Professor A. MacLean has shared in the work and has been of very great assistance, especially in the preparation of the map. For short periods, when Professor MacLean was not available, A. R. Crozier and J. G. MacMillan acted as assistants and gave excellent service.

Previous Work

High above Lake Ontario, and usually some distance inland from it, old shore cliffs and gravel bars are well displayed in many places, and the work of water on a large scale was early recognized. In 1842, an eminent English geologist, Sir Charles Lyell, crossed Lake Ontario from Niagara to Toronto in order to see, under the guidance of Thomas Roy, a land surveyor, old beaches and a gravel deposit at 208 feet above the lake, according to Roy, which must have belonged to Lake Iroquois.[1] In the following year a distinguished American geologist, James Hall, described gravel ridges used as roads in New York state and mentioned shells and wood as occurring in the beach gravels.[2] In 1861 Sandford Fleming (later Sir Sandford), a great Canadian engineer, described and mapped part of the beach north of Toronto.[3] Thus, more than seventy years ago, a few points on the old beach had received some attention. The broad outlines of the old sheet of water were not determined, however, till 1889, when J. W. W. Spencer published "The Iroquois Beach; a Chapter in the Geological History of Lake Ontario."[4] In this paper he gave a rough map of the beach, drawing on the work of G. K. Gilbert for the part of the shore in New York. He suggested the name "Iroquois beach" and showed that the shore was not horizontal but was tilted up toward the northeast. In 1907 he published a report on "The Falls of Niagara,"[5] in which his final views on the tilting of the beach, etc., are given, with references to the literature up to that time. The first large-scale map of the beach was published by H. L. Fairchild in 1900[6]; but the part in Ontario was enlarged from the small outline published by Spencer and gave no added details.

In 1904 the present writer published a somewhat detailed account of the Iroquois beach, accompanied by a more complete map than any previous one, in the annual report of the Ontario Bureau of Mines[7]; and in the same year covered similar ground in a paper before the Geological Society of America.[8]

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[1]Sir Charles Lyell, "Travels in North America," New York, 1845, Vol. II, pp. 102-106.
[2]Geology of New York, 4th Geol. Dist., pp. 348-351.
[3]Can. Jour., New Series, Vol. VI, 1861, pp. 247-253.
[4]Roy. Soc. Can., Proc. and Trans. 1889, pp. 121-134; Am. Jour. Sci., Vol. XL, 1890, p. 446.
[5]J. W. W. Spencer, Geol. Surv. Can., Pub. No. 970, 1907, pp. 277 *et seq.*
[6]N.Y. State Geologist, 20th Ann. Rept., 1900.
[7]A. P. Coleman, Ont. Bur. Mines, Vol. XIII, pt. 1, 1904, pp. 225-244.
[8]A. P. Coleman, Bull. Geol. Soc. Amer., Vol. 15, 1904, pp. 347-368.

In doing this field work, more than thirty years ago, the maps available, which were those of the townships surveyed for the division of farm properties, were rough and often inaccurate. Elevations were determined by hand-level from points on railways or by readings of an aneroid barometer; and at a distance from fixed points these could not be very accurate.

The Map

The preparation of contoured maps of the region by the Department of National Defence, Ottawa, has made it desirable to cover the ground once more. The map-sheets, which are on the scale of one mile to the inch, have provided an excellent foundation for mapping the old beach. The survey has indicated bench marks at many road corners, giving excellent fixed points for determining elevations, which has facilitated the working out of the old water levels.

Owing to this truthworthy topographical foundation it has been possible in the present map to show details of shore lines, such as bars and the outlines of bays, much more completely than before, and it has been less difficult to work out the relations of the islands and channels in the archipelago formed by the hills of the interlobate moraine between Trenton and Peterborough.

The writer wishes to acknowledge the courtesy and kindness of W. C. Mendenhall, Director of the United States Geological Survey, Washington, D.C., in supplying a large number of maps covering the portion of New York state included on the Lake Iroquois map-sheet; also the kind co-operation of D. Noonan, Assistant Commissioner of Highways, Department of Public Works, Albany, N.Y., who supplied material for accurately mapping the main highways in New York state.

When the eastern part of the former map of Lake Iroquois was prepared in 1904, the country was far less developed than now and much of the work was done on foot. At present almost all parts of the Iroquois shore are within half a mile of roads on which a motor car can travel, and the field work was relatively easy. The new map is, accordingly, far more accurate than the old one. When it was recognized that the features of the Iroquois shore indicated the work of a large body of water, there was much speculation as to its nature. Lyell considered it to have been an arm of the sea; others thought it a lake, but were unable to state how it was held up to the level of its beach. Already, in 1862, Newberry had suggested that the barrier might have been ice,[1] but this seemed too revolutionary an idea to many and was not widely accepted. Spencer, one of the first to define the old beach, named it the "Iroquois Water," using a noncommittal term, and believed it was formed at sea level. G. K. Gilbert, who worked on the old shore in New York, held to the ice-dam theory and traced the outlet of the lake to the Mohawk valley at Rome, N.Y. The finding of freshwater shells in Iroquois beach deposits at Toronto seemed to settle the question as to the character of the water, but did not prove that the barrier was of ice.[2]

Field work at the northeastern end of the basin during recent summers has located many small, fresh-looking moraines, indicating the position of the glacial front and finally proving that it was ice that blocked the St. Lawrence outlet, raising the water to the level of the next channel through which it could escape toward the sea.

Although Spencer was wrong in supposing the Iroquois water to be an arm of the sea, there is reason to believe, as will be shown later, that the old lake

[1]Geol. Soc. Amer. Assoc., Vol. XLVII, 1898, p. 33.
[2]A. P. Coleman, "The Iroquois Beach," Trans. Can. Inst., 1898-9, pp. 37, 38.

was much nearer sea level than the present height of its shore above Lake Ontario would suggest. During its lifetime and since it ended, the region has been greatly tilted, the northeastern end having risen hundreds of feet above the southwestern end at Hamilton.

The following account of Lake Iroquois will apply specially to that part of its shore within the province of Ontario. Very little field work was done in the state of New York, though the facts that the outlet of Lake Iroquois was past Rome, N.Y., to the Hudson valley and that the ice dam crossed the St. Lawrence at the Thousand Islands into New York make conditions to the southeast of the boundary of the province of much importance.

The basin of Lake Ontario is an extraordinary one, going much below sea level toward its southeast end and having a far greater depth than Lake Erie, though the latter covers a larger area. Lake Iroquois was hundreds of feet deeper still. Its shores were extremely varied much more so than those of Lake Ontario, and included stretches of lofty rock cliffs, cliffs of sand or clay, many miles of low shore, and shallow muddy bays. Toward its northeast end, and to a less extent southeast in New York state, there were crowded archipelagos, suggesting the Thousand Islands of to-day, though the islands were of clay instead of hard granite and gneiss.

In its southwestern part the shore of Lake Iroquois follows rather closely that of Lake Ontario though a few miles inland. Toward the northeast, however, it differed greatly from the present lake, spreading out to a width of more than 130 miles and having many miles of glacier as its margin.

In most places the old shore can be recognized without difficulty, though it has been cut through at various points by river valleys. The following account of the Iroquois beach will begin at Niagara, going west to Hamilton and then turning northeast to its end north of Belleville.

The Iroquois Beach

Niagara to Hamilton

The cliff of shale covered by limestone, reaching 550 feet above the sea at Queenston, rose 180 feet above Lake Iroquois in its later stage and must have formed an impressive part of its shore. To the north shallow water extended for seven miles to Niagara-on-the-Lake, providing the soil for the present rich farming and fruit-growing Niagara region. No deposits of the lake have been observed at Queenston, but a very interesting gravel bar occurs across the river at Lewiston, where the cliff of the Niagara river displays 50 feet of coarse gravel with long cross-bedding turned southwards, as if formed by waves beating over the bar from the lake to the north. The bar rises to the 375-foot contour.

Although no wave-formed materials are to be seen at Queenston, a gravel pit 5½ miles north, not far from Fort George, shows 12 feet of beach gravel, indicating wave work at a much lower level than the one at Lewiston, since it reaches only 300 feet above sea. It is probable that this was formed at an early stage of the lake.

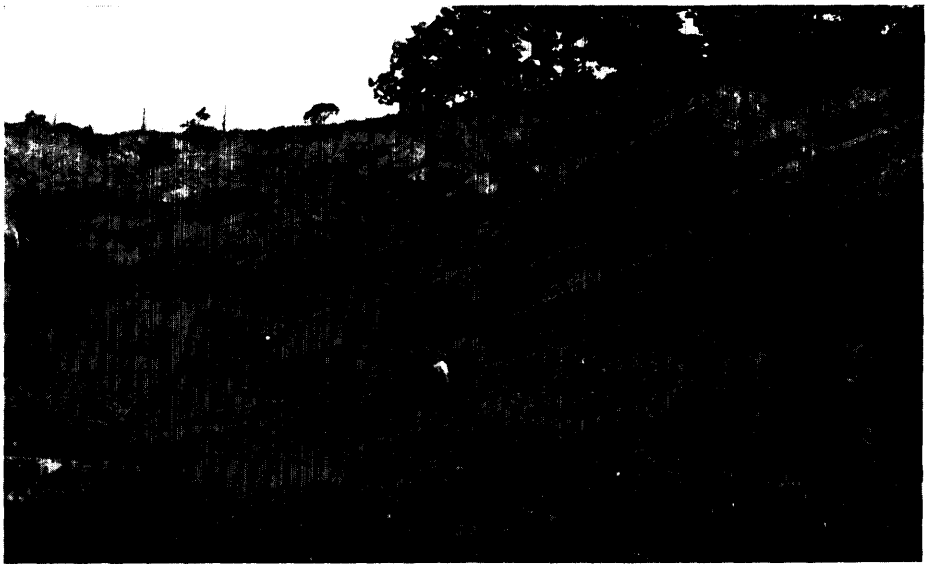
A much larger deposit of gravel, but not belonging to Lake Iroquois, occurs just south of St. David's valley at the edge of the Niagara escarpment. It may have been made by the Niagara river before it occupied its present channel, probably in an interglacial period. It reaches 656 feet at its highest point, and a pit sunk to obtain material for diverting the highway shows 46 feet of coarse gravel with long cross-bedding running from east to west. The gravel extends

for hundreds of yards down the valley toward the southwest and is opened by large pits lower down.

There are features of this gravel deposit that suggest glacial relations. At the west side of the upper pit the gravel, which is well stratified, is overlain by stony till, above which is a thin layer of varved clay, indicating a high-level glacial lake.

A mile and a quarter to the north a beautifully striated surface of limestone may be seen at the Queenston quarry near the edge of the escarpment. The smooth rock is covered by a few feet of yellowish drift containing some boulders, but showing no stratification.

The relation of the Niagara river to Lake Iroquois is very close, and when the vast block of ice that filled the Ontario basin began to melt at the close of



Cross-bedded gravel, head of St. David's valley.

the last glaciation it is probable that there was open water only on the south, a comparatively narrow sheet connecting the falls with the Mohawk outlet. Fairchild has published maps showing early stages of the lake,[1] which will not be discussed here.

Although the old shore begins impressively in Ontario at the foot of a fine cliff, the escarpment withdraws toward the south in a mile or two, and the shore continues westward past St. David's valley below gentle hills of drift and is not sharply marked. The contour line of 375 feet is a little above the level of the beach, and the highway between Queenston and St. Catharines runs just to the south of it.

The low shore of drift continues to Homer, a suburb of St. Catharines, where a long gravel bar begins and extends 3 miles west, underlying most of the city. To the south there must have been a very shallow bay, but its outlines are lost in the maze of waterways and railway lines connected with the old and the new Welland canals. There are gravel pits on the Homer bar in

[1]N.Y. State Mus., Bull. 160, 1912.

which mammoth remains have been found, and a mammoth tooth from 22 feet below the surface is preserved in the collections of the Wentworth Historical Society in St. Catharines.

During the excavation for the locks of the new canal near Thorold, hard and ancient boulder clay of a red colour was encountered at the foot of the escarpment. It is nowhere to be seen at the surface and was probably laid down in the first glaciation.

Beyond the valley of the river flowing past St. Catharines, the Iroquois terrace is once more recognizable just south of the C.N.R. station, and the highway runs west along drift hills just above it as far as Fifteen- and Sixteen-mile creeks, though these small streams have cut away the shore for short distances. The low shore cliff continues to Jordan, where it is interrupted for half a mile by a valley, after which the highway once more occupies the shore at the foot of higher cliffs as far as Beamsville.

In the Beamsville region the Niagara escarpment almost disappears and shows no rocky cliffs, while the shore cliff of Lake Iroquois becomes more marked and consists partly of till with few stones and partly of red shale. West of Beamsville the escarpment is once more distinct, and the Iroquois shore follows its foot a quarter of a mile south of the highway to Grimsby. Beyond this town it continues at the foot of lofty cliffs to Stoney creek and is unbroken by stream valleys.

The road along the top of the escarpment in this region, often 300 feet above the plain at its foot, gives splendid views of the Iroquois terrace, sloping gently to the shore of Lake Ontario a mile or two north, the whole belt of low-land between the two shores forming a rich fruit-raising region. It is evident that the sandy loam left by the Iroquois waters provided a suitable soil, though distinct lake deposits are not often to be seen except where streams have cut through the terrace or in the cliffs of Lake Ontario.

Stoney creek comes tumbling down the rocky slope of the escarpment and has little effect on the terrace, though it forms a narrow lake near its entry into Lake Ontario.

Half a mile west of Stoney Creek village a long gravel bar begins and extends two and a half miles northwest to Bartonville. It has been cut in two by Red Hill creek, which comes down at a sharp re-entrant of the escarpment, and a shallow bay spreads southward from the bar with vague shores scarcely recognizable. Beyond Bartonville the terrace once more lies at the foot of the escarpment cliff, which is here steep and imposing, and continues into the city of Hamilton.

Hamilton and Vicinity

The Iroquois beach has its most striking development at Hamilton, where it turns northeast. The western end of Lake Ontario has been cut off by a bar forming Hamilton bay. The ancient lake had a similar bar five miles to the west, cutting off a bay which may be named from the town on its shore, Dundas bay. The two bays are much alike in shape and area, but the floor of Dundas bay of Lake Iroquois is now mainly dry land, while its bar stands up as a very striking wall to the north of Hamilton. No finer example of a wave-built bar can be found than this great deposit of sand and gravel rising steep-walled more than a hundred feet above the level of the water. It crosses the valley as a causeway two miles long, giving an impressive entrance for the highway and railway into the city.

The creek draining the Dundas valley originally passed round the northern end of the bar to Hamilton bay; but many years ago, when navigation was

more important for local traffic than now, a canal was cut through the bar to permit small craft to reach Dundas.

When the Desjardins canal was excavated bones of animals were found, and the Geological Survey made a study of the section.[1] The report refers to the ridge as Burlington Heights and states that clay underlies it at the level of the lake and that bones of the mammoth were found at a height of 70 feet and 7 feet higher horns of wapiti and the jaw of a beaver. This bar and its relations interested J. W. W. Spencer also, who began his work on Lake Iroquois at Hamilton.[2]

Originally the bar rose 116 feet above the present lake, or 362 feet above the sea, but it has recently been cut down a few feet in improving the Hamilton-Toronto highway. Its width is less than a quarter of a mile at the base. Its lower part, when first studied by the present writer, consisted of well-stratified sand up to 57 feet, and its upper and steeper part was composed of fine and coarse gravel, often cross-bedded and usually cemented to a fairly resistant conglomerate.

The bar can be followed southeast past a cemetery into the city to the foot of the steep Niagara escarpment, here usually called the Hamilton mountain, ending a block or two south of James Street. The bar was cut through when the Hunter Street tunnel was excavated years ago and showed 30 feet of cross-bedded gravel resting on 2 feet of brown unstratified clay, evidently an old soil, with 8 feet of blue till beneath it. In the brown clay there was partly decayed wood, named by Penhallow *Larix americana* and *Picea* (probably *nigra*), and bones of mammoth were also found.

The bay was largely filled in during the lifetime of Lake Iroquois and now forms a plain toward the southwest, rising about 80 feet above the present lake, or 325 feet above the sea. The original terrace has been cut down in the centre by stream work, giving rise to the marsh called Coot's Paradise, which is traversed by the canal. Near the city the terrace has been opened in many places by brickyards and sand and gravel pits, often both on the same property, as the clay overlies the sand. In earlier days the following section was to be seen at Crawford's pit:—

	Thickness	Level above bay
	feet	feet
Clay making red brick	6	78
Grey clay and gravel	30	72
White sand	5	42
Hard pan	4	37
White sand with tusks and bones	33	33

The sections vary considerably from point to point, however, the Frid Brothers pit (Main and Macklin Streets), showing 7 feet of red brick clay and 10 of grey, overlying 10 feet of gravel followed by fine sands.

From the old soil in which are the remains of tamarac and spruce trees, found in the Hunter Street tunnel 30 feet below the level of the bar, it is evident that at one stage Lake Iroquois was much lower than the final water level, 362 feet above the sea; and the steep-walled bar itself indicates a beginning of wave action not far above the present lake with a gradual building up of a spit of

[1] "Geology of Canada, 1863," p. 914.
[2] Am. Jour. Sci., Vol. XXIV, 1882, p. 415; Trans. Roy. Soc. Can., 1889, p. 129 *et seq.*

sand and gravel as the outlet of Lake Iroquois was elevated and the water rose towards the west.

A small gravel pit near the Hydro-Electric power transformer station east of Dundas evidently belongs to a low stage of the old lake. Its floor is about at the level of the marsh, and above it rises a deposit of 30 or 40 feet of coarse lake gravel; it was probably formed before the great bar just described cut off the waves of the open lake. The history of the changes of level of Lake Iroquois will be discussed later.

Hamilton is built mainly on the southeastern part of the great bar and the sandy and silty slopes running down from it toward the harbour. The original drainage of the Dundas valley was northward round the end of the bar just described, though the former outlet was filled by a railway embankment after



Dundas escarpment, overlooking the city of Hamilton.

the Desjardins canal was opened. The old creek turned straight south for half a mile after passing this point, and its channel has high ground on each side, the bar just described on the west and a ridge almost as high on the east. The latter ridge is gravelly, also, and appears to have been built by the waves of Lake Iroquois of materials coming from the northeast instead of the south.

This ridge is not nearly so conspicuous as the one in front of the Dundas bay, rising, as it does, from a land surface instead of the water level, and its boundaries are not very distinct. It begins about 2 miles west of Burlington at an old railway ballast pit and runs southwest for 3 miles to Hamilton bay. Beside the ballast pit, now much grown over, there are openings still in use just to the southwest, including the Howard sand and gravel pit on lot 7, concession I, East Flamborough township, and the Aldershot sand and gravel pit just beyond, displaying 40 feet or more of typical beach gravel. Still farther along the ridge are the Holy Sepulchre cemetery and Woodland cemetery.

This gravel bar reaches 350 feet and hence is a little lower than the one to the west and south, which rises to 362 feet. It is followed for about two miles

by the Toronto highway before the viaduct crossing the former valley of Dundas creek is reached.

The two great bars overlap for half a mile and, therefore, could not have been built at the same time. It is probable that the one just described is the later of the two, at least as far as its southwestern extremity is concerned.

The shore line of the Dundas bay is very indefinite, as might be expected, since its area was small and the water level was changing. It begins to the southeast in the city, with the steep cliff of the escarpment rising abruptly as Hamilton mountain to an elevation of 650 feet, 300 feet above the old water level at its highest stage. The top in the city is a flat tableland; but to the west morainic hills rise above it, reaching 850 feet a mile beyond Ancaster and giving a tumultuous surface leading down to Dundas. Wells sunk in the moraines southwest of the town of Dundas show the presence of hundreds of



Limestone quarry of the Canada Crushed Stone Company at Dundas.

feet of drift filling an ancient valley, which some suppose was once the bed of a river connecting with the basin of Lake Erie.

Beyond the valley and north of Dundas the escarpment turns suddenly northeast and forms a vertical cliff rising to 750 feet, which gives a wonderful view of the Dundas valley, the old gravel bars, and the city of Hamilton with its bay and beach. This is the highest and most impressive part of the Iroquois shore in Ontario, reaching 400 feet above the water level in Dundas bay. On top the cliff excavations at the limestone quarry of the Canada Crushed Stone Company show a polished surface with striae running in three directions, 268, 283, and 296 degrees, the latest direction of ice motion being 296° azimuth.

The west-northwestward flow of the ice seems unnatural, but was probably due to the fanning out of the ice lobe after it escaped from the Ontario basin. The section of drift at the quarry shows two sheets of till separated by 10 or 12 feet of rudely stratified silt and clay.

The lower part of the cliff north of Dundas is hidden under stratified sand, which rises 100 feet above the Iroquois level and may represent some higher stage of water.

North of Aldershot and inland from the bar with the cemeteries on it, drift has been piled up against the escarpment by the advancing ice, making a

hilly morainic surface under which the original limestone cliff is almost completely hidden.

The shore deposits of Lake Iroquois at Hamilton are of much interest, as shown above, in providing a record of the different stages of water level; but they also give evidence of more species of land animals than have been found elsewhere. Since the publication of the "Geology of Canada, 1863," which mentioned mammoth, elk, and beaver, found when the Desjardins canal was cut,[1] there have been a number of finds of animal remains. C. C. Grant reported horns of a buffalo from the great bar and also the shoulder blade of a moose,[2] and a tusk of mammoth or mastodon was found 12 feet below the surface in 1911, when the foundations for the building of the Standard Sanitary Company on Jackson Street were being excavated. Mammoth tusks and bones have also been found in sand pits west of the old bar, at a level only 33 feet above the present lake.

The only species of trees known at this time are the tamarac and spruce, identified from wood in the Hunter Street tunnel, suggesting a forest of a more northern type than at present. The buffalo. however, probably lived in open country. It is to be regretted that no specimens of these animal remains, so characteristic of the region a few thousand years ago, are to be found in the two museums of the city of Hamilton.

Burlington to Lambton

The Iroquois shore between Burlington and Clarkson runs nearly straight and is parallel to that of Lake Ontario, 2 miles inland. It is low and not strongly marked, with a gentle slope to the present shore. It is interrupted for short distances by deep ravines cut by the Bronte and Oakville creeks, where red shale is displayed in vertical cliffs. Gravel deposits are rare and small as compared with those near Hamilton, but one locality may be mentioned, on lot 35, concession III, Trafalgar township, because it includes two bars, one 15 feet higher than the other, with a shallow lagoon between. The pebbles are flat and not well rounded, and are formed of the harder layers of the shale exposed near by instead of limestone as are the pebbles of the Hamilton bars.

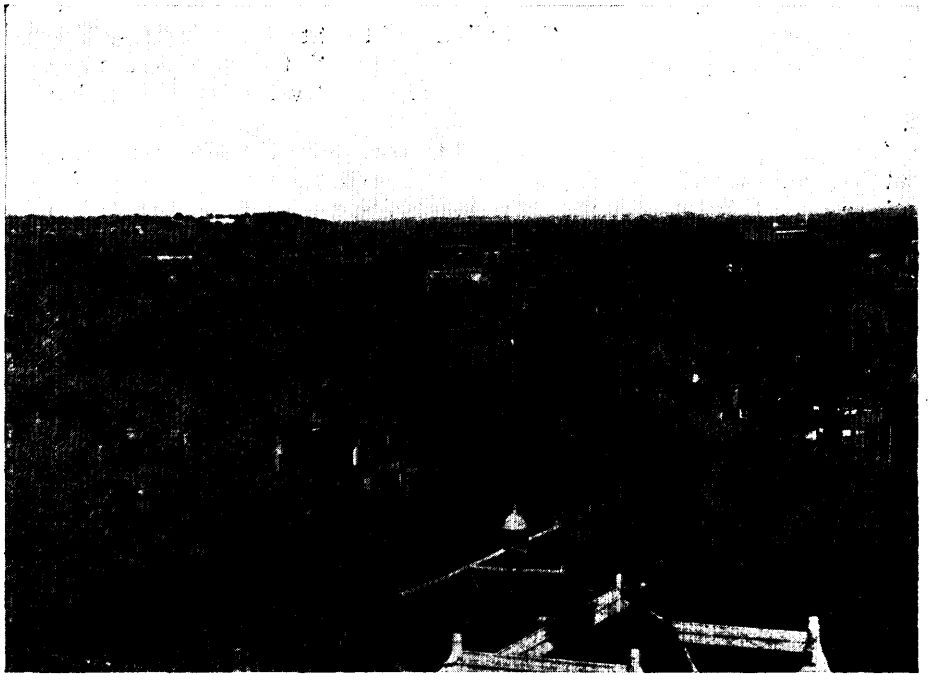
The shore follows closely the contour of 375 feet at first but gradually rises toward the northeast and approaches the 400-foot contour near Clarkson, where it turns northward toward a sharp bend of the Credit river. The river here has cut its way down 25 feet into grey shale, which has a few feet of boulder clay over it. To the west of the bend, near the Erindale school-house, a bar is seen between 325 and 350 feet. The southern end of it along the river has been cemented to a conglomerate, as may be seen from the Dundas highway. On the southeast side of the river bend another bar runs for a mile north and south and rises to the 400-foot contour. The first-mentioned bar must have been made in a bay of Lake Iroquois at a low-water stage before the later bar, which cut it off from the main lake, was begun.

For three miles northeast, to Cooksville, the shore is often poorly marked against a slope of weathered shale; but north of the village a bay was cut off by a bar, which was used extensively for ballast by the railway. Another bar runs northeast of Dixie, and a third one pushes in the same direction into the valley of Etobicoke creek forming a bay a mile long. After a vague bit of shore for a couple of miles, a fourth bar forms a bay at Islington in the valley of Mimico creek, after which the shore turns north along the west side of the Humber valley.

[1]Page 914.
[2]Personal communication.

On the northeastern stretch of the Iroquois shore there is in most places comparatively little drift overlying the bed rock of shale, and distinct cliffs are seldom seen, but the gravel deposits across valleys are numerous and easily recognized. The Dundas highway follows the shore fairly closely from Erindale to Lambton, partly above the low cliff, partly below it, and partly on gravel bars.

As the direction of this part of the shore is nearly that of greatest deformation since the removal of the load of ice to the northeast, its rise between Hamilton bay and Lambton, a suburb of Toronto, is rapid; and it will be observed that



Iroquois shore cliff north of Toronto, showing re-entrant at the Don river. (Photographed by G. A. Clive from the top of the Medical Arts Building.)

on the map the boundary ranges from contour 375 at Burlington to contour 425 at Lambton.

Toronto

Toronto was one of the first points where the Iroquois shore was studied, and as a detailed account of its features was given in a recent report of the Ontario Department of Mines,[1] only the most salient points need be referred to here. Two rivers, the Humber on the west and the Don on the east, entered the lake at Toronto and their valleys were flooded, forming large bays, which were almost completely cut off from the lake by long bars built westward by easterly storms. Striking shore cliffs cut in a southward-projecting branch of the interlobate moraine, which traverses eastern Ontario from the escarpment to the river Trent, one between the two valleys, the other at Scarborough Heights, east of the city; and the two bars are almost as massive as those at Hamilton and far surpass any others thus far mentioned. The bays behind the bars were

[1]A. P. Coleman, "The Pleistocene of the Toronto Region," Ont. Dept. Mines, Vol. XLI, pt. 7, 1932.

filled in with sand and clay to the old water level and now form plains; and the shallow-water deposits of sand in front of the bars and shore cliff may reach even a hundred feet in thickness, as shown in the cliff of Lake Ontario near Victoria Park.

There is good evidence in brickyards and wells that early Lake Iroquois stood about 70 feet below its latest stage, and a buried shore cliff, as well as sand and gravel with shells, has been found at that depth, confirming the evidence of change of level found at Hamilton.

The numerous pits for sand and gravel in the two bars give excellent sections of wave-built structures and have yielded a number of fossils, including three or four species of freshwater molluscs, bones and horns of caribou, bones and



Section across shore cliff of Lake Iroquois, Scarborough.

teeth of mammoth, and skulls of muskox. The resemblance of the modern and ancient gravel bars at Hamilton has been noted, and a similar parallelism is found between the Iroquois bar across the Don bay and the present Toronto island, which is of about the same size and shape.

The Don bar of Lake Iroquois is close to Lake Ontario, whose waves are attacking its eastern end, and a part of the Iroquois shore cliff east of the bar has been cut away for half a mile in the Scarborough cliffs. This is the only point where the modern lake has encroached upon the old shore.

The branch of the interlobate moraine that pushes the Iroquois shore southwards ends at Scarborough Heights, and beyond it the shore features withdraw to the north and for a few miles are indistinct, since the bay thus formed gave some shelter from waves.

The elevation of the beach, as levelled on the Humber bar, is 421 feet above the sea, and that of the shore just east of Scarborough is 445 feet, showing a rise of about 2 feet per mile in that distance.

Scarborough to Bowmanville

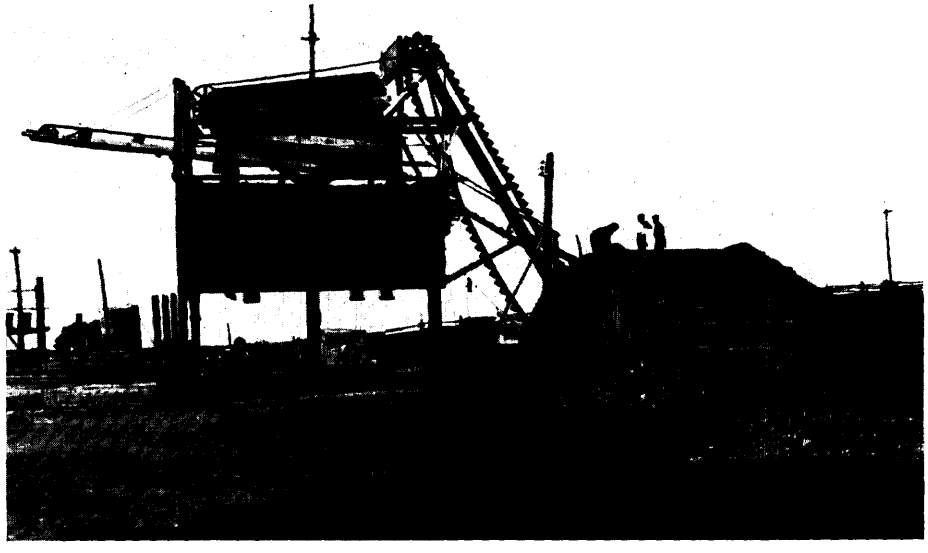
The usual succession of wave-cut cliffs with gravel bars across valleys occurs east of Scarborough, but in the somewhat sheltered bay these features

are not very pronounced and the cliffs are low. To the southeast there are nearly flat plains, carved by the waves and boulder strewn, except where the farmer has piled the stones into broad fences about his fields. In other places



Iroquois gravel pit, Pickering township.

depressions have been filled up with outwash sand. A bay has been cut off near Greenwood, north of Pickering, and another with much more striking scenery at the Devil's Den northeast of Whitby; a third one near the village of



Crusher, Rayner's road-building outfit, north of Bowmanville.

Brooklin on Lynde creek has provided a convenient route north for the Whitby and Port Perry railway. Bars on each side of the creek have been worked as sand pits, and a railway ballast pit was in use there in earlier days.

Similar small bars with sand and gravel pits are found at the headwaters of Oshawa creek and at points to the north and northeast of Oshawa city; but a new type of shore feature shows itself to the east of Farewell creek, between Oshawa and Bowmanville. Here the interlobate moraine breaks up into isolated hills between which the water passed, making a bay three miles long from west to east, but protected from the main lake by low islands connected by nearly continuous beaches.

At several points along this varied shore there are deposits of sand and gravel 20 or 25 feet in thickness; at two places cement block works are located, and south of Taunton a large pit is equipped with screening or sorting machinery.



Gravel digger, Rayner's road-building outfit, northeast of Bowmanville.

The Iroquois sand deposits extend far to the south of the old shore and supply water for the farmers at depths of 35 or 40 feet, according to W. G. Ward, who digs many of the wells in the region.

At Gaud's Corners on Bowmanville creek a deep valley has been cut since the time of Lake Iroquois and a still deeper and wider one on Soper brook at Stephens gulch three miles north of Bowmanville. Half way between the two valleys and a little east of Tyrone, Iroquois deposits give rise to splendid springs, furnishing a flow of 200 gallons per minute as a water supply for Bowmanville, two and a half miles to the south. A shallow bay extends behind almost continuous bars to Orono, and for a mile farther east gravel deposits form the shore, ending at a great morainic hill, which rises to nearly 800 feet above the

sea. For the whole distance of 35 miles thus far described, from Cherrywood station a little northeast of Toronto to a bay beyond Orono, the old Canadian Northern railway follows the Iroquois shore, thus securing a level roadbed with plentiful supplies of ballast, features very attractive to the railway engineer, but leaving the towns some distance to the south.

Although to the eye the Iroquois terrace seems perfectly horizontal, there is a change of elevation between Cherrywood station and Orono from 472 feet above sea level to 516 feet, a rise of 44 feet, owing to the northeastward tilt of the beach.

At four points a mile or two south of the Iroquois shore between Whitby and Bowmanville, gravel beds 50 feet lower than the shore itself have been opened by pits, showing features very like those already described and suggesting a lower water level, but it has not been possible to connect them as a continuous beach. The eastern beds stand higher than the western, showing a tilt like that previously mentioned.

The large amount of sand covering parts of the Iroquois terrace is due to the work of waves on the sandy and kame-like moraine in this region, and west of Orono the sandy tract has been put to use for reforesting operations, since the soil is too light for profitable farming.

Newcastle to Port Hope

In the Newtonville region, between Newcastle and Port Hope, the moraine, hitherto fairly compact and continuous, begins to spread apart, and its scattered hills extend far south of its usual boundary, even reaching the shore of Lake Ontario and there forming cliffs. As the higher hills rise well above the Iroquois level, the general outline of the shore is pushed southwards as a broad promontory, the gaps between the hills being filled in more or less completely by the building of bars.

Two miles northeast of Orono, some of the hills reach 1,000 feet above sea level; but the valleys between them show levels down to 500 feet, well below that of Lake Iroquois at this point, and a network of channels must have separated the hills, though wave action in the sheltered interior was too slight to leave much impression. The archipelago was 8 miles long and 6 miles wide, and its southern boundary is mostly massive gravel bars connecting a few bold cliffs of till. Highway No. 2, possibly the most travelled in Ontario, follows the shore for several miles, and this typical bit of the Iroquois beach is familiar to many travellers. The village of Newtonville is right on the beach, and large gravel pits are scattered along the road, a particularly large one toward the west having been a railway ballast pit many years ago.

The old Canadian Northern railway, now part of the Canadian National system, swings across the northern end of the archipelago and then turns south to Port Hope.

Three miles east of Newtonville the shore formed a sharp promontory, and a well-marked shore cliff facing east runs a mile and a half to the north, followed by two miles of bar reaching across a bay in the same direction. This deep eastern bay, drained by the headwaters of the Ganaraska river, which flows into Lake Ontario at Port Hope, was so sheltered that its shores are hard to follow and have not been worked out with certainty.

The western part of the archipelago is drained by Crooked creek, which meanders through wooded ravines so deep and tangled that the township roads do not cross them. The creek reaches Lake Ontario at Bond Head, the port of Newcastle.

The undoubted work of Lake Iroquois is next picked up 4 miles northwest of Port Hope and half a mile west of Quay station on the railway between Port Hope and Peterborough. Here a massive hill of boulder clay rises with a bold cliff toward the south. This hill was an island in Lake Iroquois. Three-quarters of a mile north of Quay on the railway, a large ballast pit is found on a bar 557 feet above sea level. This also was an island, and indistinct shores are found to the north; but well-marked cliffs rise a mile and a half east of Quay, where the Iroquois beach was exposed to the broad lake, and from this point it can be readily followed.

The bar near Quay station is important in the study of Lake Iroquois, since it is on the pivot line running through the outlet of the lake at Rome, N.Y. In the northeastward rise of the region, as the load of ice on the glacial centre north of Quebec was lifted by melting, the beach was deformed, the southwestern part sinking and the northeastern rising. As the older beach levels to the southwest were successively buried by later deposits, in most places the shore appears to be a unit as far as Rome in New York state and Quay in Ontario, whereas the beach is split up into diverging levels toward the northeast.

A few outlying morainic hills occur near Port Hope, not high enough for the main shore, but showing gravel deposits and boulder pavements 75 feet below it, evidently belonging to a later water level, corresponding to that found between Oshawa and Bowmanville. Gravel pits have been opened on two of them a mile northwest of Port Hope and on another on lot 17, concessions III and IV of the township of Hope.

The hills cease suddenly on the west bank of the Ganaraska river, which flows over flat-lying limestone through the town; and except for small drumlin hills at Trinity College School, the region to the east is low as far as Cobourg.

Near Cobourg and Colborne

Four miles northwest of Cobourg a drumlin hill forms a promontory on the Iroquois shore, and beyond a bar, on which is a gravel pit, a wide bay extends northeast to Camborne, which stands on a terrace, and continues eastward to the picturesque village of Baltimore. There are several islands in the bay, and the railway from Cobourg to Harwood, long abandoned, followed the valley of Cobourg brook toward the north.

North of the southernmost island, on lots 13 and 14 on each side of the road between concessions II and III of Hamilton township, there are gravel deposits; Gidding's pit has been worked on a large scale, and others have been opened just south of Baltimore. The highway north from Cobourg to Baltimore follows the crest of a narrow drumlin, which formed a shoal in Lake Iroquois and was cut down by its waves. A few miles north of Baltimore the road crosses the Northumberland Forest plantations on a broad sandy tract largely covered with trees of different ages. It includes considerable areas that rise above 1,000 feet, and at one point reaches 1,175 feet. Some of the most extensive kame deposits in the province have been heaped up here in the interlobate moraine.

A mile and a half southeast of Baltimore the bay ends, and high shore cliffs, cut in crowded drumlins with short bars in the narrow valleys between them, extend for some miles to the east. At The Gully a gravel pit shows a splitting-up of the deposit into an upper part with finer gravel and a lower one with coarser materials, with about 20 feet between the two levels. A less notable division had already shown itself among the islands in the bay, and from this point northeastward two or three distinct beach levels are found. A

mile east of The Gully and the same distance north of Grafton, a bar built across a valley encloses a pond, which must have been a small bay of Lake Iroquois.

Drumlin hills are scattered to the south of this straight bit of shore, the higher ones levelled by waves and showing a flat stony top, the lower ones often well formed and easily studied from No. 2 highway, which passes between them near Grafton. The general surface toward the south is flat having only a thin sheet of till, and Cobourg brook flows over bed rock of shaly limestone within the town.

Shelter Valley creek has cut a deep and picturesque set of ravines among the hills, 2 miles east of Grafton, and a bay with drumlin islands stretches with vague shore lines to the north; but 3 miles beyond this appropriately named valley, the Iroquois cliffs are once more well marked and can be followed easily to the north of Colborne.

Near Brighton

Three miles northeast of Colborne the straight shore of cliffs cut in the hills suddenly changes to long gravel bars and swings southeast to a point only a mile and a third from Lake Ontario, leaving the moraine completely and enclosing a succession of shallow bays, one of which contains a pretty lake three-quarters of a mile long and half a mile wide. This Little lake, as it is called by the people on its shore, was once named Silver lake, but is now designated on the maps as Biddy lake. It is a bay of Lake Iroquois cut off by the long bar just mentioned. Though it stands 320 feet above Lake Ontario and is only 2½ miles from it, the stream that drains it flows north and makes its way to Cold brook, a tributary of the Trent river, and its waters make a round of 28 miles before reaching the Ontario level in the Bay of Quinte.

It is evident that when Lake Iroquois began, the hills to the east of this stream formed an island cut off from the mainland by a narrow channel, and that the pushing of the bar across the channel by wave action tied it to the shore, turning the island into a peninsula. Three distinct water levels are found in the bars southwest of Biddy lake, the highest 28 feet above the lowest, showing that elevation toward the northeast was progressing during the lifetime of Lake Iroquois.

The bars to the southeast have been worked in several places for sand and gravel; and at the south end of the promontory there is an extensive ballast pit once used in railway construction. This was excavated far below the Iroquois level in coarse kame gravels, the upper part of which supplied materials for the lake-formed bars just referred to.

Colborne gets an excellent water supply from springs coming from Iroquois beach deposits a couple of miles to the north. This flows by gravity to a point near the town, where it is pumped to a tank, which forms a landmark on a neighbouring hill.

The Kingston Road (Highway No. 2), which goes through the town, follows approximately the contour of 325 feet for many miles, keeping to the southern edge of morainic hills, which have a flat plain to the south, suggesting a possible water level. Although a small sand and gravel deposit, which has been opened by a pit, occurs three-quarters of a mile east of Wicklow, there are no gravel bars between the hills to the north.

Beyond the sharp point 4 miles east of Colborne the Iroquois shore cliffs are once more distinct and extend for 8 miles northeast with brief and unimportant interruptions. Brighton, like Colborne, gets its water supply from

springs 2 miles to the north, which originate in beach gravels east of Wade Corners and are gathered in a reservoir giving a pressure of 80 pounds in the town. Many other springs rise in the 50 acres owned by the town and join to form a tributary of Butler creek.

The most important sand and gravel deposits in the Brighton region are on the 500-foot contour, 2 or 3 miles south of the Iroquois beach and about 100 feet lower, and probably belong to the low stage of water already mentioned. Piester's sand pit on the south half of lot 31, concession II of Brighton township, and another on lot 2, concession A, half a mile north of Smithfield, belong to this level.

A belt of flat country extends for several miles on the south side of the Iroquois shore; as it is poorly drained and is largely covered with swamp and woods, the township road allowances in many places have not been opened up.

The Trenton Region

The interlobate moraine ends in the compact group of hills, called Murray hills, in the township from which the name is derived, 3 miles west of Trenton. They rise to 850 feet above a very flat plain and form a striking promontory, wooded and not crossed by roads, ending the continuous stretch of the Iroquois beach in eastern Ontario. Beyond this, only isolated hills rise high enough to reach the Iroquois level, and these formed islands in the broad lake.

The Murray hills were carefully studied and its elevation worked out by J. W. W. Spencer many years ago when he outlined and named Lake Iroquois.[1] Since Spencer quoted different elevations for the beach in different publications, the present writer repeated the work with a Wye level with the following results:[2] —

	Feet
Highest terrace (faint)	696
Well-marked terrace	687
Rear of gravel beach	632
Lower bar on road	620
Rear of boulder pavement	585

A gently sloping terrace, sometimes bouldery, extends for more than a mile to the east of the shore cliff and indicates the distance cut back by the waves during the life of Lake Iroquois. It is largely covered with orchards, for which the somewhat sandy soil is specially suitable.

A mile north of the point where the highway between Trenton and Wooler touches the Iroquois shore, there is a bar with a gravel pit on the 550-foot contour, which probably represents a late stage of the lake, which has been described at several points to the west.

These successive beaches, so well displayed at the foot of the Murray hills, show that the level of the water, or rather the elevation of the land to the northeast, underwent great changes during the history of the lake, amounting to 76 feet, if all the terraces are included, or to 55 feet if only the well-marked water levels are considered. The terrace at 632 feet is very well marked, and it is probable that the lake stood at this level for thousands of years, during which its waves cut back the lower part of the cliff to its present position.

As one goes around the north end of the Murray hills two terraces are

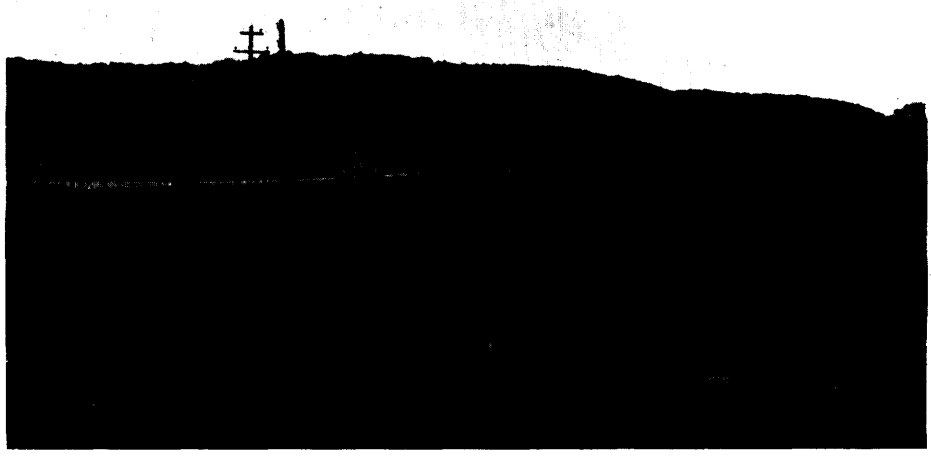
[1] Trans. Roy. Soc. Can., Sec. IV, 1899, pp. 121-134; "Duration of Niagara Falls," Am. Jour. Sci., Vol. XLVIII, 1894, p. 44 *et seq.*

[2] A. P. Coleman, Ont. Bur. Mines, Vol. XIII, pt. 1, 1904, p. 231; Bull. Geol. Soc. Am., Vol. 15, 1904, p. 355.

found where small bars have been opened by gravel pits; but the shore to the west of the large island is not well marked, since it was on a bay where wave action was not pronounced.

It is evident that the highest water level is the oldest, and also that the different beaches represent halts in the northeasterly elevation of the land, the main beach at 632 feet requiring a much longer time to form than the others. The distance between the beaches here is twice as great as that found at Biddy lake northeast of Colborne (55 as compared with 28 feet).

The lowest well-marked beach, that at 632 feet, must be considered as the continuation of the beach found west of the hinge line at Quay north of Port Hope, which stands at 557 feet, showing a differential rise of 77 feet in the 35 miles, or a little over 2 feet per mile.



Shore of Lake Iroquois, Murray hills, west of Trenton.

From the hill top which represents the summit of the Iroquois shore cliff, there is a wide and impressive view over the country, showing toward the northeast and north many drumlin hills, the higher ones flat-topped, apparently decapitated by the waves and cut down to shoals. Beyond them rise a few wooded points above a flat platform, evidently islands in the lake.

Islands to the Northeast of the Trent River

The wide, low valley of the Trent river lies to the east of the Murray hills, and no land high enough for the formation of the Iroquois beach is to be seen in that direction; but 8 miles to the north-northeast wooded summits on each side of the river reach the proper level and may be considered as the continuation of the old shore. The hill on the west side, enclosed by the great bend of the river, presents a tableland with more than a mile of gravel bars stretching northeast and southwest, but with no shore cliff. It was a shoal in the early and higher stages of Lake Iroquois but was awash in the later stage with a low island on the eastern side.

Oak Lake Island.—Southeast of the Trent below its sharp bend a long wooded hill formed an island running northeast, which was connected by a bar with a sharp conical hill; a short distance beyond in the same direction a

much larger island, rising to 750 feet in places, is conspicuous in the landscape. It may be called Oak Lake island from its most picturesque feature, a beautiful body of water near its centre. The island begins with gravel bars and runs 4 miles northeast, ending with more gravel bars.

On the southeast side there are steep cliffs, in places reaching nearly a hundred feet in height; the opposite shore consists mainly of gravel deposits. Oak lake is bounded on the west by these gravel deposits and is, therefore, an authentic part of Lake Iroquois, a bay of the ancient body of water cut off from it by wave work and preserved to the present. It is three-quarters of a mile long and half a mile wide and has a depth of 43 feet. There is no visible outlet, but it no doubt drains through some porous layer, since springs come



Iroquois terrace near Oak lake.

from below the massive enclosing bars. On the contour map the level 668 feet is given for the lake, and the bar reaches 689 feet. There are also bars at lower levels, one at 675 feet, and a boulder pavement at 655 feet.

Near the northeast end of the island a pond is enclosed by a bar in a similar way, but the water level is a few feet higher than in the lake and the enclosing bar reaches 707 feet. About 2 miles southwest of Oak lake and 4 from the pond, a well-formed bar stands at 643 feet, a difference of 64 feet, part of which, however, is accounted for by the upward tilt toward the northeast.

The highway between Belleville and Stirling crosses the island close to Oak lake, which is a summer resort, so that this small remnant of Lake Iroquois is easily visited.

Pancake Hill Island.—Seven miles northeast of Oak lake and 13 north of Belleville another area rises above the Iroquois level, called on the contour map Pancake hill, perhaps from its flat surface as compared with its steep sides. In former publications it has been referred to as West Huntingdon island, from the railway station 3 miles to the southwest. The tableland is largely a boulder pavement with stony fields, evidently wave-washed in shallow water; but toward the northwest corner the surface rises a little higher and consists of gravel bars

running north and south for half a mile with a width of 400 yards. The highest bar reaches 730 feet at a gravel pit on the east and west township road and rises 3 or 4 feet higher a little to the south. This is the highest point on the Iroquois beach in Ontario. Another bar stands 26 feet below it, and between the two there is a shallow lagoon.

No higher land or shore cliff is to be found, and one may suppose that kame gravels at the same level have been worked over by the waves, since a large gravel pit on the west side of the hill a little lower down shows undoubted kame structure. This pit has been worked on a large scale by the Consolidated Sand and Gravel Company, of Toronto.

As the separation of the highest from the lowest bar at the Murray hills is more than 50 feet, and the separation here is only 26 feet, it is probable that



Iroquois bar at 730 feet on Pancake hill.

at the highest level of Lake Iroquois this island was under water, rising above it only in the later stages.

No points as high as 700 feet occur for miles to the north and east of this hill, and more distant hills that reach the expected level show no signs of wave action; this set of gravel bars, therefore, must represent the end of the Iroquois beach toward the northeast in Ontario. The character of the gravel and its well-marked stratification indicate a considerable amount of wave work, implying open water around the shoal or island, at least during the latest part of the lake's history.

Near Campbellford

About 15 to 18 miles to the west, near Campbellford, beyond the next bend of the Trent river, a well-defined shore can be followed along a row of lofty islands for 10 miles, with short interruptions, ending almost as far north as the bars on Pancake hill. Since the wave work is most pronounced at the north end of the row of islands, the description will begin there.

Half a mile south of Healey Falls on the Trent river and 4 miles north of Campbellford, a flat-topped hill rises as a broad promontory with shore cliffs

and gravel bars as well defined as on the main beach west of Trenton. Here three bars occur at 678, 688, and 721 feet, showing a change of water level of 43 feet. On one of these a gravel pit, known as Rutherford's, has been worked for many years. A mile to the south the two upper bars are found at a large gravel pit, and a shore cliff occurs below them at 642 feet.

The shore is strongly marked for 4 miles southwest, presenting cliffs and short bars across narrow valleys without interruption to a point two and a half miles from Campbellford on the highway towards Hastings. There a creek valley followed by the Canadian National railway breaks the continuity for a quarter of a mile, and gravel beds are found at three levels, 625, 651, and 674 feet, the highest being 49 feet above the lowest.

Across the valley to the south two long gravel terraces can be traced in wooded territory on the side of an island three-quarters of a mile long, separated by another gap from a second island with heavy gravel bars running west from its northern end. Similar islands with shore cliffs and long bars between them continue southwest to Hermiston lake, a pond of the same nature as Oak lake. From this point, where two striking beach levels are 25 feet apart, another bar extends south. The road to Warkworth, which is 2½ miles distant, is built on this bar.

The Iroquois shore is very easily recognized on the southeastern side of the row of islands just described, since it was exposed to waves on a wide part of the lake; but the northwestern side of these islands, 8 miles west of Campbellford, is too indefinite to map, though a couple of ponds at 680 feet among the hills are about at the level of the lowest Iroquois bar.

To the east of Healey Falls, the contour map shows two hills rising to the Iroquois level, and these were visited. One of them, a mile north of Petherwick Corners and three-quarters of a mile east of the Trent river, shows a well-stratified gravel deposit at about 675 feet, which probably represents the lowest water level. The other, about a mile south of Rylstone and three miles east of Healey Falls, shows three bars. The highest bar is about on the 700-foot contour and is 23 feet above the lowest. No shore cliffs were found, and the gravel beds seem to be rearranged kame deposits, but they correspond to Iroquois levels and must have been small low islands in the later stages of the lake. North of these hills the country for some miles is too low to show a beach, but east and west of Crow lake, near Marmora, there are hills that reach 700 feet but show no evidence of wave work; and the same is true of the high points near Havelock and Norwood, though at the latter place a flat plain near the 675-foot contour suggests a water level.

South of Havelock and a mile west of the Trent river, where the valley turns southwest toward Rice lake, a well-marked gravel terrace rises a little above the 675-foot contour and runs for half a mile parallel to the river. This is the most northerly beach on the Iroquois shore, being a few miles north of Pancake Hill island. It is not so high, owing to the tilt of the region.

A couple of miles southwest and a mile in from the river another gravel deposit is at the same level, and the whole valley must have been under water.

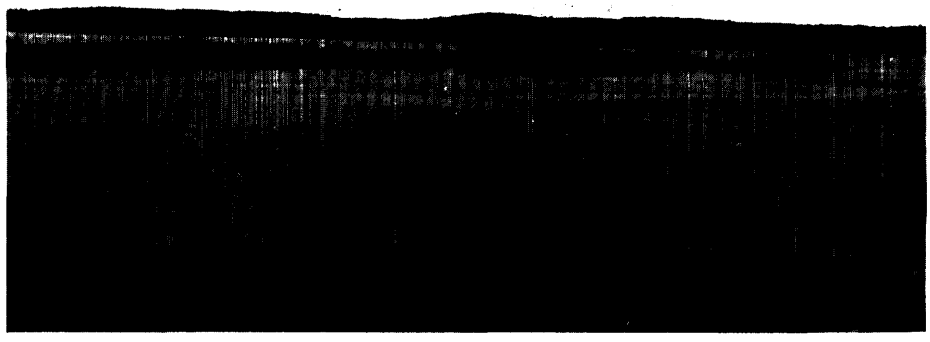
An Archipelago among the Moraines

The outer limits of the Iroquois beach toward the north and northeast have been indicated in the accounts of its shores and islands in the vicinity of Trenton, Frankford, and Campbellford. In most cases they are distinctly marked by cliffs and gravel bars around the eastern end of the so-called interlobate moraine; but this double moraine was formed of materials dumped to

the south by the Lake Simcoe–Georgian Bay ice lobe, and to the north by the lobe occupying the Ontario basin, and was not a continuous range of hills.

The two moraines did not always meet, and as the morainic materials were often heaped up as separate hills with spaces of low ground between them, the waters of the lake spread in complicated ways within the morainic area. In many parts the channels were too narrow for effective wave work, but in wider parts the shore can often be recognized in the field, and in a number of places gravel deposits have been formed between the hills.

It has already been noted that Biddy lake, 4 miles northeast of Colborne near the south side of the moraine, has Iroquois gravel bars to the southwest, preventing its drainage to Lake Ontario, which is only 2½ miles away and 320 feet lower. A small stream flows north from the lake and joins Cold brook, which runs northeast and enters the Trent river just south of Frankford. The headwaters of Cold brook rise near Castleton and Vernonville, and it drains



Rice lake, looking south to the interlobate moraine.

the irregular gap between the two sides of the interlobate moraine for 20 miles. For the last 12 miles the brook is very crooked and has a gentle descent, the northeastward rise of the region having diminished the original slope.

Salt creek, Mill creek, and Percy creek, much smaller streams, drain minor valleys toward the northwest into Percy reach and the Trent just above it.

It is clear that the moraine, which looks so massive and impenetrable from the towns to the south and from Rice lake to the north, is loosely constructed and everywhere broken by valleys except in the large and lofty area of sand in the great Northumberland kame deposit, which is uncut by stream valleys and crossed by few roads.

Coming in by the Cold creek valley from Frankford to the village of Wooler we see to the north a mass of hills, which must have formed a large shoal scarcely reaching above water level at the lowest stage of the lake, but showing wave work in well-stratified gravels, which have been opened up at points 1½ or 2 miles northeast, north, and northwest of the village.

A few miles to the west a similar shoal or low island rises north of Orland. On it is a gravel deposit, on which Cowan's pit, belonging to the McNamara Construction Company, of Toronto, is located. The bar is split up into two levels, like others in the region.

Still farther west Cramahe hill rises as a prominent mass, reaching the 750-foot contour, and must have been an island even at the highest stages of Lake Iroquois. A mile and a half southeast of the village of Norham a bar connecting the main island with a smaller one has been opened as a sand and gravel pit for Northumberland county, and a little west of Warkworth two pits are seen on the south side of a large island. Two miles southwest of Warkworth a bar belonging to the low stage of Lake Iroquois extends for half a mile and has been opened with a pit at its southwest end.

A mile and a quarter southwest of Morganston, gravel pits occur on each side of the road at a gap in a prominent shore cliff belonging to a promontory extending south toward Castleton. This may be seen on the highway between the two villages, and about half way there is a large gravel pit on a bar coming from the south shore of the interior bay. Castleton itself is partly located on a small bar on one of the upper branches of Cold brook; but the shore lines are in general so vague that mapping was difficult.

In addition to these bars of Iroquois age, and doubtless also others not observed in our field work, there are frequent outcrops of kame sand and gravel, providing the interior region of the interlobate moraine with abundant building materials of this sort.

The Rice Lake-Otonabee Region

Near Hastings and Rice Lake.—A large area northwest of the region which has been described includes glacial hills, drumlins, kames, and sometimes eskers, which rise to levels that should have been invaded by the waters of Lake Iroquois; but no continuous and undoubted beach deposits have been found, and mapping of such features is impossible except by the use of contours on the map. Owing to the tilt of the region since Iroquois times the eastern end of Rice lake should have been beneath its level and the western above it; but the valley occupied by Rice lake is narrow, and wave action must have been feeble, so that no very certain evidence has been found to prove it. At the outlet of the lake into the Trent river, however, large deposits occur, and there is 20 feet of coarse gravel in a pit north of the river in the town of Hastings, rising to a terrace at about the 650-foot contour. This extends eastward through the town and also westward for half a mile and may be an Iroquois level or perhaps a river deposit, since the cobbles or small boulders seem too large to be the result of wave work in such narrow waters.

A mile southwest, on the north shore of the Trent where it widens into Rice lake, a small gravel bed at about 625 feet seems to be wave-formed, and 4 miles farther on, near the shore of the lake, a vague terrace with gravel containing many clam shell suggests a lake level 15 feet above the present. At Birdsall point gravel appears again at the same level; and across the lake a terrace rises 10 or 15 feet above the water.

The small gravel flats just mentioned are about 25 feet below the beds of coarse gravel at Hastings and are very different in appearance, so that they probably represent different stages of water. When the water stood at 625 feet a bay several miles long must have covered the low ground to the north in the valley of the Ouse river, and there must also have been long inlets reaching up the valleys of the Indian and Otonabee rivers.

On the southeast side of the lake, a mile in from Idylwild point, there appear to be two vague terraces, the higher one about at contour 625, which may represent this low stage of water.

Rice lake, with its very irregular shores, often swampy but at many points rising as steep hills, and its numerous islands and promontories of boulder clay,

looks very youthful. The long continued rise of its outlet has drowned the shores of its southwestern end, and there has been no cutting off of points or driving of bars across bays. In any case, wave action is ineffective on a body of water so narrow and island-studded. No bed rock appears on its shores. On the northwestern side there are narrow steep-walled drumlins, sometimes half buried under kame deposits, and on the southeastern shore there is the interlobate moraine, which has here its highest elevation and rises as a great mass of sandy kame hills reaching 1,175 feet in the Northumberland Forest[1] and forming a large area of soil unsuitable for farms, as already mentioned. If the northeastward lift of the Rice Lake basin should continue to the extent of 62 feet more, a connection would be made with the headwaters of the Ganaraska river, which empties at Port Hope. The intervening drift materials could easily be excavated so that the Otonabee drainage would go southwestward instead of following the roundabout route of the Trent river. It was suggested years ago that this route should be adopted for the canal to Georgian bay.

The Otonabee near Peterborough.—The northern lakes have two connections with Rice lake and the Trent system, by the Indian river and by the Otonabee, the latter far the more important of the two. The Otonabee forms a well-marked boundary between quite different types of landscape. To the east the surface consists chiefly of very long and narrow drumlins oriented a few degrees east of north and west of south, and east and west roads encounter a constant succession of steep hills. To the west the country is hilly, but with sprawling morainic forms without any particular order except along the bank of the river, which is followed for some miles by esker ridges. The cause of this striking difference between the two glaciated regions is not very apparent, but may be connected with the fact that all Iroquois shore features seem to end with the Otonabee. Nothing that can be interpreted as formed by its waves has been found to the west.

Limestone occurs along the river north of Peterborough and at Lakefield. About a mile and a quarter above the upper-road bridge in Peterborough on the east bank of the river, gravel deposits are found between contours 675 and 700 and continue for 2 miles to the south. The deposits have been opened up at several points, some of the excavations being large; but the best section is in the river bank above the lower-road bridge, where more than 20 feet of very coarse but well-rounded gravel may be seen. Some of the stones reach a foot and a half in diameter, and the deposit was probably made by powerful river currents rather than by waves. A distinct terrace extends a quarter of a mile east to a striking drumlin at Ashburnham park, and at two places pits show that the gravel grows finer and at length sandy the farther it is from the river bank.

Most of the city is built on this terrace, interrupted by a small drumlin on which the court-house stands, and which extends for several streets to the west. To the south the gravel changes to sand on a wide flat, and finally, on Princess Street, to sandy loam forming a low plain only a few feet above Little lake, an expansion of the river.

The gradual change from coarse to fine materials and the gentle slope of the plain, which drops about 50 feet from its highest point to the flats at the river, strongly suggests a delta built by a powerful river entering standing

[1]Established in 1924 and enlarged to 1,000 acres in 1931. It is situated on lots 24 to 29, concessions VI to VIII, township of Haldimand, and belongs to the united counties of Durham and Northumberland.

water; and in a former publication[1] it was suggested that this body of water was separate from Lake Iroquois and should be called Lake Peterborough.

It now seems more probable that it joined a bay of Lake Iroquois by winding channels between drumlin islands, since the contoured map, not then available, shows depressions between the hills down to 650 or 625 feet.

The river that built this great delta seems to have been much larger than the Otonabee and was, no doubt, the Algonquin river, which for a time drained the vast Lake Algonquin, including the basins of all the upper lakes, into Lake Iroquois. The materials for the delta must have come from the esker on the west side of the river above Peterborough.

There are a few connecting links between the Peterborough terrace and the Rice lake bay in the form of small gravel bars just north of the eastward bend of the Otonabee, between contours 625 and 650. One of them just north of the Hiawatha Indian Reserve includes a large railway ballast pit, probably used long ago by the abandoned Cobourg and Peterborough Railway. The deposit looks like a bar formed at the north end of a high drumlin hill, which would imply waves coming from open water to the south.

The relations of land and water in this region of crowded drumlins and moraines are very intricate, and the foregoing account of the northeastern islands of Lake Iroquois must be looked on as an outline rather than a detailed description of the ancient shores.

In a very interesting study of "The Trent Valley Outlet of Lake Algonquin and the Deformation of the Algonquin Water-plane in Lake Simcoe District, Ontario,"[2] W. A. Johnston describes conditions in the region just discussed and takes a somewhat different view of the relationships from that just given. He thinks that the Indian river was much more important in the drainage of Lake Algonquin than the Otonabee and that the latter river carried only "part of the outflow of Lake Algonquin for a short time during the 'two-outlet' stage of the lake before the discharge was entirely diverted from the Trent outlet by uplift."

The field work here reported upon has shown that most of Rice lake and the low ground between the drumlins immediately north of it between Hastings and Peterborough was beneath a bay of Lake Iroquois when the Peterborough delta was built, and that the Indian river valley was submerged for a number of miles during the late, high-water stage of Lake Iroquois. Any delta built by the Indian river in Rice lake must have been formed earlier and at a lower level.

New York State

The outlet of Lake Iroquois was long ago discovered by G. K. Gilbert,[3] who found that its waters flowed past Rome through the Mohawk valley to the Hudson, and concluded that this was because the St. Lawrence valley was still obstructed by an ice-sheet. Later, H. L. Fairchild[4] mapped the shore in New York state, supplementing the rough outlines of Gilbert and following the old beach north to Adams Center and Watertown.

Still later Fairchild suggested that toward its close Lake Iroquois was drained past Covey Hill on the New York–Quebec boundary[5]; but this must have been a very transient stage, since all the beaches studied in Ontario focus

[1]Bull. Geol. Soc. Amer., Vol. 15, 1904, p. 357.
[2]Geol. Surv. Can., Mus. Bull. No. 23, 1916, p. 12 *et seq.*
[3]Sixth Ann. Rept. Commissioners State Reservation, Niagara, 1890, p. 67 *et seq.*
[4]Pleistocene Geol. Western N.Y., Rept. Progress, 1900, p. 107.
[5]N.Y. State Mus., Bull. 209, 210, 1919, p. 12 *et seq.*

about the level of the Rome outlet, unless the vague gravel deposits 50 or 100 feet below the main beach near Oshawa and Port Hope represent it.

A visit was made by the writer to Watertown and Adams Center, and the bars and shore cliffs there seen are comparable in every way with those of the main Iroquois beach north of Lake Ontario. South of Adams, in the slopes toward Allendale creek, the splitting-up of the beach is well marked, great bars of gravel having levels 23 feet apart. Typical beach deposits are found in the hills a mile or two east of Watertown, between contours 620 and 640, not unlike those of Oak Lake island in Ontario, but there seems to be no equivalent to the archipelago in our interlobate moraine. The map of the lake in New York, as prepared by Fairchild, shows a wide bay at the southeast corner, with comparatively few islands.

From northwest to southeast, measuring from the promontory near Healey Falls, the lake was 130 miles wide, but to the west it was only a little wider than Lake Ontario.

Position of the Ice Dam

For more than forty years geologists have believed that Lake Iroquois was held up to the Rome outlet by a barrier of ice that crossed the St. Lawrence channel in the Thousand Island region, but this belief has been due to theoretic inferences from the general history of the retreat of the ice at the end of the glacial period and not from evidence in the field. It was decided, therefore, to study the region with the object of fixing the position of the ice front during the life of the lake, and field work during 1933 was for a time directed toward solving the problem. The question naturally arose as to how the position of the ice front could be recognized. What would happen where an ice-sheet was slowly thawing with its edge under water?

One point was certain—that the latest glacial deposit in the region must have been left by this waning edge of the ice. It must rest upon any previous drift materials, and it should be the freshest of all, having been exposed for only a short time as compared with the older deposits.

The older moraine forms were familiar, drumlins and kames and less definite shapes of irregularly dumped boulder clay and sand and gravel mingled with stones and boulders. They were to be seen everywhere in the interlobate moraine and the belt of lower land between it and Lake Ontario, and there could be no doubt that these features of a glaciated region were older than the beach whose shore cliffs were cut in them. All the parts of the region below the Iroquois level had been under water, which would tend to soften their forms.

The old glacial deposits displayed broad, sweeping outlines with smooth curves of slope and no sharply defined features except where cut by modern streams; and they seldom bore thickly strewn boulders except below the shore cliffs of Lake Iroquois. They had been shaped mainly by the moulding of the ice-sheet passing over them and in this region had not been much masked by materials dumped during the ice retreat, which must have gone on rather uniformly and rapidly.

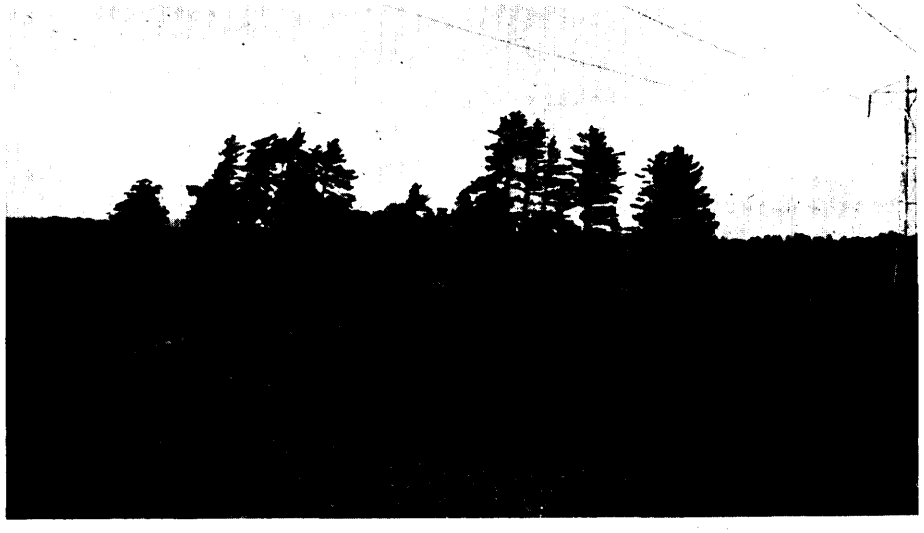
Evidently we should look for sharp ridges and mounds of moraine on a small scale strewn with angular boulders. Examples of this sort had been encountered before in our field work in the northern parts but without attracting particular attention. An excursion northeast from Healey Falls led into wooded country a few miles from the last Iroquois shore, and there very rough and stony little hills showed themselves, hopeless for farming purposes and therefore left as woods. This circumstance had more or less hidden the late moraines

from view and accounted for the lack of attention given to them. Excellent examples of these miniature morainic ridges were found, however, on land that had been burnt over south of Marlbank; and the ridges, crowded with angular slabs and boulders of pale-grey limestone were very conspicuous.



Moraine near Marlbank.

Where the late moraines occurred on land which has been cleared they were easily spotted, and a rough survey was begun by traversing the township roads in the region a few miles north of the last islands or promontories of the



Moraines near Norwood.

Iroquois shore. Unfortunately the areas on which they were to be expected were usually wooded and in many cases crossed by very poor roads or none at all.

It was presently found that these little moraines were specially marked and most easily recognized where limestone came to the surface as bed rock.

The blocks of limestone, owing to the jointage of the beds, were loose and easily plucked, to be carried a little way and then dumped on the ridges. On Archean rocks, so much harder and with colours so much less conspicuous, the little moraines were much more difficult to recognize; and in places where the drift was deep and no bed rock was within reach there were only mounds and ridges so like the surface on which they rested that they were often very hard to be sure of. They were just minor ripples on the waves of ground moraine.

One gradually learned to pick out these small features without much difficulty except in wooded Archean country, where the sharp and ridgy hills of bed rock, especially the Grenville limestones, were often deceptive. In some places there were two or three narrow moraine ridges in succession from a few yards to a hundred yards apart with shallow troughs between, suggesting short stages



Moraines northeast of Campbellford.

of ice retreat, perhaps annual. Some of these ridges were only a few feet high but stony and distinct; and there were places where they were not much more than a row of blocks of stone, angular and with rough surfaces. On the other hand there were in a few places much larger hills with sharp outlines and stony slopes and crests.

Where the ridges were more than a contour (25 feet) in height the map often showed intricate forms, which suggested the late variety of moraines and called attention to points which should be examined, especially in wooded country.

In addition to small and sharp moraines there were hummocky esker ridges, steep-walled and with very uneven crests of sand and gravel, which, if crossed by an ice-sheet, would certainly have been levelled down. These were often followed for miles by roads and were conspicuous landscape features, running across the older glacial forms and evidently left during the last withdrawal of the ice.

It was intended at first to map the marginal moraine of the last ice front in some detail, but it was soon found that there was no definite and sharp

morainic rim, like the loops mapped round the ice lobes in the States to the southwest; but that small features of the sort described above were scattered over a considerable width of territory and nowhere consolidated to a well-marked range of hills. North of Belleville all the roads were traversed as far as Moira, Stoco, and other lakes in Archean country, and small, recent-looking moraine ridges were found from point to point over a width of 8 or 10 miles.

How much farther north they could have been followed was not determined, since they were difficult to recognize among the rugged, wooded hills traversed by few roads, and other features of the Pleistocene seemed more important.

As opportunity offered the small fresh moraine ridges were picked up to the west as far as Lakefield, north of Peterborough, and as far east as Gananoque, though in the latter region the combination of rolling surfaces of ground moraine with rough Archean hill tops made their recognition far from easy. There were no limestone blocks to make them conspicuous, only small swells and ridges of till. The ice must have carried few boulders to be dropped here.

To make sure of the relations, New York state across the St. Lawrence was visited, and a few moraines observed near Alexandria Bay and Clayton were enough to suggest the continuance of the ice barrier toward the foothills of the Adirondacks.

At the western end the small moraines seemed to stop a little east of the Otonabee, and none were found west of the river, which was to be expected, since Lake Algonquin is believed to have drained into Lake Iroquois by that route for at least a part of its history.

No moraines of the sort described were seen close to the Iroquois beach, except around Pancake hill, which they encircle on the east, north, and west sides. The gravel bars on this hill represent late and low stages of Lake Iroquois, and it is probable that the hill was ice-covered when Lake Iroquois began but was released toward the end of its existence. The gravel bars are well stratified, indicating a wide stretch of water about the island when they were formed.

From Lakefield to Alexandria bay is nearly 100 miles in a direction a little south of east, and there is no doubt that the ice margin extended farther east to the Adirondack region and also farther northwest to make the dam for Lake Algonquin, a much larger glacial lake than Iroquois.

Lake Frontenac

In several places south of the Iroquois shore, water-laid gravel deposits of some practical importance occur from 50 to 100 feet lower down, as has been mentioned on earlier pages, and this stage of water level should be specially referred to, though the different deposits have not yet been connected in the field. The points noted are as follows:—

	Contours feet
Near Whitby (2 gravel pits)	425
Halfway between Oshawa and Bowmanville (2 gravel pits)	450
Halfway between Newtonville and Port Hope	475
Northwest of Port Hope (2 gravel pits)	475–500
East of Brighton	500
North of Smithfield	500
North of Murray hills	550

The levels were not measured but were referred to the nearest contour on the map, and, as will be seen, there is a steady rise from southwest to northeast in the same direction as was found on the Iroquois bars, making it very probable that the deposits at the different points belong to a real water level. It is

likely that this stage of water corresponds to Lake Frontenac, which has been referred to by earlier students of the Pleistocene lakes, though its boundaries have never been outlined.[1] It probably represents the water level when the Covey Hill outlet of Fairchild was functioning.[2] It should be noted that these water-laid gravels have not yet been found west of Whitby, though the water level should have extended to the other end of the Ontario basin.

As these lower gravel deposits represent the last stage of water controlled by an ice dam, Lake Frontenac brings to an end the glacial lakes of the region, and any lower shore lines must have been formed at sea level or as early phases of Lake Ontario.

Glacial History and Iroquois Water Levels

Thus far this report has been largely concerned with the Iroquois beach, and it has been shown that the old shore is no longer horizontal but is now tilted up toward the northeast and also that its eastern end is split up into strands at different levels. These features are closely connected with the

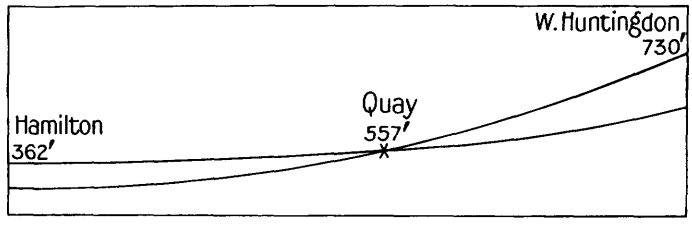


Diagram illustrating the differential elevation of the Iroquois beach. The flatter curve shows the position of the early water level, and the strong curve the latest water level of Lake Iroquois. The nodal point is a few miles north of Port Hope.

retreat of the last ice-sheet which covered the country, and it is worth while to consider these relationships at greater length. It has been shown that the old lake was held up by the front of an ice-sheet that blocked the St. Lawrence valley, and that the water reached the level of the next higher outlet, at Rome, N.Y., where the Mohawk valley leads to the Hudson.

The ice-sheet was thousands of feet thick at its centre in the province of Quebec, and its weight depressed the earth's crust to correspond to the load. As the load was lifted by thawing, toward the close of the ice age, the land rose, and the rise was greatest at the glacial centre which had been most depressed. This centre was toward the north-northeast, and the direction of greatest rise has been worked out as N. 20°E.

The rise in temperature that removed the ice was not steady and continuous but was sometimes halted, and the corresponding elevation of the land toward the northeast ceased for a time. The longest halt lasted for thousands of years. Since the outlet of Lake Iroquois was to the south of our region and the tilt of the basin was in the direction of N. 20°E., the water levels swung about a pivot at right angles to this. The pivot passed from Rome, N.Y., through Quay in Ontario, a few miles north of Port Hope.

Having noted the essential facts, their effects on the water levels may be pointed out. As the unequal lifting of the region deformed the originally

[1]F. B. Taylor, U.S. Geol. Surv., Mon. LIII, p. 445.
[2]H. L. Fairchild, N.Y. State Mus., Bull. Nos. 209, 210, 1918.

horizontal beach, it rose in the direction mentioned, and the rise is differential. If expressed in feet per mile the rate steadily increases toward the northeast, and the old water level may be represented as very gently curved upwards.

The difference between the levels at the two ends of the lake as measured at Hamilton, 362 feet above the sea, and Pancake hill, 730 feet above the sea, amounts to 368 feet; but this apparent difference is much below the real figure when the splitting up of the beach into separate strands is taken into account.

It was shown in the report of 1932 that Lake Iroquois began at Toronto 70 or 80 feet below the level of the well-marked shore line, which stands at about 420 feet at Davenport station.[1] We find, on the other hand, that the splitting of the beach near Trenton amounts to at least 55 feet in the other direction, the oldest water level being the highest, so that the rise of the upper beach at Trenton must have been at least 125 feet. The Murray hills near Trenton are 20 miles from Pancake hill, the last point on the shore toward the northeast in the direction of tilt, and the spreading apart of the upper from the lower beach would there be more than double the 55 feet just mentioned. The lowest bar at Pancake hill is only 26 feet beneath the highest, instead of 110 feet, as the calculation just given suggests, and the earliest level of Lake Iroquois at its northeast end should be at present 814 feet above the sea instead of 730. It is probable, however, that Pancake hill was still ice-covered in the earlier stages of Lake Iroquois, though the conditions indicated above would apply in regard to the actual shore at the time, which must have been of ice.

If this reasoning is correct there was, during the lifetime of Lake Iroquois, a rise of the northeast end of the basin as compared with the southwest end of more than 500 feet, which would indicate that the ancient lake began somewhat below the present level of Lake Ontario.

The uplift toward the northeast continued during the later water levels, of course, and may have amounted to 100 feet in the case of Lake Frontenac, whose strand line is now deformed to the extent of 125 feet. The question of marine water levels will be discussed later.

Fairchild, in his interesting discussion of the differential uplift of the Iroquois beach, gives 668 feet as the amount at Covey Hill, the point where the lake was finally drained when the ice dam withdrew from the northern foothills of the Adirondacks.[2]

Climatic Relations of Lake Iroquois

For many thousands of years, while the Ontario basin was covered with ice which reached a hundred miles south into the state of New York, the climate of the region must have been Arctic, like that of the inland ice of Greenland; but the thawing of the vast ice block, even though it went on very slowly, indicates a great rise in temperature, which must have lasted a long time to dispose of the 10,000 cubic miles of ice in the basin. The thawing was halted for thousands of years, however, while the ice dam stood five hundred or a thousand feet thick across the St. Lawrence valley at the Thousand Islands. This was the time when the very mature late beach was built, when great shore cliffs were cut back into the hills and immense gravel bars were pushed across the mouths of bays, as at Hamilton and Toronto.

What caused this long recurrence of a cold climate is not known. The climate did not revert to truly Arctic conditions, however, since the ice did not

[1] A. P. Coleman, Ont. Dept. Mines, Vol. XLI, pt. 7, 1932, p. 45.
[2] H. L. Fairchild, N.Y. State Mus., Bull. Nos. 209, 210, 1919, p. 12.

readvance but had a stationary front, perhaps protected by a thick sheet of drift and perhaps even covered with hardy forest growths as on the expanded front of some of the great Alaskan glaciers.

We know that spruce and tamarac trees grew at Hamilton. That the mammoth, the elk, and the beaver lived there was shown long ago by the Geological Survey of Canada,[1] and C. C. Grant[2] has reported also horns of buffalo. At Toronto there were mammoths, caribou, and musk-oxen. Spruce and tamarac still grow in Ontario, though not along its southern margin. Caribou live north of Lake Superior; the buffalo lived far south of the Great Lakes within historic times, but the musk-ox is now a distinctly Arctic animal. The mammoth was well clothed with fur and was equipped for a cold climate. On the whole one may assume that the climate on the shore of Lake Iroquois was considerably colder than now, perhaps like that on the shore of James bay.

Of the temperature of the water of the lake we know only that three or four shellfish found in its gravels at Toronto are of species that still live in the region. The fact that for 130 miles the northeast shore was of ice indicates little as to the temperature of the water. Lake Ontario in its deeper waters does not rise above 39° F., the temperature of greatest density, and the present deep-water fish would have been equally at home in Lake Iroquois.[3]

Finally, the cool temperate stage gave way to present conditions, and the dam of ice departed from the foothills of the Adirondacks, allowing the waters to escape by the St. Lawrence and ending Lake Iroquois.

It is generally held that this took place about 16,000 years ago, though the data for this estimate are not all very certain. The age of Lake Ontario has been worked out as 8,000 or 9,000 years from the rate of recession of the cliffs at Scarborough and the rate of growth of the bar enclosing Toronto bay, generally called Toronto island.

The time that elapsed between the end of Lake Iroquois and the beginning of Lake Ontario is much less certain. The events known to have taken place in that time include the existence of Lake Frontenac, as mentioned earlier, followed by shorter stages of fresh water until the ice departed completely from the St. Lawrence valley and finally by an invasion of the sea, which lasted long enough to carve shore features of some importance in the county of Prince Edward. It has been suggested that all told these episodes might total 7,000 or 8,000 years.

As the shores of Lake Iroquois have about the same maturity as those of Lake Ontario, its life history probably required as long a time, which gives 8,000 or 9,000 years for its duration. Summing up, we may suppose that Lake Iroquois began about 25,000 years ago.

Economic Features of Lake Iroquois

The basin occupied by Lake Iroquois was, of course, pre-glacial, but in the ice advances it received a coating of till and also, in places, of morainic materials of various kinds, and the original surface of deeply weathered bed rock was mostly covered, though sometimes scoured bare. The economic deposits of the lake consist mainly of glacial products rearranged by wave action. Boulder clay is a mixture of rock fragments of all sizes from masses sometimes weighing tons to the finest "rock flour," and when cliffs were cut by the waves in boulder

[1] "Geology of Canada," 1863, p. 914.
[2] Personal communication.
[3] Univ. Toronto Studies, Biol. Series, No. 21, 1922, pp. 61-65.

clay or drumlins or moraines the finest parts were swept as clay or silt into deeper water off shore, sand was deposited in shallower places, coarser fragments, small enough to be handled readily by the waves, were rounded and thrown up as gravel bars, and heavy blocks were left as boulders at the foot of the cliffs or stranded in shallow water.

Where kames or eskers were being attacked, sand and gravel supplied the main spoils, the sand being widely spread in the shallow water and the gravel built into long bars and beaches.

In a few places toward the west end of the lake rock cliffs, undermined by the waves, furnished materials to be ground into gravel and sand, but on most of the shore this supply was unimportant and need not be discussed.

The boulders were sometimes thickly strewn as "boulder pavements," to be piled up by man, after years of toil, into stone fences around the fields or gathered to build picturesque houses or to make the lower walls of bank barns or other foundations. In limestone regions the blocks in the fields in early days were sometimes burned for lime. In more recent times boulders have been crushed for road metal where gravel was not available.

The gravel bars across the mouths of bays have, however, been the most valuable of the Iroquois deposits and, until recent years, have everywhere been used for road-building and as ballast for railways. Now, when near towns and cities, they are of more importance for concrete.

With the gravel there is often sand, which also has its uses, especially as a constituent for mortar and concrete in building, or in the making of sand-lime brick; in the more important commercial pits sorting machinery to separate the different grades of material has been installed. The finer silt and clay is widely used in making brick, red from the weathered upper part, buff or "white" from the lower limy layers. Behind the gravel bars in bays there is usually 10 or 15 feet of good brick clay, as may be seen between Hamilton and Dundas and in the Don and Humber bays at Toronto.

Varved Clays

Lake Iroquois was a glacial lake, and one might expect varved clays, which are clays laid down annually from the glacial mud, owing to the melting of the ice, to be widely spread. These clays, of course, would be only in the deeper water near the ice front and are not to be confused with the silt and mud due to the action of the waves in cutting shore cliffs.

Undoubted varved clays of this age are mostly found toward the east end of the basin, as might be expected from the history of the lake with its dam of ice persisting for thousands of years in the Thousand Island region.

There are excellent sections of varved clay at Toronto, as described in the report on "The Pleistocene of the Toronto Region,"[1] and also at several points in the cliffs of Lake Ontario from Scarborough to Port Hope, but they belong to a much earlier glacial lake which occupied the Ontario basin during the Illinoian ice invasion and are usually buried under Iroquois sand and gravel.

Stratified silty clay suggesting Iroquois varved clay may be seen in the low shore cliff of Lake Ontario where the Niagara river enters on the Canadian side, but rarely on the north shore until one goes east of Toronto. A few feet of what may be considered Iroquois varved clay is found near Pickering; and on lot 29, concession II of Whitby township, a little west of the town of the same name, 6 feet of varved clay has been worked to make grey brick and tile. South of

[1]A. P. Coleman, Ont. Dept. Mines, Vol. XLI, pt. 7, 1932, p. 14 *et seq.*

Bowmanville, also, from 3 to 8 feet of yellowish varved clay may be seen in a yard that once produced red brick.

Weathered varved clays occur along the banks of a number of streams in the lower part of their course in this region but are not important enough to require mention, and the same is true of sections along the shore of Lake Ontario; but near Belleville varved clays are widespread and of economic importance. A mile east of the city a few feet are used to make red brick at D. W. Rollins' brickyard, and 20 miles north, near the town of Tweed, similar clay is used by the J. T. Houston Company. The latter exposure of varved clay is of interest as standing 500 feet above the sea, one of the highest points at which varved clay has been observed in our work. The locality is within the area over which small late moraines are scattered, indicating the position of the ice dam of Lake Iroquois. The varves are thin and not very distinct, and they were probably laid down during the final melting of the barrier.

It is worthy of note that these varved clays usually burn to red brick, showing that their materials were not ordinary "rock flour" clay, which in other parts of Ontario provides buff bricks. This may, however, be owing to post-glacial weathering, since the thickness is not, as a rule, more than a few feet.

Much the most important use of varved clay in the Belleville region is for the making of cement, and north of Point Anne, a few miles east of this city, large areas have been stripped for this purpose, leaving unsightly fields strewn with boulders and ponds. In several places near No. 2 highway the stripping is so complete as to lay bare the polished and striated limestone underlying the drift of the region, showing that boulder clay as well as varved clay has been removed.

Their latest stripping, about a mile farther north, is not so complete, but shows an uneven surface of blue and very stony till underlying the varved clay, which is thick and weathered-looking. The section left by the steam shovel shows from 5 to 12 feet of stratified stoneless clay of a brown colour, not blue like the Illinoian varved clay used for brick-making at Toronto.

The manager of the Canada Cement Works, at St. Anne, J. H. Legate, states that when the plant is running full time the supply of clay for 5 days requires the stripping of an acre to the depth of a foot, and that the clay in the pit averages 7 feet in thickness. The composition of the clay is given as follows:—

	Per cent.
Silica (SiO_2)	51.63
Alumina and iron oxide (Al_2O_3 and Fe_2O_3)	23.00
Lime (CaO)	9.03

Limestone, mixed with the clay to give the proper proportions of lime and silicate of alumina for cement, is quarried at the plant on the shore of the Bay of Quinte.

In former years near Marlbank, 20 miles to the northeast, cement was manufactured from marl, which supplied the lime, and clay, which was obtained from adjacent fields. The stoneless clay, which was stripped from the fields, leaving stony till beneath it, must have been Wisconsin varved clay, and from the map contours seems to have stood above 500 feet. This clay pit, like that south of Tweed, is in the belt of small moraines left by the ice barrier and must have been formed as the ice was departing.

On the east bank of the Napanee river, just south of the town, at the Napanee Brick and Tile Works, belonging to J. Chapman, 18 feet of varved clay can be seen, the lower part well stratified, the upper less evidently so. The lower part is limy and burns to a grey brick, while the upper, weathered part burns red. The clay rests on an uneven surface of sand, which passes down into gravel.

Red brick was made at one time from clay with indistinct stratification, probably varves, a half mile south of the Kingston Junction station of the Canadian National Railways. Beneath it was a thin sheet of boulder clay resting on a beautifully striated surface of limestone. Near the canal lock at Kingston Mills, a little farther east, a good section of well-preserved varved clay may be seen, and, no doubt, clay of the same kind occurs in many other parts of the region. It is stated by M. B. Baker that such varved clay in the Kingston region reaches about 250 feet above Lake Ontario,[1] which is about the same level as similar clay at Marlbank, mentioned above. Varved clays are found in various places farther east, on No. 2 highway near Gananoque and on Howe island, where a shore cliff shows 16 feet under 3 or 4 feet of till. This apparently interglacial varved clay has not the firmness or blue colour of the Illinoian varved clay and was probably of Wisconsin age but covered by a slight readvance of the ice.

From the outline just given it will be seen that Wisconsin varved clay supplies stoneless clay for brick- and tile-making and also for cement production in the eastern part of the old lake; but its real importance is in the formation of excellent soil for the farmer, free, or almost free, from the boulders that occur in the till of the morainic region to the north.

In an interesting paper on "Glacial Lake Stages about the East End of Lake Ontario"[2] the varved clay just described is referred to as formed in Lake Frontenac and its level is put at the 325-foot contour or below. Earlier in the present report it has been shown that varved clay of the same kind occurs up to 500 feet. Lake Frontenac was a short-lived body of water, and its ice dam was far to the east of this region; and it seems to the present writer that these widespread varved clays were much more likely to have been deposited by the deeper and much longer lived Lake Iroquois.

The Iroquois Plain

The sands and gravels and varved clays of Lake Iroquois have been of direct value in the development of different parts of the region covered by its waters, but there are some broad features of its work which have been much more significant in the development of the region.

It is not an accident that the most important fruit-growing area of Ontario lies as a belt a few miles wide between Lake Ontario and the ancient shore. The famous crops of grapes and peaches of the Niagara district and of the apple orchards of the north shore show the suitability of the old lake deposits for fruit-growing; but in addition there has been the preparation of the region for the farmer and fruit-grower by the levelling of its surface. Before Lake Iroquois began the valley must have been largely morainic with ridges of till and undrained hollows; but the waves cut down hills and ridges and filled in depressions most effectively, leaving a plain with a gentle slope inwards, sufficient for proper drainage.

Along the actual shore the way has been smoothed for roads and railways, and practically the whole outline of the lake is occupied by highways and railroads giving most useful routes of easy communication and favouring the development of towns and cities. The gravel bars, naturally well drained, were used for Indian trails before the white man came, and were favourite "ridge roads" for the early settlers. The gravel deposits favoured road-building and thus helped

[1]M. B. Baker, "The Geology of Kingston and Vicinity," Ont. Bur. Mines, Vol. XXV, pt. 3, 1916, p. 21 *et seq.*

[2]M. B. Baker and W. A. Johnston, Trans. Roy. Soc. Can., 3rd ser., Vol. 28, sec. IV, 1934, pp. 75-80.

to open up the country. The same bars and aprons of sand extending lakewards from them supply splendid spring water for nearby towns and are tapped by innumerable wells for the use of the farmers of the region.

Largely because of the ease of travel by road and by rail along its margin, the two largest cities of the province, Toronto and Hamilton, grew up on the Iroquois shore, although of late they have been expanding beyond it; and for the same reason a row of smaller towns have been developed along the old shore to supply the wants of the farmers and fruit-growers who occupy the plain. More than a third of the population of the immense province of Ontario lives on, or close to, the plain left by Lake Iroquois, which covers less than a thousand square miles of dry land.

Part of this crowding of towns and cities and thickly peopled farm lands is due, of course, to the presence of Lake Ontario, the successor of Lake Iroquois, with its facilities for navigation; but the fundamental features are due to the ancient lake.

The waves of Lake Iroquois, some thousands of years ago, finished up the geological preparation for our present occupation of the Ontario basin, and left the region in excellent shape for the pioneers to push their roads and settlements into Southern Ontario and lay the foundations for the future province.

Geology of the North Shore of Lake Ontario

By A. P. Coleman

Introduction

Lake Ontario, the lowest of the Great Lakes of the St. Lawrence system, has some very remarkable features. Its surface stands 245 feet above the sea, but toward the southeast end its waters reach a depth of 737 feet, 492 feet below sea level. The shape of the basin suggests an old river valley following its deeper, southern side; but it is evident that under present conditions of land and sea no river could have carved such a valley, since the broad barrier of Laurentian granite and gneiss at the Thousand Islands cuts the basin off from the St. Lawrence valley beyond. Unless some unknown pre-glacial channel is hidden under the drift in New York state, the way toward the east is completely barred.

The Ontario basin seems to be rock rimmed, and its depth can be accounted for only by great changes of relative level in its enclosing formations, which may be outlined in this introduction.

The early history of the region commences with a vast pre-Cambrian peneplain, which must have been at first dry land but which was later submerged by the advancing seas of early Paleozoic time. The marine deposits include representatives of both the Cambrian and Ordovician.

The Potsdam of the Cambrian appears at the eastern end as a thin and often interrupted sheet of sand and pebbles. Extending from the margin of the Potsdam near Kingston westward along the north shore of the lake, as far as Hamilton, and from there as a narrow strip to the Niagara river, are the limestones and shales of the Ordovician. Later comes the Silurian with massive limestones capping the Niagara escarpment, nowhere reaching the actual shore of the lake but rising as cliffs a mile or more to the south.

Toward the end of the Paleozoic owing to an uplift from the northeast, the region became dry land. The soft shales so exposed were attacked by the weather and by running water and were carved into an unsymmetric river valley, bounded towards the south by the Niagara escarpment.

The river has been named by Spencer the Laurentian and is supposed to have come from the upper lakes valley through Georgian bay, then south through a buried valley to Toronto, afterwards following the deep southern side of the Ontario basin and finding its way northeastward across the Frontenac axis of Laurentian rocks, then much lower, to the St. Lawrence.[1] This implies, of course, that in later times the Laurentian axis was warped up to its present level, blocking the ancient river channel and changing the part of it in southern Ontario into a closed basin.

There are difficulties in the theory that this supposed Laurentian river connected the pre-glacial valleys now occupied by the Great Lakes with the St. Lawrence and the Atlantic; and an American geologist, A. W. Grabau, postulates the theory that the drainage was southwest across the basin of Lake Erie to the Mississippi,[2] but Spencer's theory of the early river system seems the more probable of the two.

[1] J. W. W. Spencer, "The Falls of Niagara," Geol. Surv. Can., Pub. No. 970, 1907, p. 391 *et seq.*
"Glacial and Postglacial Lakes in Ontario," Univ. Toronto Studies, Biological Series, No. 21, 1922, pp. 6-12.

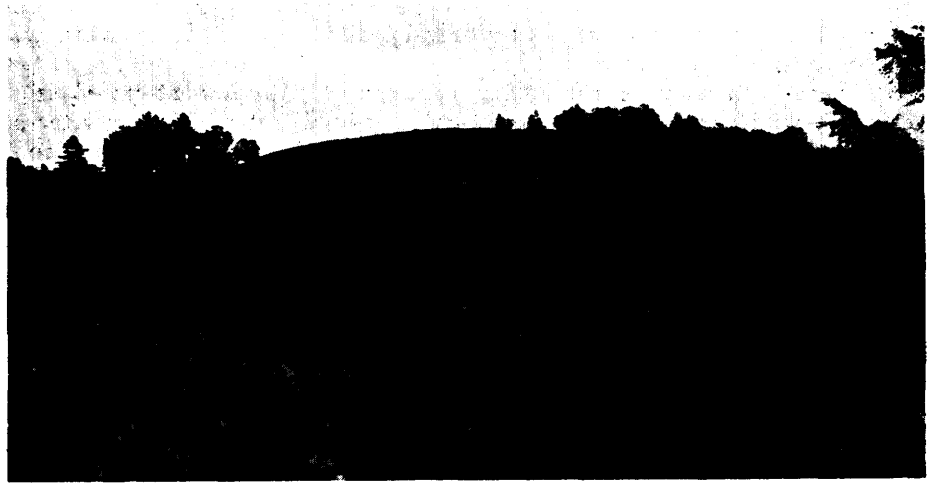
[2] N.Y. State Museum, Bull. No. 45, 1901, p. 37 *et seq.*

Although the bed rock is known to enclose the Ontario basin on all sides it is not to be seen everywhere, and the actual shore is often of drift, which sometimes rises as cliffs, the most striking being at Scarborough, east of Toronto and between Newcastle and Port Hope. The only impressive cliffs of rock are along the shores of Prince Edward county. In the archipelago of the Thousand Islands, also, splendid cliffs of granite and gneiss are to be seen.

Glacial Deposits.

The region has been crossed three times by ice-sheets coming southwest from central Quebec. The last ice front advanced in the form of lobes, which filled the upper lake basins to the north and the Ontario basin to the south. With the melting of the Ontario lobe, the ice halted for thousands of years with a broad northwest-southeast front at the Thousand Islands.

All three ice invasions left deposits of drift upon the bed rock in most places, each later one more or less displacing the materials dumped by the one before.



A drumlin.

The shaping of the country is, therefore, largely due to the last one. While most of the region is drift covered, there are places where the scouring action of the moving ice has cleaned everything off, leaving a smoothly polished and striated surface, the striae indicating the direction of ice movement. The original surface of rock was very uneven, with cliffs and ridges and steep-walled valleys, but in most places the old bed rock forms are buried out of reach. The amount of drift is varied, ranging from thin layers to massive hills hundreds of feet thick; and the materials are of all grades of fineness from "rock flour," through sand and gravel, to stones of all sizes. These ingredients may be mixed in all proportions or may be assorted into clay, silt, sand, gravel, and boulders.

The most fundamental type of deposit is till, which is ground-up rock mixed with pebbles and boulders, the latter of various kinds of rock, often gathered from a wide area. This is often called "boulder clay," an appropriate name, and in this region generally contains masses of Archean rocks, especially granite and gneiss, along with fragments of shale or limestone of Paleozoic age.

Over most of the region a continuous sheet of till has been spread by the ice, varying in thickness from point to point and often covered with later de-

posits. The unchanged boulder clay is usually bluish-grey in colour, but weathers brown for two or three feet below the surface. It may be spread out



Section of an esker, northeast of Campbellford.

in a flat plain, but has generally wavelike forms, which are characteristic and easily recognized.



Kame structure near Glen Ross.

In some parts of the region, as north of Belleville and east of Peterborough, the till has been shaped into the elongated domes called drumlins, which present

quite perfect geometric forms with steep sides and a rounded back having an outline like a reversed catenary. Drumlins may be from half to three-quarters of a mile long and hundreds of feet high, and may occur in closely set swarms, making picturesque scenery but difficult country for roads and for the farmer.

Where the ice front halted for some time the materials it transported were dumped as moraines, which are ridges or hills of very irregular form, usually more stony than ordinary till, though the sheet of boulder clay mentioned above is sometimes called ground moraine.

There are often, in addition, fluvio-glacial deposits where a subglacial river has piled up sand and gravel and stones at the edge of the ice, as a kame, or has made humpy ridges of the same coarse materials within walls of ice, called eskers. An esker can be followed for miles in many cases and usually ends in a kame. Often the stream coming out from the ice front spreads sand or gravel on the bare ground or in a lake, forming what are called outwash deposits or aprons.

In our region the sandy or gravelly kames and eskers just mentioned are usually the latest deposits and may bury the earlier-formed sheets of till or drumlins or moraines, dominating the landscape, but they are not nearly so widely spread; and over large areas the surface consists of boulder clay with gentle undulations. Most of the land surface of Ontario has been shaped by glacial materials of the kinds mentioned above, though the original forms may have been more or less softened by later weathering or may have been carved into shore features by glacial lakes.

The Shore from Niagara to Brighton

Niagara to Hamilton

The Canadian bank of the Niagara river below Queenston consists for about 3 miles of red shale, which has been appropriately named the Queenston shale,[1] with a thin covering of drift above it. The shale then disappears and is followed by a low cliff of grey till. At the mouth of the river near Fort Mississauga the till is no longer exposed, and the 20-foot cliff shows only gravel, covered in places by 6 feet of varved clay, but the foot of the cliff is hidden by talus, which may conceal boulder clay, since the shore beneath is strewn with boulders. The gravel may be of early Iroquois age or may possibly belong to the much later stage of Lake Frontenac.

From Niagara-on-the-Lake southwest to Port Weller the shore cliff ranges from 12 to 20 feet in height and consists mainly of till, sometimes covered by a few feet of varved clay. At one of the highest points, where the second road east of Port Weller reaches the lake, there is red till at lake level, followed by bluish till, covered by 4 feet of brownish till. There are evidently two sheets of till, the older one largely formed of ground-up Queenston shale.

The lake level was low when the section was studied, yet the waves were attacking the cliff and cutting it back. This is a little west of Eightmile creek and a mile east of the former Tenmile creek, now completely lost in the new Welland canal, which opens into Lake Ontario at Port Weller.

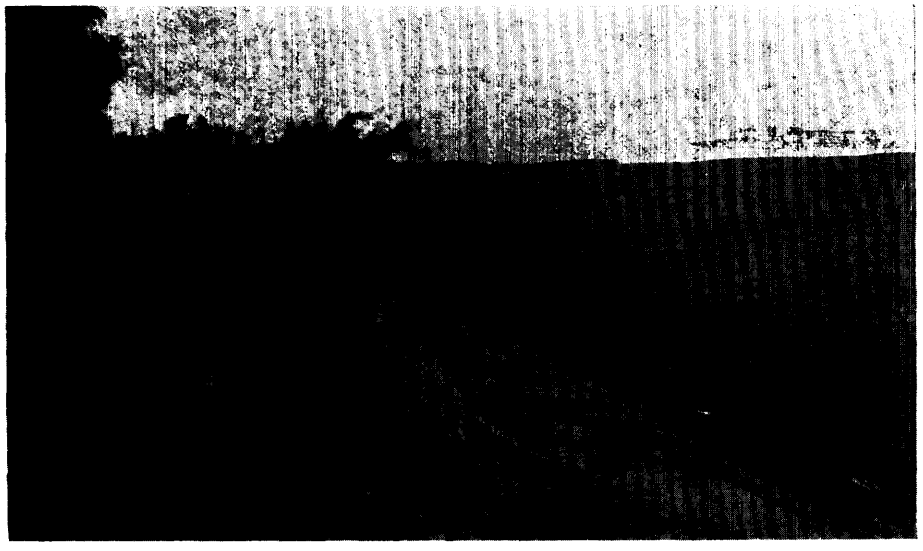
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[1] I am indebted to the late W. A. Parks for the following information regarding the formations that occur near the west end of Lake Ontario:—

LOCKPORT: Dolomitic limestones.
ROCHESTER: Shale (grey).
CLINTON: Limestone.
MEDINA: Shale (red).
CATARACT: Sandstone.
RICHMOND: { Queenston shale (red). / Meaford shale (grey).

The shore between Port Weller and Port Dalhousie, at the mouth of the old Welland canal, is similar to that just described; and the same is true for 3 miles southwest of Port Dalhousie, where the shore cliff is interrupted for half a mile by gravel bars across the mouths of two narrow ponds, evidently formed by the drowning of creek valleys by a rise in the water of Lake Ontario, which will be discussed later.

The shore cliff grows higher for a couple of miles west, and a section at the second road east of Jordan Harbour shows 23 feet of grey till, a few inches of brown sand, and 10 feet of brown, sandy till; in other places there are several feet of stratified material under the upper till. It is probable that the Illinoian and Wisconsin glaciations are both represented.



Shore of Lake Ontario near Beamsville, showing road cut off by washing away of shore.

At Jordan Harbour, the mouth of Twentymile creek, the cliff is once more interrupted by a bar across the mouth of a pond, caused by the rise of Lake Ontario. A road that follows the top of the cliff and crosses on the bars here and 2 miles to the east is being undermined and has been shifted farther inland more than once, showing that Lake Ontario is cutting back its shore.

In order to gain an idea of the rate of recession of this part of the shore it was decided to remeasure two lines on the property of S. M. Rittenhouse, marking the west and east boundaries of lots 20 and 21, Broken Front, Louth township. The deed of the property showed the length of the lines from an east and west road to the shore fifty years ago; and our chaining proved an average annual recession of 3.92 feet on the east line and 2.1 feet on the west line.

The Rittenhouses are experimenting with a low wall and tree planting to prevent further attacks by the waves, and it will be interesting to find how effective their barrier will prove to be.

The rate of recession given above is more rapid than that worked out for fifty years at Scarborough, which amounted to 1.62 feet per annum.[1]

The shore road continues west past the Ontario Government Experimental

[1]Univ. Toronto Studies, Biological Series, No. 21, 1922, pp. 68, 69.

Fruit Farm on lot 1, concession I, Clinton township, to a point nearly north of Beamsville, and the cliff has similar features to those described above; but for a mile or two here the road has been washed away and the recession of the shore seems to have been rapid. At the Prudhomme Nursery we were told that in the high water three or four years ago not only the road but trees 10 or 15 feet south of it were completely washed away.

Westward from this point no road follows the shore, but it was examined at the points where it is touched by north and south roads. At Grimsby Park 2 miles east of the town, there are low cliffs of till, and the shore seems to have receded very little since the park was established forty-five years ago. At the



Burlington bar.

first road east of Grimsby creek the cliff is 24 feet high and is formed of bluish till with a few feet of brown Iroquois sand above.

The Grimsby water works are at the mouth of the creek, where shale rises a little above the present low water, the cliff above being of till. The engineer at the water works states that the shore to the west has receded 25 feet in ten years, which accords fairly well with the estimates made on the Rittenhouse farm of 3.92 feet and 2.1 feet, averaging 3 feet a year. A quarter of a mile west of the waterworks the cliff shows 12 feet of shale with a few feet of till above it, and the waves seem to be undercutting the shale rather rapidly.

For 4 or 5 miles in the Grimsby region Lake Ontario is within a mile of the Iroquois shore and the cliff of the Niagara escarpment, and the Iroquois terrace is here very narrow.

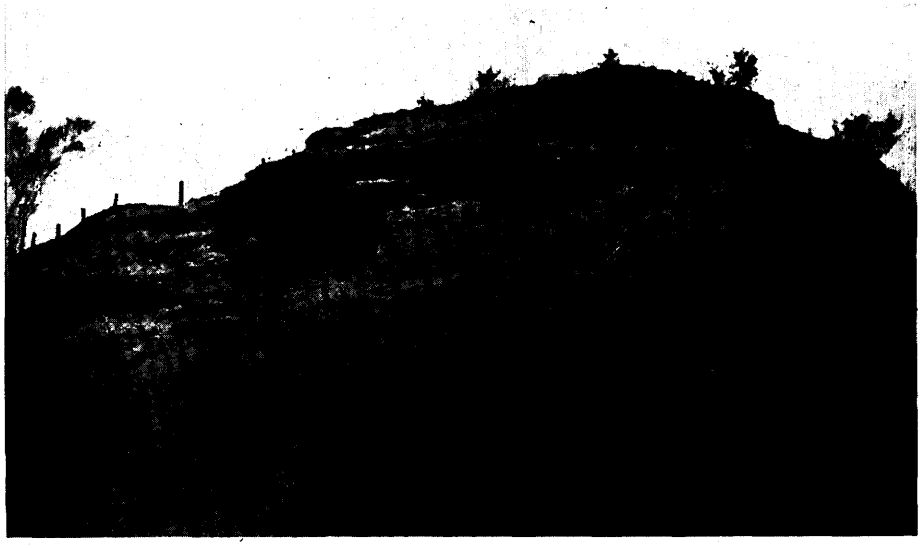
A mile west of the waterworks the shale is no longer to be seen, and clay forms cliffs from 12 to 24 feet in height as far as Winona Park north of the village of the same name. Here residents believe the shore is being cut back at the rate of 10 feet a year, but no definite data were given and the estimates are probably much too high.

From Winona Park to Stoney Creek the drift shore is low. At the mouth of the creek the usual bar occurs, forming a narrow pond in the low stream

valley, owing to the backing up of the water in Lake Ontario from the rise of its outlet.

A mile northwest of the mouth of Stoney creek, one of the most interesting bars on the shore of Lake Ontario begins, first as a wave-built beach forming a pond at the mouth of Red Hill creek and then striking northwest for more than 4 miles to Burlington, cutting off the western end of the lake to form a triangular bay 5 miles long. The bar and the bay were once named for Burlington, but are now generally called Hamilton beach and Hamilton bay.

This straight and narrow band of gravel was built by easterly storms, which had an unbroken sweep of 180 miles and shifted beach material from the southern shore across the mouth of the bay. Originally the outlet of Hamilton bay was



Top of Burlington bar.

at the north end beside the town of Burlington, but for safer navigation a canal has been dug a third of the way south and the old outlet has silted up.

The two shores of Hamilton bay differ greatly, the southern one being low and marshy, and the northwestern one rising as a cliff a hundred feet high toward the west and reaching 116 feet on the ancient bar of Lake Iroquois. The parallelism of the modern bar with the ancient one has already been referred to, and the resemblance would be still more striking if Lake Ontario were lowered, since the bay is 78 feet deep and the present bar would then present a similar wall-like character though not so lofty as the old one. The depth of water in the bay is mostly due to the rise of the outlet of Lake Ontario.

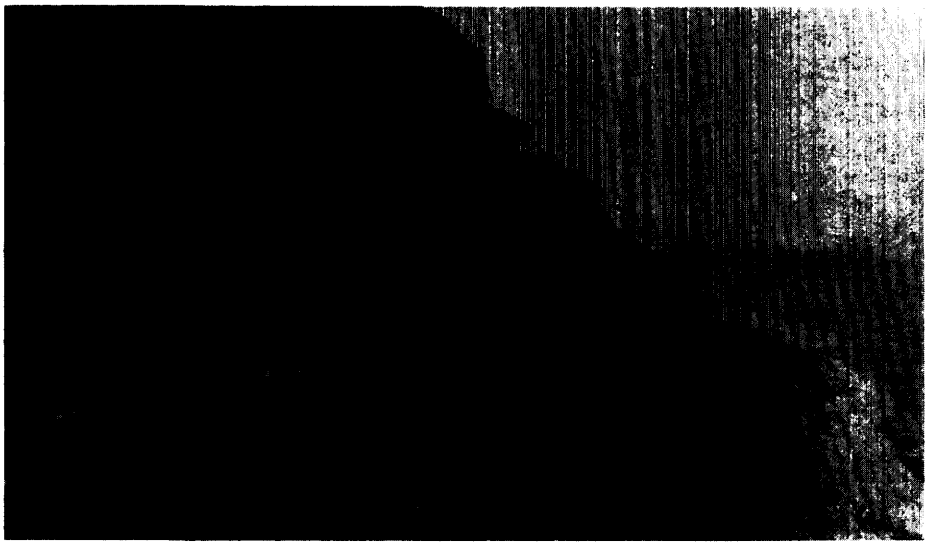
Burlington to Toronto

Low cliffs of dull red Queenston shale show in several places under boulder clay or Iroquois deposits northeast of Hamilton bay. In most places the boulder clay is from 3 to 10 feet thick. The red is often seamed with thin sheets of green, and narrow vertical strips may extend from one to another of these sheets. Both the horizontal seams and the vertical strips of greenish shale are due to the penetration of water charged with organic matter, which has acted as a reducing agent. The best exposures of these cliffs are developed during periods

of high water, when the debris accumulated at the base by the slumping on the cliff face is removed and undermining exposes a fresh section on the cliff face. During the high water of 1929 and 1930, good exposures were to be seen at Burlington and farther northeast, giving excellent sections along the shore; but these were again destroyed in the following years when the water had receded 50 or 100 feet, leaving a flat surface of jointed shale exposed below the cliffs.

Similar cliffs extend northeast to Bronte, and walls of the same red shale, sometimes a 100 feet high, extend for miles up the canyon of Bronte creek, though the plain between the present shore and that of Lake Iroquois is mostly of till with little rock to be seen.

A mile west of Oakville the shale is only 3 or 4 feet high and is covered with bluish till, parted by a "boulder pavement," which indicates two advances of the



Shore of Lake Ontario where the Hamilton highway turns north to Clarkson, showing grey shale, the upper part weathered brown, covered by brown till.

ice; a few feet of sand cap the low cliff. Near the waterworks just west of Oakville creek an interesting drift section was to be seen a few years ago with no shale beneath it. Four feet of bluish till charged with slabs of shale were covered by 12 feet of brown, silty sand, greatly contorted, and this was covered by about the same thickness of undisturbed sand.

Grey shale shows itself a little east of Oakville along the Ontario shore, but the canyon of Oakville creek, 2 or 3 miles west, is cut down for more than a hundred feet in the overlying red Queenston shale.

Farther northeast a few feet of grey shale underlies 8 feet of brown till, and the beach beneath is of shingle consisting of small flat slabs of shale rounded by the waves. This is well seen on the shore south of the sharp elbow of the Hamilton highway between Oakville and Clarkson, where grey shale rises from 5 to 12 feet, the upper part weathered brown and covered by a few feet of brown till.

The shore of Lake Ontario here turns north and sinks to a low sandy beach with sand hills inland; the shore rises again at Lorne Park to 30 or 40 feet and is mostly composed of yellow sand so far as can be seen at present. In former

years, a mile to the north a section, which showed no shale, had a boulder pavement a foot above the gravel beach, followed by 6 feet of blue till, 5 feet of yellowish clay, unstratified, and 8 feet of contorted stratified clay, probably varved clay.

Farther north in the village of Port Credit grey shale forms a low cliff. This shale has been used for making bricks. At the mouth of the Credit river there is dead water, which is due to the tilt of the Ontario basin, making a small harbour for fishing boats.

The monotonous grey shale outcrops in various places beneath a few feet of boulder clay along the shore between Port Credit and the Humber river, sometimes with contorted varve-like sheets of silty clay overlying it. Just southwest of the mouth of the Humber the stratified clay is used for brick-making.

The junction of the overlying red shale of the southwestern part of the shore with the older grey shale, which occurs near Oakville, is generally held to represent the bottom of the Queenston where it is underlain by the Dundas formation, as defined by Dr. Parks.[1] In the classification adopted in the Bruce peninsula to the north a group called the Meaford comes between them. Whether the Meaford extends to the shore of Lake Ontario or, if it does, where it ends toward the northeast has not yet been determined.

Grey shale overlain by till, and often also by sand of Iroquois age, is found in cliffs inland along the Credit river, Etobicoke creek, and other streams crossing the plain from the northwest.

In earlier reports on the region the grey shale has been referred to as the Lorraine shale, but the fossils it contains differ considerably from the Lorraine in the states to the south.

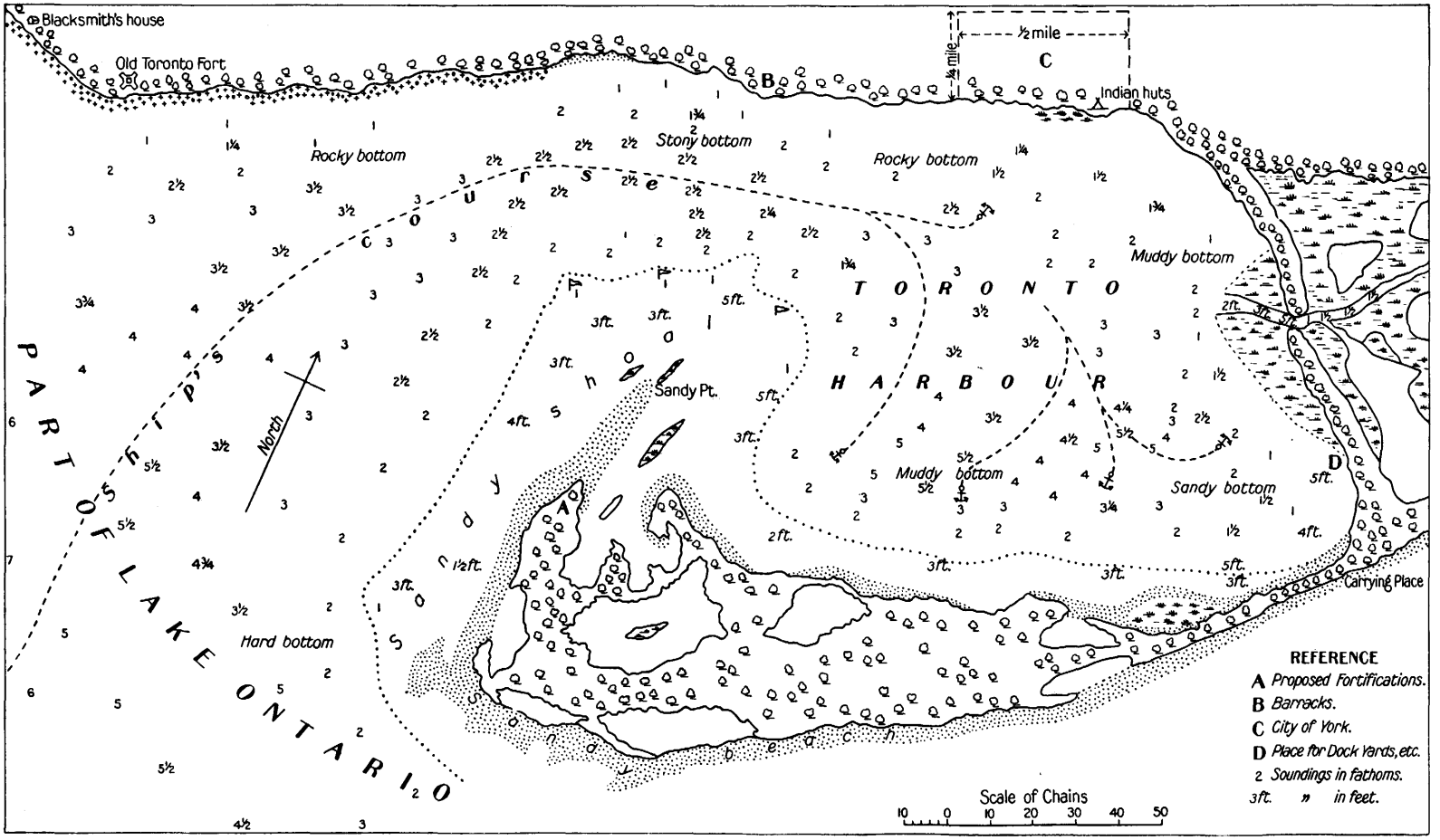
Toronto and Vicinity

The Pleistocene of the Toronto region has already been described in considerable detail so far as the glacial and interglacial deposits are concerned,[2] but the shore forms of the present lake were not referred to in that report. The comparatively low shores between Hamilton and Toronto provide little material for waves to work upon, and no bars or other sand and gravel deposits of importance occur along that part of the north shore thus far described; but just to the northeast of Toronto a great spur of morainic and interglacial material reaches Lake Ontario from the interlobate moraine, which runs through the southern part of the province from the Niagara escarpment at Caledon to Trenton. This mass of easily attacked drift material has been cut by the waves to form Scarborough cliffs, the highest point on the shore of the lake, and sand and gravel thus obtained have been shifted along the shore towards the southwest, building the great bar, generally called Toronto island, which encloses Toronto bay. Beginning near the Woodbine the bar extends in a nearly straight line for 5½ miles to Gibraltar point, where it turns north toward the main shore near the old fort.

The word "bar" should perhaps be replaced by "hook" because of the shoreward bend at its western end. A glance at the map shows a number of lagoons curving to the west and northwest, dividing the island into a succession of hooks or claws, and suggesting a growth westward, hook after hook, each pushing farther into the lake and giving evidence as to the mode of formation of the long ridge of sand.

The fine natural harbour enclosed by this long curving peninsula of sand has always been of interest to dwellers in the region, and accounts for the existence of the city of Toronto; its formation and growth are thus of importance for busi-

[1]Ont. Dept. Mines, Vol. XXXII, pt. 7, 1923, pp. 99, 100.
[2]Ibid, Vol. XLI, pt. 7, 1932.



TORONTO HARBOUR IN 1793

Copied from a copy of "Plan of Toronto Harbour with the Rocks, Shoals and Soundings, etc. Surveyed and Drawn by J. Bouchette."

ness men as well as geologists. There are many references to it in the history of Ontario from the time of Indian canoe navigation and the early French fur traders to the present, but we need not go farther back than 1792, a hundred and forty years ago, when a detailed map of the bay was made by Lieutenant Bouchette of the British Navy.[1] This shows a narrow unbroken peninsula extending west from the east side of the bay as far as the present island, broadening then with band after band of sand toward the west and north, the last strip of sand reaching the mouth of the bay and ending a mile from shore, opposite a blockhouse. The mile-wide entrance to the harbour is shown with a depth of 2½ fathoms (15 feet) on the north side, but with a broad shoal around the spit to the south. Toward the east a strip of beach, broken by the mouth of the Don, separates the harbour from a marsh on the side toward Ashbridge's bay.

A number of later maps of the bay have been made showing a progressive growth of the sand area toward the west and also of the narrow spit northwards, tending to close the western channel and to change the bay to a lake. This northward growth of the sand bar, threatening to destroy the harbour, greatly worried the authorities, and in 1850, a young engineer named Sandford Fleming (later Sir Sandford) finished a careful survey of the bay and peninsula, begun the year before and partly carried out on the ice during the winter. This was described in a paper read before the Canadian Institute and aroused much interest. In it Fleming gave a clear and correct account of the mode of growth of the bar, showing that easterly storms attacked the cliffs at Scarborough and shifted the sand westward to add to the area at the southwest end, from which southerly winds urged the sand northwards, year by year narrowing the entrance to the bay and making trouble for shipping. He found that thirty acres had been added at the west end in fifty years.

In 1852 a severe winter storm made a breach in the bar at the narrow part toward the east end of the harbour and the authorities closed it with a dike of sand and gravel supported by planking. In 1854 the Harbour Commissioners were so disturbed in regard to the future of the bay that, with the aid of the city council, they offered premiums for reports as to the best means of making the harbour secure, and several reports on the subject were handed in. A

[1]The late W. R. Rogers, Director of Publications and Statistics for the Department of Mines, furnished the following interesting details as to the mapping of Toronto harbour:—

"The Report of the Ontario Land Surveyors for 1933 contains an article on the founding of Toronto by R. M. Anderson, O.L.S., of the firm of Speight and Van Nostrand, in which he refers to a survey of Lake Ontario by Captain La Force and Lieutenant Louis Kotte, who surveyed the north shore of the lake in 1783 and the east and south shores in 1789 by order of his Excellency, Lord Dorchester, then Governor.

"A copy of this map in the Toronto Public Reference Library is on a scale of two-thirds of a mile to the inch and contains small inserts of Oswego harbour, Kingston harbour, and Toronto bay. The last-mentioned is on a scale of 2,000 feet to the inch and shows soundings. This is really the first authentic map of Lake Ontario available.

"Regarding Bouchette's map, it appears that he was the son of Commodore Bouchette, commander of naval vessels in Lake Ontario, and was commissioned by Governor Simcoe at the age of 18 to map Toronto harbour. His original map was made in 1792 and was just returned last summer to the city of Toronto from England. It now hangs in the office of the City Surveyor and Town Planning Commissioner, Tracy D. Le May, O.L.S.

"The plan here reproduced appears to have been made by Bouchette in 1793, and is modified somewhat from the original plan made for Governor Simcoe.

"It is of historic interest to note in connection with the 1783 survey, mentioned above, that four townships were outlined in eastern Ontario by Deputy Surveyor-General John Collins in the autumn of the same year. They were subdivided the following year for settlement by disbanded soldiers and United Empire Loyalists. These townships were first numbered one to four, but later became Kingston, Ernestown, Fredericksburgh, and Adolphustown. By the autumn of 1784 some 1,746 settlers, including women and children, had been located between Kingston and the Bay of Quinte."

report on "The Preservation and Improvement of Toronto Harbour," by Henry Youle Hind, Professor of Chemistry in the University of Trinity College, received the first premium of £100; the second of £75, was awarded to Sandford Fleming; and the third, of £50, to Kivas Tully. Although Hind's long and painstaking report received the first premium, Fleming's, based on his survey mentioned above, was the best, and his prediction of the future growth of the northern spit has proved correct.

In 1858 an April storm swept away the temporary barricade at the eastern beach and made a wide gap through which vessels could enter the harbour from the south, and with the building of piers and dredging of the channel between them in later years this entrance has become the more important of the two.[1]

It is evident that the building of piers out into deep water at the east entrance must interfere with the transport by wave action of sand and gravel westward along the bar, which Sandford Fleming had shown to have been the origin of the whole structure; and there were different opinions expressed by the engineers as to the effect this would have on the island thus formed and on the silting up of the western entrance.

In 1913 the present writer studied the problem of the age of the bar and went somewhat carefully into the rate of building of the "island," the results being published in a paper entitled "An Estimate of Post-Glacial and Interglacial Time in North America," read before the International Geological Congress held that year in Toronto.[2] A large triangle of sand had been built up above water level to the east of the long pier on the east side of the channel, and it was estimated that during the thirteen years since the pier had been placed there an average of 42,000 cubic yards of sand had been added per annum and that 22 ⅔ acres of land had been formed altogether.

Some years earlier a number of bore-holes had been sunk to bed rock through the sand composing the island, the thickness averaging 107 feet, and the volume of sand in the island and the shoals beside it was estimated at 337,000,000 cubic yards; and 42,000 divided into that sum gave in round numbers 8,000 years.[3]

It is possible that the rate of addition of sand was somewhat overestimated, since it is stated that at present an average of 31,800 cubic yards only is dredged per annum to keep the canal open. This would give about 10,600 years. However, one may suppose that much sand moves westward still on the outer slope of the bar beneath the level reached by the dredges, since wave motion goes to a considerable depth in violent easterly storms, and the earlier estimate may not be far wrong.

In Sandford Fleming's report a diagram was included to illustrate the formation of the bar, showing an earlier stage with Scarborough Heights projecting south from the present cliffs, and suggesting that the waves had cut back a promontory providing materials to be carried westward to build the bar. It was well known to the farmers along the shore that the cliffs were being cut back by the waves, giving a definite foundation for the theory.

In 1912 it was decided to get more accurate information as to the rate of recession of the cliffs, and the firm of Speight and Van Nostrand were instructed to resurvey the township lines at Scarborough that had been run fifty years before

[1]The reports on "The Preservation and Improvement of Toronto Harbour" were published as a supplement to the Canadian Journal in 1854. The gist of these reports and much additional information of interest in regard to the harbour are recorded in journals kept by W. M. Roberts, Librarian of the Harbour Commission.

[2]A. P. Coleman, Proc. Twelfth Internat. Geol. Congr., 1913, pp. 435-449.

[3]Ibid, pp. 440, 441.

by an Ontario land surveyor, F. F. Passmore.[1] Seventeen lines were chained from corner stones to the edge of the cliff. Of these thirteen, which were considered to represent normal conditions, showed an average recession of 81 feet, which in fifty years gives 1.62 feet per annum.

A study of the chart of Lake Ontario shows a very gentle slope of the lake bottom southward to a depth of 75 or 100 feet, beyond which there is a rapid drop to deep water. It has already been mentioned that Lake Ontario has had its outlet elevated, backing up the water towards the west, and an old channel of the Humber river has been found at a depth of 93 feet below the present water level,[2] showing that amount of rise of water at Toronto. The present deep water begins about 13,000 feet south of the Scarborough cliffs, marking the limit of the promontory suggested by Sanford Fleming; and dividing 1.62 into 13,000 gives 8,000 years, which corroborates the estimate made from the rate of transport of sand to the westward.

Some of the reports in regard to the harbour have suggested that the Don river has played an important part in forming the sand bar in front of Ashbridge's bay and also in laying the foundations of the island; and there is no doubt that the mud that it brings down when in flood tends to fill in the marshy boundary between that bay and Toronto bay. It is very doubtful, however, if the small amount of detritus it carries had any important share in the work. The Rouge river to the east and the Humber to the west, both much larger streams, have not succeeded in building deltas where they enter the lake, and before the bar grew westward past its mouth the Don mud must have been swept out into deep water by the waves, preventing the formation of a delta.

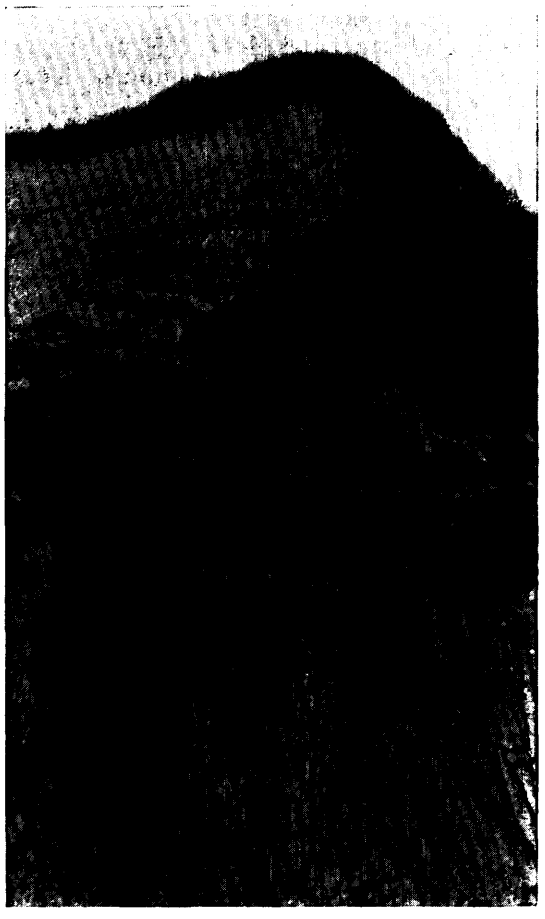
It will be understood, of course, that the time estimates given above are only approximate, since the data employed are not sharply definable; but the results are probably as nearly correct as any others in regard to Pleistocene time records.

The cliffs of Scarborough, which have been referred to as providing the sand from which the peninsula enclosing Toronto bay has been built, were described, as far as their geology is concerned, in the "Pleistocene of the Toronto Region,"[3] but should be briefly mentioned here. They extend for nine miles northeast of Toronto, rising above Lake Ontario at the new filtering plant and reaching 350 feet about 3½ miles east of the city, then sinking gradually till they end at the valley of Highland creek. No other point on the lake shore reaches this elevation, and the scenery is very striking. As already noted, the waves are undercutting the cliff, but this does not take place uniformly, since most of the work is accomplished in high-water years, such as 1929 and 1930. The water level varies to the extent of 5 feet and some inches; in the autumn of 1934 it was at its lowest extreme and a broad beach was exposed in front of the cliff, so that not even violent storms reached its foot. In low-water years like this the only vertical cliffs are where an interglacial river valley was filled with glacial clay, which is very compact and resistant. In most places interglacial sand occurs and is easily attacked by rain, giving a foot-hold for bushes. At a number of points side ravines have been cut by small streams, often flowing only after rain, and since the land has been cleared, destroying the protection afforded by the roots of trees, this process has gone on rapidly and has greatly changed the character of the scenery. In some cases, steep-walled amphitheaters result, giving good sections of the Pleistocene, even in low-water years.

[1] A. P. Coleman, Proc. Twelfth Internat. Geol. Congr., 1913, p. 437.
[2] A. P. Coleman, Ont. Dept. Mines, Vol. XLI, pt. 7, 1932, p. 47.
[3] Ibid.

Scarborough to Brighton[1]

The magnificent Scarborough cliffs form the scenic climax of the shore of Lake Ontario, and beyond the mouth of Highland creek at their eastern end, the banks are much lower and less interesting. Three-quarters of a mile northeast of Port Union a steep-walled ridge, part of the Rouge hills, reaches the shore with a height of 70 feet and displays three tills separated by boulder pavements;



Cliff showing Illinoian varved clay overlain by stratified sand, which is covered by Wisconsin till.

and a mile beyond it low cliffs include 20 feet of interglacial clay, the last-known outcrop of the interglacial cool climate formation toward the east.

A mile of the shore beyond is formed of gravel bars cutting off a pretty body of water called Frenchman bay; and this is followed by low cliffs made up of two sheets of till, an upper sandy one, the Wisconsin, and a lower one of bluish clay with many stones, probably the Illinoian.

Except for a half mile's interruption south of Pickering, where Duffin creek

[1]Alfred W. G. Wilson, in "A Forty-mile Section of Pleistocene Deposits North of Lake Ontario," read before the Canadian Institute, March 7, 1904, gives many interesting details of drift sections in the region here described.

meanders sluggishly through marshes to the lake, similar relations extend to Richardson point and, with one or two marshy gaps, to Whitby harbour.

Beyond Whitby, cliffs not more than 20 feet in height consist mainly of sand and gravel, the latter often coarse and bouldery. The finer material is sometimes cross-bedded and greatly crumpled, probably pushed by advancing ice. In places the sand changes to silt, where the martins bore deep holes for their nests. Beyond Ross point the two sheets of boulder clay show themselves once more, with in places a few feet of Wisconsin varves overlying them.

At projecting points the shore is being cut back by the waves, and in one place this has gone so far that only half of the stone foundation of a ruined building remains.



Upper till and sand sapped by springs, southeast of Newcastle.

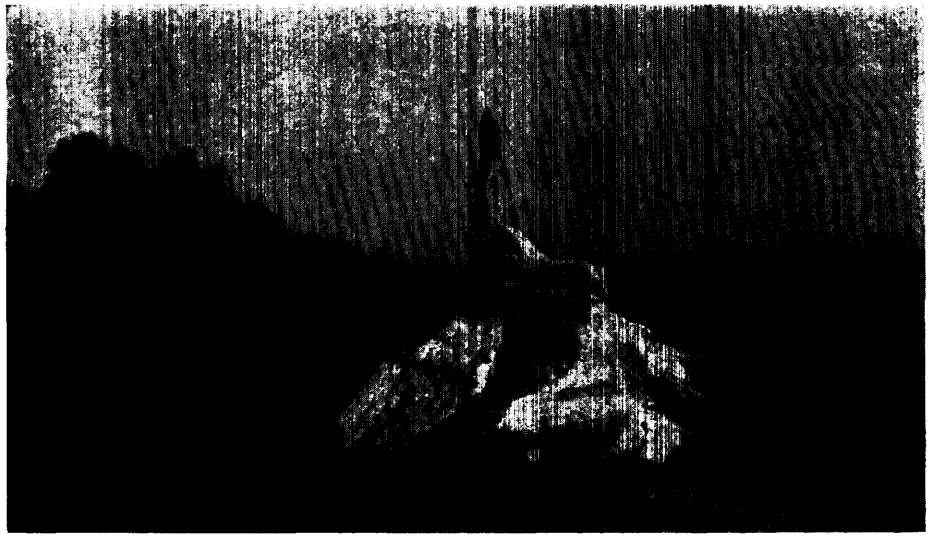
Southeast of Oshawa for two or three miles the shore is low with long gravel bars cutting off marshy bays, and little drift is exposed; but near Darlington Station two beds of till are once more to be seen, often with varved clay overlying the lower till; farther east the cliff rises to 50 or 75 feet. Where this occurs the lower varved clay may be 15 feet in thickness, projecting as a rounded shelf under 30 or 40 feet of stratified sand capped by the upper till. The shore cliff sinks again at Raby head, but rises even higher a little to the east, consisting mainly of sand and the upper sandy till. Then follow low and swampy shores with gravel bars to Port Darlington, south of Bowmanville.

A mile and a half to the east the shore cliff reaches 40 feet near the Wireless Relay Station and discloses an interesting section of a small Illinoian drumlin buried under stratified silt and sand, the whole covered by Wisconsin till. Beyond this the shore is once more low and presents little of interest as far as Bond Head, the port of Newcastle.

In many of the lower valleys grey and weathered-looking Wisconsin varved clay is found, and in many places in shore sections they overlie the latest till. They provide excellent brick clays, as already mentioned, and have been put to use in Whitby township, a little west of the town of the same name and just south of Bowmanville.

This varved clay, resting on the Wisconsin boulder clay, must have been deposited in the deep water of Lake Iroquois much below the old beach gravels. The more ancient bluish-grey varved clays overlying the Illinoian boulder clay in shore cliffs have not been used for brick-making in this region, though they are worked on a large scale at Toronto.

Three miles southeast of Newcastle, after a long stretch of uninteresting shore, cliffs again rise above Lake Ontario and present excellent sections with striking scenery, almost rivalling that of Scarborough, though not rising above 150 feet. The higher shores in this region are due to a broad southward projection of the interlobate moraine, causing a marked promontory on Lake Iroquois, as has been noted. For 5 miles, with brief interruptions, the shores



Shore line east of Port Granby.

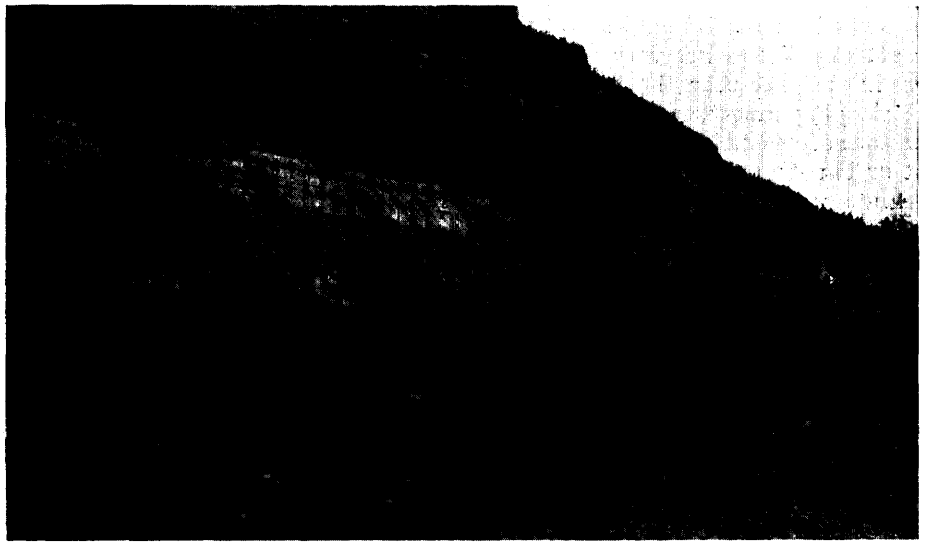
are high, sometimes wooded, but at many points displaying steep cliffs with almost vertical faces; and there are rapid changes in the materials, making it difficult to present a brief account of the sections. At first there appear to be three sheets of till separated by boulder pavements, then a lower grey till covered by a thin layer of varved clay, followed by thick sand under sandy Wisconsin till. Springs come out above the lowest till and undermine the cliffs above, forming impressive amphitheatres. In many places the original surface is let down intact with the trees continuing to grow at the lower level.

At one point stratified silty material forms a few feet of varve-like deposits within the lowest till, dividing it into two parts, but probably representing only a short recession of the earliest ice-sheet. In one large amphitheatre the succession from below upwards includes 15 feet of hard till and varved clay, 30 or 40 feet of sand, a few feet of grey till, 25 feet of sand and silt, and a varying thickness of Wisconsin till. A little beyond it toward the east the varved clay thickens to 25 feet, is in places greatly crumpled, and projects as a shelf, since the tough clay resists weathering much better than the sandier materials above.

At Port Granby the cliffs are interrupted for a short distance by a valley floored with a terrace and small gravel bar 25 feet above Lake Ontario, evidently belonging to a stage of water much lower and later than Lake Iroquois, perhaps

corresponding to the marine invasion called the Champlain sea. Beyond Port Granby toward the east, cliffs rise again in much the same way as just described on the west, and as beds of quicksand over the lower boulder clay cause slumping, ravines are eaten back into the fields at a rapid rate.

West of Crysler point low shores begin again, alternating with swamps at the mouths of streams as far east as Port Britain, beyond which Otty point rises as cliffs with the usual three tills and slumping interglacial sand. A mile of low shore follows, until, about half a mile west of Port Hope, cliffs rise to a height of 50 to 70 feet. The receding upper part is of sand and sandy till, and the lower part, which projects like a shelf, is composed of hard blue Illinoian varved clay. The cliffs end at the valley of the Ganaraska river in the town.



Illinoian varved clay west of Port Hope.

To the east of Port Hope the shore is very low and consists of sand and gravel as far as Cobourg; farther east there is little of interest to note in the Pleistocene deposits, since only thin beds of sand or till overlie the bed rock as far as Brighton, and the shaly limestone rises only a few feet above the water.

Rock Formations of the Eastern Part of the Basin

Since the shore to the east includes more bed rock than drift it is advisable to note the succession of formations in the region.

The interlobate moraine, so often mentioned in connection with Lake Iroquois, runs parallel to the shore of the present lake a short distance to the north and presents a great mass of glacial material, sometimes 500 or 600 feet thick, effectually hiding the bed rock on which it lies; but just to the east of its sudden end in the Murray hills flat limestone shows itself and is widely spread in the valley of the Trent river and also along the shores of the Bay of Quinte and of Lake Ontario. Bed rock of shale is found, also, in ravines cut through the drift by streams farther west. Both the shale and the limestone are of Ordovician age and are classified by Dr. Parks[1] as follows:—

[1]Personal communication.

ORDOVICIAN: Gloucester. Collingwood. Cobourg. Trenton. Black River.

Beneath the Black River in the Kingston region and farther east there are outcrops of Potsdam sandstone and pre-Cambrian rocks, which will be referred to later.

The Ordovician limestones and shales have a very gentle dip toward the southwest, and lower and lower groups are exposed as one goes eastward. The Potsdam sandstone usually occupies the bottoms of the valleys in the underlying pre-Cambrian, which has a very irregular and rough surface.

Rocks of the Ordovician group consist of limestone, which is a fairly strong and resistant material, and shale, which tends to crumble into clay and resists the attacks of weather very poorly. As a result the beds of limestone are far more in evidence than the shales, which are apt to appear only where protected by overlying limestone, especially in cliffs. For this reason, flat surfaces of limestone often end in an escarpment or cliff, which may be of any height from a foot or two to more than a hundred feet and which may run for miles, often skirting a valley. In places the escarpment may continue all around a resistant area of limestone, making a flat-topped hill or tableland.

The limestone usually has two sets of joint planes, roughly at right angles to one another. Where the surface has been long exposed, the solvent action of water charged with carbon dioxide has enlarged the openings along these joints. They may be several inches wide and extend downward for several feet. Owing to this, blocks are split off when weathering has attacked the shale beneath and fall to the foot of the cliff, forming a talus. Very often, however, the cliff and talus effect is concealed by drift materials that have been plastered against an escarpment facing the direction from which the ice came; or drift may have accumulated in the lee of the hill or tableland where boulder clay was protected from the scouring of the advancing glacier.

Many square miles of flat limestone have been cleaned of all drift materials by the moving ice and have been left as barren stretches, not enough weathering having taken place since the glaciation ended to provide much soil. Where the sheet of limestone is shaly, however, it crumbles rapidly into gravel, on which is produced good crops of certain kinds in spite of its coarse and stony appearance.

Where limestone that has been sealed up and protected under boulder clay is exposed, glacial striae and polished surfaces may be seen, giving evidence of the motion of the ice; often two directions of striation are found, a later one crossing an earlier one, showing that the direction of movement had changed.

Ordovician from Port Hope to Deseronto

Shales belonging to the Gloucester and Collingwood groups are exposed in a few stream valleys near Whitby, Oshawa, and Bowmanville, but play no conspicuous part in the shaping of the region. The Cobourg limestone is more widely displayed and is a feature of the lake shore.

In Port Hope the Ganaraska river has cleaned off the drift to the east of a group of morainic hills and exposes flat limestone surfaces in which large trilobites may sometimes be found; but the lake shore is deeply covered with varved clay and sandy till to the west and no rock is to be seen on the low shore to the east.

In Cobourg the creek flowing through the town has cut down to shaly limestone in its southern course, but the best exposure of bed rock is along the shore

to the east, where it rises a few feet above the lake and in places where boulder clay has recently been removed shows a striated surface.

South and east of Colborne similar shaly limestone appears along the shore, in places rising 3 or 4 feet above the water and cut into little overhanging cliffs. Flat striated surfaces can be seen with striae pointing southwest, as at the exposure near Cobourg. The outcrop here runs for a third of a mile and contains many fossils. Much of the shore is, however, covered by a few feet of sand or sandy till with rock showing only at the water level.

The belt of low land between highway No. 2 and Lake Ontario in the Brighton region is one of the flattest observed, the contour of 275 feet being half or two-thirds of a mile inland and the next one, 300 feet, more than a mile from shore. Probably the whole area is of limestone, though a thin bed of sand covers



Shore cliffs, Presqu'île.

most of it. To the southeast the flat surface of Presqu'île peninsula is of limestone with cliffs rising a few feet above the lake. It seems to have been originally an island, but the waves have built a sandbar out to it, tying it to the mainland and changing it to a peninsula. Another point of rock rises a few feet above water at Gosport, or Brighton harbour, but the rest of the shores of Presqu'île bay are of sand, often built into dunes by the wind, or shoals with reeds and rushes.

According to Dr. Parks[1] the contact between the Cobourg and Trenton formations runs just west of Brighton, touches the west end of Presqu'île point, and passes through Picton in Prince Edward county. South of No. 2 highway the level surface of Trenton limestone extends eastward to the town of the same name, though it is often hidden by a thin coating of sandy drift. It was found under sand when the Murray canal was excavated.

For most of the way to Trenton an escarpment 20 to 30 feet in height faces the shore of the Bay of Quinte, but it is much lower and less impressive than escarpments facing in the opposite direction across the bay in Prince Edward county.

[1]Personal communication.

From the mouth of the Trent to Healey falls, where the river bends westward, limestone is exposed almost continuously, and the falls is caused by a drop of 76 feet over steps of limestone. For 10 miles north there are similar exposures, and the hill behind Marmora is really a small tableland of limestone deeply fissured by the enlargement of joints. This tableland is 700 feet above sea level and suggests that the whole region was once covered with this rock to at least that level. If so, many square miles of material have been eroded and removed to a depth of 300 or 400 feet since the region was elevated above the sea.

East of the Trent river the low plain continues past Belleville. It is mostly covered with a thin layer of drift but has many outcrops of bed rock and several hills bounded by low escarpments, two of them in the city itself, one on each side of the Moira river. The plain ends 3 or 4 miles north of the Bay of Quinte in a belt of drumlins and kames, which may be looked on as a vague continuation of the interlobate moraine to the east of the Trent. The Moira river, like the Trent, flows over limestone in the southern part of its course, but rises in lakes among the Archean hills to the north.

Belleville is a long way from the well-assorted gravels of the Iroquois beach and gets its supply of road metal from quarries in the limestone on the river bank. Many other small quarries for rock that may be crushed for use on the roads have been opened along the highways towards the north and east in the region. Such openings give many opportunities for study of the Ordovician; but the best exposure is in the great quarry opened for cement-making at Point Anne, 5 miles east of the city.

The same limestone surface extends with frequent outcrops to Shannonville, where it is widely exposed along the Salmon river and in the shallow valleys of Marysville and Selby creeks to the southeast. The valley of the Salmon river continues straight for 20 miles to the northeast, bounded for most of the distance by cliffs of shale and limestone so steep that road crossings are infrequent; the level tableland on each side presents broad surfaces of the same rock. Towards Deseronto on the south, however, the drift is more continuous and hides the rock over much of the area.

It is worthy of note that 2 miles south of Deseronto, across the bay in the township of Fredericksburgh, cliffs facing the Long reach show wave work in the form of terraces, one at 325 feet and another about 10 feet higher, indicating old water levels, which will be discussed in the account of Prince Edward county.

Pre-Cambrian Hills

Two miles northwest of Shannonville a hill of a new type shows itself. A ridge of the pre-Cambrian projects through the Ordovician. displaying crystalline limestone, quartzite, and gneiss, evidently phases of the Grenville series. The ridge runs a little east of north and west of south, continues for a few hundred yards, and is enclosed by steeply dipping limestone beds to the northwest and southeast.

Half way between this ridge and Shannonville another Archean hill, quite different from that just mentioned, rises just northwest of the Canadian Pacific railway. It is very hummocky and craggy, and consists of a schistose and gneissoid conglomerate containing pebbles of quartz, felsite, and rather coarse granite, the latter in blocks as much as 2 feet in longest diameter. Some of the pebbles have been drawn out and deformed. This rugged hill top rises 100 feet above the plain, reaching the contour of 425 feet.

A third hill in Prince Edward county, 5 miles south of Belleville, consists of coarse-grained, pinkish-grey granite. The three hills are all pre-Cambrian,

but consist of entirely different rocks, suggesting great variations in the Archean surface beneath. The schist conglomerate has not been reported elsewhere. These isolated hills represent the highest points of the very rugged Archean land over which the Ordovician sea advanced some hundreds of millions of years ago.

Ordovician and Cambrian at Napanee and Eastward

At Napanee the limestone rises once more as well-marked escarpments on each side of the river valley and is close to the surface for 10 miles to the north and northeast until it is cut off by the pre-Cambrian hills of the Frontenac axis, which is a narrow strip of pre-Cambrian rocks connecting the Archean territory to the north with the Adirondack outlier.

It will be noted that all the rivers of the region run in straight courses from northeast to southwest, parallel to the escarpments, which have the direction of one of the sets of joint-planes. Thus the apparently minor factor of jointing controls the main lines of the topography, escarpments and river valleys.

At the south end of Varty lake, 10 miles northeast of Napanee, the limestone has been thrown into small anticlinal folds; and between this lake and Mud lake, near a schoolhouse, a curious conglomerate of quartzite pebbles cemented by limestone comes between the Ordovician and a ridge of Grenville quartzite.

About 2 miles southwest of Roblindale the limestone contains large *orthoceras* fossils, and a dome-shaped hill shows the beds dipping away from it in quaquaversal fashion, no doubt conforming to the shape of an Archean knob beneath it. Just south of the Canadian Pacific railway, and half a mile north of Forest Mills, there is a small outcrop of gneiss with limestone plastered into its irregular surface and dipping away from it.

The limestone in this general region seems to be thin and to have its bedding more or less adjusted to the Archean surface beneath, but actual contacts between the two rocks were not often seen, partly perhaps because the Archean rocks provide poor soils and are therefore mostly left in woods.

The Ordovician invasion of the sea must have been rapid, since the limestone was, no doubt, laid down in fairly deep water. There is no deposit of coarse and sandy conglomerate such as would have been formed out of the weathered and crumbling surface of the old rock along a shore washed by waves if the encroachment of the sea had been gradual in the region here described. There is no equivalent of the Potsdam sandstone and conglomerate found farther east.

The level surface of limestone, broken frequently by small escarpments, especially along stream valleys, extends east of Napanee almost to Kingston and south to the Bay of Quinte. There are low cliffs along the shores of Hay bay and Adolphus reach and also along the North channel, and nowhere is there a great thickness of drift, though a number of low ridges of till run parallel to the shores of the bay, about northeast and southwest, conforming to the structural lines of the region.

In the vicinity of Kingston the Trenton overlies the Black River, and the boundaries of the two formations are shown on the map accompanying M. B. Baker's report.[1] The character of the formations and their fossils are discussed by E. M. Kindle[2] in appendix I of this report, and appendix II has descriptions and figures of common fossils.[3]

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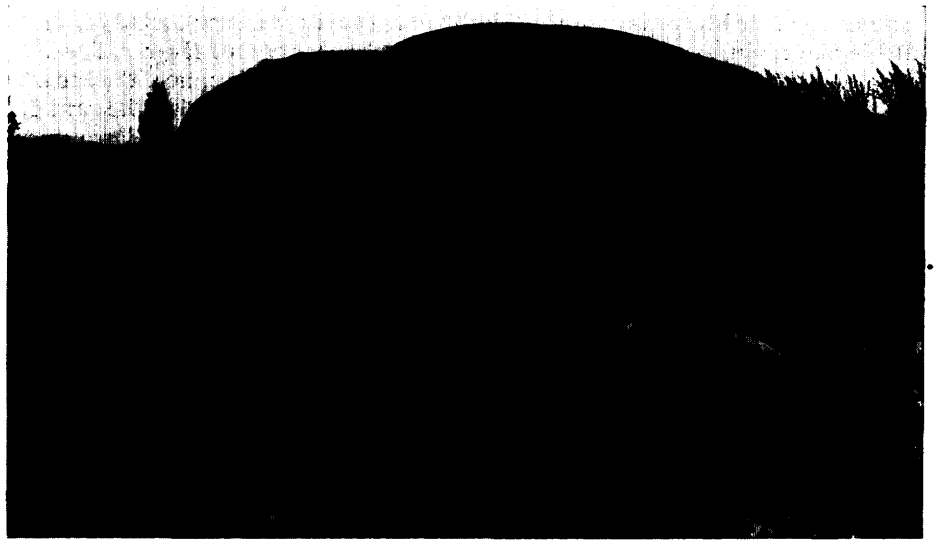
[1]M. B. Baker, "The Geology of Kingston and Vicinity," Ont. Bur. Mines, Vol. XXV, pt. 3 1916.

[2]E. M. Kindle, "The Ordovician Limestones of the Kingston Area," Ont. Bur. Mines, Vol. XXV, pt. 3, appendix 1, 1916, pp. 37-44.

[3]Alice E. Wilson and K. F. Mather, "Synopsis of the Common Fossils of the Kingston Area," Ont. Bur. Mines, Vol. XXV, pt. 3, appendix 2, 1916, pp. 45-67.

The Potsdam has been sufficiently described and illustrated by Baker and needs only a brief reference here. Its sandstone and basal conglomerate form the natural beginning of the sedimentary series of rocks after the long dry-land period between the Archean and the Cambrian, when the sea encroached and waves began to work up the debris of the ancient land; and very interesting outcrops are to be seen northeast of Kingston Mills, including extraordinary cylindrical concretions.

The boundaries between the Ordovician and the Cambrian and between the Paleozoic formations and the pre-Cambrian are exceedingly irregular and complicated and have not been worked out in detail except near Kingston. Baker's map gives a good idea of the intricate projections and indentations,



Roche moutonnée, north of Kingston.

the islands and the outliers of the Paleozoic and the pre-Cambrian in a small part of the region here briefly described in connection with the distribution of the drift.

The Pre-Cambrian Surface

No greater contrast can be imagined between two adjoining rock formations than that between the Ordovician and the pre-Cambrian. The limestones just described, in spite of their great age, dating from the early Paleozoic, still lie almost as flat and undisturbed as when they were laid down on the ancient sea bottom. They have been hoisted up and consolidated by the draining off of the water with which they were charged in the beginning, but otherwise are almost unmodified. Their firm beds of limestone extend for many square miles of even surface with so gentle a tilt that it is imperceptible to the eye.

The immediately adjoining pre-Cambrian presents one of the most rugged surfaces to be found, with sharp ridges, irregular steep-walled hills, and precipitous valleys and troughs, the tangled foundations of a great mountain system. The present surface, though full of steep slopes and cliffs and ravines, is not mountainous but roughly hilly, sometimes giving a climb of one or two hundred feet in as many yards, however, and making cross-country excursions very toil-

some. The lowlands are very often occupied by swamps or lakes, and the hills and valleys are usually wooded.

In spite of the excessive irregularity of the surface, there is a well-marked trend to the structures, which run roughly northeast and southwest, corresponding to the direction of the pre-Cambrian mountain ranges and of the jointage of the later rocks.

In contrast with the monotony of the limestone and shale of the Ordovician there is a great variety in the rocks of the pre-Cambrian, as may be seen in Baker's account of them near Kingston,[1] already referred to; but only a few of them need be be mentioned here. The Grenville crystalline limestones and quartzites differ so much in hardness that where interbedded they give rise to very rough ridges, which



Weathered rocks of the Grenville series, northwest of Gananoque.

when wooded are easily mistaken for small moraines. The knobs and hills of Laurentian granite or gneiss, on the other hand, are often rounded, and where smoothed by the ice present *roche moutonnée* forms, which when forested suggest the shapes of ground moraine or of drumlins. Fresh surfaces of the pre-Cambrian are often striated and sometimes deeply grooved.

Owing to the disordered structures of the pre-Cambrian and their precipitous slopes, the roads crossing such areas are sinuous and excessively hilly, as different as possible from the level and rectangular road system on the limestone plains, where the only breaks in the monotony are the descent or ascent of an escarpment at the edge of a stream valley.

The Grenville marbles and gneisses are often deeply weathered and provide yellow or brown sandy slopes and soils, almost suggesting drift materials. Much of this weathering may be post-glacial, but probably part of it dates from very ancient times, even before the Ordovician, since there is some evidence that the weathered Archean surface was covered by Ordovician shale and limestone, which was stripped off in later geological times. The large number of limestone blocks in the more recent moraines show that this work of stripping was actively carried on in the last glaciation.

[1]M. B. Baker, op. cit.

In many parts of the pre-Cambrian region ground moraine has been deposited, more or less burying the rough surface just described and leaving only the higher points of rock as hill tops to show the character of the foundations beneath the drift. In such cases there may be considerable areas of excellent farm land in the midst of hopeless tracts of barren Archean hills, where woodland and rough pasture are the only resources for the farmer.

The very irregular boundary between the pre-Cambrian and the Ordovician, with patches of the one surrounded by the other, gives rise to rapid and striking changes in the character of the surface and of the soil; but there are also comparatively thick deposits of drift hiding completely the bed rock in places and providing gently rolling country very like the farming districts farther west.

The Hastings series, the latest of the pre-Cambrian rocks, including various sediments such as limestone and slate, is widespread in the north; and 2 miles



Folded beds of the Hastings series.

north of Madoc slate of this age has recently been quarried by the Canadian Slate Mines, Limited. This operation was recommenced in 1933 after the old slate quarry had been abandoned for half a century.

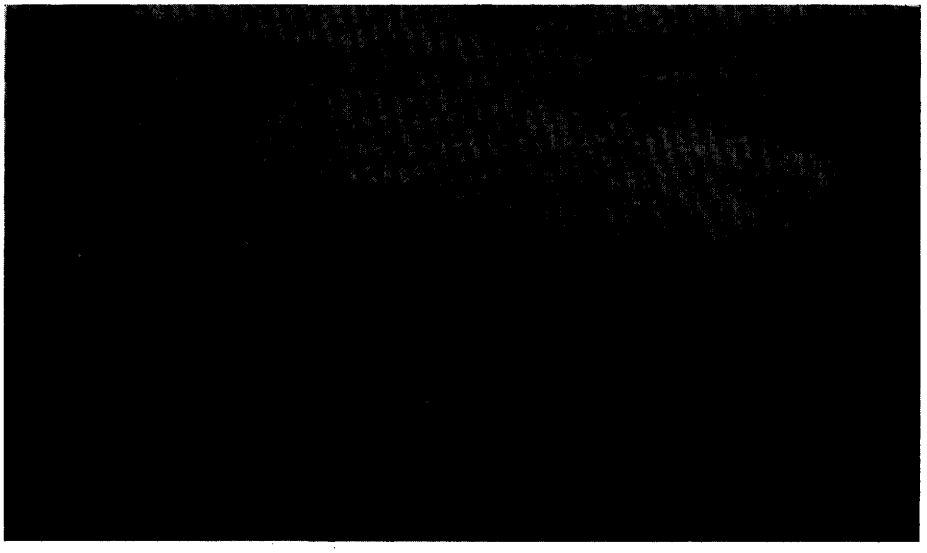
Bed Rock Features of the Thousand Islands

The Ordovician shales and limestones end in the large islands south and east of Kingston, and beyond Wolfe and Howe islands the Frontenac axis rises, connecting the pre-Cambrian of the north with the great mass of ancient rocks forming the Adirondack mountains in New York state. The lowest part of the axis is flooded by the waters connecting Lake Ontario with the St. Lawrence, and the highest parts rise above these waters as the Thousand Islands. They begin southwest of Gananoque and end at Brockville, but the crowded part of the archipelago lies toward the southwest. The islands are of every size from 7 miles long and 3 miles wide to tiny rocks a few square feet in area, but almost all are rocky and very uneven in surface, with comparatively small deposits of drift. On the larger islands, hills rising to 350 or 375 feet have rugged forms, except a few composed of drift which have tops flattened by wave action, probably during

some stage of Lake Frontenac. In many places cliffs rise 20, 50, or even 100 feet out of deep water; and on the north shore at Landon bay such a cliff reaches 150 feet and the hill above more than 450 feet above the sea, or 200 feet above the river.

The commonest rocks are granite or syenite of a pink to grey colour belonging to the Laurentian, or perhaps in part to the Algoman; but there are also Grenville sedimentary rocks, especially quartzite; and large or small masses of the quartzite are often embedded in the granite. Dikes of coarser-grained granite or pegmatite penetrate the older rocks, and in some places there are later dikes of dark-grey diabase.

A few of the islands differ entirely from the others and consist of Potsdam conglomerate or sandstone, pale-grey in colour and horizontal in attitude, giving a flat surface. The basal conglomerate is formed almost entirely of quartzite



Concretion in Potsdam sandstone, Thousand Islands.

pebbles, but there are places, as on a small island just west of Forsyth island, where the conglomerate is wanting and the sandstone almost blends into the weathered and fissured surface of the underlying quartzite. Sometimes the sandstone itself is consolidated into quartzite, white and marble-like in appearance.

The Potsdam displays the cross-bedded features to be expected where sand is acted on by waves in shallow water, but includes also an extraordinary columnar structure passing vertically through a number of strata with a definite boundary against the adjoining rock, though consisting of the same materials. Cross-sections on the surface show concentric circles, sometimes 12 or 15 feet wide, occasionally with a hub-like raised centre suggesting a cartwheel. In a few instances one set of curves cuts across another.

The most perfect example of these columns occurs in a cliff of brown Potsdam on the main land, lot 9, concession V, Pittsburgh township. It has been described and figured by Baker in his report on "The Geology of Kingston and Vicinity."[1] They are generally thought to be concretions, though Baker sug-

[1]Ont. Bur. Mines, Vol. XXV, pt. 3, 1916, pp. 19, 20.

gests they were formed by whirlpools or eddies; but it is hard to see how intersecting structures could be formed in this way.[1] These authors suggest the concretions were formed by sand settling in vertical tubular springs, which were rising through the sea floor.

The rocky islands were powerfully carved by the glaciers that crossed them and show smoothed and rounded forms, sometimes resulting in "whaleback" or *roche moutonnée* surfaces. Some cliffs have polished and grooved and even undercut faces. Striae run often in two directions, the quartzitic variety of Potsdam displaying them best. The most common directions of striation are N.35° to 40°E. and N.10° to 15°W. magnetic. As the ice advanced from the northeast, that end of rocky islands is well smoothed and rounded, whereas the southwest end generally has a rougher surface and may be covered with boulder clay in the sheltered lee.

Pleistocene of the Eastern Part of the Basin

Near Trenton and Belleville

Although the surface of most of the region just sketched is bed rock, in many places a thin sheet of till is present, blue if fresh and brown if weathered. On it there is often a widespread cover of brownish varved clay and there are scattered gravel deposits, much less continuous than those of the Iroquois beach, indicating short-lived lower water levels.

There are also a few striking kame hills standing out prominently above the plain and terraced by the lower waters just mentioned.

At Trenton these hills of sand and coarse gravel rise suddenly with a steep slope and run very irregularly for 4 miles southwest. The highest hill, just west of the town, reaches 440 feet and is locally called "the mountain." Springs coming from its foot provide a convenient water supply for the town. Sand and gravel pits, and two large railway ballast pits, have been opened on this hill and the succeeding hills. There are rather vague terraces at 270, 324, and 380 feet.

These hills with their steep and irregular forms of heaped-up sand and gravel could never have been crossed by ice. The plain at their foot on each side of the Trent has beds of coarse gravel, which look like kame deposits but are so low and flat that they probable represent a water level only a few feet above the present lake. These gravels are best exposed at the northwest corner of the aviation field a mile east of the town. Excavations for levelling the surface show about 5 feet of gravel over boulder clay; toward the southeast the gravel is covered by a few feet of varved clay. The surface is about 265 feet above sea level; but a mile to the north gravel pits on both sides of the road stand at 330 feet and show evidences of a much higher stage of water.

North of Bayside West there are sand and gravel beds at 275 feet, apparently a little too high to correspond with the bed in the flying field; and a bar against what seems to be a shore cliff north of Bayside East is at about 325 feet, a little too low for the upper level. The number of apparent water levels and their lack of continuity, so unlike the splendid Iroquois shore, supply a puzzling set of problems. Four miles farther northeast, beside the causeway across the bay at Belleville, a small gravel deposit at 260 feet looks as if it were water-formed, and 2½ miles farther east a well-formed bar crosses No. 2 highway and goes south to the Canadian National railway at about the 275-foot contour. This is

[1]These structures have been discussed in a paper on "Cylindrical Structures in Sandstones," by J. E. Hawley and R. C. Hart, Bull. Geol. Soc. Amer., Vol. 45, No. 6, 1934, pp. 1017-34.

the most certain of the beach deposits of the region and seems to represent a well-defined stage of water, but the shore line cannot be followed for any great distance. From Belleville eastward and northward, varved clay is widespread.

Near Deseronto and Napanee

At Mount Pleasant, 3 miles north of Deseronto, there are gravel pits showing wave-formed materials on the contour of 375 feet; another quite similar deposit on a kame-like hill in the Indian reserve between Shannonville and Deseronto reaches only to the 325-foot contour, corresponding in height to the one near Bayside East. A water-laid deposit of sand and gravel 1½ miles east of the mouth of Marysville creek matches the lower beaches near Belleville.

Near Deseronto the drift grows thicker, and narrow ridges of till run a few degrees north of east and south of west, a direction very different from that of the drumlins and clay ridges northwest of Belleville, which trend not far from north and south. Highway No. 2 follows such a ridge for some distance between Deseronto and Napanee. The two directions are as divergent as those of the striae showing on the limestone in the region and probably have the same relation to glacial movements.

In Fredericksburgh township, southeast of Napanee, very similar clay ridges are even more pronounced and are followed by roads for half a mile or more, but the direction here is about northeast and southwest.

Along the Napanee river limestone shows itself, and near the railway and highway bridges the river falls over limestone ledges, but above the fall it meanders in a broad valley with an escarpment 100 feet in height to the southeast; below the town the river is almost without current as it winds for 3 miles through marshes to the Bay of Quinte. Locally this part of the river is famous for its "tides," which rise and fall a foot or 18 inches and flow up for a time and then down, oscillating in direction. They are really seiches, rather than tides, in the ordinary sense of the latter term. The river is navigated by cargo boats up to the town of Napanee.

Along the Napanee valley, especially on the flanks of the high escarpment toward the southeast, kame sand and gravel are often heaped, to some extent masking the cliff; and beyond Yarker toward the north and west the small late moraines left by the Iroquois ice barrier are scattered over a rough surface of pre-Cambrian traversed by few roads. Around the lakes in this area the shove of ice in winter has pushed up walls of drift, which in places reach a height of 7 feet; large boulders are sometimes found, as on the shore of Varty lake. This work, of course, still goes on every winter.

Where a limestone escarpment faces the pre-Cambrian a mile of wooded swamp in many places separates the two rock types, the contact being apparently a zone of weakness which is eroded more deeply than the surrounding area.

Just west of Croydon on a hill slope of limestone three very narrow and stony recent moraines run parallel to one another within a couple of hundred yards, and probably represent annual stages of ice retreat like those shown to the writer in Finland by Matti Sauramo. Parallel moraines run northwest and southeast in a similar way near a school-house 2½ miles northwest of Enterprise; and it may be that sufficiently detailed work along the band of scattered moraines indicated on the map will at some time give a means of estimating the rate at which the ice withdrew. Among the ridges and hills of the disordered Archean rocks, however, such work will require time and patience. Small moraines are common in the region, and with these in places are associated minor eskers.

The Kingston Region

Between Napanee and Kingston the Trenton limestone has been swept almost bare, and on account of the thinness of the soil large areas have been left as woodland, as may be seen along No. 2 highway east and west of Odessa. Most of the cultivated areas are in stream valleys. Along the lake-shore road, which runs through Bath, low cliffs of shaly limestone are the chief feature; and the roads between the two highways are mostly on bed rock, though occasionally on narrow ridges of till. Rarely there is a drumlin hill, as in the Wilton creek valley south of Thorpe school-house.

Nearer Kingston there is kame gravel and sand at the cemetery in Cataraqui village and boulder clay to the south near Cataraqui bay. Near the new elevator an excavation that provided material for filling shows 6 feet of stratified sand covered by 3 or 4 feet of silty sand with some boulders and 3 feet of boulder clay, evidently Wisconsin till.

In the park south of the city a variety of drift materials are seen along the shore, including sand, stony till, and varved clay, but the sections are poorly exposed.

At Kingston Mills near the canal lock a rounded hill of granite rises, suggesting a *roche moutonnée* smoothed by the work of ice; but across the road from it is a limestone cliff, which apparently is the edge of a sheet of limestone that originally covered the granite. In that case the apparent *roche moutonnée* was in existence before the Ordovician sea covered the region with its sediments.

Not much undoubted Pleistocene drift was to be seen in the Archean region northeast of Kingston, but a mile north of Wilmer a large deposit of kame sand has been opened for railway ballast. It proved almost impossible to recognize the small moraines of the Iroquois ice dam on the weathered, hummocky, and bouldery surface of the pre-Cambrian where it was tree-covered, as was generally the case. Wolfe island, south of Kingston, has a surface mainly of limestone like that already described from the mainland, but a few small late moraines were found on the long eastward projection of the island.

Near Gananoque

The pre-Cambrian area north of Gananoque is in many places still a wilderness, riddled with lakes and swamps and without roads, but toward the south it is covered with till, forming good soil, though the tops of the hills are of gneiss. Occasionally a mass of kame sand rises above the general level, as at Lindsay point, 2 miles southwest of the town; and in several places, both east and west, small ripples of till upon the swelling slopes of older till have been interpreted as late moraines deposited by the ice barrier of Lake Iroquois. They are not more stony than the rest of the surface, but their small ridges and kettle-shaped depressions are less smoothed out, suggesting a later age.

Most of the surface of Howe island is of limestone thinly covered with drift, and a few late moraines are found; but 3 miles southwest of the ferry to Lindsay point, Grenville quartzite and crystalline limestone rise through the Ordovician and are themselves penetrated by red granite, which forms the highest hill on the island.

The account thus far given applies to the belt of country within 2 or 3 miles of the St. Lawrence. To the northwest, and also to the northeast, there are flat plains of rich farmland, sometimes requiring extensive drainage ditches and probably floored with varved clay, though this is seldom visible. A ditch on lot 32, concession V, Pittsburgh township, showed black soil or muck over 2 or 3

feet of clay, stoneless but not distinctly stratified. Occasionally a gentle rounded surface of granite shows itself, and farther northwest, between Joyceville and Pine Hill, there is limestone rising as an escarpment with a flat tract of woodland on top. The outcrops of granite and gneiss are glacially rounded and sometimes deeply grooved by the ice.

The most interesting Pleistocene feature in the whole region is a hill near Washburn, a mile southeast of the bridge across the Rideau canal and on the edge of the plain just mentioned. Doyle's hill has a rounded drumlin-like form but seems to be an unusually symmetrical kame, built of very stony materials with pebbles up to a foot or more in diameter. It is three-quarters of a mile long and rises 125 feet above the plain, more than 500 feet above sea level.



Glacial grooves in gneiss, northwest of Gananoque.

The water levels of this interesting hill are given below, the east and west ends, which are not exactly alike, separately:—

East End	Feet	West End	Feet
Upper indistinct terraces		Highest terrace	480
		Terrace with gravel pit	451
Terrace against shore cliff	428		
Horseshoe bar	416	Terrace	421
Lower terrace	402		
General level	390	General level	395

The horseshoe bar at the east end is followed by a shallow lagoon and a boulder pavement reaching up to the terrace at 428 feet, behind which the hill rises as a shore cliff. At the west end of the hill a terrace, on which is a large gravel pit, stands at 451 feet, with no apparent equivalent at the east end. From the foot of the ridge containing the gravel pit, a boulder bar runs half a mile west to a church, which is on a sand and gravel flat at 385 feet. The boulder bar was evidently built by waves coming from the east.

The hill stood up as an island above successive water levels, the horseshoe bar representing the longest halt in the rise of the land, perhaps at the marine stage.

Twenty miles almost due north a similar hill rises above a plain on the 475-foot contour, with terraces at 505, 519 to 532, and 542 feet, the most important being a beach beginning with a gravel pit at 519 feet and gently rising to a horseshoe bar at 532 feet. These levels are at the west end of the hill and are much more distinct than the vague benches at the east end. On the north side there is a terrace with a gravel pit at 523 feet. The hill rises above the 550-foot contour and there is a large gravel pit on top. The gravel in this pit is not assorted and is probably of kame origin. All of these terraces are above those of Doyle's hill and seem to have no relation to them.

There are several less notable gravel deposits in the region between the two hills. One large pit where highway No. 32 bends eastward, half a mile from South lake, looks as if it were water-formed but has not the level surface to be expected in a lake deposit. It is about on the 375-foot contour. Another, a mile and a half south of Morton on No. 15 highway, stands at 443 feet with a plain below at 412 feet. It consists of bouldery materials as shown in a highway pit, but its surface development is terrace-like. A similar gravel deposit 2 miles southeast of Lyndhurst has a level top at 410 feet, but seems to be of kame materials.

None of these gravel deposits has much resemblance to a lake-formed bar, but they are mentioned for completeness' sake.

North of Wolfe lake, Sand lake, and Upper Rideau lake, near Westport, steep cliffs rise 200 to 250 feet as the front of a tableland, which is 600 feet above sea level and consists of Archean rocks forming a peneplain with flat stretches and low hills. South of the lakes there is limestone, often presenting low escarpments, the lake depressions occurring at a line of contact. Very little drift was observed and no terraces or anything to suggest a continuation of the water levels on the hill just described near Crosby, though the cliffs and the hill are only 8 miles apart. Gravel deposits 2½ miles southwest of Westport are probably parts of a low kame.

A number of pre-Cambrian hills reaching an elevation of 500 feet or more in the Gananoque region were visited, but were found to be very scantily covered with drift, the higher parts being almost bare; and the conclusion was reached that the only likely places for well-marked water levels were isolated kames of the sort just described or, for the lower ones, the crumbling cliffs of shale and limestone at escarpments.

A flat-topped hill on Grindstone island in the state of New York, 4 miles southeast of Gananoque, seemed from a distance to belong to the kame type of hill just referred to and was visited. It is considerably lower than the two hills described above, reaching only to the contour of 380 feet on the American map of the Thousand Islands.[1]

A gravel pit on the south side of the hill is bouldery and shows the irregular structure of a kame. The flat top is a boulder pavement, no doubt formed in shallow water, and there is a distinct shore cliff above a terrace at 322 feet (aneroid). On the north side there are vague suggestions of terraces but nothing well defined.

The general relations of the water levels of the region will be discussed in a subsequent section.

[1]The American contours are at 20-foot intervals instead of 25-foot, as in the Canadian military map-sheets.

Prince Edward County

Prince Edward county is almost completely separated from the mainland by the Bay of Quinte; and the connecting strip of low land at the Carrying Place, 1¾ miles in width, has been cut by the Murray canal. Some thousands of years ago, with a somewhat higher level of water, it was actually an island. Compared with the smoothly outlined shores of Lake Ontario in its western part, the jagged and crooked outlines of Prince Edward county present an astonishing contrast, for which a cause is not easily found.

Except for one small hill of pre-Cambrian granite 5 miles south of Belleville, the rock of Prince Edward county is limestone. Its highest tableland reaches 500 feet above sea level, and parts of its ragged shore rise above the Bay of Quinte and Lake Ontario as vertical cliffs, reaching 170 feet in height at Glenora; but many miles of its shore line are low sand bars across the mouths of bays.

Large parts of its surface are of rock more or less weathered into coarse gravel, but boulder clay sweeps as gentle swells across other parts, and a striking esker occupies a belt in its centre.

The county has a number of lakes, the largest of them bays cut off by sand bars from Lake Ontario, but two small ones are high up at the edge of a tableland and hard to account for.

From the point of view of Pleistocene geology the most interesting features are the old beaches, which are best seen along escarpments, particularly where there are promontories with steep cliffs, which in earlier times rose sheer from a higher level of water. No part of the county is as high as the level of Lake Iroquois, and its beach is lacking; but the lower beaches are better displayed than on the mainland.

The Northwestern Side.—Prince Edward county can be reached by motor car by a road crossing the Murray canal, or a few miles farther northeast by a causeway and bridge across the Bay of Quinte from Belleville. Both roads begin on a low plain but soon rise upon higher ground, the highway between Belleville and Picton climbing an escarpment at the misnamed "Mountain View."

The plain is chiefly of till, usually with few boulders, but limestone is near the surface and forms low cliffs along the bay, and in the lowest parts there are broad swamps. At the west end near the Carrying Place sand is the prevailing surface material, but at Onderdonk a hill of limestone rises 100 feet above the bay with two fairly well marked terraces facing northwest, one at 307 feet, the other at 330 feet above sea level.

A couple of miles northeast near Rednersville, a larger island-like tableland reaches 400 feet above sea level and presents a bold escarpment toward the Bay of Quinte, but only indistinct beach levels were observed on it, though stratified sand and gravel occur at about 325 feet, where a road running inland scales the escarpment. At the east end a road runs southeast from Rednersville, and a mile from the village there is a broad gravel flat, which can be traced for half a mile at about 300 feet. This has been opened by three pits and seems distinctly water-laid. Two miles southwest of the village, in the rear of the tableland, gravel occurs at two points about 330 feet above the sea, with a separation into two bars a few feet apart and with a shore cliff to the north and a stony field to the south.

After a mile of swampy depression an escarpment rises toward the south near Victoria church and runs east past Ameliasburg, Mountain View, and Crofton to Demorestville, a distance of about 15 miles, with an elevation of 100 feet in most places. Along the foot of the cliff the advancing ice piled up boulder

clay and a considerable amount of kame material. All along this escarpment terraces and gravel pits are to be found, one of the most interesting developments being near Roblin Mills at the village of Ameliasburg.

Here a deep recession in the wall of cliff encloses a pond and leads toward Roblin lake on the tableland. The steep slope of the cliff into the ravine enclosing the pond shows two water levels, but they are not very strongly marked because of the narrowness of the valley. Roblin lake is a mile long and a third of a mile wide and is reported to be 75 feet deep, yet it stands near the edge of the flat limestone tableland with a shallow ditch as outlet. How was it excavated? The ravine a little to the north is deep enough to drain it, but there is no visible connection between them. There must be some former outlet filled with drift.

Roblin mill, when running, used 50 feet of fall, and two lower falls were used by saw-mills. Flour was once shipped by team to Rednersville to be transported to Belleville and Montreal, but this industry ended long ago.

On C. D. Sager's farm, northeast of the narrow valley and north of the lake, an unusual number of fairly distinct terraces are found. At the foot of the escarpment there is a flat plain, probably a water level, 300 feet above the sea, followed by terraces at 315, 330, 349, and 366 feet, and the plain above reaches 383 feet as shown by a bench mark.

As one goes east frequent gravel pits are seen, often on two terraces, 15 or 20 feet apart, the largest at about 330 feet, as was the case in the series near Roblin Mills, and above it rises a distinct shore cliff of crumbling shale and limestone.

At one or two places to the north the lowland has been affected by waves at a somewhat lower level, the best example being a mile and a quarter southeast of Rossmore, where the crossing from Belleville ends. There a gravel bar, on which shallow pits have been worked, runs for more than a quarter of a mile at a level of about 310 feet.

At Mountain View, where the Picton highway climbs the escarpment, terraces occur at 292 feet and 305 feet, and the main terrace, on which is a gravel pit, is at about 330 feet with a steep shore cliff to the south. Toward the east, at a point where road metal was quarried, there seems to be a very low terrace, at 265 feet, just above the marsh; but in many places the escarpment is steep and no terraces can be traced.

A mile west of Crofton, where a road leads steeply down to the foot of the escarpment, the cliff was scoured and undercut by the ice and boulder clay was plastered against it; next comes steeply sloping kame gravel, ending with a narrow bench cut by waves at the usual level of about 330 feet.

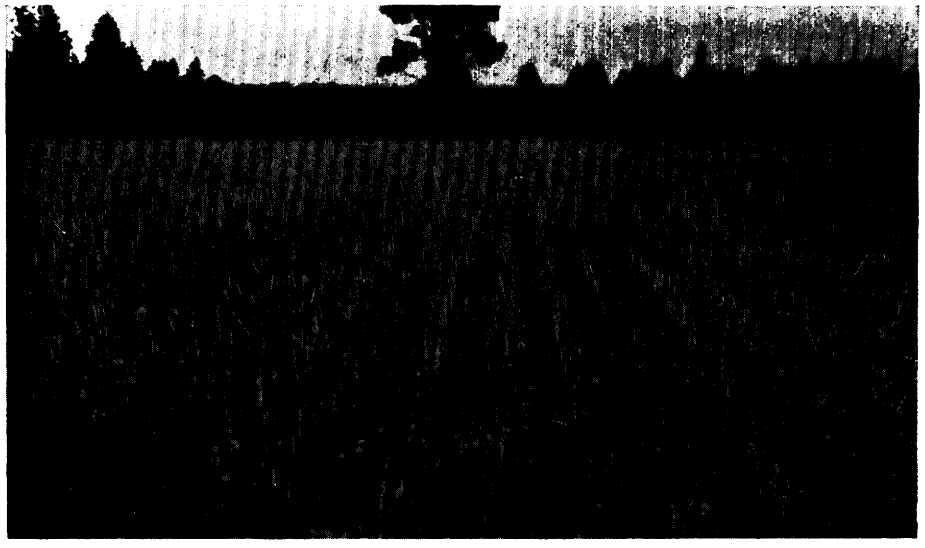
At Crofton there is a deep recession of the escarpment, but to the east the cliff becomes steep once more and reaches open water on an arm of the Bay of Quinte. Farther east it faces a swampy creek valley, and the slope becomes more gentle. A mile west of Demorestville there is a broad flat at 276 feet and a terrace with gravel pits at 303 feet, but the main terrace was not found.

A road crosses the swamp to Big island, no part of which reaches much above 300 feet; only the highest ridges show scouring by waves and no marked terraces were found. Boulder clay forming good soil covers most of the island. For 4 miles northeast to Northport no well-marked escarpment shows itself, and the country is mostly wooded; but to the east a small wooded tableland with steep slopes rises to the contour of 425 feet, and the main terrace forms a bench round its projecting northeast end. Wooded country with no striking terraces extends from this hill to Green point on the Long reach of the Bay of Quinte, which cuts

off the eastward-trending cliffs and hills with a long, straight channel reaching south to Picton.

At Green point probable terraces occur at 254, 300, 315, and 331 feet. The peninsula to the north is mostly limestone and wooded. A mile and a half northeast, on the mainland side of the Long reach and about 2 miles due south of Deseronto, what seem to be water levels are found on a steep slope at 290, 311, 326, and 335 feet. The two sets, so near together, do not agree well, but the latter group is not distinct enough to give much certainty.

From Green point the "high shore" extends for four miles south, most of the way with a cliff too nearly vertical to show terraces; but beside a little bay at Roblin Mills, Sophiasburg township, there are probable water levels at 272, 286, and 339 feet.



Stubble field with limestone fragments or gravel.

The Central Part.—South of the long escarpment described in the foregoing section the country is high and forms a tableland of limestone, often almost bare but in places covered with swells of till of no great thickness, elongated from northeast to southwest. Much of the tableland is so flat as to be poorly drained, and two large belts are uninhabited swamp. The eastern swamp encloses Fish lake at 347 feet, a shallow body of water a mile long and three-quarters of a mile wide. The other swamp, with a few small interruptions, extends for 14 miles, almost across the county, and ends at Consecon lake, which is nearly at the level of Lake Ontario. This shallow depression drains most of the interior of the county.

In many places the surface of the limestone has crumbled into coarse gravel with rounded fragments, giving a soil which looks unpromising but yields abundant crops, particularly of tomatoes and Indian corn. In the absence of gravel of glacial origin the roads are made of crushed or naturally crumbled limestone quarried close by. The limestone plain is crossed in places by escarpments, which are due to more resistant layers, and culminates east of Picton in a broad upper tableland at 450 to 500 feet above the sea.

At Picton a narrow belt of kame and esker begins and runs as a very uneven series of ridges and hills almost to West lake. It seems to have been dumped where it is because of the shelter of the tableland just mentioned and sinks from 450 feet at the cemetery in the town of Picton to 300 feet at its southwest end. Its crest is followed by a "ridge road," and at various points along its course sand and gravel are quarried; it is the most important source of these materials in the county.

The central tableland sinks gently toward the southwest, perhaps because of the dip of the limestone, and the shore of Weller bay is low and in places swampy. There is a little drift. No fresh striated surface has been found, and what boulder clay there is seems to rest on the crumbled limestone, showing that in this region, perhaps because of its southwestward slope, no scouring was done. This feature was noted by Alfred W. G. Wilson many years ago.[1]

Consecon lake, which is nearly 4 miles long and about half a mile wide, is almost wholly enclosed by bed rock, and its outlet seems to be over limestone. Three other parallel depressions end in North bay, Pleasant bay, and Huyck bay, which are almost lakes, since bars of sand and gravel nearly cut them off from Lake Ontario.

Low shores extend from Huyck point to the village of Wellington, where an immense sand bar, nearly 5 miles long, separates West or Yeo lake from Lake Ontario. This bar, which begins at the Sand Banks with a width of half a mile, tapers to 100 feet at Wellington. The lake is triangular and has narrow ridges of till projecting southwest into it. A couple of miles to the southeast is Spence or East lake, which has been formed by a shorter sand bar. The esker mentioned above ends between the two lakes, and the sand for the two great bars seems to have been derived from glacial deposits.

The Sand Banks are famous in the region and provide typical examples of dunes. Sometimes winter snow-banks are buried with drifting sand and later disinterred in hot summer weather. In their motion the dunes overwhelm fences, trees, and buildings; and the Ontario Forestry Department is putting down barriers and planting trees, which will ultimately fix the sands and prevent further encroachments.

A little east of Yeo lake, on the 300-foot contour, a narrow ridge of drift forms a hook bending eastward, and suggests a stage of water at that level, instead of the usual levels of 330 or 335 feet; but beyond this no pronounced bar or terrace was found in the southwestern part of the county.

At Cherry valley the landscape is morainic, and kame sand shows itself resting on limestone; farther southwest, along East lake, a ridge of sand extends for a mile or two, somewhat esker-like but almost without gravel and stones.

The Eastern Peninsula.—East of Picton and north of the highest tableland there are escarpments and steep declivities along the shore of Picton bay almost as far as Glenora, but no distinct terraces were recognized, probably because this part of the shore was on sheltered water.

At Glenora is the famous "Lake on the Mountain," close to an almost vertical cliff rising directly from the Bay of Quinte. The lake, which is 415 feet above the sea and 170 feet above Lake Ontario, is about three-quarters of a mile across and has soundings going down to 90 feet; but it seems to be rock rimmed, though there are two places where its shore is of drift. The drainage is by a hallow channel at the fish hatchery. There must be a drift-filled channel at

[1] "Trent River System and St. Lawrence Outlet," Bull. Geol. Soc. Am., Vol. 15, 1904, p. 224.

least 90 feet in depth to account for it, but none is evident on its shore and, like Roblin lake, its origin presents an interesting problem.

Farther east, where the shore is not so steep, terraces begin, and near Bongard and Cressy some of the most striking developments of the lower beaches are displayed. The best is on a partly wooded promontory, whose summit reaches 400 feet, half a mile southwest of Cressy wharf. Here terraces occur at 254, 290, 312, 325, and 334 feet, the highest forming a fine horseshoe round the east end of the promontory. A lagoon sinks 8 feet below the crest of the beach,



Cape Versey, Prince Edward county.

and beyond it rises the vertical cliff of the old shore. The horseshoe bar seems puzzling at first, since part of it consists of flat slabs of shaly limestone that seem too large for transportation by waves. Later similar slabs were found on a modern beach below a cliff on the shore of Lake Ontario to the south. It may be that ice aids in the transport of these slabs, which are sometimes a couple of feet across. There must have been many miles of open water to the east when this beach was built.

Seven miles southwest of Cressy, on the lakeward side of the peninsula, in the settlement called Waupoos, excellent beaches occur on a slope rather steeper than the one just described. By hand level, terraces were worked out at 308, 328, and 334 feet, with a cliff to the north whose foot was 349 feet above the sea.

A shallow lagoon separated the main bar at the 334-foot level from the foot of the cliff.

The terraces near Cressy wharf and Waupoos are very definite features, especially the main one at 330 or 335 feet, and one would expect to find similar terraces on any land rising to this height; search was made wherever the contours were over 300 feet, but with success only when escarpments faced what must have been open water.

Southwest of Waupoos the escarpment remains high most of the way along the edge of the Black river valley toward the village of Milford, but the terraces are indistinct except for the first two or three miles where the escarpment faces Smith bay. Toward the northeast the road along the south side of the peninsula passes two terraces, about at the main level but a few feet apart. At Waupoos East, there is a tableland reaching 400 feet, which presents a good terrace at 312 feet near a church; and bars are found at 321 to 325 feet and at 335 feet. The escarpment is followed by the road to Cape Versey, where there is a lower terrace at 303 feet just above an overhanging cliff of Lake Ontario. The escarpment here has wooded slopes and turns north toward the splendid horseshoe bar near Cressy wharf.

The peninsula runs 4 miles farther northeast to Pleasant point but is low and without well-marked water levels.

North and south of the mouth of the Black river two hills, which were once islands, display a series of well-marked terraces. One of them, Vanderlip hill, has an elevation of 375 feet and on its southeast side there are shelves at 277, 296, 306, 317, and 335 feet, the one at 306 feet having a bar with a shallow lagoon.

Farther south near Port Milford, a rounded promontory at the mouth of South bay shows the main terrace and some lower ones, and southwest of the bay a prominent point of cliff has terraces at 304, 326, and 335 feet. Beyond this point the southeastern peninsula projects 9 miles into Lake Ontario, but is low and without distinct beaches.

It is a striking fact, not easily accounted for, that all of the characteristic beach formations, including the most pronounced one at about 334 feet, are found on escarpments on the north and east sides of the county, and none have been found with certainty on the south or the west. This seems to imply that the effective waves came from the northeast. One would have expected just as active waves from the southwest.

Beaches below Lake Iroquois

Much of the foregoing report has been occupied with details of old water levels, especially with the oldest and highest, that of Lake Iroquois, which can be followed with as much certainty as the shore of the present Lake Ontario. Its bold cliffs and broad gravel bars are as mature as the present cliffs of Scarborough and the gravel bars of Toronto island and Hamilton beach. We know that it required thousands of years to imprint that vast scar and wide terrace on Eastern Ontario and that the ice load was lifted during the lifetime of the lake sufficiently to change the level of its waters at least 70 or 80 feet toward its west end and 55 feet toward the east, since its two ends have their bars split up to that extent. There was, however, a halt of great length, permitting a widespread cutting-back of its shore cliffs of boulder clay before its outlet shifted from the Mohawk valley to the foothills of the Adirondacks on the slope toward the St. Lawrence, at the boundary between Quebec and New York.

Then came a much shorter halt, probably with an outlet at Covey Hill, when gravel bars were formed from 50 to 100 feet lower, in what has been called

Lake Frontenac. This has been recognized over a distance of 60 miles from Whitby to the Murray hills as disconnected deposits and has already been briefly referred to. The gravel bars near Whitby are 180 feet above Lake Ontario, and the water level must have extended to the other end of the basin at Hamilton, but this extension has never been traced in the field. Nor has it been found farther east, unless it is represented on the hill already mentioned[1] 23 miles north of Gananoque, where the highest terraces reach 532 and 542 feet. As this hill is 100 miles northeast of the Murray hills and no connecting links are known, the relationship is doubtful.

If these gravel beds were formed when the Covey Hill outlet was in operation, there should be corresponding deposits along the Adirondack foothills in New York, but Fairchild's account of that region does not seem to fit the levels given above. He mentions water levels from 1,030 to 729 feet at the outlet, the lowest belonging to a marine stage.[2] Even the lowest seems too high for the beds in question, which do not go above 550 feet.

A long gap separates the shores of Lake Frontenac from the next water level of importance, bridged only by terraces on the remarkable hills in the Gananoque region, one of which has just been mentioned as possibly reaching the Frontenac level.

The very interesting set of well-formed beaches at levels from 325 to 335 feet, which have been traced with unimportant gaps from Onderdonk hill near the west end of Prince Edward county to Cressy wharf near its east end, a distance of more than 30 miles, probably belong to a marine stage. At promontories exposed to strong wave action from easterly storms, well-formed horseshoe bars occur, but none are found at the west end of the county, a fact that suggests tides and open water toward the east. It is strange, however, that the extensions that one would expect to find on the mainland to the north are vague, and no continuous shore has been traced there.

A terrace at 324 feet on a kame hill in Trenton and another at 330 feet a mile and a half to the northeast probably represent a continuation on the mainland, but beyond this toward the west only one well-formed beach deposit is known near the right level, at Port Granby on the shore of Lake Ontario southeast of Newtonville. This is at 270 feet, which suggests a tilt of more than 50 feet in 46 miles, a not improbable rise toward the northeast, since the higher shores already described have a tilt of 2 feet per mile in that direction.

Fairchild has traced a similar shore on the south side of the lake as far southwest as Oswego and has named the body of water Gilbert gulf, for the famous geologist who, with Spencer, first studied old beaches in the region.[3] Fairchild connects the gulf with the body of water that has been inappropriately named the Champlain sea. It should have been called the St. Lawrence sea, since the main body of water filled the St. Lawrence valley of which the Champlain water was only a narrow bay.

Although the word "sea" is used, the water was not salt. No marine fossils have been found in the Lake Ontario region, the nearest known marine shells occurring at Brockville, 50 miles to the east. One may suppose that the Niagara river sufficed to keep it fresh.

As previously noted, there are fragmentary beach deposits below this marine level, but these may be considered to represent early stages of Lake Ontario. The 80- or 90-foot change of level between the well-formed beaches in Prince

[1]Page 66.
[2]H. L. Fairchild, N.Y. State Mus., Bull. Nos. 209, 210, 1918, p. 55 *et seq.*
[3]Pleistocene Geol. Western N.Y., Rept. Progress, 1900, pp. 157, 158.

Edward county and the present Lake Ontario seems to have had no halt long enough to leave any continuous beach. J. W. W. Spencer has suggested that at first the lake was held up above its present level by a dam of drift, which was rapidly removed by the current of the newly formed St. Lawrence river, and this seems a natural assumption.

Since the Thousand Island barrier rose above the sea forming Lake Ontario, the northeastward elevation has continued until the lake surface is now 245 feet above tidewater. It is probable that the earliest stage of the lake reached a point some miles short of Hamilton and was at least 90 feet lower than at present south of Toronto, as shown by a buried channel of the Humber reaching that depth. That all the rivers entering the west end of the lake have dead water for the last mile or two indicates the same change of level, but it is probable that the northeastward rise is now at an end, the once ice-burdened region at the glacial centre in Quebec having reached equilibrium.

Geology of Pelee and Adjacent Islands[1]

By E. M. Kindle[2]

Introduction

This report is concerned with some of Canada's most southerly islands, which lie in the western part of Lake Erie. The shallow water, which in the western part of the lake seldom exceeds 25 feet, together with a shore line on



Fig. 1—Key map showing the location of Pelee island in the western part of Lake Erie.

the north side composed largely of glacial till have conspired to develop through the agency of wave and current action large deposits of gravel, sand, and lime-

[1]Published with the permission of the Deputy Minister, Department of Mines, Canada.
[2]Chief, Division of Palaeontology, Department of Mines, Canada.

stone shingle at certain localities. One of these, Point Pelee, has been described in some detail in an earlier report by the writer.[1] The present report deals with the gravel and sand deposits and other geological features of Pelee island and other small islands located a few miles southwest of the Point Pelee foreland. Lake Erie is the shallowest as well as the most southerly of the Great Lakes, having a maximum depth of less than 200 feet, or about one-quarter the maximum depth of Lake Ontario. The unconsolidated sediments which constitute a considerable part of the Pelee island shore line make erosion one of the most important geological problems of the island.

Pelee island, although it is within sight of the airline route of travel between Toronto, Detroit, and Chicago, is probably as little known to most Canadians as Ellesmere island, Canada's most northerly land. Its attractive beaches are as yet known to only a few summer tourists.

It was the writer's good fortune to have in the field work the co-operation of the late W. R. Rogers, who prepared the maps which accompany the report and contributed to the section on geography. Some of the field work, including a second survey of Fishing point was done by Mr. Rogers several months after the writer's visit to the area. This work, owing to the untimely and deeply regretted death of Mr. Rogers, turned out to be the last field work he did for the Ontario Department of Mines, to which he had given many years of faithful and able service.

Geography

Some forty miles from the western end of Lake Erie the traveller by airplane may see a belt of islands trending north and south across the lake. The largest of these, Pelee island, is located about 8¼ miles southwest of the tip of Point Pelee and has an area of about 10,000 acres. The distance from Lighthouse point at the northeast corner to Fishing point, the most southerly extremity, is 7¾ miles. The smallest of the adjacent islands is called Little Chicken and is only a mass of limestone rocks tenanted by myriads of water birds. Middle (or Boundary) island lies just north of the International boundary and is the most southerly land in Canada. Its old abandoned lighthouse is 1,800 feet north of the International boundary in latitude 41°41′. Hen island is a small rocky island located 5 miles west of Pelee island. Both Middle island and Hen island are occupied by clubs for recreational purposes. Pelee island has a population of about 800.

Early Occupation

These islands placed like stepping stones for a giant between the tip of Point Pelee on the north and Sandusky bay on the south side of the lake afforded a natural and relatively safe canoe route across Lake Erie for the predecessors of the white man. The Indians left evidence of their occupation of Pelee island in various mounds, some of which were excavated and described by David Boyle[2] in 1899. Mounds opened by Boyle and others in lots 34, 36, and 39 have yielded charred beans, maize, pottery, bone awls, flint arrow points, two celts, copper beads, and human remains.

Pelee island in all probability was occupied by these nomadic native tribes only seasonally. There are still to be seen some low mounds which were used

[1]E. M. Kindle, "Erosion and Sedimentation at Point Pelee," Ont. Dept. Mines, Vol. XLII, pt. 2, 1933.

[2]David Boyle, Archaeological Report, 1899, being part of the Appendix to the report of the Minister of Education, Ontario, pp. 30-34.

for burial purposes. Human bones, stone pipes, flint arrow heads, and primitive pottery cooking utensils have been unearthed. Three such mounds on the southeast side of the island may still be seen. The two largest were pointed out to the writer by Mr. Mahoney, caretaker of the Breezy Point Club, who was born on the island in 1859. They are elliptical in shape, one approximately 40 by 60 feet and the other about 40 by 50 feet, and neither rises more than 3 feet above the surrounding level. Other mounds said to be on the island were not observed; careful search and digging on high ground would be necessary to find them.

J. J. Bigsby, who visited Pelee island in 1821, tersely described it as "a mere swamp with a belt of sand girding its circumference. . . . It is compact, swampy within, and surrounded by a belt of trees."[1] Of Pelee and the Eastern Sister islands he says: "They are uninhabited except by runaway slaves or outlaws for a season."[2] The city of Sandusky, Ohio, 18 miles south of Pelee island Dr. Bigsby described with equal brevity as "a miserable cluster of houses facing the water."

The original release of the island was secured by an indenture between the chiefs and sachems of the Chippewa and Ottawa Nation of Indians to Thomas McKee, himself half Indian, in consideration of an annual payment of "three bushels of corn or the value thereof annually if demanded."[3] The permanent occupation of Pelee island by white men began in 1834 when William McCormick with his family of eight sons and three daughters moved to the island. Thaddeus Smith has recorded the following observations concerning the wild life of Pelee island as it was before and at the time of the arrival of the McCormicks:—

> There was a time when elk and deer roamed the island, as is evidenced from deer horns and numerous immense antlers of the elk found in the woods, and more recently in the marshes since they have been reclaimed. But these animals had both disappeared. There is no evidence that any of the large ferocious animals such as wolves, bears and catamounts were ever on the island; foxes and raccoons were plentiful and muskrats numerous, their houses dotting the marshes, giving the appearance in the fall of a prairie meadow covered with hay cocks. They were trapped and speared by both white and Indian hunters—sometimes to the number of 5,000 or 6,000 a year. No mink or otter was found; no rabbits or squirrels, no moles or skunks; no quail or grouse. The wild duck made this a breeding and a feeding place. The mallard and wood duck and other varieties used to breed in the woods and marshes, and great numbers of ducks and wild geese stopped here in the spring and fall, in their migration north and south, to feed upon the wild rice and other food abounding. Snakes were innumerable and of many kinds, mosquitoes, deer-flies, horse-flies and other biting insects, were there throughout the summer, to torment both man and beast. Such was the condition of the island when this family first went upon it in 1834, and it remained nearly in the same condition for the next twenty-five years.[4] . . .
>
> The clearing of the thick woods and underbrush and the drainage of the marsh have removed all causes of malaria, as well as the breeding places of mosquitoes and deer-flies. Consequently these have almost disappeared, and with them have gone the thousands of snakes that used to infest the island.[5]

The writer's experience fully supports the statement of Smith regarding the disappearance of objectionable insects. No deer-flies were seen on Pelee island, though they were troublesome on one of the small islands. The writer saw only a single specimen of garter snake, which was collected and found to be *Thamnophis s. siratalis*,[6] a variety common on Point Pelee. The Fox snake occurs on all of the islands visited and was particularly abundant on the long rocky point at Middle island.

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[1]J. J. Bigsby, "A General Description of Lake Erie," Quart. Jour. Sci. Lit. & Art. (London), 1828, pp. 366, 369, 370.

[2]Raymond Knister, "Pelee Island," Can. Geogr. Jour., Vol. VI, No. 6, June, 1933, p. 297.

[3]Thaddeus Smith, "Point au Pelee Island; An Historical Sketch of and Account of the McCormick Family Who Were the First White Owners of the Island," The Echo Printing Co., Amherstburg, Ont., 1926, p. 28.

[4]Ibid.

[5]Ibid. p. 45.

[6]Determined by Clyde L. Patch.

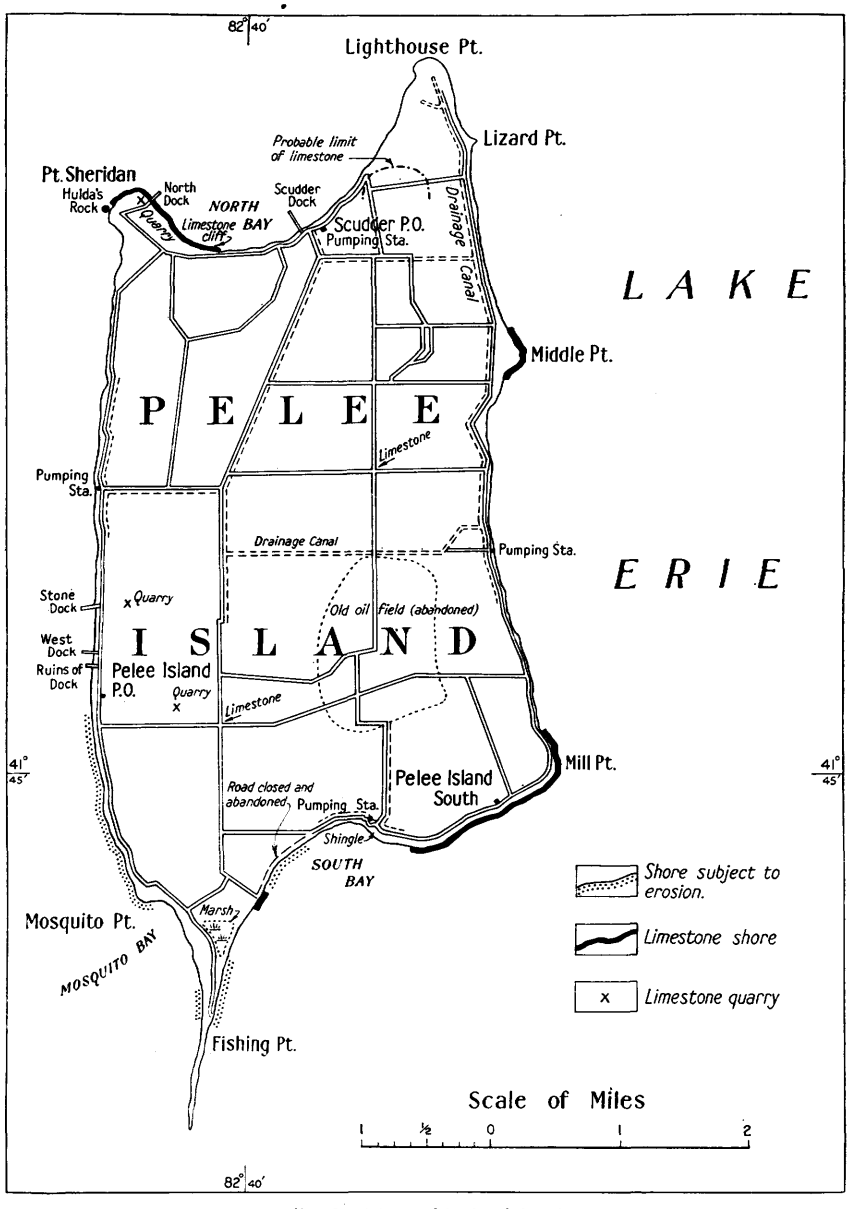


Fig. 2—Map of Pelee island.

Relief

Pelee island originally consisted of several islands separated by marshes and the name of one of these, Middle island, on the east side, still persists. To-day half the area of the island, or 5,000 acres, is reclaimed marsh land, and if the low wet timbered land is included the area is increased to 7,000 acres. Nowhere does the natural shore cliff rise more than 12 or 15 feet above lake level. Only at the limestone cliffs on the north shore west of Scudder and at the clay scarp on the west side of the island, about 1½ miles south of West Dock, do vertical shore cliffs appear.

The island rises to 30 feet above lake level at only two places. One of these, a small plateau, lies about a mile east of the west shore on the east-west road. The other is about half a mile north of West Dock and a less distance inland from the west shore. An old quarry is located here, and near it is the summit of the island, 38 feet above lake level. Sand dunes at Lighthouse point rise 17 or 18 feet above the lake. Much of the reclaimed marsh land is at lake level or slightly above it. Some of it, however, is 2 to 3 feet lower, necessitating the water level in the artificial drainage ditches being kept at a lower level. Hence it will be seen that water levels in Lake Erie are important. If a big storm should occur at a time of extreme high water not only would the dikes be broken through but all the low land would be flooded and irreparable damage done. Tops of embankments thrown up from the drainage ditches bordering and traversing marsh land have been utilized as roads. Except for its insular character Pelee with its dikes, drainage ditches, and reclaimed land may be described as a miniature Holland.

Climate and Agriculture

The midlake location of Pelee island gives it a climate exceptionally free from the great daily fluctuations of temperature that in midsummer are characteristic of parts of Ontario remote from the Great Lakes. The relative mildness of the climate is indicated by the following table showing the mean annual temperature of various points in Ontario, which was assembled by the late Professor A. B. Klugh.[1]

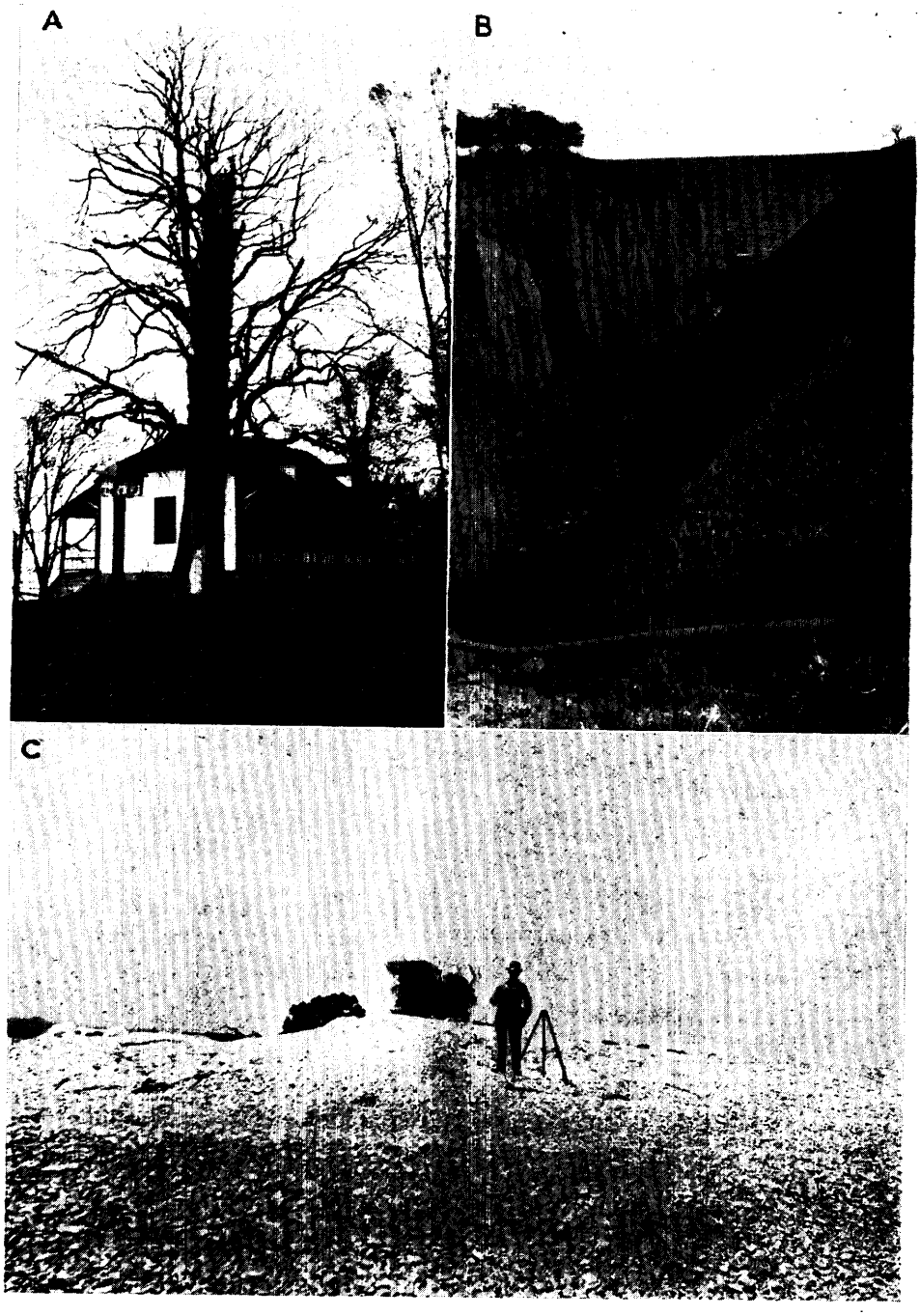
TABLE OF MEAN ANNUAL TEMPERATURES AT SELECTED ONTARIO LOCALITIES

Pelee island	49.3°F.
Stoney Creek	49.1
Chatham	47
Collingwood	46.6
London	45.8
Toronto	44.2
Kingston	43.8
Guelph	43.7
Peterborough	43.5
Owen Sound	42.8
Gravenhurst	41.5
Ottawa	41.1
North Bay	39.8
Bruce Mines	39.6
Rat Portage [Kenora]	36.2
White River	32.6
Savanne	32.3
Moose Factory	31.1

Owing to its location in Lake Erie, Pelee island has a more equable climate than any other part of Ontario. Early and late frosts are absent, which permits early planting. The reclaimed marsh land is rich. Wheat, corn, tobacco, and hay are the principal crops. The growing of soya beans, for which both soil and climate are ideal, has been introduced in recent years. Grape culture was started in 1865 with great success. Crops of 4 and 5 tons to the acre were common. Tobacco-growing has, however, supplanted the vineyards because of the larger margin of profit. Peaches can be and are successfully grown. The great handicap to all farming, fruit-growing, and vegetable-growing is the remoteness of a market and expense incidental to shipment by boat. The island climate affords more favourable conditions during very severe winters than the mainland for peaches and other fruits susceptible to low temperatures.

[1]Circulating Bulletin of the Great Lakes Ornithological Club, No. 4, 1905.

Photos A and B by W. R. Rogers



A—Largest white oak on Pelee island.

B—Gully erosion on highway No. 3, three-quarters of a mile east of Port Alma, Kent county.

C—Terraces on limestone shingle at Big Chicken island. The late W. R. Rogers is standing in the centre.

The severe winter of 1898–99, which proved disastrous to the peach trees on the mainland opposite the island, did no damage to peach trees on Pelee island.[1]

The presence in the forests of the island of the shell-bark hickory, black walnut, and other trees characteristic of the forests south of Lake Erie but unknown north of the environs of the north shore are visible indexes of the climate.

Trees

Many trees grow on Pelee island which are not native to the rest of Ontario, but are similar to those of Ohio on the south shore of Lake Erie. At Fishing Point many large trees belonging to the original forest remain, although some lumbering has been done. Some of the southern trees in this botanical paradise are sycamore or boxwood, hackberry, locust, box elder, hickory, cottonwood, and roughbark walnut. To-day the oak, maple, elm, basswood, whitewood, etc., are plentiful. Red cedar was originally both abundant and of large size. The oldest house on the island, about three-quarters of a mile northeast of Scudder, on property known originally as the Fox farm, is a log structure built entirely of red cedar. Wild-grape vines festoon the roadsides, particularly along the shore line where dikes or sand dunes are located.

A very large white oak, perhaps the largest and oldest in southern Ontario, is located close to the shore on the grounds of the Pelee Point Club at the northwest corner of the island. Measurement of its trunk at 5 feet from the ground showed a circumference of 16 feet 6 inches, or a diameter of 5 feet 3 inches (see photograph "A" on page 80). Its age is probably 300 to 400 years. A group of four oaks on the property of Roy Hooper, about a mile west of Scudder, were measured, but the diameter of the largest of these was only 3 feet 8 inches at the same height above the ground. Many large cottonwood trees grow on the east shore.

Transportation

The distance from Scudder dock at the north end of the island to Leamington is 16 miles, and to Kingsville about the same. The SS. *Pelee* of 461 gross and 219 net tons serves the island during the season of navigation. This boat is 149 feet long, has a 27-foot beam, and draught of about 11 feet. Motor cars are transported to and from the island at a reasonable charge. In winter mails and passengers are carried by airplane from the mainland to the island. Roads on the island are mostly gravelled. Those built on the top of dikes are somewhat narrow.

Ice covers the lake from the island to the Ontario shore in winter. Navigation commonly opens April 1. In 1934 the first steamer reached the island on April 2. Dr. Bigsby reported an ice field in Lake Erie as late as May 12, in 1821.[2]

> On the 12th of May, 1821, the steamboat could not proceed on account of the ice. From an adjacent eminence, the lake was seen to be covered with it in one compact mass, as far as the eye could range.

Ice forms each year thick enough to permit travel to the Canadian shore; travel over the ice to the American islands and mainland is possible in some winters but not feasible in others. Steamship service between Kingsville, Ont., and Sandusky, Ohio, affords transportation facilities to the island throughout the navigation season.

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[1] Thaddeus Smith, op. cit., p. 46.
[2] J. J. Bigsby, op. cit., p. 360.

A cable to the mainland gives telephone communication with the island throughout the year.

Fish and Game

Commercial fishing, both gill and pound net, is carried on under license from the Ontario Government. In the spring and autumn members of private clubs frequent the island, chiefly for bass-fishing on the shoals and reefs in the vicinity of Pelee and adjacent islands. The Pelee Point Club at the northwest corner of the island and Breezy Point Club at the southeast corner are made up chiefly of Americans. The Quinnebogge Club of Cleveland, Ohio, owns Hen island, 5 miles to the west of Pelee, and the Chicken islands, which lie south of Hen island. There is also a club house on Middle island, which is immediately south of Pelee.

In 1927, the Ontario Department of Game and Fisheries introduced ring-necked pheasants on Pelee island. Time has demonstrated that ideal conditions prevail for the propagation of these game birds. During the past two or three seasons, under strictly limited conditions, shooting in the autumns has been permitted, with no apparent diminution in the number of birds. There are some pheasants also on Middle island, which is privately owned.

Tourist Resorts

As a summer resort, Pelee island has never proved to be more than moderately successful. There are numerous good bathing beaches, and summer cottages have been erected at several points on the island shore. A good summer hotel serves the public at West Dock, and there is a boys' camp near Scudder on the north shore. It would appear that the insular position and limited transportation facilities have been the deterrent factors. With the advent of motor cars, touring on the mainland, particularly by American visitors, has rapidly increased. This is evidenced by the great popularity of Point Pelee National Park maintained by the Federal Government.

Organization and Social Conditions

Thaddeus Smith states that the assessment roll of 1898 showed the total population to be 783. To-day the figure is about the same. It was 700 in 1889, when the Act was passed amending the charter of the Township of Pelee, originally organized in 1868. Although a part of Essex county, the island because of its isolated position was granted certain powers of towns and cities not ordinarily possessed by a township, such as dividing the island into 4 school wards. Two school-houses were erected in 1870. To-day there are four, the one at the north end of the island being a continuation school. There are two post offices, Scudder and Pelee Island, the latter being located at West Dock. There are also stores at both points, that of A. M. McCormick and Son at West Dock, now run by Norman McCormick, a grandson of the pioneer settler, being a large general store. There are five churches: Anglican, Roman Catholic, two United, and a mission.

A rural telephone system is installed having cable connection with the mainland. Docks are located at Scudder and West Dock, and the *Pelee* calls at both. The distance by boat from West Dock to Windsor or Detroit is 53 miles. The municipality has a debt incurred for drainage and shore protection. Taxes are high, and the financial depression since 1929 has been keenly felt.

Marsh Reclamation

The official survey of the island by A. Wilkinson, P.L.S., in 1867 showed a total area of 10,138 acres. Assessed land in 1898 shows 9,657 acres and in

addition 107 acres non-taxable used for school and church purposes. In 1847 P. D. Salter, Deputy Provincial Surveyor, made the first survey of the island. He computed the marsh land at 5,413 acres and the low wet timbered land at 2,000 acres. There were three marshes, two small ones and the Big marsh of over 4,000 acres extending right across the island, making passage from north to south impossible except along a narrow strip of sandy beach. It was always covered with water from one to five feet deep and a heavy growth of aquatic vegetation. In 1878 Lemuel S. Brown, of Cleveland, Ohio, bought 625 acres of land on the east side known as "Middle island." Within it was a marsh of several hundred acres. In a year of low water he grew crops successfully in the margins of the marsh land, and conceived the idea of draining it. He interested Dr. John M. Scudder, of Cincinnati, in his hobby, and between them they bought from the McCormick family for $2 an acre the entire Big marsh with the adjacent wet timbered land. In 1888, steam dredges were put to work and 12 miles of canals cut. The canals led to a pumping station where the water was lifted and emptied into the lake. The South marsh, 470 acres in extent, was next drained by Messrs. Duvelle and Lewis of Sandusky, Ohio, who bought it along with 100 acres of upland. Dr. Scudder lived only a few years after the drainage of the Big and Middle Island marshes. Some of the reclaimed land was sold, but much of it fell to his heirs. Brown expended more money on the enterprise than he could afford, and much of his interest passed to other hands.

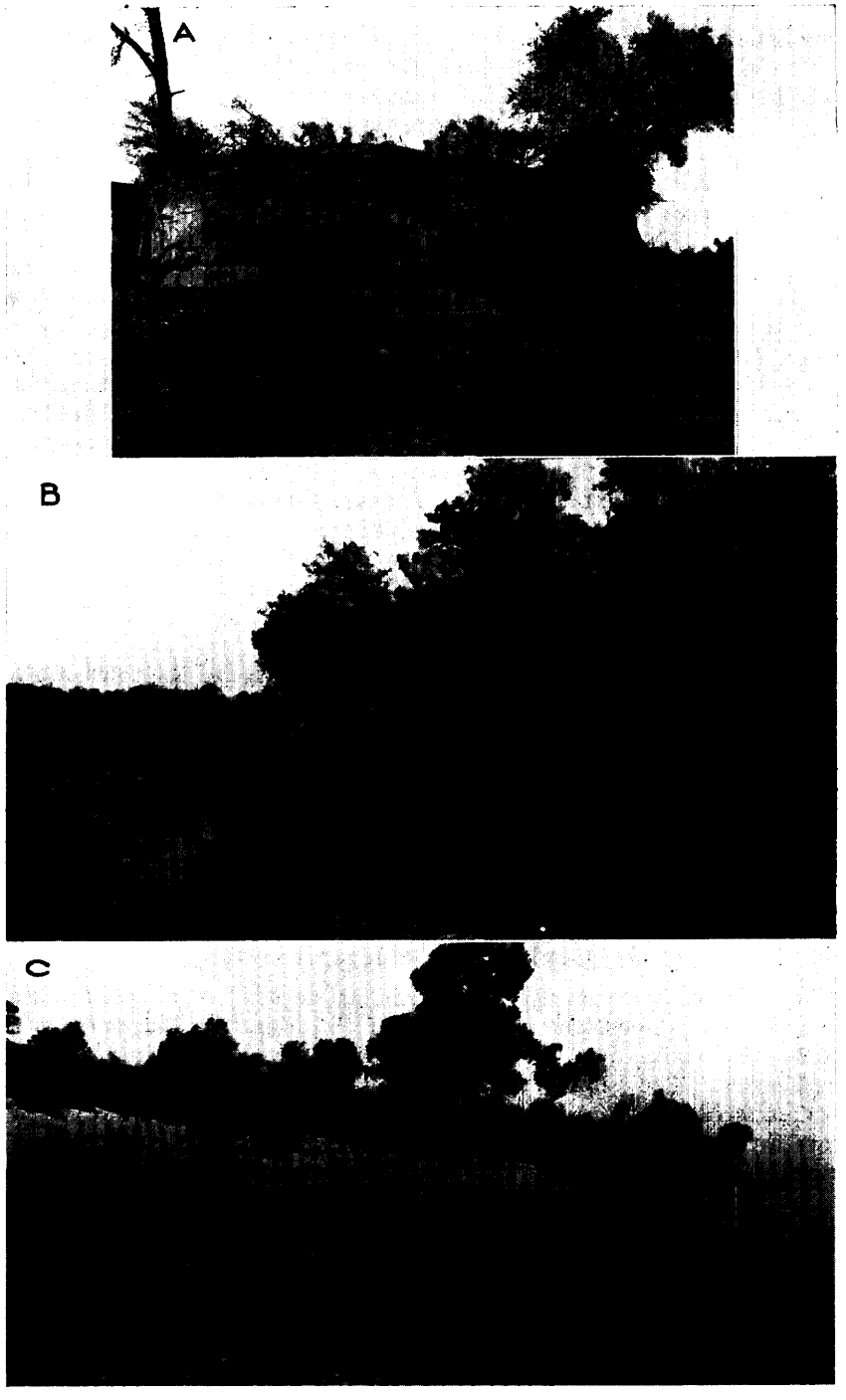
Later the whole drainage scheme was put in charge of the township council. Some $22,000 was borrowed in debentures, and the canals were deepened and additional pumping stations installed, making a total of five. These are still operated, usually for about two months during the spring of the year, and for other short periods when the occasion warrants. The general level maintained in the canals is about 5 feet below lake level. Embankments or dikes in places rise as high as 10 feet above canal water level, and serve for roads. The debenture and maintenance cost is assessed against the lands benefitted. The reclaimed land is a vegetable muck overlying clay subsoils.

Outline of Geological History

The human history of Pelee island is, as we have seen, short and simple, falling into two periods, the occupation of the island by the Indians and its occupation by white men. Both probably fall within an interval of a few hundred years. The geological or physical history of the island, however, is highly complex and covers a vast period of time. Instead of hundreds, millions of years are represented by the accumulation and shaping of the materials from which the island is made. The rocks comprising Pelee island represent two classes: consolidated and unconsolidated sediments. The latter includes the sands, gravels, and clays of the island and are of recent origin, having been produced and transported to their present location during or since the ice age. The limestone nucleus of the island, which consists of sea shells and calcareous sediments of chemical and organic origin, was formed on a Devonian sea bottom many millions of years before the glacial period.

Following the long ages when the limestones and shales of southern Ontario were accumulating on the sea bottom there came a period of uplift when the continent assumed outlines somewhat resembling those of the present. The Devonian and Carboniferous seas withdrew. The destructive erosion of running streams began to carve a drainage system out of the sea bottom deposits. Rivers flowed where the Devonian sea had been. Two of these rivers, which have been

Photo A by W. R. Rogers; photos B and C by E. M. Kindle



A—Limestone cliff, facing east and northeast, scored by deep glacial flutings rising at a high angle, half a mile west of Scudder dock, Pelee island, May, 1934.

B—Limestone polished and deeply graved by glacial action, west of Scudder, Pelee island, June, 1933.

C—Dune ridge and beach, east shore of Pelee island.

called Ancient Dundas river and Buffalo river,[1] appear to have done the chief work in carving out the basin in which Lake Erie now lies. Continental uplift, which stimulated stream erosion and lowered the temperature, continued until the northern half of North America stood probably a thousand feet or more above its present level. In late Tertiary times the general high elevation of the continent combined with high precipitation resulted in a continental ice cap, which at one time reached as far south as the Ohio river. During the ensuing glacial period southward-moving glaciers transported vast quantities of earth, rock, gravel, and sand, which blocked the drainage systems throughout the northern part of the continent. When the ice eventually withdrew, the Great Lakes and thousands of smaller lakes were left behind in the debris-blocked river valleys of pre-glacial times.

It will thus be seen that the Lake Erie islands are the product of the sculpturing agencies of ancient and long-vanished rivers supplemented at a later period by the planing, polishing, and excavating work of the great continental glaciers. On the east shore of the island the wide shallow grooves cut by the ice-embedded boulders display admirably the graving power of the ice. In the limestone cliffs facing the lake half a mile west of Scudder, deeply cut glacial grooves rise from the lake surface at an angle of 40 degrees; these were formed as the glacial ice moved upwards over a limestone hillock (see photograph on page 84).

Nearly all of the Lake Erie basin east of Pelee island has been carved out of Devonian shales; the basin to the west is cut largely in Silurian limestone. As the shales are less resistant than the hard limestones, the water east of the island is relatively deep, whereas to the west it rarely exceeds a depth of 30 feet. The western islands represent the erosion remnants of a limestone plateau which originally overlooked a lowland now covered by the deeper middle and eastern part of the lake.

Glacial Geology

Glacial striae are well displayed at most localities on Pelee and the adjacent small islands where the limestone is exposed near the shore line. In the outcrops on the northern part of Mill point on Pelee island the striae seen in a groove 12 feet wide and 18 inches deep trend N. 85° E. Most of the striae observed trend within 2° to 5° of east-west. At one point on the southeast shore outcrops of two sets of striae are well preserved; the older set trends N. 78° E., and the younger, less distinct ones, N. 17° E.

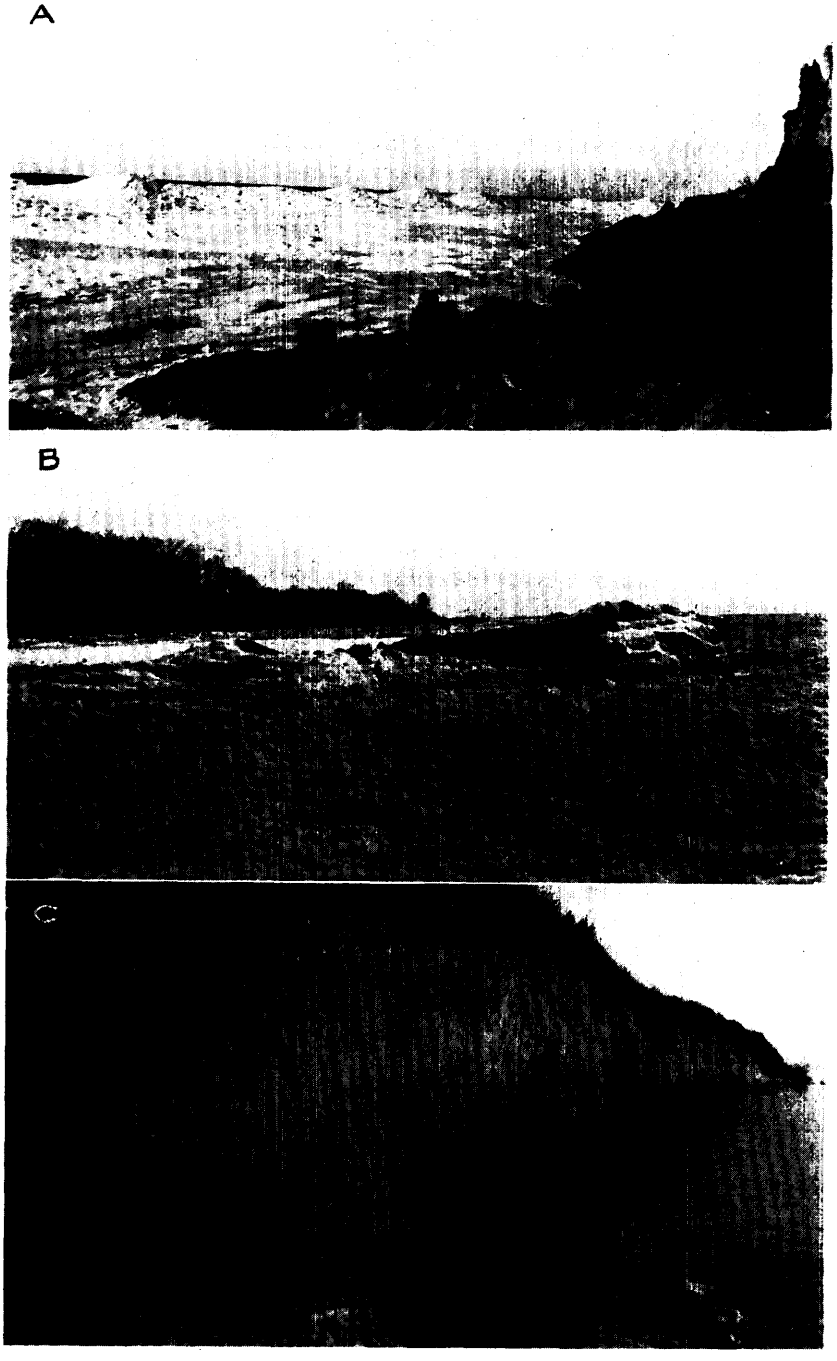
Near the southeast corner of Middle island striae were seen trending N. 80° E., approximately the direction of the long axis of the island. On the north side of this island very large ice-scoured grooves, some curving, also occur near lake level. The largest has a width of 20 feet and depth of 2 feet 3 inches.

Limestone lies near the surface over a considerable area in the southern third and in the northeastern part of Pelee island. There is also a limestone area northeast of the old stone dock on the west side of the island. A considerable part of Pelee island is composed of glacial till, a light-buff clay with numerous small stones, gravel, and boulders. This till accumulated during the glaciation of the Lake Erie basin on the lee side of two or more detached and slightly elevated limestone areas, which except for the glacial clay mantle uniting them would now appear as separate islands.

The best exposures of the glacial clay occur on the west side of the island two-fifths of a mile south of West Dock. Brownish-buff till in vertical exposures

[1] A. W. Grabau, "Guide to the Geology and Paleontology of Niagara Falls and Vicinity," N.Y. State Mus., Bull. 45, 1901, p. 45, (fig. 6).

Photos by E. M. Kindle



A—Clay cliff, 10 miles west of Point Rowan, north shore of Lake Erie, protected by ice attached to shore in late winter. Note wave-built ridge of ice at water's edge.

B—Ice attached to shore, with floating ice in front, north shore of Lake Erie, 10 miles west of Point Rowan.

C—Clay cliff exposed to erosion, half a mile south of West Dock, west shore of Pelee island, June, 1933.

8 to 10 feet high facing the lake were here exposed to wave action in 1933. All of the drainage canals are cut in the till and the thin layer of lake or marsh deposits that overlie the till in the reclaimed areas. Various wells have been sunk near the west shore of the island in the glacial till without reaching the limestone. Some of these have yielded a very strong flow of water. A well sunk on the farm of Horatio Stewart in the northwest quarter of the island, 300 feet from the west shore and 130 feet north of the line between lots 64 and 65, passed through 125 feet of clay and sand before reaching bed rock. The 125-foot thickness of Pleistocene deposits shown by this well discloses evidence of the existence of a pre-glacial valley more than 100 feet deep which separated the northwestern limestone area from another limestone area in the southern half of the island. The mantle of silt left by glacial ice unites two pre-glacial limestone hills and probably joins two others in the area that is now Pelee island. It also suggests for the western part of the Lake Erie basin pre-glacial valley bottoms at least 100 feet below the water level of Lake Erie.

Erosion

A clear understanding of the source and origin of the several kinds of unconsolidated sediments at Pelee island involves the untangling of a variety of closely related facts. The glacial clay or till which forms a considerable part of Pelee island and of the shore line of Lake Erie is the product of glacial agencies that disappeared at the end of the Pleistocene epoch. Shore line alteration began with the birth of Lake Erie on the retreat of the ice cap from its basin. But destruction and alteration of the present shores of the lake by the agencies of erosion, the water of streams, waves, and lake currents, began when the Great Lakes had shrunk in volume to their present level, long after the ice cap had vanished.

Examples of destructive erosion in Lake Erie include Spit island, which was located near Sandusky and composed entirely of unconsolidated sediments. This island disappeared completely about 1860. Eagle island in Sandusky bay in 1820 had an area of 134.42 acres. In 1904, less than 2 acres of it remained.[1]

Evidence of the considerable retreat of the Lake Erie shore line north of Pelee island has been recorded by the writer.[2] Professor Coleman has estimated that the retreat of the Scarborough clay cliffs east of Toronto has been at the rate of 1.62 feet per year. He concludes that they formerly extended lakewards of their present position an average distance of 2½ to 3 miles.[3] A survey of the Lake Huron shore line in Sanilac county, Michigan, made in 1823, compared with a resurvey by the Michigan Geological Survey of the same shore line in 1901 showed a total recession of 449.46 feet, or an average of 5.7 feet per annum. In the high water years of 1870-71 and 1885-86, the shore retreat at Lexington, Mich., is reported to have approached a rate of a rod per year.[4]

A rate of erosion much higher than any reported for the Great Lakes has been recorded for an island in Chesapeake bay. Hunter[5] found that the cutting at Sharp's island for a 10-year period had been at the rate of 110 feet per year.

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[1]E. L. Mosely, "Formation of Sandusky Bay and Cedar Point," Proc. Ohio State Academy of Science, 13th Ann. Rept., 1904, p. 190.

[2]E. M. Kindle, "Erosion and Sedimentation at Point Pelee," Ont. Dept. Mines, Vol. XLII, pt. 2, 1933, pp. 5, 6.

[3]A. P. Coleman, "Wave Work as a Measure of Time: A Study of the Ontario Basin," Amer. Jour. Sci., Vol. 44, 1917, pp. 351-359.

[4]C. H. Gordon, "Wave Cutting on West Shore of Lake Huron, Sanilac County, Michigan," Rept. Geol. Surv. Mich. for 1901 (1902), pp. 283-290 (Figs. 5-7).

[5]J. Fred Hunter, "Erosion and Sedimentation in Chesapeake Bay around the Mouth of Cheptank River," U.S. Geol. Surv., Prof. Paper 90B, 1914, p. 15.

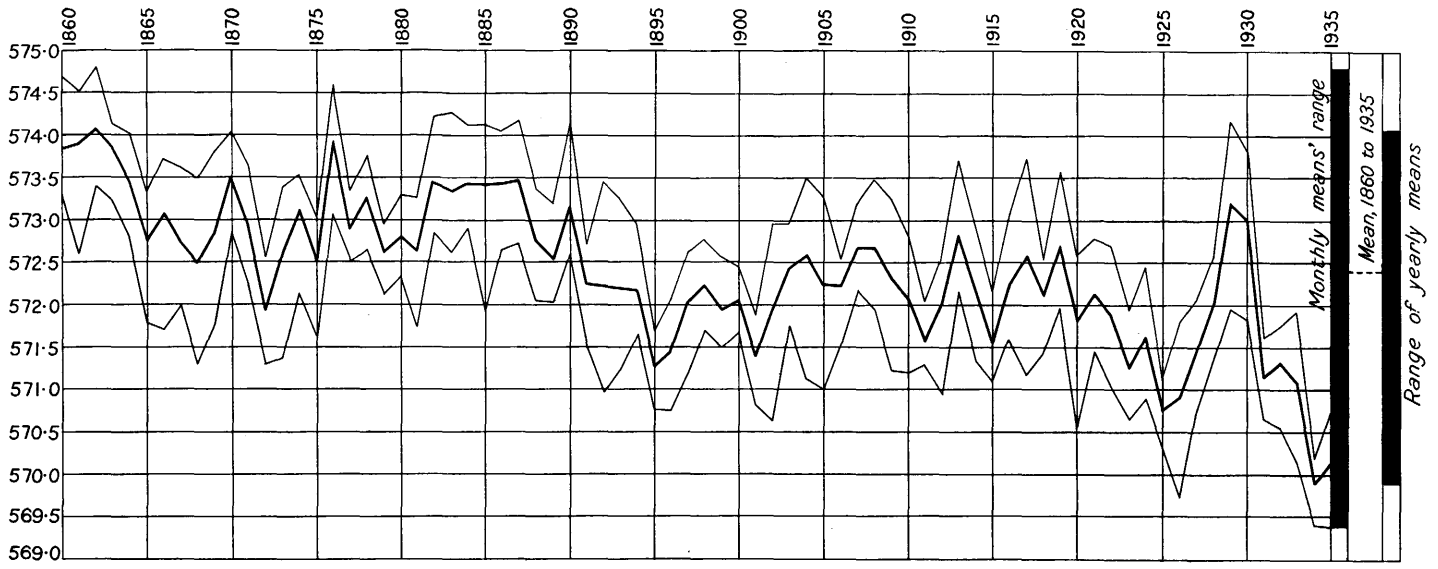


Fig. 3—Water surface elevations of Lake Erie from 1860 to 1935 (yearly means, also maximum and minimum monthly means of each year) as recorded by the Department of Railways and Canals and the Canadian Hydrographic Service, Department of Marine, Ottawa. Elevations in feet above mean sea level are referred to U.S. Lake Survey datum of 1903 adjustment. High water of 1838 was 575.11 feet above mean sea level.

His study of the island led him to predict that it "will probably be entirely effaced before 1950." The very high rate of erosion, as compared with anything reported for the Great Lakes, is doubtless due to the fact that the erosion rate is low during the low-water cycles which periodically effect the Great Lakes, while this factor never operates to reduce erosion on the sea coast. In connection with another Chesapeake bay island with an average annual erosion rate of 15 feet per annum, Hunter points out that "the spit at the end of the point has persisted throughout a period of 62 years."[1] While nearly all spits shift their positions from time to time, they are apt to be the most persistent parts of any shore line composed of unconsolidated sediments.

The disintegration of the glacial clay as it has been eroded around the shores of Lake Erie and the accompanying sorting of its constituents by waves and currents into fine, easily transported silt, sand, gravel, and boulders has supplied the sands and gravels of the Pelee island beaches. Three samples of glacial till collected by the writer were subjected to mechanical analysis. The resulting ratios of gravel, sand, silt, and clay are as follows:—

Sample No.	Gravel (more than 2 mm. diam.)	Sand (2 to 0.1 mm. diam.)	Silt (0.1 to 0.01 mm. diam.)	Clay (less than 0.01 mm. diam.)
1	8	18.4	17	56.6
2	4	19.4	20.4	56.2
3	3	18	17.6	61.4

Sample No. 1—Shore of Lake Erie 15 miles east of Leamington.
Sample No. 2—West shore of Pelee island.
Sample No. 3—Lake bottom west of Fishing point.

The approximate ratios of the content of sand to gravel per pound of till, determined on 455 grams of sample, are as follows:—

	Ratio
Sample No. 1	4:1 (100 to 27.5)
Sample No. 2	2:1 (85 to 40).

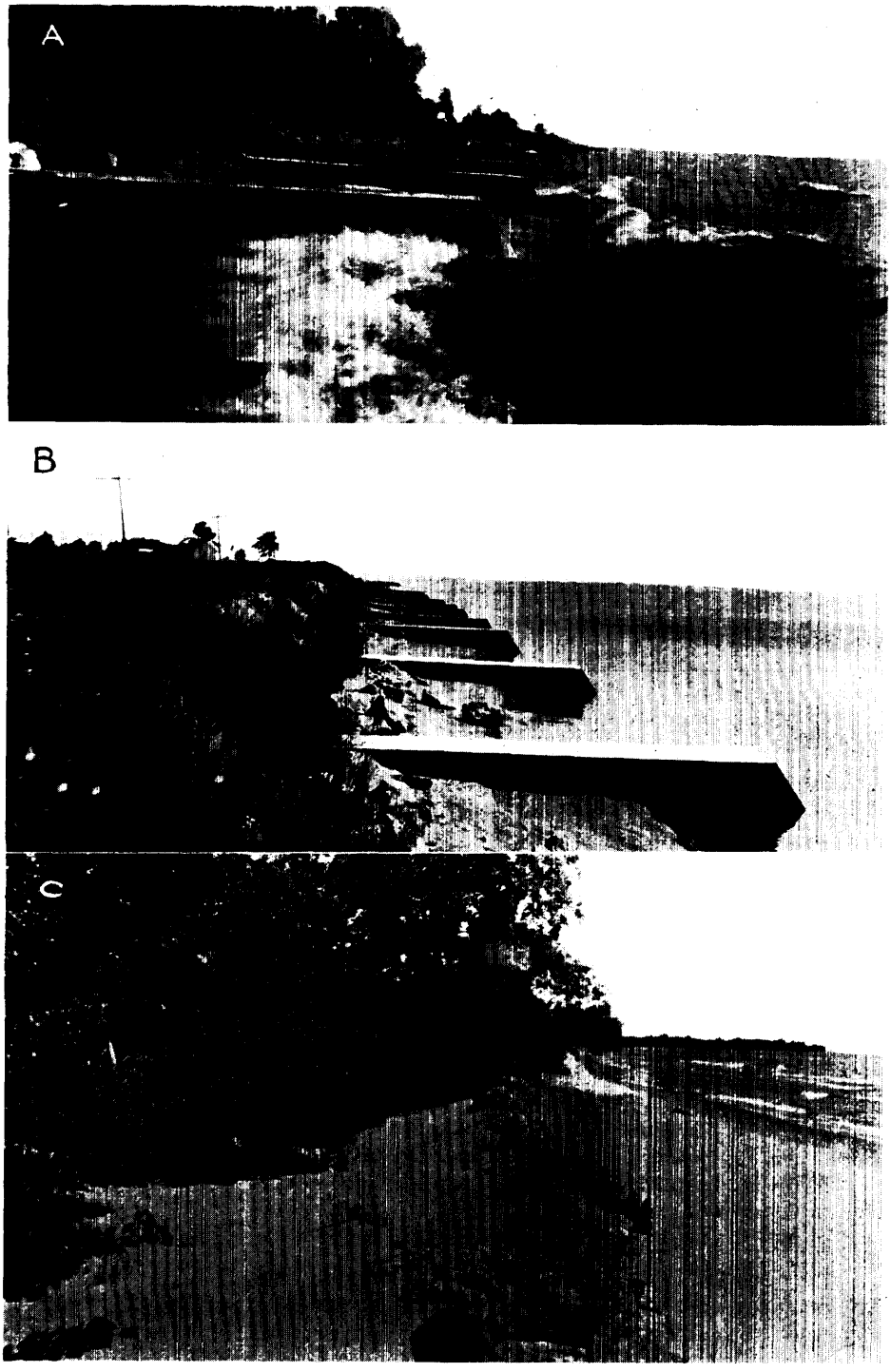
Since the whole of the west shore and the greater part of the east shore of Pelee island consist of glacial till and other unconsolidated deposits, erosion is a major problem in the island. In islands like Middle island, with a shore line entirely of limestone, this problem does not exist. Erosion becomes an acute problem on Pelee island during those years when the lake level stands high and is more or less forgotten in periods of low water like that of the last three years. Erosion is closely connected with climatic conditions. Precipitation and evaporation are the climatic factors regulating the water levels of most lakes. Evaporation rate is "a function of the local temperature and humidity of the air and of the velocity of the wind." Any marked divergence between different lakes in the trend of the water level is the result of differences in some or all of these climatic conditions.

Water Levels in Lake Erie

There are two familiar kinds of water-level changes in lakes: the periodic, corresponding with the different amounts of precipitation that characterize different seasons of the year; and the non-periodic changes, which are independent of the annual oscillations and represent intervals of various lengths greater than a year. We are here concerned only with the latter. Rising rivers and lakes in northern latitudes are the barometers that annually record in spring

[1]J. Fred Hunter, op. cit., p. 12.

Photos by E. M. Kindle



A and B—Groynes on the west shore of Pelee island, 1933.

C—Riprap at top of beach accumulating wind-blown sand on landward side, east shore of Pelee island, 1933.

the arrival of changed weather conditions. In like manner rising or falling lake levels that develop over a period of years give notice of climatic changes, which often come so slowly as to be not easily detected without such evidence.

The records of water levels in Lake Erie cover a period of nearly three-quarters of a century. Official records kept by the Department of Railways and Canals and the Hydrographic Service, Department of Marine, are available from 1860 to date (see Fig. 3). Other records by Whittlesey[1] supplement the official records back to 1819. The graph of these records shows cycles of quite variable length. The yearly means for Lake Erie with maximum and minimum of monthly means for each year from 1860 to 1935, are shown as elevation above sea level in Figure 3. In the 75-year record from 1860 to 1935, only one period as long as 5 years of nearly uniform high-water means appear.

These non-periodic long-period rises and falls of the lake surface have a maximum amplitude approximating 5 feet. The graph shows six periods since 1860 when the mean maximum water level rose to 574 feet above sea level, or higher. Colonel Whittlesey's records show, prior to 1860, two periods, 1838 and 1852, when Lake Erie appears to have reached this high water-level.

The low-water cycles represent periods when lake-shore erosion proceeds so slowly as to be of negligible importance. During high-water cycles, however, erosion is greatly accentuated. In the case of reclaimed land lying, as much of that in Pelee island does, near or below average lake level, serious damage may result in a few days or even a few hours through the conjunction of a high lake-level and a great storm from the southeast or southwest.

The high water-levels which prevailed in 1917 and 1918 and again in 1929 and 1930 resulted in active erosion of parts of the southwest shore. Retreat of the boulder-clay cliffs made it necessary to move the road back from the shore south of West Dock.

Groynes

Following the extreme high water of Lake Erie in 1929 and 1930, measures were taken by the Township Council, with assistance from the Provincial Government, to protect the island shore-line at weak points. Concrete groynes were placed where most needed. These have a cross-section of 5 feet square and an average length of 30 feet. They were placed at right angles to the bank. Forty-two of these were built between West Dock and the east-west road three-fifths of a mile south (see photographs "A" and "B" on page 90). On this particular section of the shore the greatest single stretch of protection was provided. At strategic points elsewhere on the island, groynes were placed, both of concrete and coarse rubblestone construction. The latter type was placed parallel to the shore line.

Shore-line Materials

The somewhat quadrangular outline of Pelee island is due largely to limestone ledges, which form the shore line at the northwestern and southeastern corners of the island, at Middle point on the east coast, and on the south shore east of South bay. These four stretches of hard rock give a total of about 3⅓ miles of limestone shore on which waves and currents have no perceptible effect. The relatively greater width of the shallow-water zone on the east as compared with the west side of the island is largely the result of the gentle gradient of the bed rock as it passes below lake level on the east side. Here the zone, which has a depth of 2 to 5 feet, has generally a width of from 50 to 200

[1]Chas. Whittlesey, "Variations in the Levels of the Lakes," Can. Jour. and Proc., Vol. II, 1854, pp. 25-27.

feet, whereas on the west shore it is seldom more than 50 feet wide.[1] Storm waves accordingly expend on the east side a larger proportion of their energy on the bottom and a smaller proportion on the shore line than they do on the west side. The difference between the depth of water and the beach slope, and the consequent effect of wave action on the east and west sides of the island, is registered in the sharp contrasts in the character of the beaches on these two sides. On the west shore the beach is composed of coarse sand and gravel. The east-shore beach consists of a fine sand of much lighter colour than that of the west shore. The fine texture of the sand and the low gradient on the east shore, when uncovered at low stages of the lake, makes a beach comparable with Florida beaches in firmness of the sand. On the lower part of the east-coast beach, which was very wide in the low-water year of 1933, tracks of wheels and footprints left only slight impressions; whereas on the west-coast beach, with its coarser sand and steeper slope, the more yielding sand recorded footprints in the usual way. The contrasts in the firmness of different beach sands has been treated in some detail elsewhere.[2] The relative coarseness of the sand on the east-shore beach is shown in the table below, in which sample No. 6 is beach sand and samples Nos. 4, 7, and 8, dune-ridge sand from the east shore. Samples Nos. 5, 9, and 10 are sand from the sand spit at Fishing point at the south end of the island, the coarsest, No. 10, being from a point near the tip of the spit and Nos. 5 and 9 from points nearer the base of the spit. Samples "A" and "B" are from Atlantic beaches in Florida, "A" being from St. Augustine.

MECHANICAL ANALYSES OF SANDS[3]

Sample No.	Gravel (more than 2 mm. diam.)	Coarse sand		Medium sand (0.5 to 0.25 mm. diam.)	Fine sand		Less than 0.1 mm. diam.
		2 to 1 mm. diam.	1 to 0.5 mm. diam.		0.25 to 0.2 mm. diam.	0.2 to 0.1 mm. diam.	
4	.....	trace	.....	52	44.5	3.5	trace
5	.....	.....	4.6	68.2	24.1	3.1	trace
6	.....	trace	.....	8.6	69.4	22	trace
7	.....	trace	.....	51.8	45.4	2.8	trace
8	.....	.....	1.1	40.6	49.8	8.5	.....
9	1	80.5	18		.5		
10	20.2	70.2	9.6	.....	.....	.....	.....
A	.....	.....	.....	.....	10	88	2
B	.....	.....	.....	.....	35	60	5

The two sand analyses ("A" and "B") from hard-sand beaches of the south Atlantic coast show that sand from the east beach of the island (sample No. 6) approaches in fineness of grain the sands of the Florida beaches. All of the hard beach sand of the east shore of the island tested on the ground passes through a 30-mesh sieve except a fraction of 1 per cent. Only about 40 per cent. of the sand on the bar separating the south-shore marsh from the lake goes through a 30-mesh sieve.

The sand beaches on the east shore of Pelee island generally have behind them a ridge of dune sand. A continuous ridge of dune sand with an average height of 8 to 10 feet above lake level extends from the most northerly of the

[1]U.S. Survey of the Northern and Northwestern Lakes, Coast Chart No. 6, Lake Erie.
[2]E. M. Kindle, "Dominant Factors in the Formation of Firm and Soft Sand Beaches," Jour. of Sedimentary Petrology, Vol. 6, No. 1, 1936, pp. 16-22, Figs. 1-3.
[3]By F. J. Fraser.

limestone outcrops on Mill point to the end of the road across the island, a distance of about 2,000 feet. Immediately south of the road end the sand ridge rises to a height of 11 feet above lake level. Much of the ridge is covered by trees, including elms, shell-bark hickory, and willows. Wild-grape vines, coarse, long-bladed grass, and the timber give the sand protection against wind and waves. In places cutting-off of the timber has started wind erosion of the ridge. Just south of the road end, the ridge is 11 feet high and the base of a large oak is being buried.

Near the pumping station on the east side, about midway between Mill point and Middle point, a boulder ridge has been built at the top of the beach 500 feet north and 100 feet south of the end of the drainage ditch. Sand is accumulating behind the boulders. South of the end of the ditch, weighted brush has been placed on the lake side of the boulders. The weighted brush is an effective first line of defense against wave erosion so long as it resists decay. The use of willow branches placed with a view to taking root is a preferable plan.

The dune ridge north from the east end of the road across the island for some distance maintains about the same character and elevation as that to the south. At the end of the road south of Middle point, however, it fades out into a mixture of limestone shingle and sand about 4 feet high. The northeast arm of the drainage ditch terminates opposite this low shore line, from which it is separated by a lagoon and a double dike 6 to 7 feet above the water level of the canal and lagoon (see Fig. 4).

The ridge reaches its maximum height near the northeast corner of the island, where in 1933 it had an elevation of 17 feet above lake level about 500 feet southeast of the abandoned stone lighthouse. In this vicinity it is 50 to 60 feet wide. About 200 feet southwest of the old lighthouse the dunes had an elevation of 18½ feet above lake level in 1934. The ridge drops to 6 or 7 feet at Lizard point, where it is crescent-shaped and covered with trees 10 to 12 inches in diameter; at one point waves have cut through the ridge. South of the point grape vines and Virginia creeper closely cover the ridge, which is separated from the lake margin by a hard, fine sand beach 30 to 45 feet wide. Footprints leave scarcely a trace on this beach. A fine set of cusps built of fine gravel on the hard, crescent-shaped beach were observed on the south side of Lizard point. The points of the cusps were spaced at distances of 5 to 10 feet with 1 to 3 feet of sand between the gravel cusps. Francis P. Sheppard has recently discussed the cyclic character of the gravel cusp formation and the destruction observed by him on the Pacific coast,[1] where the neap-tide periods introduce a factor not present in their production and effacement in inland lakes.

Southeast of the lighthouse some 600 feet of shore line has been protected by large limestone blocks, some as much as 5 feet in length by 1 foot in thickness, placed on willow branches. Many of these branches have taken root, and the combination of riprap and growing willows promises to be a very effective type of shore protection.

About 600 feet of riprap has been placed on the low sandy shore a third of a mile east of Scudder. Cliffs and ledges of limestone afford shore protection for the western third of the north shore of the island. The limestone ledges which protect the northwest corner of the island from erosion disappear a short distance south of the detached mass of limestone known as Hulda's rock. The west shore of the island south of the northwest corner consists of clay with a veneer of coarse sand and gravel along the shore. A mile and a half of the

[1]Francis P. Sheppard, "Gravel Cusps on the California Coast Related to Tides," Science, Vol. 82, No. 2124, 1935, pp. 251-253.

north half of this shore line coincides with the original lake margin of the North marsh, and the shore line is low. A section on this part of the shore exposed 3 feet of buffish till full of pebbles, capped by 4 feet of silt.

The most effective check on the drift of sand and gravel on this shore is an old stone dock built forty-five years ago. This dock shows very clearly that the direction of the major drift of sand and gravel is south. On the north side of the dock the sand and gravel have built out from the shore line about 155 feet, and on the south side about 100 feet. One of a pair of groynes north of the dock shows more sand on the north side than on the south. Between the old stone dock and West Dock riprap protects the shore for about two-thirds of the distance. Willows at the top of the beach supplement this protection.

A stretch of 1⅓ miles between the end of the east-west road across the island and Mosquito bay consists of clay cliffs, 6 to 13 feet in height, which have long been subject to erosion during cycles of high water in the lake. These are partially protected by a series of groynes.

The series of cement groynes which protect the shore south of West Dock for a half mile were carefully examined by the writer, twice in June, 1933, with reference to relative amounts of sand and gravel on the north and south sides of these structures. Accretions of sand and gravel on the north side were found with a few exceptions to be notably in excess of those on the south sides. In the few exceptions, there was little difference in the quantity on the two sides. Within the two-day period which separated the two observations the quantity of sand and gravel had perceptibly changed but the north side remained about the same.

Sand and Gravel Accretions at Groynes

The figures in the following table are observations made by the late W. R. Rogers on October 11, 1933, and May 10, 1934, between West Dock and the last groyne of the series extending south therefrom one-half mile to the east-west road. Measurements indicate the distance between the top of the accumulated sand and the top of the adjacent groyne at the mid-length on both the north and south sides. The groynes are numbered from south to north. Their cross-section is 5 by 5 feet, and their average length 30 feet; they are spaced on the average 60 feet apart. On May 10, 1934, the road at the south end was 13 feet above water level and at West Dock 9 feet. The groynes were built in the autumn of 1931.

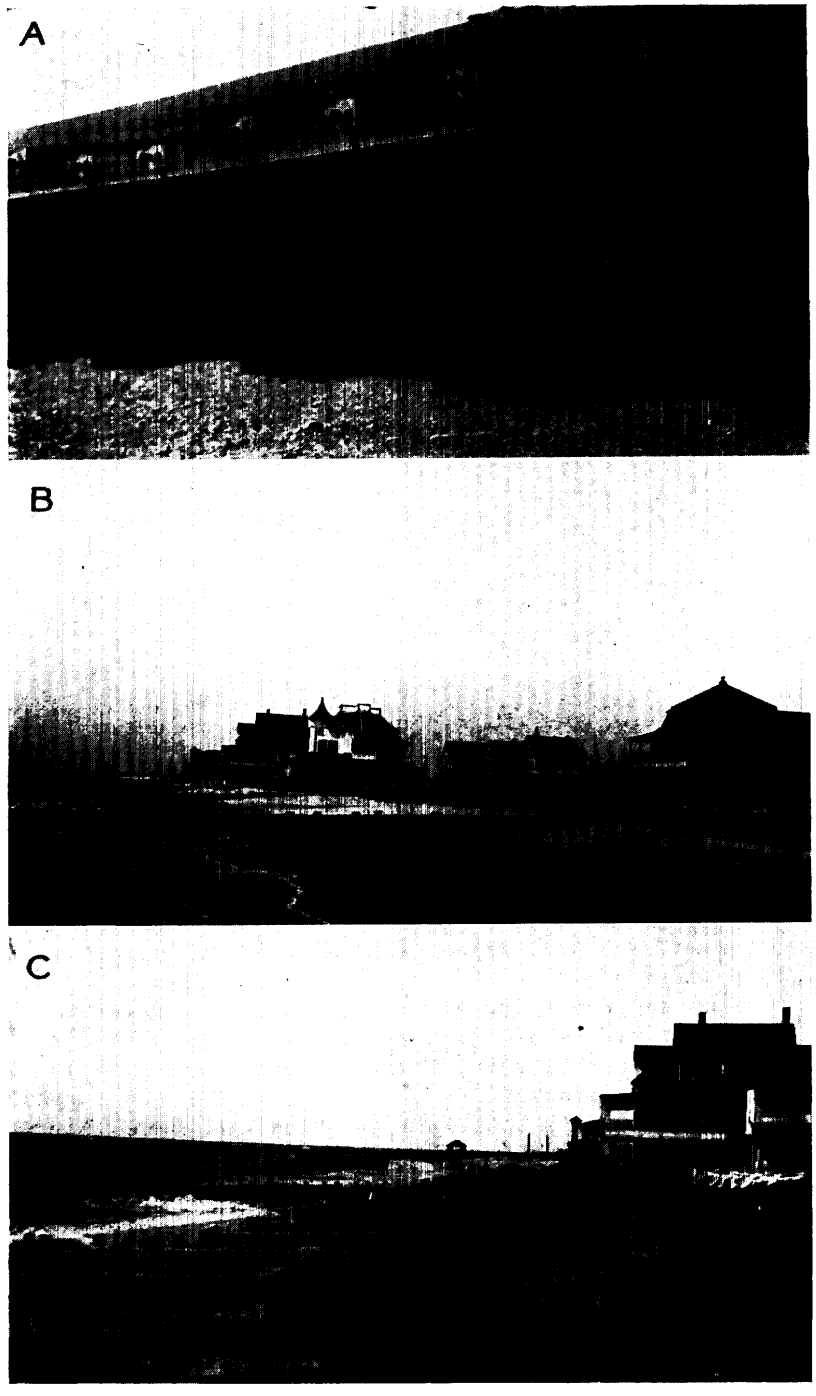
Groyne No.	South side		North side		Remarks
	Oct. 11, 1933	May 10, 1934	Oct. 11, 1933	May 10, 1934	
	inches	inches	inches	inches	
1	undetermined	36	.....	29	Photo taken Oct. 11, 1933.
2	28	36	16	25	Photo taken May 11, 1934.
3	26	28	18	28	
4	18	25	24	20	
5	22	28	20	24	
6	22	25	22	20	
7	22	24	18	18	
8	24	26	22	27	
9	24	22	21	22	
10	23	25	23	27	
11	22	28	18	25	
12	24	31	19	26	
13	29	27	24	24	
14	36	36	30	31	Coarse stone around ends of groynes between Nos. 16 and 22.
15	27	31	32	32	
16	31	36	31	34	

Groyne No.	South side		North side		Remarks
	Oct. 11, 1933	May 10, 1934	Oct. 11, 1933	May 10, 1934	
	inches	inches	inches	inches	
17	38	43	30	35	
18	.....	.....	.....	.....	Wooden crib.
19	32	36	36	32	Coarse stone around these 3 groynes.
20	34	37	36	36	
21	39	36	39	38	
22	36	34	30	34	Ice-house between Nos. 22 and 23.
23	34	34	35	36	
24	40	39	42	40	
25	40	42	28	32	Wood crib at end.
26	34	36	34	36	
27	.....	.....	.....	.....	Wood crib.
28	29	33	27	33	
29	.....	36	.....	30	
30	.....	30	.....	29	
31	.....	32	.....	30	Opposite McCormick's store.
32	.....	31	.....	32	
33	.....	27	.....	27	
34	.....	31	.....	30	
35	.....	33	.....	31	
36	.....	25	.....	26	
37	.....	28	.....	29	
38	.....	34	.....	30	
39	32	30	22	18	
40	.....	.....	.....	.....	Remains of old stone dock extending 150 feet from shore, about 9 inches out of water on May 10.
41	.....	20	.....	25	Hotel Pelee crib dock.
42	.....	42	.....	44	Last groyne 250 feet south of West Dock.
43	.....	.....	.....	.....	West Dock.

It will be noted that in most cases accretion of sand and gravel has been greatest on the north side of the groynes and that in general less sand was present in May, 1934, than in October, 1933.

The evidence supplied by the groynes that the general movement of gravel and sand along the west shore is southward under the impulsion of waves and currents is supported and confirmed by the sand and gravel spit called Fishing point, which extends southward from the southwest corner of the island. The sand and gravel that moves southward along the west shore finds a resting place in this foreland, which had in 1933 a length of 1,950 feet.

Fishing point resembles in important features the much larger Point Pelee foreland of the mainland to the northeast of Pelee island (see Fig. 6). Both extend nearly due south into the lake. The wide timbered basal part of each has developed along the southwestern margin of a triangular-shaped marsh. The initial stages in the development of Fishing point are recorded in three or more rather inconspicuous sand ridges, which traverse the woodland west of a small marsh approximately parallel with its western border. An irregular sand-dune belt 100 to 150 feet wide, which rises in some places as knob-like elevations to a height of about 9 feet, runs near the west side of the timbered base of Fishing point. West of this zone of dune sand a belt of gravel and sand some 225 feet wide, without forest, slopes gently toward the lake and suggests a shore line of rather recent origin (see Fig. 6). Both the dune sand ridge and the belt of growing west side shore line are features common to both Fishing point and Point Pelee. Near the southern end of vegetation on Fishing point, however,



A—Groynes of sheet-steel piling held together by heavy timbers, Cape May, N.J.

B—Groynes of heavy timber supplemented by a breakwater of piles and stone, Cape May, N.J.

C—Shore at Cape May, N.J., with three lines of defence—a cement breakwater, two lines of piles enclosing large blocks of stone, and groynes of heavy timber and piling.

uprooted trees indicate that erosion has been cutting into the shore. In its early stages of development this foreland had a direction trending southeast as did Point Pelee.[1] In the eastern part of Lake Erie foreland structures move eastward instead of westward.

At Fishing point we have an example of a steady southerly drift of sand and gravel down the sides of the island from the Pelee Passage area and the northwestern shore of Lake Erie. The natural tendency of the active agencies of erosion at work on the west and east sides of Pelee island is to sort out from the eroded till the sand and gravel content, transport it southward and leave it in the sand spit at the south end of Fishing point.

Instead of building directly out into the lake as Fishing point does, some foreland structures develop in a direction roughly parallel to the shore line, as those at Rondeau and Erie on the Lake Erie shore and that at Toronto in Lake Ontario. The north point of the bar or spit that forms Toronto harbour, before it has been stabilized by piling and riprap, moved westward at the rate of 19 or 20 feet per annum. Hugh Richardson[2] stated in 1854 that it had advanced about 400 feet in 22 years. On the southern part of the Lake Erie shore at Erie, Pa., the direction of littoral drift is eastward. The easterly drift of shore-line material is demonstrated by changes developed during the recent history of the westerly pointing pistol-shaped bar that forms Erie harbour. The tendency there is toward differential erosion with shore destruction on one part of the foreland structure and rapid accretion on an adjacent part. The lake currents and waves constantly tend to carry away the sand that forms the narrow barrel-shaped western part of the long bar and deposit it on the north-eastern side of the bulbous end. In spite of the efforts of the harbour engineers to check or counteract this tendency, W. L. Morrison, Superintendent of the State Park and Harbour Commission at Erie, states: "We are satisfied that Presqu'île has drifted east at the rate of about one-half mile in a hundred years."[3] The Park Commission and the Federal Government have built over three miles of bulkhead and 10 jetties for groynes, all constructed at different angles with the object of checking this troublesome eastward shore-line drift of sand at Presqu'île harbour.

A little more than half the distance across the lake, from Point Pelee to Marblehead peninsula on the opposite side, is occupied by the three islands, Pelee, Middle, and Kelleys. During stormy periods the passages between these islands and the mainland and the inter-island passages develop currents which are probably stronger than any actual measurements indicate, since such measurements are not easily made when currents have their maximum strength. Hind[4] has described the condition under which lake currents are developed at a comparable though much narrower constriction in Lake Manitoba, which has nearly the same length as Lake Erie.

> At the Narrows, Lake Manitobah, a northerly wind will cause a strong current to flow through the straits into the lower or southern half of the lake; while a south wind produces a corresponding effect in the northern portion, and perceptibly increases the volume of water in the Little Saskatchewan. At the Dog's Head the current sometimes approaches the force of a rapid when the wind blows from the north. . . . At Manitobah House I observed the water rise fully eighteen inches before a storm.

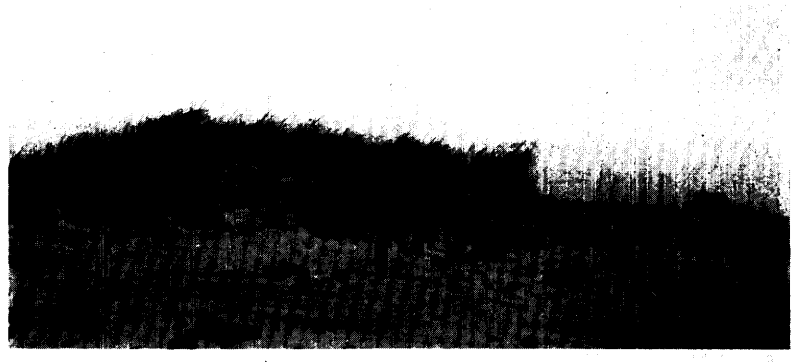
[1] E. M. Kindle, "Erosion and Sedimentation at Point Pelee," Ont. Dept. Mines, Vol. XLII, pt. 2, 1933, p. 11.

[2] Hugh Richardson, Reports on the Preservation and Improvement of Toronto Harbour, Can. Jour. Proc. Can. Inst., Vol. 2, 1854, p. 37.

[3] Letter to W. R. Rogers, July 26, 1933.

[4] H. Youle Hind, "The Canadian Red River Exploring Expedition of 1857 and the Assinniboine and Saskatchewan Exploring Expedition of 1858," Vol. 2, p. 75.

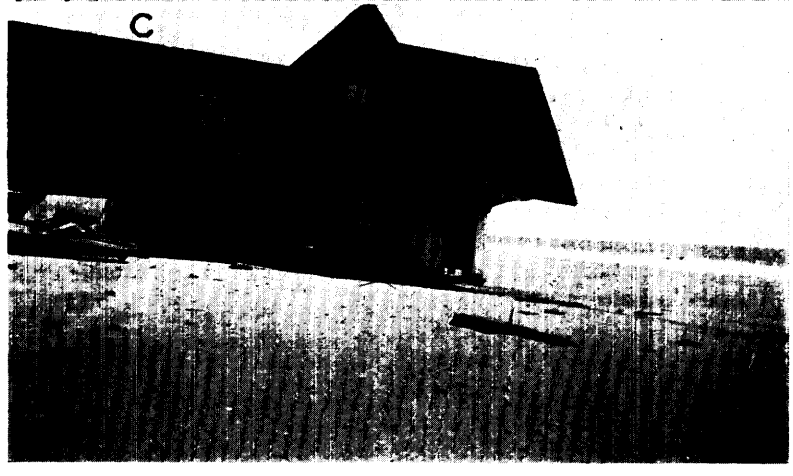
A



B



C



A—Shore of Cape May, N.J., showing piles in last stages of decay and recent erosion.

B—Shore of Cape May, N.J., showing chair, 200 yards from the shore, partly buried by the September hurricane of 1936.

C—House wrecked by the September hurricane of 1936, Cape May, N.J.

Development and Prevention of Erosion

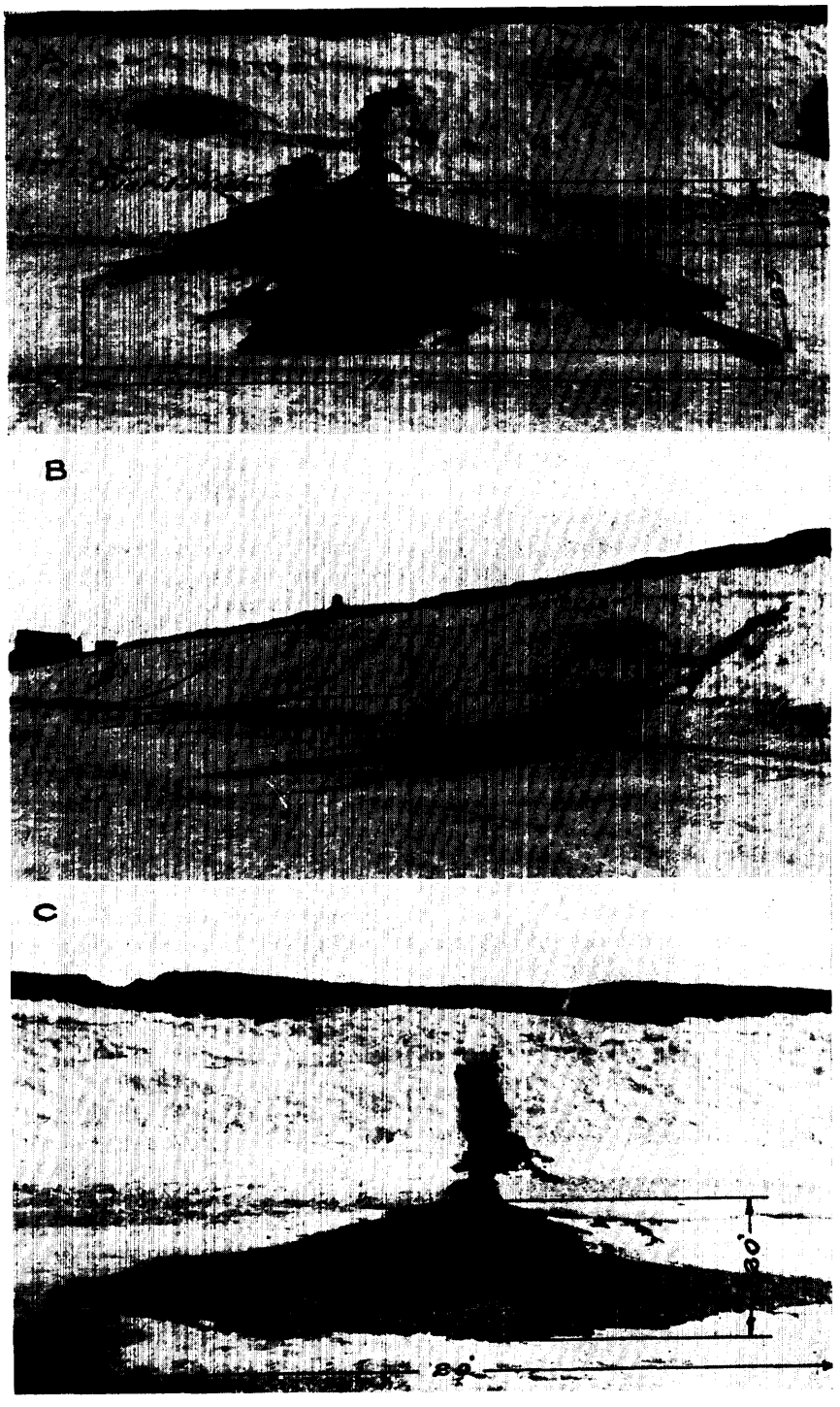
Checking erosion at an early stage if great loss is to be avoided is of the same order of importance as checking a fire before it has gained headway. In the case of buildings burned new ones may be erected, but land bordering lake shores or river banks when destroyed by waves or stream erosion can seldom be restored. Erosion problems, accordingly, should have consideration and solution if possible at an early stage of their development. It usually happens, however, that the existence of such problems is ignored till the necessity of removal of a highway inshore or the imminent destruction of a lakeside residence compels attention to them. In the case of lake-shore problems, it is particularly important that they should have attention during the low-water cycles, when the artificial structures and the vegetation that may help to solve them can be most easily constructed and established.

Photographs taken by the author shortly after the September hurricane of 1936 (see photographs on pages 96 and 98) at Cape May, New Jersey, show in graphic manner both the immunity from damage that modern shore protection will give and the destruction of land and buildings that its neglect engenders. Almost any piece of lake or sea shore can be protected from destructive erosion if the value of the land and buildings involved justifies the cost of the work and structures required. The parts of the New Jersey coast examined by the writer just after the September hurricane of 1936, which had wind velocities on the Atlantic coast reported to be around 100 miles per hour, were damaged only where groyne and pile protection had been neglected or permitted to decay (see photograph "A" on page 98).

The erosion problem at Pelee island is confined to shore-line protection. The absence of streams, the nearly level surface of the reclaimed marsh lands, and the slight relief of the higher land eliminate the types of erosion associated with running water. During one-third of the year the island is immune from shore waste and the possibility of flooding of drainage canals in stormy periods. The protection afforded by lake ice begins in November or December and ends in April. The ice border that fringes the shore may develop a definite ice-ridge wave barrier near or at the open water margin which affords a bulwark against wave action along the shore line after nearly all of the lake ice has disappeared (see photographs "A" and "B" on page 86). Erosion may and often does begin at the top of clay or sand cliffs at an early stage of the spring thaw. Sand swallow holes on the north shore of Lake Ontario are sometimes responsible for the initial stages of erosion. The melting snow often develops subsurface channels, through which tiny streams of mud and sand, originating often at gravel-clay contacts, flow down on to the surface of the ice at the foot of clay or silty cliffs (see photographs on page 100). These short-lived mud springs and rivulets carry a considerable amount of sand on to the ice at the foot of clay cliffs, much of which eventually floats away and contributes its quota of sand to the lake. It is immediately after the spring thaw that the caving of clay and silt cliffs is likely to be most active.

With the disappearance of the ice barrier in the spring the clay shore of the west coast of Pelee island becomes exposed to the direct wave impact developed by westerly storms (see photograph "C" on page 86). On the sea coast the force of wave impact is sometimes equal to 2 or 3 tons per square foot. When the waves strike the shore in an oblique direction the effect of successive waves is to move the sand, gravel, and shingle along the shore and set up littoral drift of coarse materials. Protection of the shore can be accomplished best by enlisting the energy of the waves in the work of building up accretions of sand

Photos by H. B. R. Craig



Views showing early spring stage of erosion with sediments escaping through channels in the snow and accumulating on the shore ice, Kaministikwia river, Fort William.

and gravel that will protect the foot of the clay banks from wave impact. The construction of groynes at right angles to the shore line secures such protection by trapping the sand and gravel between the groynes as it moves along the shore (see photographs "A" and "B" on page 90). Vertical wall revetments which directly oppose and check wave erosion do not gather any accretions from the littoral drift and they are eventually apt to be undermined by wave action.

All of the groynes in a series are not equally successful in trapping sufficient sand and gravel to protect the adjacent bank, and the shore end may in certain cases even be cut around and erosion of the bank increased instead of retarded. When accretions fall short of the need for adequate shore protection the groynes may be supplemented by stone blocks at the shore line with willows planted on the land side of the stone. The protective influence against erosion of willow roots can scarcely be overestimated. A single slender rootlet may be many feet in length. A bank slope held together by hundreds of rootlets is well protected also against slumping during the spring thaw period.

In the case of high banks of clay and silt or sand, such as those bordering parts of the north shore of Lake Erie, where frequent slipping of the bank makes the restoration of protective vegetation difficult, log fences built across the slumping area parallel the top of the bank will greatly aid in the re-establishment of a vegetation-protected slope.

The east shore of Pelee island has in the dune-sand ridge, which borders the shore just above the beach, a very important natural bulwark against lake invasion. The breaks in it include the limestone shore near Middle point and Mill point, where it is least needed.

The importance of protecting the vegetation covering dunes as a means of retaining their protection against wave erosion and preventing their destructive migration over adjacent lands through wind drift was recognized as early as 1758 on Long island and at other points on the Atlantic coast. An act was passed that year prohibiting the farmers from turning their cattle out to graze on the Long island dunes, which formed a natural protection against coast erosion. The east-shore sand-dune ridge on Pelee island has in places been denuded of its original cover of forest and vines, and the efficiency of the dune sand as a protection against storm waves has been reduced. Restoration of the shrub, vine, and forest cover and its permanent protection should be one of the features of the island's coast-protection plans (see photograph "C" on page 84).

Where a dune ridge is too low for adequate shore protection, it is reported that a new littoral dune may be established, in some dune belts, landward of the original one or the original dune raised by erecting a continuous line of paling fence, using boards about 6 feet long by about 6 inches wide, with a 1-inch space between. The sand accumulates on both sides of the fence. When only a few inches of the boards remain uncovered the planks are pulled up about 3 feet, the process being repeated as required for the necessary height.

A method of beach protection which was tried over stretches of lake frontage totalling about 6,000 feet in the Point Pelee district has been described in some detail as an appendix[1] to the report on "Erosion and Sedimentation at Point Pelee." This patented system includes planting white willow poles in shallow trenches trending across the beach at 4-foot intervals, supplemented by wire-mesh groynes at 100-foot intervals along the beach. These consisted of 30-foot lengths of highway-type interlocking guard fence, 24 inches in width, supported

[1]W. R. Rogers, "Beach Protection and Reclamation," Ont. Dept. Mines, Vol. XLII, pt. 2, 1933, pp. 23-26.

Photos by E. M. Kindle

A



B



C



A—Undercutting of bank at the end of vegetation, Fishing point, Pelee island, June, 1933.

B and C—Shore protection methods used at Cape May, N.J. Note the pile and heavy timber groynes at right angles to shore revetment.

by angle-iron posts. These groynes, which were expected to trap moving beach materials and protect the trees in early stages of growth, when inspected in 1932 were found in most cases to have been knocked down and destroyed. Later observations will indicate more fully the effectiveness of this experiment.

At Pelee island the abundant supply of limestone at points near the lake shore where additional protection of the beach is needed should encourage its use in future attempts to check shore-line erosion. Large blocks of limestone placed on the beach as a riprap structure parallel to the shore, covering and protecting the lakefront ends of willow poles planted in shallow trenches, would give protection to the willows till they had taken root and become well established. Willow brush, if lightly covered with sand in the early spring and used as a riprap base, might be expected to supply an abundance of young shoots, which in a few years should with their roots and stems afford excellent binders for beach sand and act as centres of further accretions from littoral drift (see photograph "C" on page 90).

A very effective type of shore protection used on the Atlantic coast at Cape May is shown in photographs "B" and "C" on page 102). These include piles reinforced on the land side by heavy stone blocks and flanked on the shore side by groynes of heavy timber bolted to the piles.

Fishing Point Foreland

Land forms consisting of unconsolidated sediments that have but slight relief and project out into lakes or seas beyond the general coast line are called by geographers "forelands" (see photograph "A" on page 102). Such structures are recognized, even by the Esquimo legends, to have had a recent origin. The Esquimo village of Tigara located near the tip of the Point Hope foreland on the northwestern coast of Alaska preserves a legend recorded by John B. Driggs, which fully recognizes the youthfulness of the great finger-like gravel foreland on which it stands. There once lived on the Arctic coast of Alaska, according to this legend, a native named Tooloogigra, who was credited with miracles even in his childhood.

When grown to manhood, he was once making a long ocean voyage with some companions in their kyaks and, being thirsty, he longed to reach some land where fresh water could be procured. His thirst becoming urgent, he cast his spear, and the western portion of the land now known as Point Hope arose from the water. The village of Tigara is at the extremity of the storm-swept point, which used to extend westward much further.[1]

Fishing point like other forelands "arose from the water," and its antiquity is less than that of the southern part of the island from which it projects. The close observer may see the growth of this sand spit, which sometimes in a single day amounts to an accretion of several inches along the shore line.

The first plan of Pelee island was made in 1847 by P. D. Salter, Deputy Provincial Surveyor, on a scale of 30 chains to the inch. This is on file in the Indian Department in Ottawa, and indicates that the tip of Fishing point at that time took a turn to the west, and pointed approximately south S.30°W. The earliest accurate survey of Pelee island was made by A. Wilkinson, P.L.S., in 1866. The plan of 1896 by Alexander Baird shows the bar at the south end of Fishing point extending a long distance into the lake (see Fig. 5). It is reported that previous to the removal of sand and gravel for commercial purposes there was always a passage about three-quarters of a mile wide between Middle island and Fishing point bar. During the 4-year period, 1915 to 1918 inclusive,

[1]John B. Driggs, "Short Sketches from Oldest America," Geo. W. Jacobs & Co., Philadelphia, 1905, p. 60.

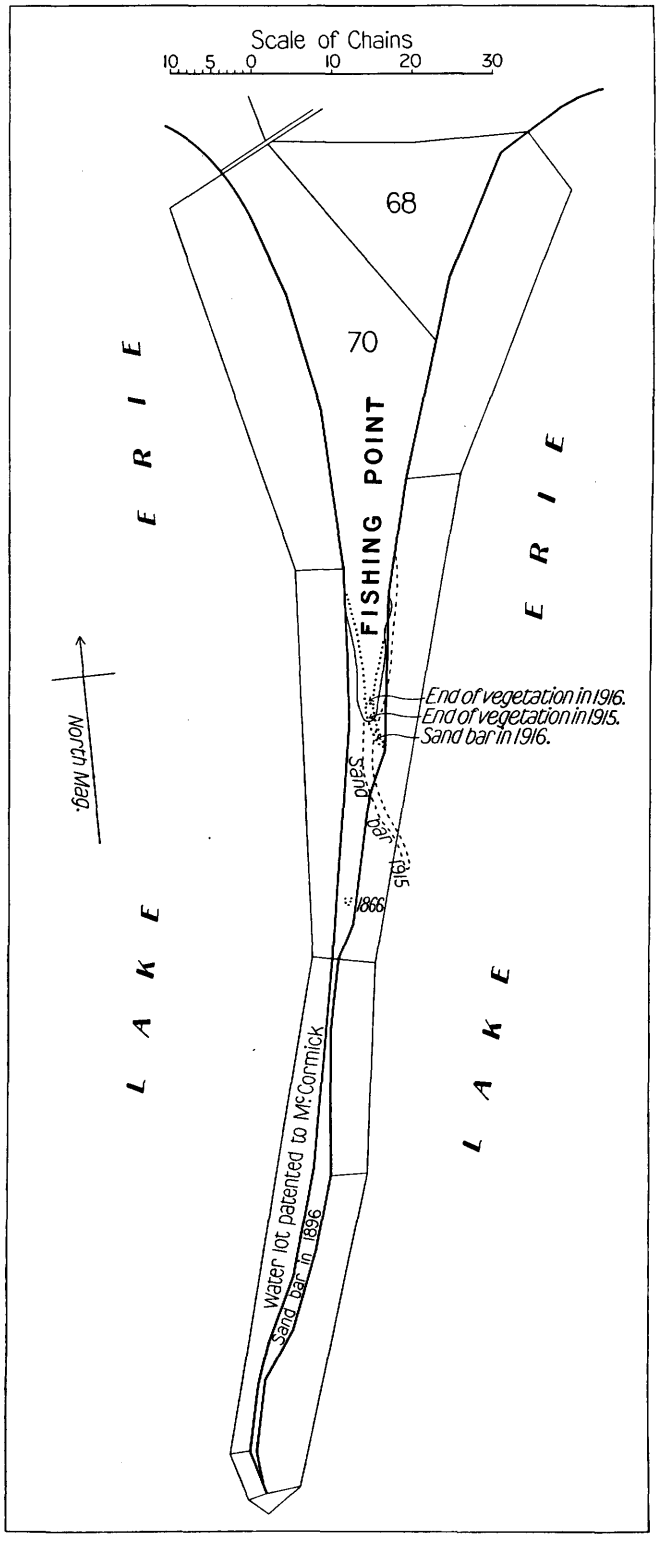


Fig. 5—Plan of Fishing point, Pelee island, showing the Alexander Baird plan of 1896, and positions of the spit in 1866, 1915, and 1916.

the Customs records show that approximately 2,400,000 tons of sand and gravel were removed. No licenses to remove sand and gravel were granted in 1919 or subsequently.

When the writer first visited Pelee island in 1919 after the exploitation of the gravel and sand deposits, Fishing point terminated in a spit about 45 feet long, trending S.65°E. magnetic. The two surveys of Fishing Point spit made by the late W. R. Rogers in 1933 show considerable differences respecting the position and direction of parts of the spit. The southward trend of Fishing Point spit indicates the general average direction of currents about the south end of the island. The base of the spit at the end of vegetation was 6 feet above lake level in June, 1933. About 300 feet farther south the highest part of the spit was 3 feet to 3 feet 6 inches above the lake and showed a minimum width of 40 feet. Widening gradually southwards near the southern extremity the spit reached a width of 290 feet at its maximum breadth, with an elevation of about 4 feet above the lake. On this lower expanded tip of the spit a few young cottonwood trees, 15 to 20 inches high, had established themselves, and large numbers of Bass gull nested there.

Two maps of the spit prepared by W. R. Rogers, one in June and the other in October, 1933, are shown superposed in Figure 6. Rogers' observations on the changes shown by the surveys, separated by a 4-month interval, and those he saw taking place follow:—

> You will note the end of the point has changed as per the dotted line survey of October 11. The full line represents the survey of June 15-20. There was a southwest wind on October 11 and the bar was being cut back strongly between X and Y and for some distance in both directions from these points. There was a small pond (dotted) near the end of the point.

The October survey gives parts of the northern half of the spit a width twice that of the June survey, the growth being mostly on the east side. Rogers in making a second survey of the spit in October, 1933, found the highest point on the spit to be 5.3 feet above lake level. He also found the end of the spit had undergone considerable shifting since June.[1] Rogers revisited Pelee island in May, 1934, and found the highest point, near the southeast end, 5½ feet above lake level. Erosion on the west shore he then found to be quiescent, owing to the low-water stage.[2]

The height of this bar as noted above during a record low stage of the lake supported the evidence adduced by a Public Works engineer, A. J. Stevens, with reference to the Point Pelee spit:—

> During the years 1889 and 1912 this bar appeared above the water. By reference to the chart showing the elevations of the lake it will be seen that the bar builds higher when the lake level is low. This appears to be caused by the waves racing up the bar being smaller, leaving the sand high and causing less backwash to wear down the top of the bar.[3]

A line of sand and gravel deposits some 25 miles in length extends in a northwest-southeast direction across Essex county from Pelton to Leamington.[4] These old bar and spit deposits represent the ancient forerunners of the Fishing Point and Point Pelee spits and were formed a few thousand years ago when the shore of Lake Erie stood more than 100 feet above its present level.

The recent history of the spit is of considerable interest, since it demonstrates that the agencies responsible for its development have been able to

[1]Letter from W. R. Rogers, October 27, 1933.
[2]Letter from W. R. Rogers, May 16, 1934.
[3]A. J. Stevens, Memorandum on Pelee Point (MS), Dept. Public Works, No. 2913, Dec. 14, 1917.
[4]A. Ledoux, "Sand and Gravel in Ontario," Ont. Bur. Mines, Vol. XXVII, pt. 2, 1918, p. 37 (Fig. 18).

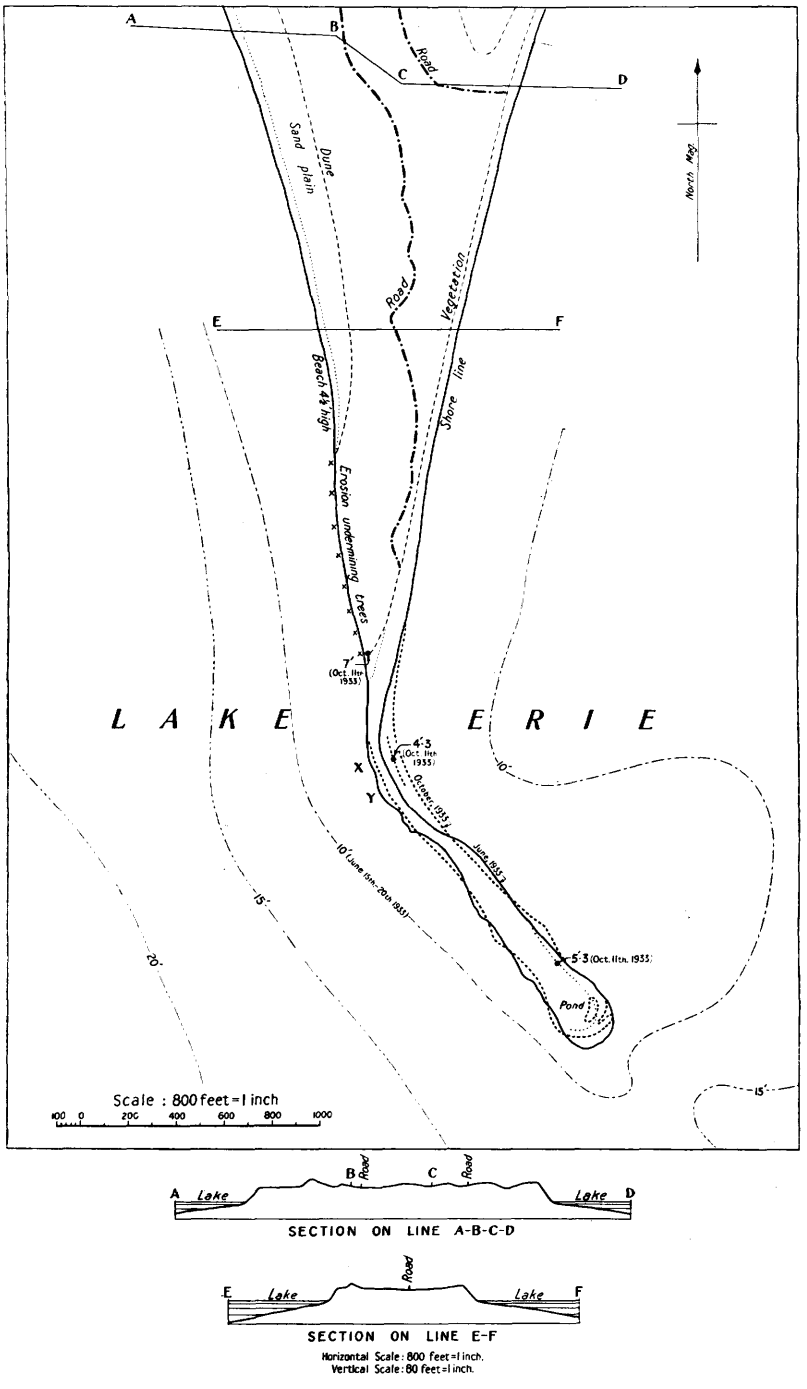


Fig. 6—Map of Fishing point, Pelee island, showing bottom contours, and positions of the sand spit in June and October, 1933, with sections across the point.

restore it within the limits of a 14-year period after it had been practically removed for commercial purposes. From a length of barely 50 feet in 1919, when it was first seen by the writer, the spit had increased to a length approximating 2,000 feet in 1933. This raises the question whether this regeneration could be indefinitely repeated if removal of the spit were permitted at intervals. Consideration of the sources of new supplies of gravel and sand, which have permitted its restoration once, affords a partial answer to this question. The clay shores of the north side of Lake Erie may be regarded as the original source of the major part of the Fishing point gravel and sand deposits. Such supplies must come largely from active erosion of the clay cliffs around the shores of the western part of Lake Erie and the shores of Pelee island. Activities directed toward checking erosion around the shores of Lake Erie have already done much to cut off new supplies of sand and gravel at their source. Future development of groyne and other kinds of shore protection will eventually greatly reduce still further the new supply from the shore line. The accumulation of gravel and sand through wave action on rocky shoals and glacial till on parts of the lake bottom sufficiently shallow to permit effective wave sorting of bottom materials will continue, but such new clastic materials will more and more continue to be trapped locally by groynes and piers along the lake shore and become a part of the shore where most needed for protection from waves. It can, therefore, be predicted that with the present aids to shore protection in use repeated restoration of the spit to its present dimensions is improbable if repeated exploitation and removal of the spit is permitted.

Its usefulness as a haven for small boats in rough weather is manifest. As a bathing beach it offers at times sharply contrasted water temperatures on the two sides, amounting to as much as 10 degrees, where the bather can have either a warm or cold bath as he may choose.

Bottom Deposits

The lake bottom in the vicinity of Fishing point sand spit was examined along a series of boat traverses extending south and east and west from the spit about as far as the target in the boat could be clearly seen through the transit at the shore stations, usually half to three-quarters of a mile. A 35-pound orange peel bucket and a light bottom sampler known as the "telegraph snapper" were used in picking up specimens of the clay, sand, gravel, and shells, which were found on nearly all of the bottom investigated (see Fig. 7).

In the area studied none of the depths encountered exceed 25 feet by more than a few inches. All of the bottom in this area is subject to heavy wave action as well as vigorous currents during great storms. This explains the entire absence from the bottom examined of the extremely fine-textured silts and ooze deposits that form the bottom deposits over extensive areas in the deeper portions of Lake Erie and Lake Ontario. All of the fine grades of silt that the lake water around Fishing point may hold temporarily during stormy weather pass, by currents and waves, to areas of deeper water and gentler currents.

The character of the dominant materials found is indicated briefly on Figure 7. In each of the two traverses on the west side, one from near the base of the spit and the other north of it, examples of clay and associated gravel occur. The clay at these points is considered to be till with a light patchy cover of gravel. The three westerly traverses starting from the southern two-thirds of the spit show gravel at most of the stations. Sand is also present in

patches or belts. A half-mile traverse south from the tip of the spit shows gravel at all of the stations. Three southeasterly traverses from the tip show both gravel and sand, the former dominant toward the west and the latter toward the southeast. A fan-shaped area extending south of the tip of the spit grades into sand towards the southeast and east. An easterly traverse starting on the east side of the tip of the spit had coarse gravel in 6 feet of water and then showed seven successive stations with fine sand only in water 14 to 19 feet deep. Fine sand is also the record for the two most easterly stations in the next traverse

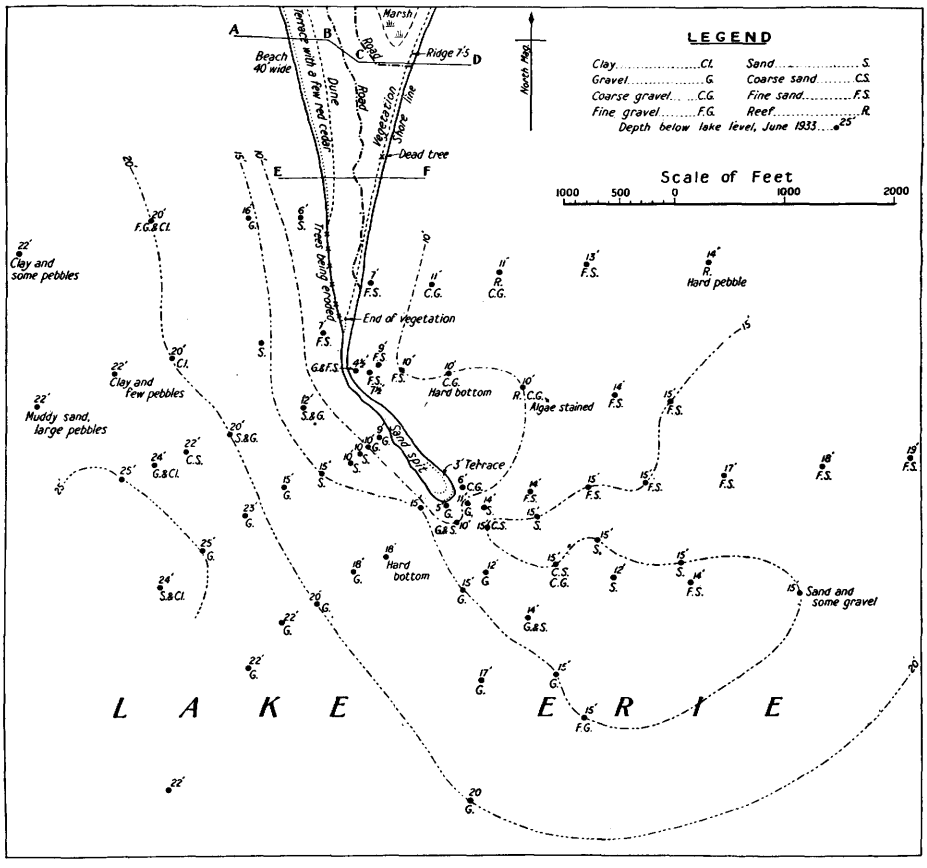


Fig. 7—Plan showing bottom deposits (June 15–20, 1933) near Fishing point, Pelee island. The sections marked by the lines A-D and E-F will be found on Fig. 6.

north. The next traverse north of this showed fine sand near the shore end and in the outer stations. These are separated by a hard bottom in depths of 10 feet where pebbles up to 3 inches in diameter were secured which had been about half buried in tough clay, the unburied half being sometimes algae-covered. Similar conditions were disclosed by the most northerly traverse on the east side where the hard pebble bottom was interrupted by patches of sand. These clay-embedded pebble reefs doubtless represent patches of pebble and boulder charged till where the battle between waves and currents prevents any lake deposits from accumulating on the bottom. Waves rolling into South bay during heavy southerly gales must develop strong southerly currents near the east shore of Fishing point, which evidently are responsible for the hard

gravel reef areas scoured free of loose materials east of Fishing point. These currents near the end of the spit meet others from the west side of the island both converging near its tip where they mutually retard their velocities and drop most of the sand and gravel in the fan-shaped area adjacent to the tip.

Paleozoic Rocks

The consolidated rocks of Pelee island consist of limestone and include only a single formation, the Onondaga (see Fig. 2). This formation enters Ontario from the State of New York at the head of the Niagara river as a narrow band forming the shore line of Lake Erie for some 65 miles. It then strikes across Lake Huron and passes under this lake west of Port Elgin. Another belt of this limestone formation strikes across the western part of the Ontario peninsula from Lake St. Clair to Pelee island and Kelleys island and into Ohio at Sandusky extending south to and beyond Columbus, where it is known as the Columbus limestone. These two north- and south-trending belts of Onondaga limestone outline the northeast and southwest limits of a highly important synclinal structure, which has yielded the major part of the oil and gas produced in Ontario.

In Pelee island the limestones lie so nearly horizontal as to show no recognizable inclination of the beds.

The physical features of the limestone are well displayed in the old Wm. McCormick quarry near the old stone dock on the west side of the island. The section here exposed is as follows:—

Section in the Wm. McCormick Quarry

	Feet	inches
Soil	4	
Light-grey massive to thin-bedded limestone	5	6
Massive single bed of limestone with one poorly defined bedding plane	7	6
Massive limestone to water in quarry	6	
Limestone below water in quarry	6	6
	29	6

Heliophyllum and other corals are freely scattered through the massive beds. A saccharoidal texture characterizes much of the massive limestone, which is represented in the quarry by many quarried blocks, the largest being 2 by 5½ by 12 feet. Stone for the canal locks at Sault Ste. Marie was secured here. Its good qualities as a building stone are shown in a house east of the old stone dock built in 1873.

The McCormick quarry is located on a limestone ridge, which is 100 to 250 yards in width and trends east and west, terminating a short distance east of the quarry. Near the barn 150 yards west of the McCormick quarry the top ledge of limestone shows numerous vertical or inclined holes, averaging three-quarters of an inch in diameter, which have weathered out to a depth of several inches. Adjacent to these in the same ledge a large, branching, plant-like impression was observed in a horizontal position, which may represent the same structure that was responsible for the upright and inclined cavities. These fuccid-like impressions also occur on the east shore at Middle point.

About 200 feet east of Hulda's rock, the detached tilted block of limestone at the northwest corner of the island, a bed of limestone, the colour of pale maple sugar, appears just at lake level and outcrops as far east as the pier at the shore end of the road traversing the peninsula. This saccharoidal rock displays numerous trail-like structures mostly parallel to the bedding. They have a diameter of about one-third of an inch.

On the north shore west of Scudder dock a bed of massive limestone rises 13 feet above lake level and is deeply scored by glacial ice on the nearly vertical face (see photograph "A" on page 84). It is followed above by 10 feet of thin bedded limestone. A quarry near the pier on the west side of North bay has a face of 23 feet 4 inches, made up as follows:—

	Feet	inches
Thin-bedded limestone top	5	
Heavy bedded limestone grading from light-coloured at the top to darker lower down; fossils abundant	18	4

Just north of this quarry a glacially scored trench 30 feet wide trends in an east-west direction.

The character of the Pelee island rocks below lake level, so far as they are known from drill records, are indicated in the log of the Horatio Stewart well (see page 111).

Fossils abound in the outcrops near Mill point at the southeast corner of the island. About 14 inches of the lowest limestone exposed there has a light-chocolate colour and fetid odour, suggesting a crude oil content.

Stauffer[1] has recognized nearly 50 species of fossils in the Onondaga limestone of Pelee island. Outcrops along the east shore afford good collecting localities for these. Photographs of the quarry stone also appear in his report.

M. F. Goudge[2] has recorded the following observations on the Pelee island limestone:—

> The chemical composition varies somewhat from stratum to stratum, but most of it can be classed as magnesian limestone. Likewise the colour varies, but the great part of the stone exposed is of dull, brownish-grey shades, with streaks of light and dark material parallel to the bedding; the light streaks are due to a prevalence of fossils concentrated in layers, and the dark streaks are seemingly coloured by organic matter. Occasional fossil cavities are filled with liquid petroleum, and the light-coloured stone is badly stained around these cavities. The stone is soft and porous and could be easily worked but, on account of the drawbacks mentioned above, it cannot be considered a high-grade stone for architectural purposes.

Well Records

Various wells on the west side of the island have reached depths of 30 to 40 feet without striking limestone. Some of these have furnished strong flows of water. Wells starting in the limestone sometimes reach water only at considerable depth. In a well on the property of Wm. Stewart, Clerk of Pelee Island Council, a small amount of sulphur water was encountered at 40 feet. Continuation of the well to 100 feet secured no water below the 40-foot horizon. In another well a short distance west of the 100-foot well abundant water is found at 35 feet. A well near the east end of the highway crossing the island from the west pumping station reached a good flow of mineral water at 112 feet. A very small flow without notable mineral content had been found in this well at 80 feet.

On the west side of the island at the house west of the McCormick stone quarry, a well 93 feet deep in limestone supplies water but has not a strong flow. Some drilling has been done on the island with oil or gas as an objective.

The Pelee Oil and Gas Company of Windsor started a well on lot 52 (Theodore Rinkel farm) on April 20, 1932. There is no complete log of this well, but

[1]Clinton R. Stauffer, "The Devonian of Southwestern Ontario," Can. Geol. Surv., Mem. 34, 1915, pp. 207-211, plates 19, 20.

[2]M. F. Goudge, "Canadian Limestones for Building Purposes," Mines Branch, Dept. Mines, Ottawa, Pub. No. 733, 1933, p. 93.

one of the drillers, J. J. Nicholls, reported that the work was stopped in September, 1932, at a depth of 765 feet. There was a good flow of gas at 760 feet, but a crevice was struck and salt water came in. This well is located about 1,000 feet north of the east-west road and 250 feet east of the Henderson road. The driller states that flooding was due to an old well with casing gone located about 1,000 feet east and to another leaking well to the north. The well was cased off at a depth of 350 feet.

Another well drilled within the limits of the big marsh on reclaimed land near the margin of the limestone island-like area that comprises the northwest corner of the island is of considerable interest because of the light that it throws on the topography of this part of the Lake Erie basin as it existed in times immediately preceding the glacial period. It is located on the farm of Horatio Stewart 340 feet east of the west shore road and 130 feet north of the line between lots 64 and 65. It was drilled in 1924 and plugged on November 1 of that year. The driller's log and water record, together with the geological interpretation of the horizons encountered, follows:—

Geological horizon	Driller's log	Thickness	Total depth	Water record
		feet	feet	
Pleistocene and Recent	Clay and sand	125	125	Sulphur water at 20 feet. Hard water at 125 feet (16-foot rise).
Detroit River series	Broken lime	155	280	Hard lime water.
Cayugan group, including Salina	Shale, sand, and chalk	300	580	Hard lime water.
	Hard lime	50	630	
	Brown lime	200	830	
Guelph(?)	Broken lime	60	890	Salt water at 750 feet, and water down to 900 feet.
	Gypsum	5	895	
	Hard lime	5	900	

Show of oil and gas was reported at 651 feet.
Casing was used as follows: 10-inch down to 125 feet; 8¼-inch to 216½ feet; 6¼-inch to 558 feet.

The first 125 feet of the record represents glacial till and younger sediments that have accumulated in the pre-glacial valleys between and adjacent to the three or more pre-glacial hills represented by the limestone areas in the northwest, northeast, and south parts of Pelee island. As this well starts in unconsolidated sediments accumulated in an ancient pre-glacial valley, the log does not include the Onondaga limestone, which constitutes the rock outcrops of Pelee island.

Thaddeus Smith in his history of Pelee island published in 1926 made the following observations on the oil and gas wells:[1]—

> Oil and natural gas have been found upon the island, but not in sufficient quantity for commercial purposes. Thirteen wells have been bored within the last five years. The first well went down to a depth of 840 feet but was not a success. Other wells were bored in the south central part of the island to a depth of 740 feet, and both oil and gas were found in several of them. Three of these were pumped and produced from 2 to 6 barrels a day, but the supply was very irregular and did not increase. Natural gas was found in the same boring with the oil just before the oil strata were reached. With the oil came also salt water strongly impregnated with sulphur and other minerals.

During the summer of 1935 a well was drilled by Pelee Petroleum Syndicate Gas, Limited, known as Syndicate No. 1, in the southeast quarter of the island

[1]Thaddeus Smith, op. cit., p. 46.

east of the Henderson road on the Theodore Rinkel farm about 10 chains south-east of the angle in the east-west road north of this property. Samples of the drill core from this well have been studied by C. S. Evans, to whom I am indebted for the correlation and details concerning sediments shown below. The well has a depth of 890 feet. The top of the well is probably about 590 feet above sea level, or approximately 18 feet above mean lake level. The following record indicates the lithological characteristics of the beds underlying the Onondaga limestone, which is the only formation on the island above lake level. These several formations rise gently towards the head of the lake until an anticlinal axis, which probably passes in a north-south direction between Middle Sister and West Sister islands, is crossed.

	Formation	Depth below surface
		feet
Fine-grained, light-grey and grey-buff limestone, somewhat granular	Onondaga	8–60
Fine, granular, grey-buff and grey-brown dolomitic limestone	Detroit River	60–130
Fine, granular, dark-brown dolomitic limestone		130–140
Fine, granular, dark-brown dolomitic limestone with 50 per cent. chert		140–150
Fine-grained, grey and grey-buff dolomitic limestone with 5 to 10 per cent. chert		150–170
Fine, granular, dark-brown dolomitic limestone		170–180
Fine-grained, grey-buff dolomitic limestone with 5 to 10 per cent. chert		180–200
Fine-grained, grey to brown dolomitic limestone, somewhat granular		200–240
Fine, light-grey to brown dolomite	Bass Island	240–300
Fine-grained, grey shaly dolomite	Salina	300–310
Fine-grained, light grey-buff dolomite		310–320
Samples missing		320–330
Fine-grained, light grey-buff dolomite	Salina	330–350
Fine-grained, light-grey dolomite		350–360
Samples missing		360–370
Fine, granular, buff and brown dolomite with 5 per cent. quartz and 5 per cent. chert	Salina	370–380
Samples missing		380–390
Grey shaly dolomite and dolomitic shale, 20 per cent. anhydrite	Salina	390–460
Grey shaly dolomite and dolomitic shale, 20 per cent. anhydrite and 30 per cent. fine-grained, buff dolomite		460–480
Fine-grained, buff dolomite, 15 per cent. anhydrite		480–500
Fine-grained, buff dolomite and grey shaly dolomite, 10 per cent. anhydrite		500–530
Fine-grained, buff and grey-buff dolomite, trace of anhydrite		530–550
Grey dolomitic shale and shaly dolomite with 20 per cent. soft, buff shale and 20 per cent. anhydrite		550–560
Fine-grained, buff and grey buff dolomite, 10 per cent. anydrite		560–570
Fine, granular, grey-buff dolomite		570–580
Fine-grained, buff dolomite and grey shaly dolomite, 10 per cent. anhydrite		580–630
Grey shaly dolomite and dolomitic shale 10 per cent., anhydrite 5 to 15 per cent		630–670
Fine-grained, buff dolomite, 50 per cent. anhydrite		670–680
Grey dolomitic shale and shaly dolomite, 20 per cent. anhydrite		680–690
Fine-grained, buff and grey-buff dolomite, 50 per cent. anhydrite		690–705
Grey shaly dolomite and dolomitic shale with fine-grained, buff dolomite, 30 per cent. anydrite		705–730
Fine-grained, buff and grey-buff dolomite, 70 per cent. anhydrite		730–760
Fine-grained, grey and grey-buff dolomite		760–815
Chiefly anhydrite		815–830
Fine-grained, grey, buff, and grey-brown dolomite		830–855
Coarsely crystalline grey and grey-buff dolomite	Guelph(?)	855–890

Middle Island

A limestone island rising 22 feet above the lake at its highest part and located just north of the International boundary bears the name Boundary island among many fishermen and others familiar with it. On lake charts it commonly appears as Middle island. A few inches of clay and soil supports a verdant cover of grass and forest trees, dominated by the hackberry. An abandoned lighthouse stands near the east end and a well-built club house near the middle of the island.

The spine-like projection pointing due west suggests, on lake charts, a sand spit similar to the southerly trending Fishing point, Point Pelee, and others on the mainland, but with a discordant direction. It is, however, not a sand spit, but a long, narrow limestone band, united to the island by a coarse gravel

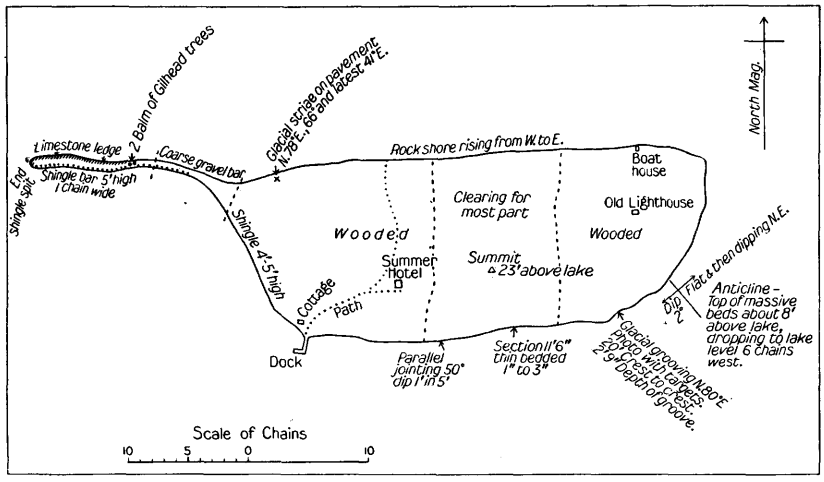


Fig. 8—Map of Middle island, June 15, 1933. The area without the spit is about 52 acres; the width, about 15 chains; the length (with spit), about 57 chains.

bar. Two lone trees standing near together on the eastern half of the westward-pointing finger constitute the only conspicuous vegetation on this projection, which extends into the lake about 1,000 feet. Shingle is thrown up on the south side to a height of 5½ feet near the south margin. West of the trees flat-lying limestone ledges rise from 6 to 12 inches above water to the extreme tip. East of the trees this odd structure appears to consist entirely of limestone shingle and coarse gravel for some 300 or 400 feet. About 75 per cent. of the gravel consists of flatish pebbles a quarter of an inch to 2 inches in diameter.

Near the southeast corner of the island the limestone dips to the southwest at 2 to 3 degrees. At the northeast corner there is a barely perceptible dip to the north.

On the shores of the island sand and gravel are practically absent, except at the west end.

The following table gives a connected section of all the limestone observed on the island:—

	Feet	inches
3. Thin bedded limestone, in half- to 3-inch layers, weathering to buff colour, with abundant corals and brachiopods	11	6
2. Massive, heavy-bedded limestone with bryozoa, corals, and brachiopods	2	6
1. Thin bedded limestone in 2- to 6-inch layers (base)	5	6

No. 2 forms a projecting shelf over No. 1 at the east end of the island. No. 3 is best exposed 18 chains east of the pier on the south side. C. R. Stauffer[1] has listed 37 species of Onondaga fossils, which include such familiar shells as *Spirifer acuminatus* (Conrad) and *Spirifer gregarius* Clapp.

Hen Island

The largest of the Chicken islands is Hen island, which has an area of about 5¾ acres. A dock is located on the south side of the island near the club house (see Fig. 9).

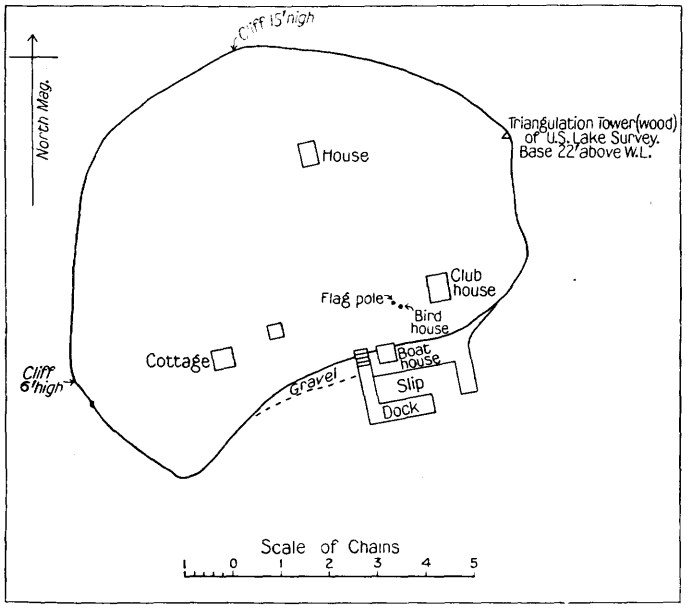


Fig. 9—Map of Hen island, June 20, 1933.
The area is about 5¾ acres.

The limestones that form the island show the following section at the northeast corner of the island:—

	Feet
1. Massive, grey, fine-textured limestone, weathering to a very irregular cavernous surface	4
2. Finely laminated limestone layers, less than one-sixteenth of an inch up to 2 inches, weathering white	5
3. White or light-grey, fine-textured limestone without *laminae*	4
4. Drab, rough-bedded limestone with fossils, massive in texture (base)	9

Nos. 2 and 3, owing to irregular joints, break into innumerable small blocks. Vertical cliffs form the northeast shore, and overhanging ledges, where waves are undercutting the cliffs, mark the northwest corner of the island. Some large masses of bed No. 1 have toppled into the lake. There appears to be a southwesterly dip of 3 or 4 degrees at the northwest corner of the island, which accounts for the low shore at the west and a high shore at the east end. The top of the bank is about 6 feet above the water at the west end. Very little

[1]Clinton R. Stauffer, op. cit., pp. 211-213.

shingle is found on the north shore, but there is a considerable amount at the dock on the south shore.

Little Chicken Island

About 1.1 miles southeast of Hen island a limestone reef rises from 1 to 2 feet above lake level. Numberless joints cut this rock into blocks, most of which are 2 to 6 inches in diameter. The reef is bordered by a bar of coarse gravel about 75 per cent. of which consists of subangular rock fragments from

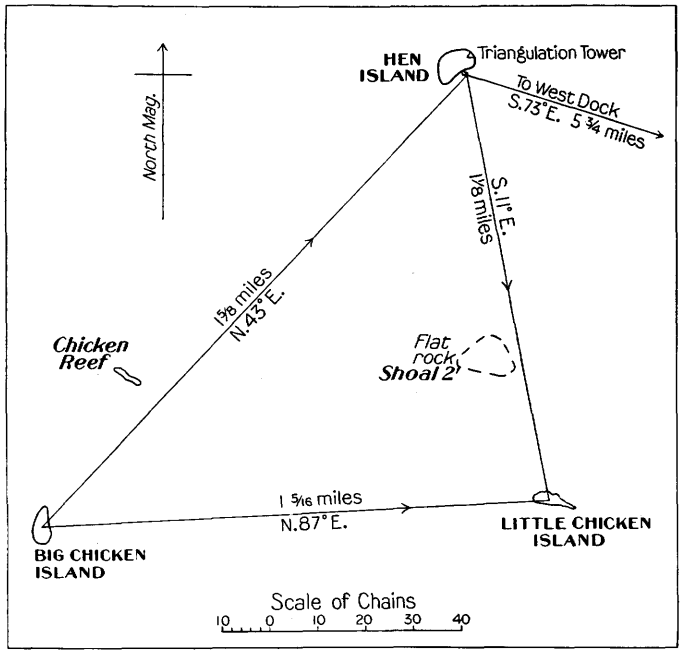


Fig. 10—Map of a group of small islands west of Pelee island. The distances between the islands are scaled from U.S. Coast Chart No. 6.

1 to 3 inches in diameter. The highest part of the bar is 5½ feet above lake level. The bar runs from the west end of the reef about 425 feet east along the reef and terminates at the east end in a spit of coarse gravel, which trends S. 20°E. This southeasterly trend indicates that the main force of the wave and current drive is in a southeasterly direction.

Big Chicken Island

Big Chicken island, which lies 1.32 miles west of Little Chicken island, is a huge mass of limestone shingle, which probably has as a nucleus a ledge of limestone lying near lake level. It consists mainly of angular limestone pebbles, which are mostly 1 to 6 inches in diameter, and rises 7 feet above lake level. Slightly south of the middle of the mass of shingle there is a depression 8 feet deep. Nine terraces were well marked on the northeast side in June, 1933. No bed rock is visible. A line of large glacial boulders of gneiss, etc., borders the north and west sides. Poles for fish nets cannot be driven on the south

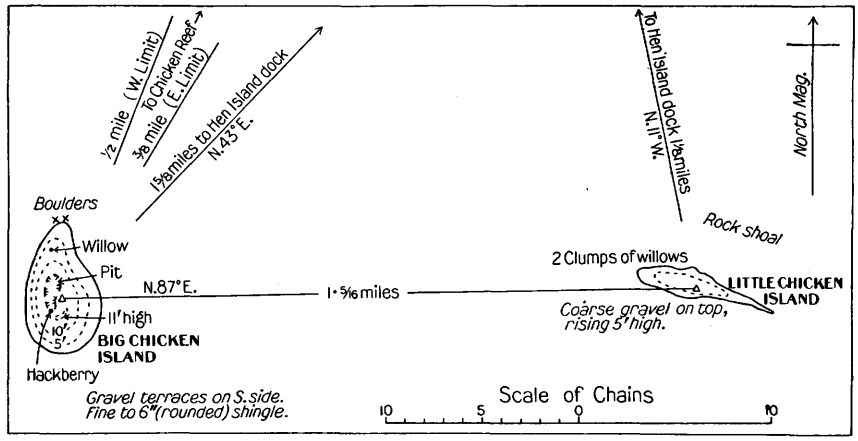


Fig. 11—Map of Big Chicken and Little Chicken islands, June 20, 1933.

side of the island closer than 75 rods. To the northeast a reef-like bottom extends most of the way to Chicken reef with a depth of 4 to 5 feet, but in the middle this increases to 9 feet.

Chicken Reef

Chicken reef has a length of 5 chains. The northeast side of this reef consists of a belt of limestone with boulders near the northwest extremity. The limestone dips south and southwest at 5 degrees. The limestone shingle on the southeast side of the island rises to 4 feet above lake level.

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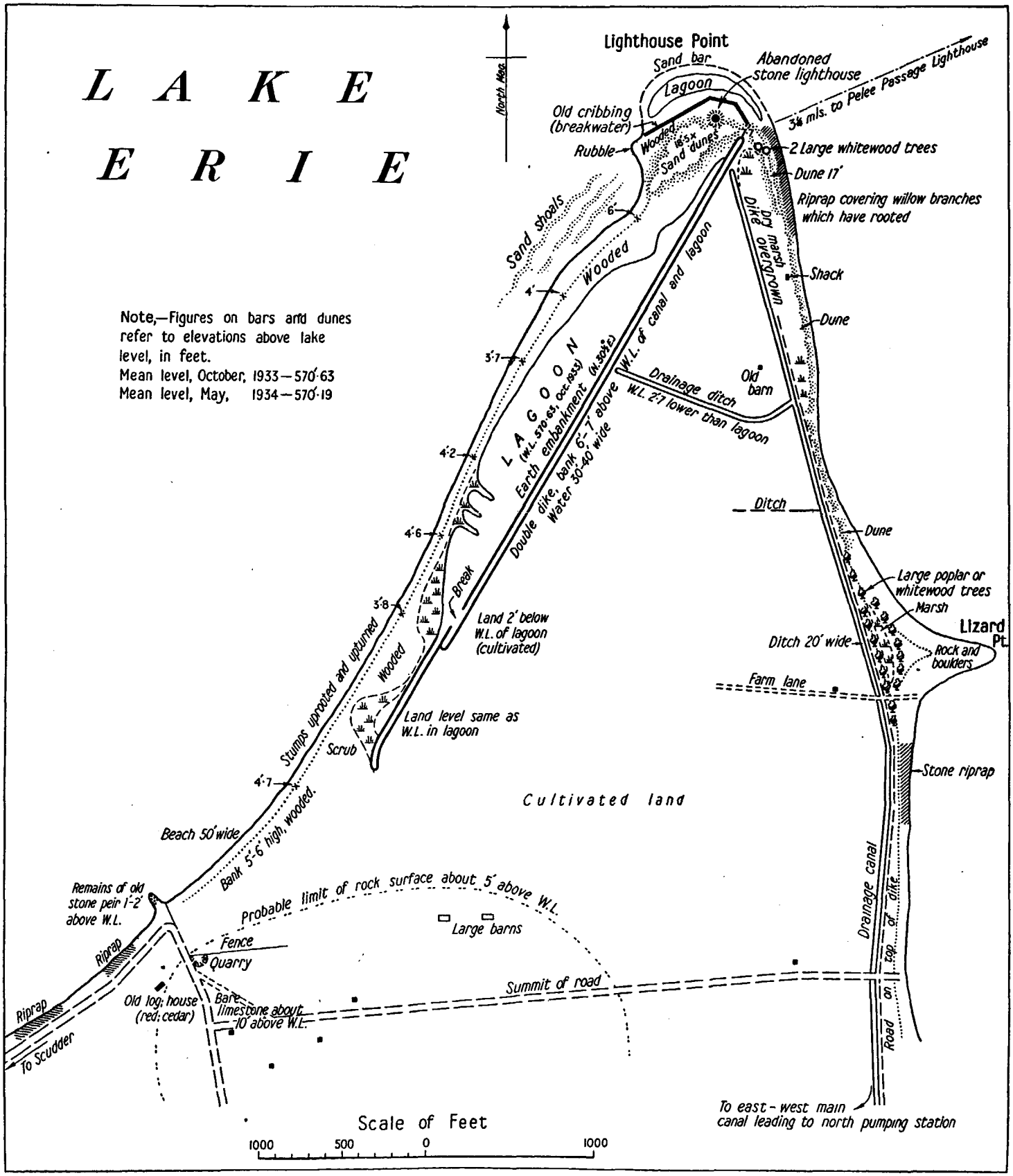


FIG. 4—MAP OF THE NORTHEAST CORNER OF PELEE ISLAND.

The compass and stadia survey of the northwest shore was made on October 12, 1933; that of the east shore, on May 11, 1934.

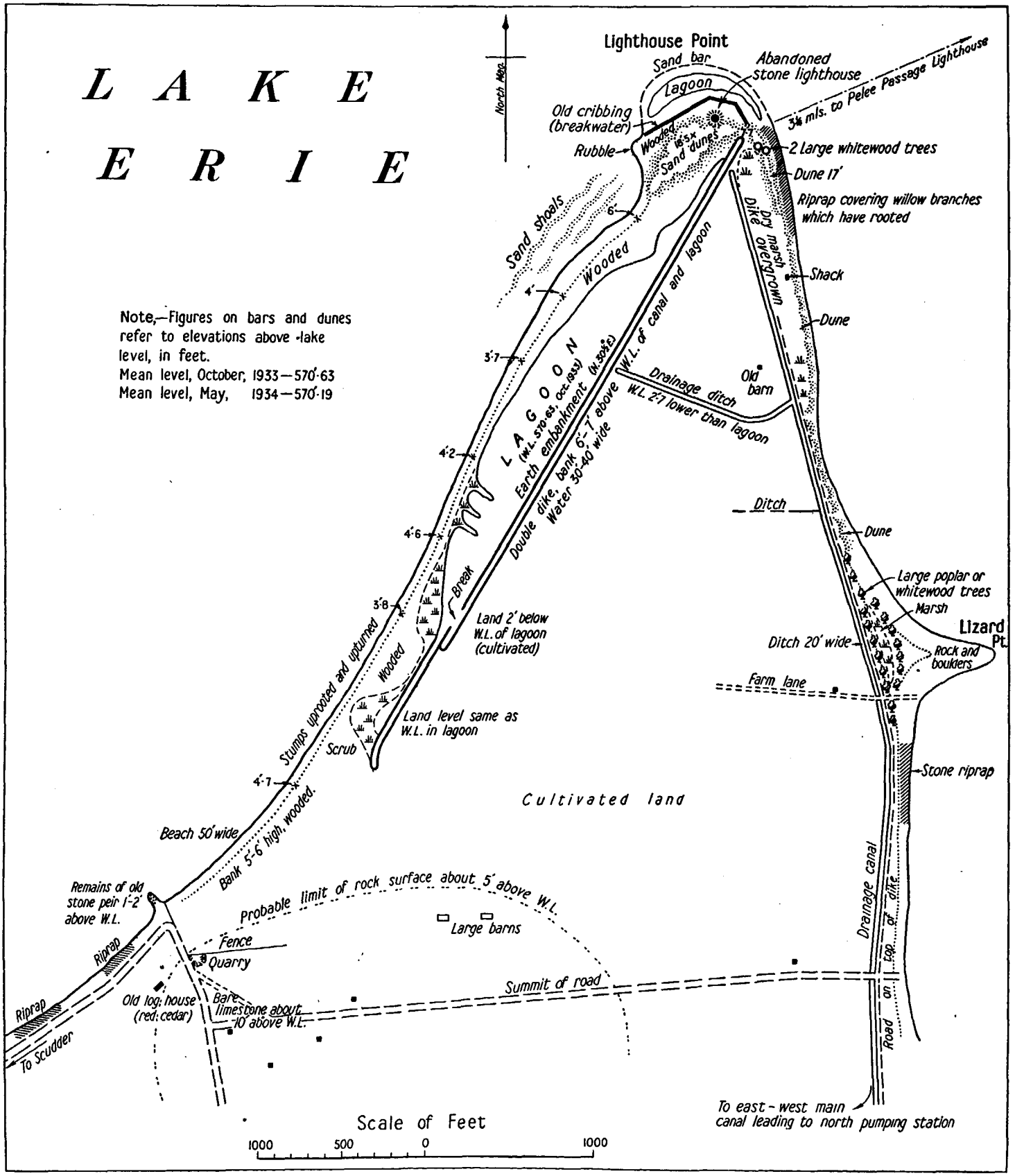
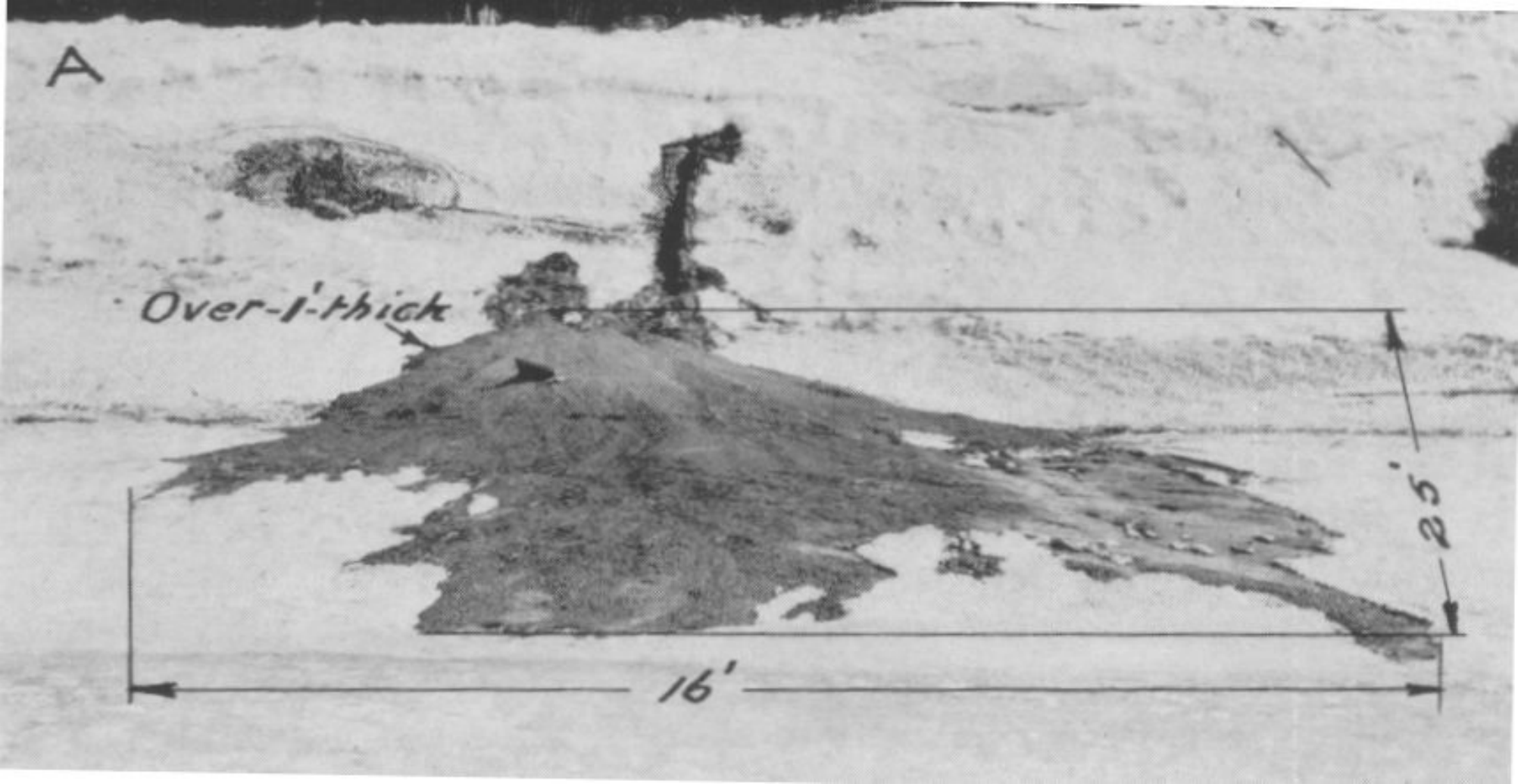
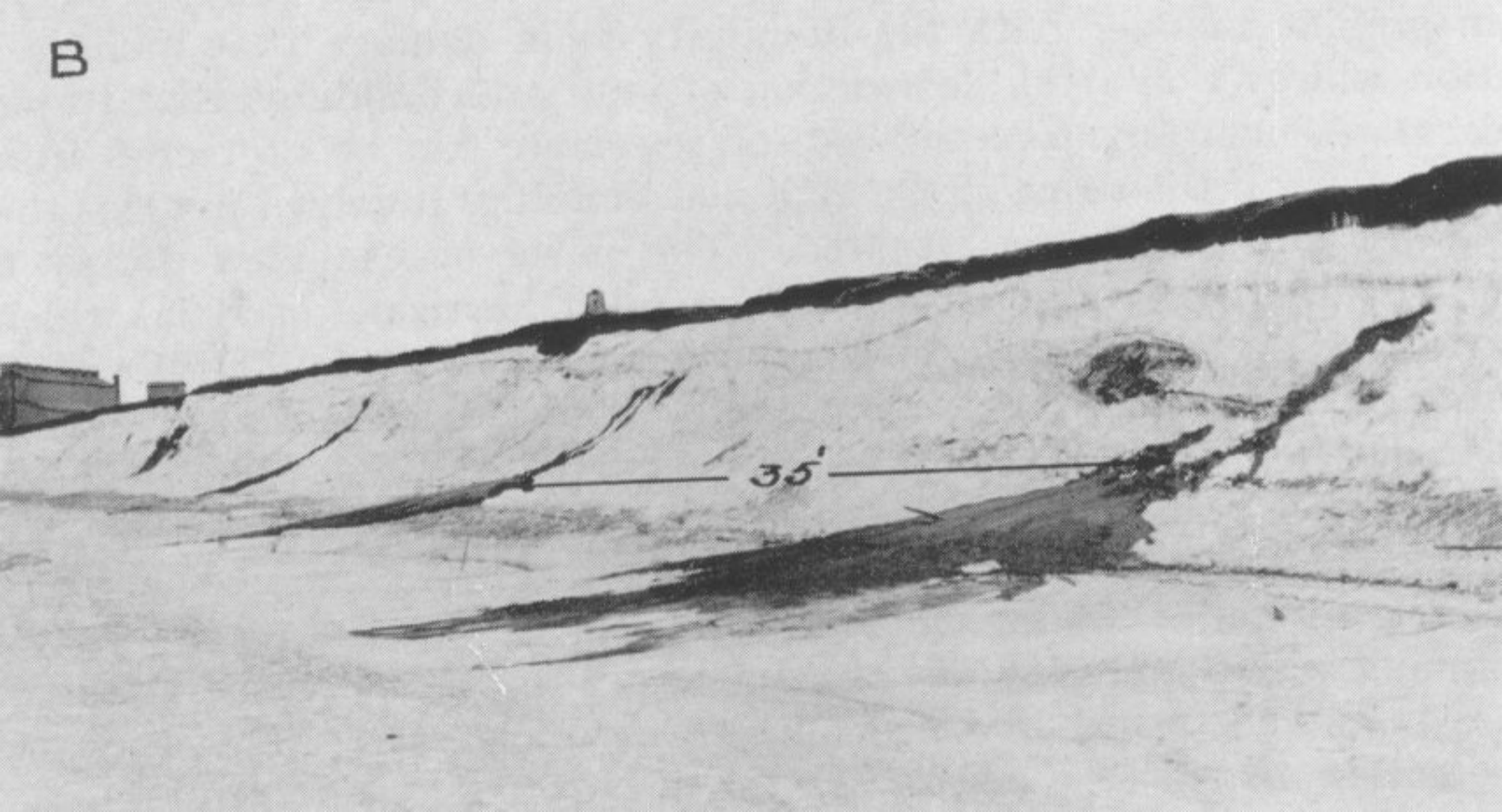


FIG. 4—MAP OF THE NORTHEAST CORNER OF PELEE ISLAND.

The compass and stadia survey of the northwest shore was made on October 12, 1933; that of the east shore, on May 11, 1934.




A
Over-1'-thick
25'
16'


B
35'


C
20'
20'


A

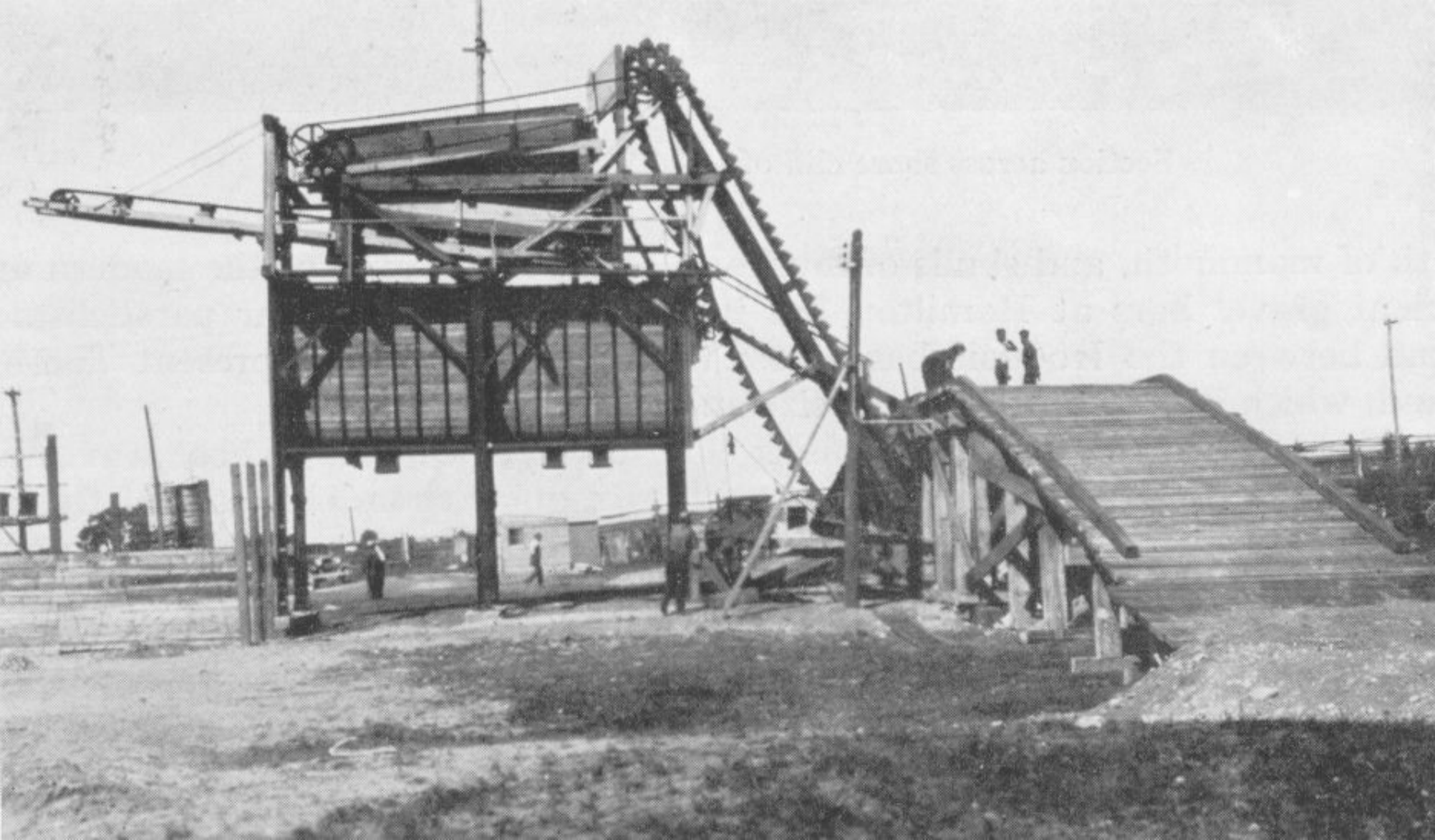

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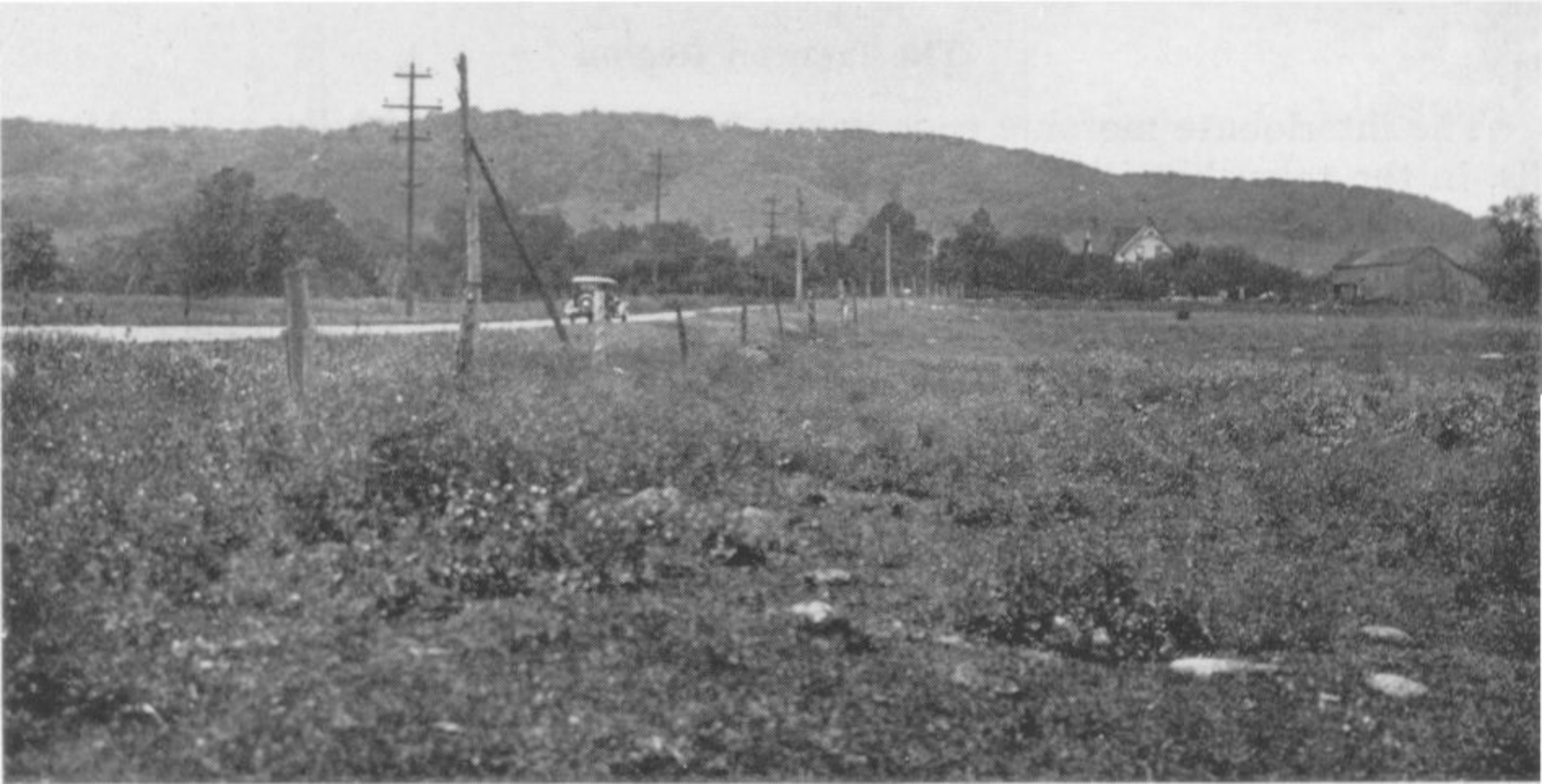
























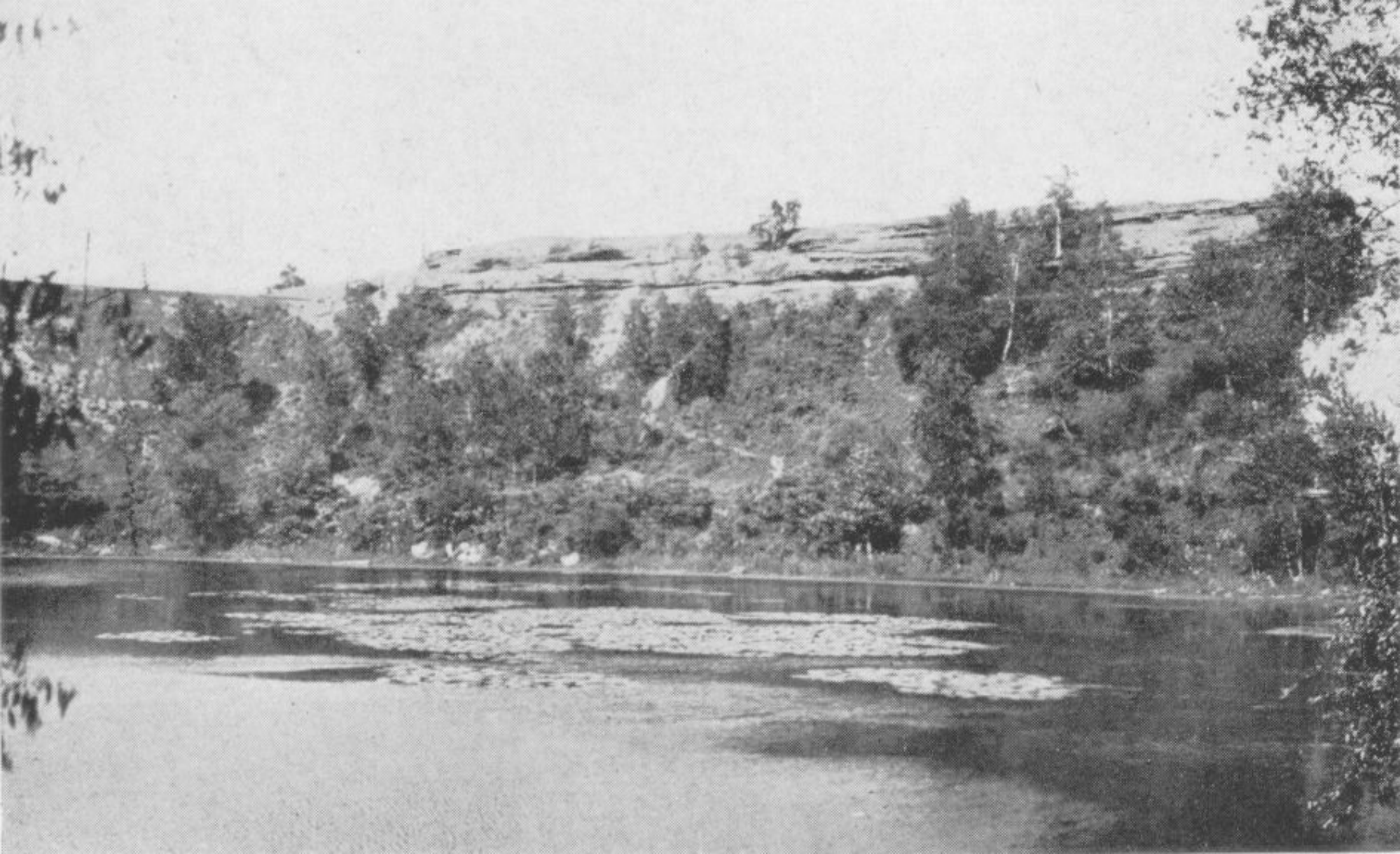










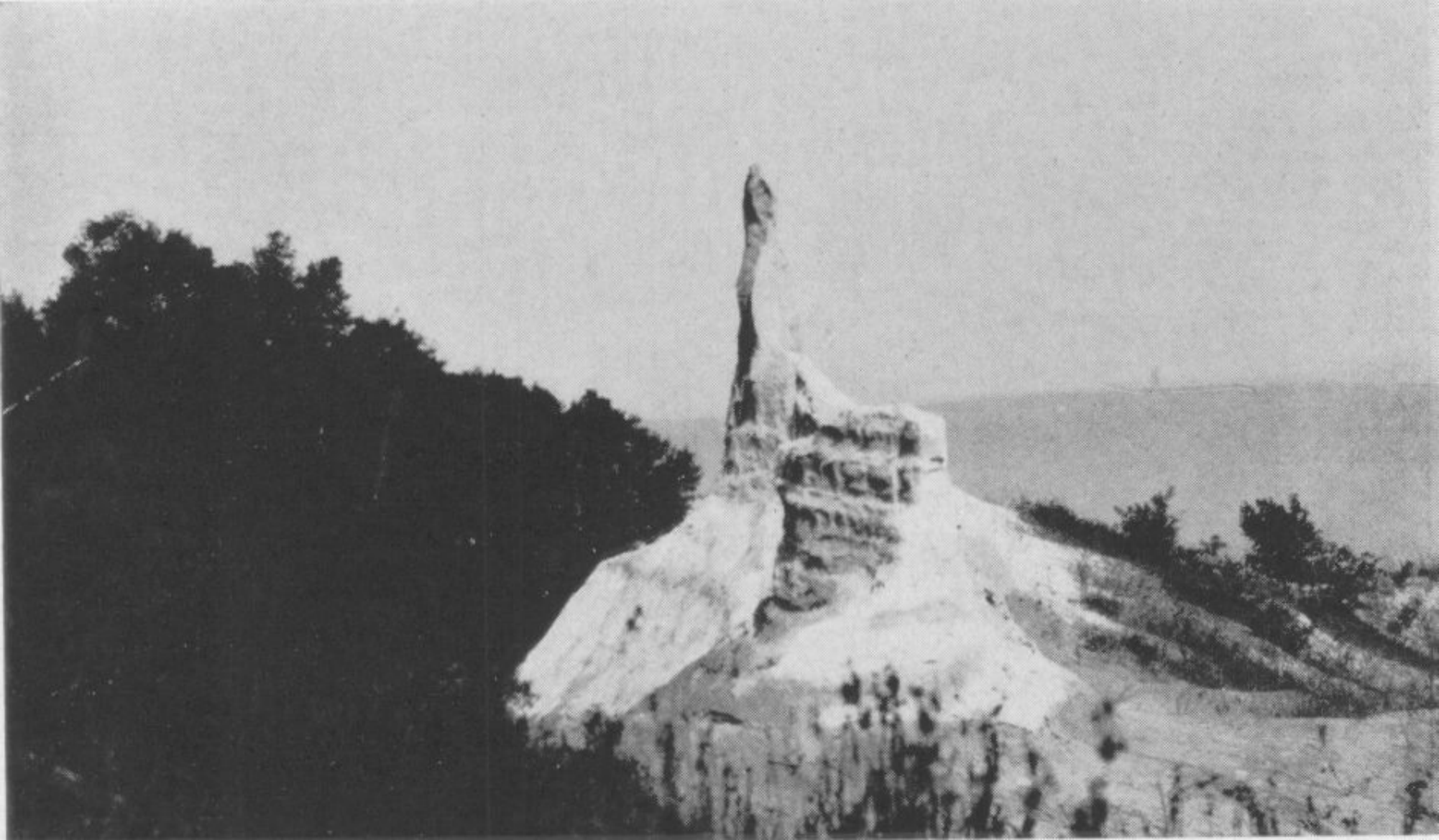


























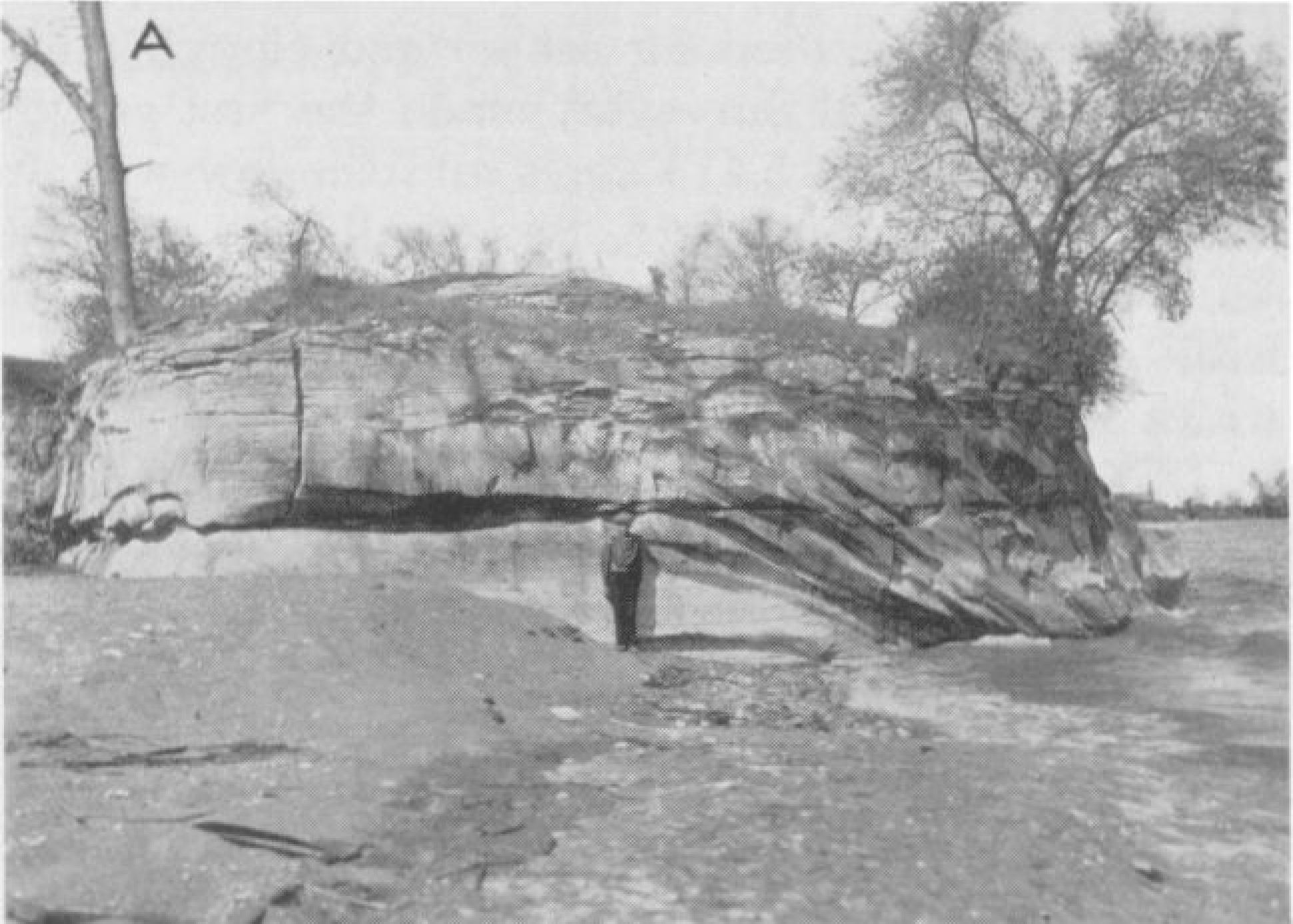





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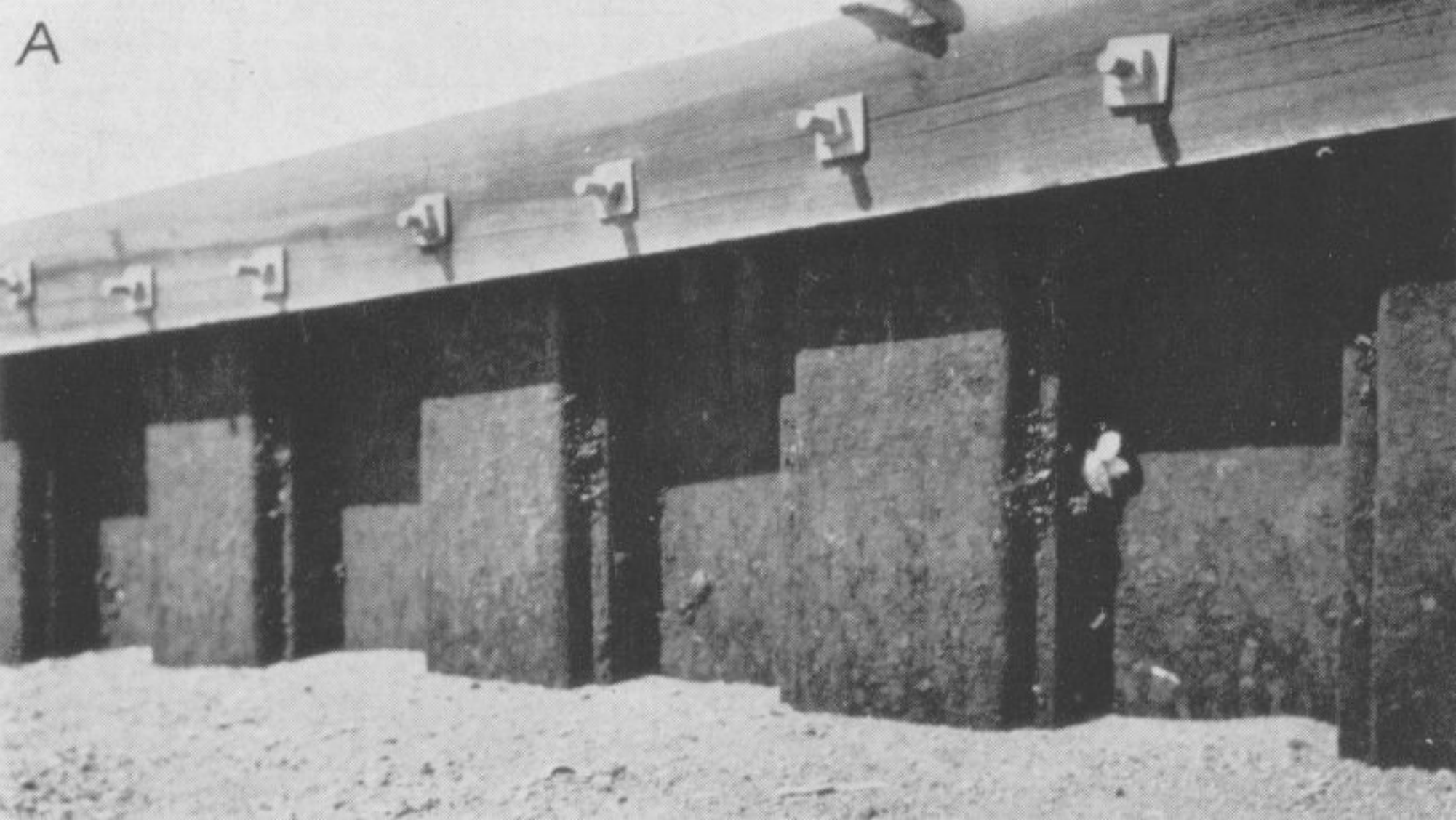

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