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LETTER OF TRANSMISSION

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

Sir,—I have the honour to transmit to you herewith, for presentation to the Legislative Assembly of the Province of Ontario, the Forty-third Annual Report of the Department over which I have the honour to preside.

I have the honour to be, Sir,

Your obedient servant,

Paul Leduc,
Minister of Mines.

Department of Mines,
Toronto, 1934.

INTRODUCTORY LETTER

To The Honourable Paul Leduc,
Minister of Mines.

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

Part I

Statistical Review of Ontario's Mineral Industry in 1933, by W. R. Rogers and A. C. Young.
Mines of Ontario in 1933, by D. G. Sinclair, R. H. Cleland, D. F. Cooper, E. C. Keeley, and A. R. Webster.
Mining Accidents in 1933, by D. G. Sinclair, R. H. Cleland, D. F. Cooper, E. C. Keeley, and A. R. Webster.
Classes for Prospectors, 1933–34, by E. M. Burwash,

Part II

The Sudbury Nickel Field Restudied, with maps 43*d* and 43*e*, by A. G. Burrows and H. C. Rickaby.

Part III

Geology of the Swayze Gold Area, with map No. 43*b*, by H. C. Rickaby.
Geology of the Makwa-Churchill Area, with map No. 43*c*, by H. C. Laird.

Part IV

Geology of the Straw-Manitou Lakes Area, with map No. 43*a*, by Jas. E. Thomson.

Part V

Natural Gas in 1933, by R. B. Harkness.
Petroleum in 1933, by R. B. Harkness.

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,

Thos. W. Gibson,
Deputy Minister of Mines.

Department of Mines,
Toronto, 1934.

PROVINCE OF ONTARIO
DEPARTMENT OF MINES

HON. PAUL LEDUC, *Minister of Mines* THOS. W. GIBSON, *Deputy Minister*

FORTY-THIRD ANNUAL REPORT

OF THE

ONTARIO DEPARTMENT OF MINES

BEING

VOL. XLIII, PART I, 1934

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STATISTICAL REVIEW OF ONTARIO'S MINERAL INDUSTRY IN 1933

By W. R. Rogers and A. C. Young

General Review

The mining industry of Ontario, more particularly the metal group, is to-day probably the most prosperous section of industry in the Province. At the turn of the year a moderate increase in industrial activity was reported in all business summaries by the leading Canadian banks. Early in 1934 the conditions were as follows: Steel plants were more active and mining machinery supply houses busier. The output of motor cars and orders for new models were substantially in excess of the same period a year ago. Tire manufacturing and woollen and textile plants were generally operating at capacity. The production of flour had improved, but export was slack. On the other hand, the production of meats and their exports were brisk. Tanners were busier, and the demand for boots and shoes was coming freely. In the lumber industry there was improved demand with slightly better prices.

While in general the economic condition of the Province has greatly improved and advancements made in gold mining have been outstanding, the recovery in the nickel-copper group was much in excess of that in any other industry.

The total value of production, exclusive of exchange equalization, was $93,333,120, as against $80,345,336 in 1932, an increase of 16.1 per cent. Exchange equalization, which in 1932 amounted to $6,132,911, rose to $16,486,437 in the following year, and taking these amounts into consideration the gain amounted to 26.9 per cent. in Canadian funds.

Metals, as may be observed in Table II, increased from $63,997,017 to $78,877,928 in value. Non-metallics suffered a slight decline, falling from $7,361,897 to $7,094,636, gypsum, natural gas, and salt among others showing decreases which offset the slight gains in feldspar, fluorspar, petroleum, and talc. Structural materials, owing to the severe decline in the building industry, were reduced to $6,335,977 in value, or 13.2 per cent. below the total of $7,295,917 in 1932. Clay products for similar reasons lost 39 per cent. in value, or fell from $1,690,505 to $1,024,579.

Apart from the materials dependent for a market on the building trades, the mineral output during the year greatly improved; and despite the slackness in some lines the number of wage-earners employed rose in number from 15,542, receiving $20,979,648 in wages in 1932, to 16,103 workers, drawing $21,885,169 in 1933. These figures take no account of the large numbers employed in prospecting and development as well as in operating but non-producing mines.

The total value of the mineral output of the Province to the end of 1933 (Table III) is in excess of two billion dollars, and half of this grand total is credited to the past 11 years, 1923 to 1933, inclusive. Metals alone account for 1,399 million dollars, and nearly half of this total has been produced during the past decade. Thus it will be seen that Ontario's mineral industry has made great strides in recent years.

Table I which follows itemizes mineral statistics for 1933, and Table II gives comparative values of production during the past five years:—

TABLE I.—SUMMARY OF MINERAL STATISTICS OF ONTARIO FOR 1933

Product (tons of 2,000 lb.)	Quantity	Value	Employees	Wages
METALLIC:		$		$
Gold (standard basis)....oz.	2,155,518	44,558,514	8,706	13,948,104
Silver....oz.	5,375,030	1,912,934	243	259,357
Copper in matte exported (*a*)....lb.	20,398,169	917,918		
Copper metallic and in concentrates, exported.... "	125,106,551	9,200,929		
Nickel in matte, in speiss, and in ore exported; metallic nickel, also nickel content of oxides and salts.... "	83,264,658	20,130,480	(*b*)3,623	5,250,433
Platinum metals....oz.	55,755	1,501,233		
Selenium....lb.	26,090	53,745		
Bismuth....oz.	7,580	3,731		
Cobalt in metal, oxides, salts, residues, and ores.... "	466,702	597,752	(*c*) 154	151,521
Lead in concentrates exported.... "	29,910	692		
Total....	....	78,877,928	12,726	19,609,415
NON-METALLIC:				
Arsenic, white....lb.	1,468,022	56,534	(*c*)	(*c*)
Barite....tons	20	60	3	4,522
Diatomite.... "	28	1,298	2	705
Feldspar, crude and ground.... "	4,387	45,350	12	6,409
Fluorspar.... "	73	1,064	5	420
Graphite, crude and refined.... "	362	16,145	16	8,845
Gypsum.... "	24,460	112,319	79	46,782
Iron pyrites and sulphur (*d*).... "	8,196	81,960	....	....
Mica.... "	666	9,371	25	3,923
Mineral water....Imp. gals.	29,794	2,347	....	....
Natural gas....M. cu. ft.	7,166,659	4,523,084	958	958,336
Peat....tons	450	900	....	....
Petroleum, crude....bbls.	136,058	253,486	....	....
Quartzite and quartz....tons	66,562	86,146	49	20,477
Silica brick....M.	183	7,351		
Salt....tons	244,107	1,755,087	242	261,214
Talc and soapstone.... "	15,114	142,134	43	31,813
Total....	....	7,094,636	1,434	1,343,446
STRUCTURAL MATERIALS:				
Cement, Portland....bbls.	1,095,845	1,587,812	268	182,250
Hydrated lime....tons	19,733	220,291	210	111,637
Quicklime.... "	126,460	1,006,905		
Sand and gravel.... "	5,670,030	2,467,916	340	168,153
Sand-lime brick (*e*)....M.	6,922	69,785	58	32,889
Stone: limestone, trap, granite, etc.....tons	1,253,907	983,268	486	205,735
Total....	....	6,335,977	1,362	700,664
CLAY PRODUCTS:				
Brick, face....no.	17,254,578	351,292		
" common.... "	11,822,004	163,338		
" fancy and ornamental.... "	6,309	387		
" sewer.... "	242,289	3,683		
Tile, drain.... "	8,745,559	179,015	581	231,644
" structural, roofing and floor....	....	74,064		
Sewer pipe, copings, flue-linings, etc....	....	185,138		
Pottery....	....	52,650		
Haydite....	....	15,012		
Total....	....	1,024,579	16,103	21,885,169
GRAND TOTAL....	....	93,333,120	....	....
Exchange equalization on gold marketed....	....	16,486,437	....	....
Total value in Canadian funds...	....	109,819,557	....	....

(*a*) Copper in matte valued at 4½ cents per pound, and nickel at 18 cents.
(*b*) Employees and wages for nickel-copper mines, smelters, and refineries include statistics of the Ontario Refining Company.
(*c*) Employees and wages for silver-cobalt smelters and refineries.
(*d*) Tonnage given is sulphur content of sulphuric acid; no iron pyrites was sold in 1933.
(*e*) No deduction made for lime used in manufacturing.

TABLE II.—COMPARATIVE VALUE OF MINERAL PRODUCTION, 1929–1933

Product	1929	1930	1931	1932	1933
METALLIC:	$	$	$	$	$
Gold (standard value)	33,535,226	35,886,558	43,117,615	47,284,621	44,558,514
Silver	4,630,820	3,998,112	1,880,860	1,910,937	1,912,934
Platinum metals	1,646,381	2,436,683	2,812,834	1,998,911	1,501,233
Cobalt (*a*)	1,801,915	1,144,007	651,179	587,957	597,752
Nickel (*b*)	27,115,461	24,455,134	15,005,080	7,179,862	20,130,480
Copper, metallic and in matte	14,622,609	15,186,467	8,907,069	5,025,684	10,118,847
Selenium	.....	.....	32,108	.....	53,745
Iron ore (*c*) and pig iron (*d*)	.....	.....	.....	.....	.....
Lead, pig, and in ore	294,431	116,034	41,987	1,756	692
Zinc in ore and concentrates	297,190	127,004	.....	.....	.....
Bismuth	23,413	6,366	3,532	7,289	3,731
Molybdenite	.....	.....	280	.....	.....
Total	83,967,446	83,356,365	72,452,544	63,997,017	78,877,928
NON-METALLIC:					
Actinolite	375	437	456	.....	.....
Arsenic, white	154,887	109,932	135,170	98,914	56,534
Barite	.....	.....	.....	.....	60
Beryl	114	.....	.....	.....	.....
Diatomite	.....	140	840	309	1,298
Feldspar, crude and ground	206,979	104,670	103,008	42,920	45,350
Fluorspar	1,120	1,240	620	464	1,064
Graphite, crude and refined	90,522	86,543	32,149	18,483	16,145
Gypsum	832,689	776,069	374,469	186,176	112,319
Iron pyrites and sulphur (*e*)	54,056	73,855	65,080	33,320	81,960
Mica	45,919	34,275	23,465	2,752	9,371
Mineral waters	13,651	20,754	8,578	2,473	2,347
Natural gas	4,968,137	5,061,588	4,635,497	4,719,297	4,523,084
Peat fuel	4,500	1,602	1,096	10,107	900
Petroleum, crude	253,678	235,746	219,993	247,468	253,486
Quartzite and quartz	316,050	274,674	148,642	93,574	86,146
Silica brick	80,374	19,120	13,702	4,303	7,351
Salt	1,420,424	1,558,405	1,760,388	1,789,752	1,755,087
Talc and soapstone	180,492	133,213	122,044	111,585	142,134
Total	8,621,427	8,492,263	7,642,308	7,361,897	7,094,636
STRUCTURAL MATERIALS:					
Cement, Portland	6,608,246	5,779,404	5,006,826	2,288,975	1,587,812
Lime, hydrated and quicklime	3,364,412	2,177,587	1,221,190	1,273,230	1,227,196
Sand and gravel	3,156,254	3,559,487	2,317,015	2,000,298	2,467,916
Sand-lime brick (*f*)	641,159	424,178	253,228	78,398	69,785
Stone: limestone, trap, granite, etc.	4,771,616	4,630,970	3,197,297	1,655,016	983,268
Total	18,541,687	16,571,626	11,995,556	7,295,917	6,335,977
CLAY PRODUCTS:					
Brick, face	2,467,539	1,811,569	1,278,954	532,728	351,292
" common	1,188,688	779,744	622,777	286,928	163,338
" fancy and ornamental	9,012	23,858	16,829	1,790	387
" sewer	92,316	12,490	33,321	18,638	3,683
Tile, drain	629,322	593,980	244,368	144,579	179,015
" structural, roofing, and floor	1,047,807	848,556	378,193	169,824	74,064
Sewer pipe, copings, flue-linings, etc	1,167,463	834,361	696,964	451,786	185,138
Pottery	96,394	89,384	73,860	67,866	52,650
Haydite	131,621	227,275	167,533	16,366	15,012
Total	6,830,162	5,221,214	3,552,799	1,690,505	1,024,579
GRAND TOTAL	**117,960,722**	**113,641,468**	**95,643,207**	**80,345,336**	**93,333,120**

(*a*) Cobalt in oxide, metallic cobalt, and cobalt content of residues marketed.
(*b*) Nickel in matte, oxide, and metallic nickel.
(*c*) Exports and shipments to points other than Ontario blast furnaces.
(*d*) Product from Ontario ore only.
(*e*) Includes value of sulphuric acid produced.
(*f*) No deduction made for lime consumed in manufacturing.

Table III 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.

TABLE III.—TOTAL MINERAL PRODUCTION OF ONTARIO

Year	Value of mineral production				
	Metallic	Non-metallic	Structural materials	Clay products	Total
	$	$	$	$	$
Before 1891....	(a) 9,520,269		(a)		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 (b).....	48,281,553	8,141,796	11,921,019	4,735,154	73,079,522
1921.....	28,777,581	6,636,217	13,967,386	5,183,125	54,564,309
1922.....	40,290,157	7,591,913	13,640,166	6,944,218	68,466,454
1923.....	44,076,660	8,511,786	13,139,757	6,269,140	71,997,343
1924.....	52,130,314	7,555,283	12,398,465	5,137,865	77,221,927
1925.....	62,495,472	7,488,034	12,451,174	5,148,626	87,583,306
1926.....	59,218,297	7,842,632	12,681,308	5,356,469	85,098,706
1927.....	62,631,255	7,638,605	14,160,552	5,853,035	90,283,447
1928.....	71,267,003	7,822,641	14,815,814	6,177,664	100,083,122
1929.....	83,967,446	8,621,427	18,541,687	6,830,162	117,960,722
1930.....	83,356,365	8,492,263	16,571,626	5,221,214	113,641,468
1931.....	72,452,544	7,642,308	11,995,556	3,552,799	95,643,207
1932.....	63,997,017	7,361,897	7,295,917	1,690,505	80,345,336
1933.....	78,877,928	7,094,636	6,335,977	1,024,579	93,333,120
Total.....	1,398,820,451		616,707,776		2,015,528,227

(a) 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.

(b) Exchange equalization figures on gold, the record of which appears on another page, should be added to the metallic and total columns to arrive at the valuation in Canadian funds.

AVERAGE METAL PRICES, CANADA AND UNITED STATES

Metal	Unit	Canada—price and market	1932	1933	United States—price and market	1932	1933
			$	$		$	$
Cobalt	lb.					2.50	2.50
Bismuth	lb.	Crude at works	0.434	1.10			1.30
Copper in matte	lb.	Estimated at works	0.035	0.045			
Copper in converter	lb.	Producers' price at works	0.638				
Copper, electrolytic	lb.	Estimated at works	0.0638	.07455	New York	0.0555	0.06713
		At Montreal	0.07516				
Nickel in matte	lb.	Estimated at works	0.18	0.18			
Nickel, electrolytic	lb.	At works				0.35	0.35
Gold	oz.	Standard	20.671834	28.60	New York	20.671834	20.671834
Silver	oz.	Estimated	.31672	.37833		.27892	.34727
Platinum	oz.		40.21	34.99	New York	36.455	30.993
Palladium	oz.		18.45	18.46	" "	17.00-18.00	
Rhodium	oz.		47.78	46.40	" "	48.00-50.00	
Ruthenium	oz.		27.85	36.09	" "	40.00-45.00	
Iridium	oz.		64.76	44.33	" "	55.00	
Lead	lb.	Montreal	0.03511	0.02392	St. Louis	0.03043	0.03869
						0.03042	0.03735
Zinc	lb.	"	0.03723	0.03211	St. Louis	0.02876	0.04029
Selenium	lb.	At works		2.06			2.00

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

Metal or product	Production to December 31, 1932	Production, 1933	Production to December 31, 1933
	$	$	$
Gold	441,522,957	44,558,514	486,081,471
Nickel, including nickel oxide and salts	339,253,135	20,130,480	359,383,615
Silver	255,773,689	1,912,934	257,686,623
Copper (*a*)	135,107,025	10,118,847	145,225,872
Pig iron from domestic ore	84,775,556		84,775,556
Cobalt (*b*)	25,331,517	597,752	25,929,269
Platinum metals	23,304,959	1,501,233	24,806,192
Iron ore (*c*)	9,463,516		9,463,516
Lead	4,484,622	692	4,485,314
Zinc, in ore and concentrates	535,696		535,696
Molybdenite	210,015		210,015
Bismuth	147,728	3,731	151,459
Selenium	32,108	53,745	85,853
Grand total	1,319,942,523	78,877,928	1,398,820,451

(*a*) Includes small quantities of copper sulphate.
(*b*) Includes metal, oxide, salts, and cobalt contents of residues exported.
(*c*) Value of ore shipped out of the Province.

TOTAL DIVIDENDS PAID BY METAL MINES

Industry	Total to end of 1932	During 1933	Total to end of 1933
	$	$	$
Nickel-copper	146,977,119	2,746,330	149,723,449
Gold	135,108,803	17,998,588	153,107,391
Silver-cobalt	97,586,281	105,000	97,691,281
Grand total	379,672,203	20,849,918	400,522,121

Gold

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

AVERAGE YEARLY WAGE, ONTARIO GOLD MINING, 1932 AND 1933

Locality	1932			1933		
	No. of wage earners	Wages paid	Average wage per annum	No. of wage earners	Wages paid	Average wage per annum
		$	$		$	$
Porcupine	4,685	7,297,216	1,557	4,728	7,645,825	1,617
Kirkland Lake	3,406	5,583,824	1,639	3,493	5,584,787	1,599
N.W. Ontario	389	641,081	1,648	485	717,492	1,480
Operating but non-producing	179	122,442	684	665	514,056	773
Total	8,659	13,644,563	1,575	9,371	14,462,160	1,543

TABLE IV.—TOTAL GOLD PRODUCTION IN ONTARIO

Year	Total production, value (standard)	Porcupine belt		Kirkland Lake belt		N.W. Ontario (*c*)	
		Value	Per cent.	Value	Per cent.	Value	Per cent.
	$	$		$		$	
1866-1891	(*a*) 190,258	.....	.....	.....	.....	.....	.....
1892-1909	(*b*) 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	2.0	.....	.....
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	62.0	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	3.0
Total to end of 1933	486,081,471	328,089,450	67.5	145,882,605	30.0	.....	.....

(*a*) Estimated. (*b*) Maximum yearly output was $424,568 in 1899. (*c*) 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.

TABLE V.—ONTARIO'S GOLD PRODUCTION, 1933

Source	Ore milled, tons	Bullion shipped				Total value of bullion[1]
		Gold content		Silver content		
		Fine ounces	Value	Fine ounces	Value	
PORCUPINE BELT			$		$	$
Buffalo Ankerite	111,402	22,342.90	461,869	2,315	811	462,680
Canusa	.....	42.78	884	8	3	887
Coniaurum	145,657	33,596.25	694,496	1,383	1,461	695,957
Dome	546,500	218,484.67	4,516,479	21,897	7,546	4,524,025
Hayden	1,593	121.57	2,513	10	3	2,516
Hollinger	1,727,102	481,279.04	9,948,920	71,135	22,957	9,971,877
McIntyre	754,360	261,528.70	5,406,276	67,566	20,725	5,427,001
New York Porcupine[2]	2,800	152.67	3,156	20	8	3,164
P. De Santis (Hayden mill)	5,630	570.90	11,802	36	14	11,816
Vipond	107,562	24,244.92	501,187	3,994	1,354	502,541
Miscellaneous[3]	26	3,726.61	77,035	73	28	77,063
Total	3,402,632	1,046,091.01	21,624,617	171,437	54,910	21,679,527
KIRKLAND LAKE BELT						
Atlas	12	8.47	175	.....	.....	175
Ashley	37,975	16,962.63	350,649	2,375	849	351,498
Barry-Hollinger	5,459	2,934.24	60,656	460	133	60,789
Kirkland Gateway (S. A. Pain)	35	41.32	854	30	11	865
Kirkland Lake Gold	49,487	18,465.35	381,713	2,332	802	382,515
Lake Shore	808,917	499,800.06	10,331,783	95,941	33,052	10,364,835
Macassa	8,101	3,682.92	76,133	302	129	76,262
Sylvanite	96,937	44,607.50	922,119	8,791	3,341	925,460
Teck-Hughes	474,700	220,035.99	4,548,548	27,792	9,633	4,558,181
Toburn	36,913	23,020.27	475,871	3,430	1,243	477,114
White Rock	17	20.28	419	.....	.....	419
Wright-Hargreaves	285,465	177,189.76	3,662,837	27,372	9,692	3,672,529
Miscellaneous[4]	.....	267.02	5,520	68	26	5,546
Total	1,804,018	1,007,035.81	20,817,277	168,893	58,911	20,876,188
NORTHWESTERN ONTARIO						
Howey	344,135	40,460.06	836,384	15,337	5,199	841,583
Minto	23,671	6,284.90	129,920	223	78	129,998
Moss	34,789	8,889.03	183,753	52,118	17,551	201,304
Parkhill	11,565	9,434.58	195,030	569	200	195,230
Miscellaneous[5]	707	335.26	6,930	49	18	6,948
Total	414,867	65,403.83	1,352,017	68,296	23,046	1,375,063
Total for gold mines	5,621,517	2,118,530.65	43,793,911	408,626	136,867	43,930,778
MISCELLANEOUS						
Nickel-copper refining	.....	36,983.08	764,608	.....	.....	.....
Other sources[6]	.....	4.58	95	.....	.....	.....
Total	.....	36,987.66	764,703	.....	.....	.....
Total gold output, 1933	.....	2,155,518.31	44,558,514	.....	.....	.....
CALENDAR YEAR 1932						
Porcupine	3,351,263	1,036,294.99	21,422,117	203,625	52,475	21,474,592
Kirkland Lake	1,799,801	1,150,469.61	23,782,313	173,130	47,167	23,829,480
Northwestern Ontario	345,990	77,778.77	1,607,831	69,008	18,309	1,626,140
Miscellaneous	22	22,850.46	472,360	.....	.....	.....
Total (1932)	5,497,076	2,287,393.83	47,284,621	445,763	117,951	46,930,212

[1]In addition to the values given, exchange equalization amounted to $8,249,321 at Porcupine, $7,448,933 at Kirkland Lake, $495,309 for Northwestern Ontario, and an estimated equalization of $292,874 on the precious metal contained in nickel-copper mattes, or a total of $16,486.437.

[2]The Buffalo Ankerite leased the Marbuan (March) mill and treated an ore dump from the New York Porcupine Mines, Ltd.

[3]Includes J. M. McLaren, and gold recovered from scrapped machinery by private concerns.

[4]Gold recovered from scrapped machinery.

[5]Includes M. J. Hendrick (High Grade Syndicate at Grace lake, claims Nos. 10,789 to 10,790), $2,295; Geo. Singleton, $137; G. A. Rowan, $368; Peter Edwards, $470; Foley Syndicate, $3,153; Wm. Longworth, $288; and Soo Mining and Prospecting Syndicate, $203; or a total of $6,948 (standard), on which $2,955 was reported as exchange equalization.

[6]O'Brien mine at Cobalt.

TABLE VI.—VALUE OF TOTAL PRODUCTION (GOLD AND SILVER) BY MINES OF THE PORCUPINE BELT

Year	Hollinger	Dome	McIntyre	Vipond (a)	Coniaurum	Porcupine Crown and Northcrown	West Dome Lake (b)	Buffalo Ankerite (c)	Marbuan (March) (d)	Night Hawk Peninsular	Schumacher	Paymaster	Rea and Newray
	$	$	$	$	$	$	$	$	$	$	$	$	$
1910....	31,194	4,355	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1911....	6,000	4,277	.....	5,160	.....	.....	.....	.....	.....	.....	.....	.....	.....
1912....	909,181	737,499	77,657	16,259	.....	.....	.....	.....	.....	.....	.....	.....	.....
1913....	2,488,022	1,242,625	236,299	.....	.....	Porcupine Crown 326,803	.....	.....	.....	.....	.....	.....	Rea 18,858
1914....	2,719,355	1,059,238	549,166	73,628	.....	685,135	.....	.....	.....	.....	.....	.....	125,255
1915....	4,206,015	1,530,287	750,812	246,053	.....	602,436	102,880	.....	.....	.....	48,236	.....	.....
1916....	5,073,401	2,153,820	1,218,073	176,686	.....	578,322	16,814	.....	.....	.....	225,301	.....	.....
1917....	4,261,938	1,480,174	1,710,204	209,738	.....	377,904	44,434	.....	.....	.....	198,605	.....	Newray 1,447
1918....	5,752,371	82,127	1,578,444	82,868	.....	124,474	103,745	.....	.....	.....	92,842	.....	1,516
1919....	6,722,266	1,290,301	1,978,014	.....	.....	.....	23,910	.....	.....	.....	.....	.....	.....
1920....	6,219,665	2,020,568	2,223,083	.....	.....	71,529	47,169	.....	.....	.....	.....	.....	.....
						N'crown 97,301							
1921....	9,051,276	2,290,264	1,827,761	.....	.....	7,943	.....	.....	.....	.....	.....	.....	.....
1922....	12,274,114	4,178,936	2,021,811	.....	.....	.....	.....	.....	.....	.....	.....	2,800	.....
1923....	10,446,412	4,374,144	2,550,129	23,876	.....	.....	.....	.....	.....	.....	.....	.....	.....
1924....	13,433,063	4,307,624	3,604,874	596,803	.....	.....	60,642	.....	.....	268,518	.....	.....	.....
1925....	15,749,109	4,365,923	3,721,499	565,379	.....	.....	287,758	.....	.....	196,947	.....	.....	.....
1926....	14,829,655	3,940,053	3,862,074	631,636	.....	.....	220,758	140,588	11,055	111,154	.....	63,551	.....
1927....	14,539,538	4,031,575	3,965,210	667,724	.....	.....	35,252	359,005	19,839	166	Purchased by the Hollinger in 1922.	135,025	.....
1928....	10,706,235	3,915,051	4,201,808	694,426	220,534	.....	.....	289,960	133,879	.....		183,271	.....
1929....	9,455,290	3,590,537	4,295,491	820,667	635,485	.....	155,797	71,684	256,303	.....		.....	.....
1930....	10,260,950	774,943	4,696,578	909,414	738,941	.....	15,662	878	306,262	.....		.....	.....
1931....	10,097,975	3,512,066	4,756,880	564,291	751,352	.....	.....	.....	217,586	.....		.....	.....
1932....	10,356,846	4,040,318	5,424,728	454,412	861,031	.....	.....	219,482	78,835	.....		.....	.....
1933....	9,971,877	4,524,025	5,427,001	502,541	695,957	.....	.....	462,680	(d)	.....		.....	.....
Total...	189,561,748	59,450,730	60,677,596	7,241,561	3,903,300	2,871,847	1,114,821	1,544,277	1,023,759	566,885	564,984	384,647	147,076

(a) Changed to Anglo-Huronian, Limited, October 16, 1933. (b) Total value of bullion in 1927 was $87,919. Figures shown in above table allow for a deduction of $52,667 due to an erroneous return made in 1925. (c) Formerly Ankerite, and renamed Buffalo Ankerite in 1932. (d) The March was renamed the Marbuan in 1934; the Buffalo Ankerite operated the Marbuan mill in 1933, treating 2,800 tons from the dump of the New York Porcupine Gold Mines, Ltd.

TABLE VI.—VALUE OF TOTAL PRODUCTION (GOLD AND SILVER) BY MINES OF THE PORCUPINE BELT—*Continued*

Year	Porcupine United	David-son	Preston and Clifton	Scottish-Ontario	Porcupine Pet	Porphyry Hill	Gold Reef	Tommy Burns	De Santis	Hughes	Miscel-laneous	Total value (Standard)
	$	$	$	$	$	$	$	$	$	$	$	$
1910												35,549
1911												15,437
1912												1,740,596
1913			Preston			4,200						4,316,807
1914			Preston 15,212		5,000							5,231,989
1915					5,551	2,036	1,547					7,495,853
1916												9,442,417
1917							588	289				8,285,321
1918		15,579										7,833,966
1919		27,089										10,041,580
1920		11,246										10,690,561
1921												13,177,244
1922			Clifton 1,664									18,479,325
1923			Clifton 8,331								(e) 2,756	17,405,648
1924			Clifton 5,270									22,266,894
1925												24,886,615
1926									146	30		23,810,700
1927				5,893							(f) 217,350	23,976,577
1928				6,795							(g) 140	20,352,099
1929	44,285										47,701	19,373,240
1930	56,913										61,940	17,822,481
1931	5,439										(h) 36,114	19,941,703
1932				Canusa							(j) 38,940	21,474,592
1933				887					(k) 11,816		(l) 82,743	21,679,527
Total	106,637	53,914	30,477	13,575	10,551	6,236	2,135	289	11,962	30	487,684	329,776,721

(e) Huddlestone & Cline. (f) Includes "high-grade" recovered from W. P. Wilson. (g) Blue Quartz. (h) Munro-Croesus, $3,955; and miscellaneous, $32,159. (j) Hayden, $1,497; Munro-Croesus, $5,722; J. Spence, $2,515; and miscellaneous, $29,206. (k) Treated in Hayden mill. (l) Hayden, $2,516; New York Porcupine, $3,164; and $77,063 recovered mainly from scrapped machinery, of which J. M. McLaren is credited with $326 on ore shipped to Noranda.

TABLE VII.—VALUE OF TOTAL PRODUCTION (GOLD AND SILVER) BY MINES OF THE KIRKLAND LAKE AREA

Year	Lake Shore	Teck-Hughes	Wright-Hargreaves	Sylvanite	Kirkland Lake	Tough-Oakes Burnside	Barry-Hollinger	Argonaut (a)	Ashley	Macassa	Canadian Assoc'd. Goldfields	Lucky Cross	Ontario-Kirkland	Swastika and Trout Creek	Total value (b)
	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$
1913	.....	.....	1,127	.....	.....	66,632	.....	.....	.....	.....	.....	14,006	.....	(c)7,172	88,937
1914	.....	.....	.....	.....	.....	117,644	.....	5,204	.....	.....	.....	.....	.....	.....	122,848
1915	.....	.....	.....	.....	.....	555,539	.....	.....	.....	.....	.....	.....	.....	.....	555,539
1916	.....	.....	.....	.....	.....	711,625	.....	.....	.....	.....	.....	.....	.....	.....	711,625
1917	.....	66,722	.....	.....	.....	342,831	.....	.....	.....	.....	.....	.....	.....	.....	409,553
1918	416,414	80,570	.....	.....	.....	139,683	(d) 10,114	.....	.....	.....	.....	.....	.....	.....	646,781
1919	263,354	169,590	.....	.....	56,263	.....	.....	2,631	.....	.....	.....	.....	.....	.....	491,838
1920	503,735	247 757	.....	.....	286,901	.....	.....	26,863	.....	.....	.....	.....	.....	.....	1,065,256
1921	495,276	322,919	468,751	.....	242,417	.....	.....	513	.....	.....	.....	.....	.....	.....	1,529,875
1922	471,341	596,495	762,753	.....	224,396	107,481	.....	.....	.....	.....	.....	.....	10,082	.....	2,172,548
1923	547,600	1,117,963	754,979	.....	223,102	12,174	.....	72,512	.....	.....	.....	.....	.....	.....	2,728,331
1924	1,098,572	1,023,025	1,088,725	.....	46,512	47,547	.....	152,072	.....	.....	.....	.....	.....	.....	3,456,453
1925	1,958,720	996,943	1,913,401	.....	.....	263,064	56,978	214,183	.....	.....	.....	Gold	.....	.....	5,403,289
1926	2,775,000	1,601,209	2,150,844	.....	126,999	309,709	86,263	143,387	.....	.....	.....	Hill	.....	.....	7,193,411
1927	3,375,053	2,781,962	2,151,916	429,424	473,673	153,215	175,692	127,448	.....	.....	34,595	(e) 865	.....	.....	9,703,843
1928	4,073,965	4,948,896	1,838,510	738,146	414,596	82,316	111,767	32,430	.....	.....	17,700	12,784	.....	.....	12,271,110
1929	6,090,189	5,048,420	1,734,728	689,465	352,789	.....	151,758	9,959	.....	.....	.....	.....	.....	.....	(f) 14,089,233
1930	7,836,779	5,398,271	2,432,888	794,459	533,851	.....	217,835	1,891	.....	.....	.....	.....	.....	.....	17,215,974
1931	11,065,618	6,093,199	2,909,837	901,168	586,250	Toburn	224,633	.....	.....	.....	.....	.....	.....	(g)1,622	(h) 21,783,162
1932	12,647,128	5,855,570	3,548,161	828,195	524,329	203,642	160,697	.....	61,290	.....	.....	.....	.....	.....	(h) 23,829,480
1933	10,364,835	4,558,181	3,672,529	925,460	382,515	477,114	60,789	.....	351,498	76,262	.....	(i) 865	.....	.....	(j) 20,876,188
Total	63,983,579	40,907,692	25,429,149	5,306,317	4,474,593	3,590,216	1,256,526	789,093	412,788	76,262	52,295	28,520	10,082	8,794	146,345,274

(a) Exclusive of copper values. (b) Standard. (c) Swastika. (d) Patricia mine, afterwards called Barry-Hollinger. (e) Samples shipped in 1923 and 1926 by the Gold Hill not heretofore reported. (f) Contains $11,925 miscellaneous. (g) Trout Creek. (h) Includes Telluride in Skead tp., $835 in 1931 and $468 in 1932. (i) Kirkland Gateway in 1933. (j) Includes Atlas, $175; White Rock, $419; and from scrap machinery, $5,546.

TABLE VIII.—DIVIDENDS AND BONUSES PAID BY GOLD MINING COMPANIES TO DECEMBER 31, 1933

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 1932 $	Dividends and bonuses paid during 1933 $	Rate per cent., or per share, 1933	Total of dividends and bonuses paid to Dec. 31, 1933 $	Date when last dividend or bonus was paid
Buffalo Ankerite Gold Mines, Ltd.	Oct. 5, 1932	1,000,000	540,270	1.00	.....	42,571.29	8 cents	42,571.29	Dec. 15, 1933
Coniaurum Mines, Ltd.	July 4, 1929	6,000,000	2,697,447	No par	80,923.41	.....	.....	80,923.41	Aug. 15, 1932
Dome Mines, Ltd. (*a*)	Sept. 30, 1923	1,000,000	1,000,000	No par	16,505,176.95	1,716,001.20	$1.80	18,221,178.15	Oct. 20, 1933
Hollinger Cons. Gold Mines, Ltd. (*b*)	May 25, 1916	25,000,000	24,600,000	5.00	61,920,400.00	4,182,000.00	17%	66,102,400.00	Dec. 31, 1933
Lake Shore Gold Mines, Ltd.	Feb. 25, 1914	2,000,000	2,000,000	1.00	22,020,000 00	6,000,000.00	300%	28,020,000.00	Dec. 15, 1933
McIntyre-Porcupine Mines, Ltd.	Mar. 16, 1911	4,000,000	3,990,000	5.00	10,992,907.86	1,496,254.57	37½%	12,489,162.43	Dec. 1, 1933 (U.S. funds)
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. (*c*)	Jan. 6, 1914	2,000,000	1,850,000	1.00	.....	.....	.....	.....	.....
Sylvanite Gold Mines, Ltd.	June 13, 1913	3,300,000	3,299,500	1.00	362,945 00	164,975.00	5%	527,920.00	Sept. 30, 1933 (U.S. funds)
Teck-Hughes Gold Mines, Ltd., The	Mar. 2, 1923	5,000,000	4,807,144	1.00	15,789,575 20	2,884,286.40	60%	18,673,861.60	Nov. 1, 1933
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. (*d*)	June 16, 1916	5,500,000	5,500,000	No par	6,118,750 00	1,512,500.00	27½c.	7,631,250.00	Oct. 2, 1933
Total	.....	.....	.....	.....	135,108,803 42	17,998,588.46	.....	153,107,391.88	.....

(*a*) On April 22, 1922, the capital of Dome Mines Co., Ltd., 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 N.P.V. shares at $7.00 per share. Of these 46,666 shares are transferred to a trustee and held in trust for the company.

(*b*) Hollinger Consolidated Gold Mines, Limited, is an amalgamation of the Acme Gold Mines, Ltd.; Millerton Gold Mines, Ltd.; and Hollinger Gold Mines, Ltd. Dividends include $160,000 paid in 1915 by Acme, also $4,170,000 paid by Hollinger to May 25, 1916, the date of consolidation.

(*c*) 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.

(*d*) 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.

TABLE IX.—YEARLY DIVIDENDS AND BONUSES PAID BY ONTARIO GOLD MINING COMPANIES, 1912–1933

Year	Porcupine						Kirkland Lake					Total
	Hollinger*	Porcupine Crown	Dome Mines†	McIntyre	Rea and Coniaurum	Buffalo-Ankerite	Tough-Oakes	Lake Shore	Teck-Hughes	Wright-Hargreaves	Sylvanite	
	$	$	$	$	$	$	$	$	$	$	$	$
1912..	270,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	270,000.00
1913..	1,170,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,170,000.00
1914..	1,170,000	240,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,410,000.00
1915..	1,560,000	240,000	400,000.00	.....	R. 12,000.00	.....	132,875	.....	.....	.....	.....	2,344,875.00
1916..	3,286,000	240,000	800,000.00	.....	.....	.....	265,750	.....	.....	.....	.....	4,591,750.00
1917..	738,000	120,000	300,000.00	541,542.45	.....	.....	.....	.....	.....	.....	.....	1,699,542.45
1918..	1,230,000	.....	.....	543,042.45	.....	.....	.....	100,000	.....	.....	.....	1,873,042.45
1919..	1,722,000	.....	.....	364,028.30	.....	.....	.....	100,000	.....	.....	.....	2,186,028.30
1920..	2,214,000	.....	416,886.00	546,042.45	.....	.....	.....	80,000	.....	.....	.....	3,256,928.45
1921..	3,198,000	.....	478,947.75	546,042.45	.....	.....	.....	120,000	.....	.....	.....	4,342,990.20
1922..	3,198,000	.....	715,000.00	546,042.45	.....	.....	.....	80,000	.....	412,500	.....	4,951,542.95
1923..	3,198,000	.....	1,430,001.00	548,542.45	.....	.....	.....	160,000	.....	206,250	.....	5,542,793.45
1924..	3,198,000	.....	1,905,668.00	774,125.00	.....	.....	.....	380,000	.....	206,250	.....	6,465,043.00
1925..	4,378,800	.....	1,906,668.00	798,000.00	.....	.....	.....	600,000	.....	550,000	.....	8,233,468.00
1926..	5,805,600	Vipond	1,906,668.00	798,000.00	.....	.....	.....	1,000,000	474,714.40	893,750	.....	10,878,732.40
1927..	6,396,000	67,500	1,191,667.50	798,000.00	.....	.....	.....	1,400,000	713,571.60	1,237,500	.....	11,804,239.10
1928..	5,412,000	.....	953,334.00	798,000.00	.....	.....	.....	2,000,000	2,860,286.40	825,000	.....	12,848,620.40
1929..	3,198,000	.....	953,334.00	798,000.00	.....	.....	.....	2,200,000	2,866,286.40	.....	.....	10,015,620.40
1930..	3,444,000	.....	953,334.00	798,000.00	.....	.....	.....	3,000,000	2,872,286.40	.....	65,990	11,133,610.40
1931..	3,444,000	.....	953,334.00	798,000.00	.....	.....	.....	4,800,000	3,118,143.60	825,000	131,980	14,070,457.60
1932..	3,690,000	.....	1,239,334.20	997,499.86	C. 80,923.41	.....	.....	6,000,000	2,884,286.40	962,500	164,975	16,019,518.87
1933..	4,182,000	.....	1,716,001.20	1,496,254.57	.....	42,571.29	.....	6,000,000	2,884,286.40	1,512,500	164,975	17,998,588.46
Total..	66,102,400	907,500	18,221,178.15	12,489,162.43	92,923.41	42,571.29	398,625	28,020,000	18,673,861.60	7,631,250	527,920	153,107,391.88

*Includes $160,000 paid by the Acme in 1915, before amalgamation with the Hollinger. †Does not include repayment of capital of $476,667 in 1922.

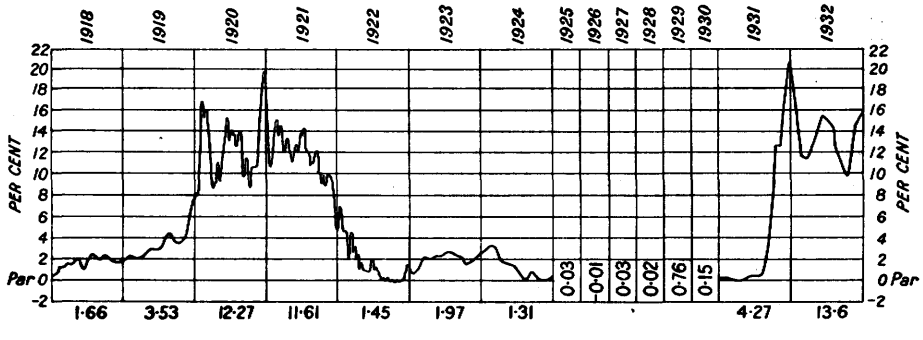
Doubtless the feature of the greatest interest to gold producers in Ontario during 1933 was the departure of the United States from the gold standard on April 19, following banking collapses and governmental intervention. Up to the date mentioned the United States had bought all Canadian gold offered, which with the exchange premium netted the Canadian producers a fair price. This market closed on April 19 except to domestic producers at the standard rate. Hence Ontario producers turned to the world's market in London, where better prices were quoted. On January 31 of this year (1934), President Roosevelt announced that thereafter the United States Treasury would buy gold from any quarter at not less than $35 per fine ounce, and he has been empowered by the U.S. Congress to offer up to $41.34 an ounce if the situation warrants. Hence the United States is now on a gold bullion standard. This has caused another change in the marketing of Ontario gold, which commenced in February to find its way again to New York. Ontario gold producers now receive the $35 price less shipping, insurance, and marketing charges, and subject to exchange adjustments. The effect of the new price on Ontario's gold mining industry was discussed by Hon. Chas. McCrea, then Minister of Mines for Ontario, in *The Northern Miner*, issue of February 8, as follows:—

Thirty-five dollar gold will not only enhance the value of our known ore reserves by about 70 per cent., but it will also increase in volume our available resources of mineable gold. These resources will henceforth include not only lower-grade sections of our mines, which were regarded as worthless rock, but new deposits as well. The bringing of this low-grade ore within the range of profitable milling will extend the life of our mines and give greater stability to our mining communities by the opening up of lower-grade gold properties in the vicinity of our producing mines. Furthermore, gold at thirty-five dollars means the creation of new mining communities in Northern Ontario. Many abandoned projects will be revived. Low-grade ore was not always the reason for the closing down of those old properties. Milling and metallurgical problems and underground faulting difficulties were responsible for the discontinuance of work on properties that showed ore of a fairly high grade. With our improved mining and milling methods, an increased price for gold, and fuller geological information, together with greater confidence and financial backing, many of the metallurical and geological difficulties will be overcome.

Prospecting will undoubtedly be stimulated. Areas that have been combed over in the past by the prospector, who was looking for gold deposits that would pay to mine at the standard price for gold, might well be re-prospected in view of the present valuation. It should be remembered that every new gold find has within it the germ of a new mining community. What that means to Ontario generally, any commercial traveller will tell you. Our mining centres are the best markets in the Province.

The expansion of our gold-mining industry, along with the growth of our mining communities will create larger markets for hydro-electric energy, more jobs for workmen, increased traffic for our railways, greater demands for lumber and the products of our farms. Revenue from taxation should rise sharply. Profits from mining will increase and dividends enlarge, while the mining industry will be stabilized on a broader basis. Capital is already gravitating to Ontario from all parts of the world for the development of our gold resources.

And this may appear like a rosy dream, but it is a dream that is based upon reality. Ontario's position as a gold-mining province was assured under the standard value of gold at $20.67 per ounce—it is doubly assured under gold at $35.00.



Graph showing fluctuations of the buying rate in Canada for New York funds from 1918 to 1932, inclusive. The average yearly premium or discount rate is noted in percentage figures at the base of the chart. Further details as to exchange equalization will be found in a separate table.

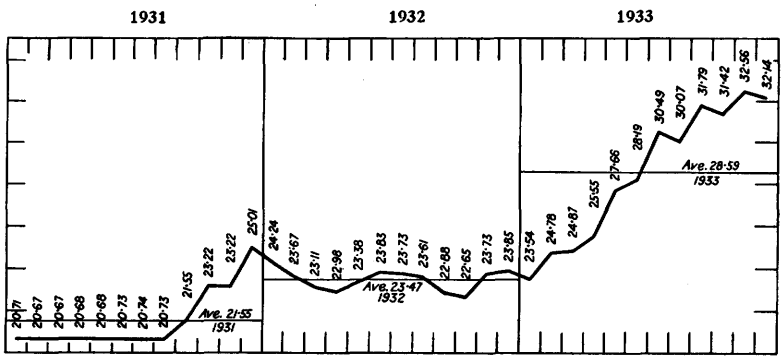


Chart of average monthly and yearly prices of gold in Canadian funds covering the past three years.

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 should be made for the years 1931 and 1932, as follows: In 1932, $81,728.42 received in 1933 should be credited to 1932; at the same time $113,088.91 should be deducted from the 1932 figures and credited to those for 1931. In 1930, the exchange did not overlap with 1931. The corrections have been applied in the accompanying table which is published for the first time.

EXCHANGE EQUALIZATION RECEIVED ON GOLD MARKETED BY ONTARIO PRODUCERS

Year	Porcupine	Kirkland Lake	Northwestern Ontario	Other areas	Grand total
	$	$	$	$	$
1920	1,265,664.29	110,354.42	256.78	.....	1,376,275.49
1921	1,238,210.72	121,425.28	.....	.....	1,359,636.00
1922	189,022.11	19,590.77	.....	7.87	208,620.75
1923	241,602.00	37,844.00	.....	.....	279,446.00
1924	172,721.71	24,027.67	.....	.....	196,749.38
1925*	—2,607.00	—231.00	.....	.....	—2,838.00
1926*	.....	—595.48	.....	.....	—595.48
1927*	.....	—235.10	.....	.....	—235.10
1928	.....	2,810.55	.....	.....	2,810.55
1929	87,173.00	70,283.00	.....	.....	157,456.00
1930	20,911.63	15,790.69	.....	.....	36,702.32
1931	830,799.04	1,006,607.22	61,857.38	26,958.00	1,926,221.64
1932	2,815,381.21	3,106,487.10	211,630.04	329.66	6,133,828.01
1933	8,249,321.00	7,448,933.00	495,309.00	292,874.00	16,486,437.00
Total	15,108,199.71	11,963,092.12	769,053.20	320,169.53	28,160,514.56

*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.

World Output.—The following statement of output by the leading gold-producing countries for 1929 and subsequent years has been abstracted chiefly from reports of the Director of the United States Mint and the American Bureau of Metal Statistics. Canada attained second place among the gold-producing countries of the world in 1930, having overtaken the United States (exclusive of the Philippine Islands). The Province of Ontario, as deduced from the table, produced 73 per cent. of Canada's gold in 1933:—

OUTPUT BY LEADING GOLD-PRODUCING COUNTRIES AND STATES
(Fine ounces—standard price $20.671834 per ounce, or one dollar = 0.048375 ounces)

Source	1929	1930	1931	1932	1933*
World	19,500,152	20,836,318	22,329,525	24,141,486	25,369,879
Transvaal (S. Africa)	10,412,326	10,716,351	10,877,777	11,558,532	11,013,713
Canada	1,928,308	2,107,073	2,693,892	3,051,676	2,949,309
Ontario	**1,622,267**	**1,736,012**	**2,085,815**	**2,287,394**	**2,155,518**
Russia (U.S.S.R.)	1,085,384	1,433,665	1,700,960	1,990,085	2,814,000
United States†	2,056,629	2,100,395	2,213,741	2,279,305	2,276,711
California	409,020	450,289	521,158	566,031	594,867
S. Dakota	312,328	406,297	431,200	485,051	519,548
Oceania‡	584,859	621,936	783,934	994,655	1,156,569
Australia	421,476	462,164	590,423	707,412	813,721
West Australia	376,176	416,369	510,570	605,561	637,207
Mexico	651,873	671,871	628,468	584,487	637,727
S. Rhodesia	560,813	547,630	532,111	574,135	642,499

*Preliminary figures from various sources subject to revision. The world estimate is that of the American Bureau of Metal Statistics. †Exclusive of the Philippine Islands (279,535 ounces). ‡Includes Australia, Tasmania, New Zealand and New Guinea.

Maximum Canadian production..... 3,051,676 ounces in 1932.
Maximum U.S. production..... 4,887,604 ounces in 1915.
Maximum Transvaal production.....11,558,532 ounces in 1932.
Maximum World production.....25,369,879 ounces in 1933.

RECEIPTS OF CRUDE GOLD BULLION FROM ONTARIO MINES AT THE ROYAL CANADIAN MINT, OTTAWA, 1929–1933

Year	Crude ounces	Precious metals			Buying rate in Canada for New York funds*
		Gold, fine oz.	Silver, fine oz.	Total value, standard	
1929	412,058	328,556	54,068	6,821,876	100.747
1930	908,209	713,527	86,419	4,760,111	100.147
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

*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.

Silver-Cobalt

The world's silver situation improved somewhat in 1933, owing partly to the efforts made in the United States to increase the price by legislation, and hopes engendered thereby gave rise to some speculative activity. The World Economic Conference in London terminated in July, and its only concrete accomplishment was a silver agreement. By its terms India undertook not to sell more than an average of 35 million ounces yearly during four years beginning January 1, 1934, and the chief producing nations agreed to purchase and withdraw from the market 140 million ounces during the four years or an amount equal to that of India's restricted sales. This agreement was ratified by India in November and in the following month by the United States. In addition the U.S. government will absorb the annual domestic production at 64½ cents per ounce, the current New York quotation for silver then being 43 cents. The U.S. Government will store in the Treasury as bullion one-half of the silver

thus bought and return half to the producers as silver dollars. One result of this has been to enliven the interest in Ontario silver camps. Canada has just ratified the London agreement, and now a movement is being sponsored by Ontario silver producers to have the Canadian Government take price action along lines similar to those in effect in the United States.

Production of silver from the famous Cobalt camp dwindled still further during the year. The Cross Lake mine of M. J. O'Brien, Ltd., was the only property continued in operation by the original owners. However, a number of lessees, as well as syndicates now owning and operating the Beaver and Coniagas, produced considerable silver and cobalt from the Mining Corporation, Foster, Timiskaming, McKinley-Darragh-Savage, Peterson Cobalt, and Agaunico mines. The destruction of the Nipissing mill by fire in August removed a landmark familiar to all mining men in Ontario.

While a further advance in the price of silver would enable a number of properties to re-open and increase considerably the present output from the silver-cobalt areas, the fact remains that the major portion of the metals has been won and future operations will centre around the recovery of ore overlooked in previous operations. The average price of silver on the New York market for 1933 was 34.727 cents per ounce as against 27.892 cents in 1932.

TABLE X.—SILVER SHIPMENTS BY CAMPS, 1904–1933

Year	Average price, cents per ounce (New York)	Silver content in troy ounces					
		Total from silver camps	Cobalt	Casey township	South Lorrain	Gowganda	Montreal R. and Maple Mountain, etc.
1904..	57.221	206,875	206,875	.....	.....	.....	.....
1905..	60.352	2,451,356	2,451,356	.....	.....	.....	.....
1906..	66.791	5,401,766	5,401,766	.....	.....	.....	.....
1907..	65.237	10,023,311	10,023,311	.....	.....	.....	.....
1908..	52.864	19,437,875	19,424,251	500	13,124	.....	.....
1909..	51.502	25,897,825	25,658,683	26,185	194,955	.....	18,002
1910..	53.486	30,645,181	29,849,981	92,544	221,133	471,688	9,835
1911..	53.340	31,507,791	29,989,893	114,789	933,912	468,687	510
1912..	60.835	30,243,859	28,605,940	253,824	834,119	549,976	.....
1913..	57.791	29,681,975	28,105,505	825,108	248,992	502,370	.....
1914..	54.811	25,162,841	24,155,699	499,643	108,199	399,300	.....
1915..	49.684	24,746,534	24,280,366	223,939	.....	242,229	.....
1916..	65.661	19,915,090	19,008,517	445,900	77,280	383,393	.....
1917..	81.417	19,401,893	18,327,258	.....	10,000	1,064,635	.....
1918..	96.772	17,661,694	16,807,407	143,901	72,188	638,198	.....
1919..	111.122	11,214,317	10,314,689	171,278	4,586	723,764	.....
1920..	100.900	10,846,321	10,402,249	.....	8,253	433,352	(a) 2,467
1921..	62.654	8,261,931	7,673,535	1,101	328,886	258,292	117
1922..	67.528	10,711,127	9,239,147	1,028	1,284,307	170,651	(b) 15,994
1923..	64.873	10,377,846	7,259,858	.....	2,955,646	160,761	1,581
1924..	66.781	9,935,902	6,704,787	.....	2,633,058	598,057	.....
1925..	69.065	10,707,235	6,252,115	.....	3,099,964	1,355,156	.....
1926..	62.107	10,543,473	6,262,249	.....	3,044,584	1,236,640	.....
1927..	56.370	8,543,513	4,482,543	.....	2,319,356	1,741,614	.....
1928..	58.176	6,745,401	3,934,020	.....	1,133,952	1,677,429	.....
1929..	52.993	7,781,429	4,823,529	.....	876,006	2,081,894	.....
1930..	38.154	9,225,610	5,329,335	.....	1,754,989	2,141,234	(c) 52
1931..	28.700	5,998,482	3,706,880	.....	594,360	1,697,242	.....
1932..	27.892	4,659,304	3,262,380	.....	22,144	1,374,780	.....
1933..	34.727	3,641,930	2,397,118	.....	.....	1,244,812	.....
Total.	.....	421,579,687	374,341,242	2,799,740	22,773,993	21,616,154	48,558

(a) Includes 885 ounces from Silver Islet, Lake Superior.
(b) Silver Islet, Lake Superior.
(c) Nickel Hill Syndicate in the Sudbury area shipped silver-cobalt ore.

TABLE XI.—TOTAL SHIPMENTS FROM SILVER MINES, SMELTERS AND REFINERIES, 1904–1933

Year	Bismuth		Copper(a)		Lead(a)		Nickel(b)		Cobalt(c)		Arsenic		Silver		Total value
	Tons	Value	Tons	Value	Tons	Value	Tons	Value	Tons	Value	Tons	Value	Ounces	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(d)							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	(f)776	1,333,676	2,059	299,940	10,711,127	7,658,802	9,355,642
1923(e)	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
Total	68	139,637	864	274,041	310	28,559	5,793	1,249,388	14,993	25,731,975	68,708	5,627,595	419,871,032	252,918,222	285,969,417

(a) Copper and lead are recovered from certain silver ores and concentrates shipped to United States refineries. (b) Nickel metal and metallic contents of all nickel compounds. (c) Cobalt metal and metallic contents of all cobalt compounds, also cobalt contained in ores and speiss residues exported. In 1932, it includes 22,258 lb. worth $10,024 from Northwestern Ontario. (d) 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. (e) Recoveries of bismuth from base bullion were not reported prior to 1923. (f) Includes 460 tons of speiss residues worth $153,116.

TABLE XII.—DIVIDENDS AND BONUSES PAID BY SILVER MINING COMPANIES TO DECEMBER 31, 1933

Name of company	Date of incorporation	Authorized capital	Capital stock issued	Par value per share	Dividends and bonuses paid to end of 1932	Dividends and bonuses paid during 1933	Total dividends and bonuses paid to 31st Dec., 1933	Date when last dividend was paid
		$	$	$	$	$	$	
Aladdin Cobalt Company, Limited	Aug. 23, 1912	500,000	500,000	5.00	75,000.00	.....	75,000.00	Apr. 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
Buffalo Mines, Ltd., The (*a*)	April 27, 1906	500,000	500,000	.50	2,787,000.00	.....	2,787,000.00	May 28, 1924
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. (*b*)	Jan. 20, 1922	2,000,000	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. (*c*)	April 16, 1913	1,000,000	1,000,000	1.00	230,000 00	.....	230,000.00	April 1, 1915
Cobalt Silver Queen, Ltd.	April 1, 1906	1,500,000	1,500,000	1.00	315,000.00	.....	315,000.00	Dec. 31, 1908
Coniagas Mines, Limited, The	Nov. 24, 1906	4,000,000	4,000,000	5.00	11,440,000.00	100,000.00	11,540,000.00	Jan. 10, 1933
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. (*d*)	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 Company, Ltd. (*e*)	Aug. 9, 1905	40,000	40,000	100.00	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
McKinley-Darragh-Savage Mines of Cobalt, Ltd.	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.	Nov. 23, 1916	8,300,250	8,300,250	5.00	7,573,937.47	.....	7,573,937.47	Dec. 19, 1929

City of Cobalt Mining Co., Ltd. (*f*)	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. (*f*)	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. (*f*)	May 8, 1906	100,000	45,011	1.00	1,042,259.61	.....	1,042,259.61	Nov. 11, 1914
Nipissing Mining Co., Ltd. (*g*)	Dec. 16, 1904	250,000	250,000	100.00	31,163,297.25	5,000.00	31,168,297.25	Dec. 30, 1933
Penn-Canadian Mines, Ltd. (*h*)	April 24, 1912	1,500,000	1,349,705	1.00	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 Mines, Ltd.	Sept. 11, 1909	2,000,000	1,685,500	1.00	252,825.00	.....	252,825.00	Mar. 17, 1917
Right of Way Mining Co., Ltd.	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 (*i*)	.....	.....	.....	.....	97,586,281.16	105,000.00	97,691,281.16	.....

(*a*) 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.

(*b*) 200,000 preferred shares, par $1.00, redeemed April, 1925, and capital reduced from $2,200,000 to $2,000,000.

(*c*) Cash assets amounting to $50,000 paid on April 27, 1917.

(*d*) Name of company changed from Temiskaming and Hudson Bay in 1909.

(*e*) In addition a return of capital amounting to $600,000 was made on July 3, 1919, to stockholders of the Kerr Lake Mines, Ltd.

(*f*) Mining Corporation of Canada, Limited, now owns and operates the City of Cobalt, Cobalt Lake and Cobalt Townsite mines.

(*g*) Includes $16,288,297.25 paid in dividends by the Nipissing Mines Co. (the holding company) to the end of 1916.

(*h*) Paid out of capital $40,491.15 on September 10, 1917, and an equal amount on April 24, 1918.

(*i*) Does not include dividends by private companies such as M. J. O'Brien, Ltd.

SILVER PRODUCTION, 1932 AND 1933

Source	1932		1933	
	Fine ounces	Value	Fine ounces	Value
		$		$
Sales of bullion by the reduction companies, smelters and mines*	4,662,059	1,455,822	3,602,529	1,258,362
Contained in silver-cobalt concentrates and residues exported	162,708	50,126	100,642	41,480
Estimated as recovered from concentrates treated outside of Ontario	282,121	86,945	236,863	87,922
In crude gold bullion	445,763	117,951	408,626	136,867
Recovered by nickel-copper refineries	663,839	200,093	1,026,370	388,303
Total	6,216,490	1,910,937	5,375,030	1,912,934

*There is included with the 1933 figures, 800,000 ounces of bullion produced in 1931 but held in storage for future sale.

Shipments of silver mines by camps during 1932 and 1933 were as follows:—

Camp	1932			1933		
	Silver	Cobalt*		Silver	Cobalt*	
	fine oz.	lb.	$	fine oz.	lb.	$
Cobalt	3,262,380	191,067	48,217	2,397,118	66,859	20,265
Gowganda	1,374,780	72,081	10,469	1,244,812	40,729	nil
South Lorrain	22,144	6,517	2,737	.....	.....	.....
Total	4,659,304	*291,923	71,447	3,641,930	161,911	20,265

*Figures represent the quantities paid for by the smelters, and values received by the mines.

Nickel-Copper and Platinum Metals

The year 1933 brought many great and fundamental changes, which vitally affected the metal-working industries of the world. Revival in industrial activity was reflected in the increased production by the nickel-copper group, in which ore smelted rose from 793,552 tons in 1932 to 1,523,814 tons in 1933, with corresponding increases in matte produced. During the period, the Creighton mine of the International Nickel Company shipped ore to both Copper Cliff and Coniston smelters, while the Frood mine shipped to Copper Cliff only. The Falconbridge increased its tonnage to the company smelter. While matte exported from Ontario to foreign plants increased by more than 100 per cent, the material treated at Port Colborne rose also, from 6,651 to 42,209 tons, the latter quantity almost equalling the total exportations. The recovery in the nickel-copper industry has helped greatly in reducing unemployment both at the smelting plants in the Sudbury area and at the Port Colborne refinery.

The output of platinum metals, all of which are recovered in the refining operations of this industry, was somewhat lower than in 1932, but the decrease shown bears little relation to the operations, inasmuch as these metals reach the markets slowly owing to a lag in the refining operations. Towards the end of the year, however, the market for platinum metals was considerably stimulated, owing partly to the price gyrations of gold and its restrictions for industrial uses.

World consumption of platinum metals in 1933 has been estimated at 175,000 ounces as against 75,000 ounces in 1932. Palladium has been an important factor in this increase, owing to increasing use in the electrical industry. As the platinum group of metals are now quoted at much lower prices than formerly, there has resulted an increased use of white-coloured alloys in dentistry in place of gold, and the luxury fine leather trade has made use of palladium leaf in high-priced leather goods, ladies shoes, etc.

The year 1933 marks the fiftieth anniversary of the finding of nickel-copper ore at Sudbury, and the following note supplied by Dr. J. L. Morris, Inspector of Surveys, Ontario Department of Lands and Forests, who went to Sudbury on the construction of the Canadian Pacific railway in the fall of 1883, is of historic interest:—

In the spring of 1884 Dr. A. R. C. Selwyn, Director of the Geological Survey of Canada, and Dr. R. F. Ruttan, Assistant Professor at McGill University, came to Sudbury, examining the rock along the right-of-way of the Canadian Pacific railway, at that time under construction.

While at Sudbury Dr. W. H. Howey and Mr. Ross, Supt. of the Indian Reserve at Whitefish, on their way between Whitefish and Sudbury along a foot trail picked up a sample of mineral rock which had a bright metallic lustre. They brought this sample to Sudbury and submitted it to Dr. Selwyn, who after examination stated "very, very pretty, but of no commercial value." Not satisfied with this, these two gentlemen sent a third party with a sample of the same mineral to Dr. Selwyn, who examined it and made the same reply.

At this time Thos. Frood, a retired school teacher from the town of Renfrew, found a sample of mineral at the location of the present Frood mine, now owned by the International Nickel Company of Canada. This prospect was purchased by Mr. S. J. Ritchie, then head of the Central Ontario Railway running from Trenton north, the parties from whom he purchased it being Thos. Frood, Robt. J. Tough, and Rinaldo McConnell, the total purchase price being $33,000.

On October 1, 1884, Thos. Murray of Pembroke secured a patent for lot 11, con. 5, township of McKim, which was afterwards known as the Murray mine. This mine was discovered through a rock cutting being made on the Canadian Pacific Railway construction three miles west of Sudbury.

TABLE XIII.—NICKEL-COPPER MINING AND SMELTING, 1929-1933

Schedule	1929	1930	1931	1932	1933
Ore shipped.....tons	1,991,910	2,115,139	1,690,192	790,614	1,533,887
Ore smelted..... "	2,033,457	2,357,154	1,689,874	793,552	1,523,814
Bessemer matte produced*..... "	132 030	166,703	100,273	41,660	82,128
Nickel content..... "	58,095	61,112	40,643	16,936	36,710
Copper content..... "	46,315	70,800	38,811	16,176	25,932
Matte exported†..... "	28,402	34,550	30,294	21,778	43,315
Nickel content..... "	14,068	20,978	16,847	8,068	20,811
Copper content..... "	8,449	5,855	6,620	8 825	12,323
Matte refined in Canada‡..... "	109,818	139,635	69,215	**6,651	**42,209
Men employed.....No.	4,546	5,246	3,530	2,269	3,325
Wages paid.....$	7,069,995	7,992,294	5,087,215	3,363,692	4,857,632

*In addition to the matte produced the International Nickel Company produces blister copper directly, figures for which are not included here.

†All matte was exported prior to 1918 when refining in Canada began at Port Colborne, Ontario. The British America Nickel Corporation commenced refining operations at Deschênes, Quebec, in 1920, and closed down finally in July, 1924.

‡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. The figures for 1932 and 1933 do not include the matte so treated.

**These figures duplicate in part the figures for matte produced.

TABLE XIV.—STATISTICAL SYNOPSIS OF THE NICKEL-COPPER INDUSTRY IN ONTARIO DURING 1931, 1932, AND 1933

Year	Number of producing companies	Number of plants in Ontario	Capital invested (*a*)	Dividends paid (*b*)	Salaried employees		Wage-earners		Selling value of products (*c*)	
					No.	Salaries	No.	Wages	Kind	Value
			$	$		$		$		$
1931	2	5 mines	20,932,914		39	167,035	2,116	2,975,821	Matte (exported)	15,701,636
		3 smelters	36,479,787	8,494,405.77	71	298,170	1,414	2,111,394	Metallic nickel	
		2 refineries (*d*)	31,874,415		126	367,390	972	1,752,020	Nickel oxide	
									Converter copper	8,172,327
									Gold (Standard)	483,328
		Construction					528	683,989	Silver	230,702
									Platinum metals	2,812,834
		Total	89,287,116	8,494,405.77	236	832,595	5,030	7,523,224		27,400,827
1932	2	5 mines	90,815,075	1,933,909.26	41	150,509	1,173	1,621,364	Matte (exported)	7,779,846
		3 smelters			77	288,609	966	1,365,220	Metallic nickel	
		2 refineries (*d*)			106	262,381	440	736,093	Nickel oxide	
									Converter copper	3,787,581
									Gold (Standard)	468,727
									Silver	200,080
									Platinum metals	1,998,911
		Total	90,815,075	1,933,909.26	224	701,499	2,579	3,722,677		14,235,145
1933	2	4 mines	91,785,900	2,746,330	46	157,795	1,459	2,238,271	Matte (exported)	21,197,469
		3 smelters			71	287,817	1,413	2,040,548	Metallic nickel	
		2 refineries (*d*)			98	251,895	751	971,614	Nickel oxide	
									Converter copper	9,005,195
									Gold (Standard)	764,508
									Silver	388,303
									Platinum metals	1,501,233
		Total	91,785,900	2,746,330	215	697,507	3,623	5,250,433		32,856,708

(*a*) The capital invested is exclusive of value of mineral lands. In the report for 1929, Vol. XXXIX, Part 1, the capital shown includes the book value for mineral lands, or a total of $74,077,808 for the lands.
(*b*) On preferred shares only in 1932. (*c*) Figures do not include the output of the Ontario Refining Company.
(*d*) Port Colborne plant, and Ontario Refining Company plant at Copper Cliff.

PRECIOUS METALS RECOVERED, 1929–1933

	1929 Ounces	1930* Ounces	1931 Ounces	1932 Ounces	1933 Ounces
Platinum metals:					
Platinum	12,474	34,000	44,725	64,897	55,755
Palladium	12,231	29,907	39,313		
Rhodium, Ruthenium, Osmium and Iridium	4,910	4,133	7,605		
Total.....ounces	29,615	68,040	91,643	64,897	55,755
Value.....$	1,646,381	2,436,683	2,812,834	1,998,911	1,501,233
Gold	7,802	22,867	23,381	22,674.72	36,983.08
Silver	429,541	1,067,154	822,971	663,795	1,026,370

*In 1930, 5 oz. gold, 62 silver, 4 platinum, and 14 palladium were includeo in ore exported from Strathy township.

Mr. R. C. Stanley, President of the International Nickel Company of Canada, in his annual report to the shareholders stated in part:—

The increase in world nickel consumption from 57,000,000 pounds in 1932 to 96,000,000 pounds in 1933 is impressive and indicates a healthy growth in the uses of nickel and such a market as has seldom been exceeded in the past. It is, moreover, significant to note that the distribution of consumption, both as to countries and uses, reflects natural and orderly progress toward improved industrial conditions.

Sales of nickel in all forms, including alloys, amounted to 74,356,959 pounds compared with 34,405,953 pounds in 1932, an increase of 116 per cent.

Sales of nickel in refinery products of Port Colborne (Canada) and Clydach (Wales) amounted to 61,353,495 pounds in 1933, an increase of 148 per cent. Sales of nickel in products of the rolling mills at Birmingham (England), Glasgow (Scotland), Huntington (West Virginia), and of the foundry at Bayonne (New Jersey) totalled 13,003,474 pounds as compared with 9,630,533 pounds, an increase of 35 per cent. Sales of monel metal totalled 9,101,219 pounds compared with 7,624,298 pounds in 1932, an increase of 19 per cent., and sales of rolled nickel, 6,287,991 pounds, were up 60 per cent. Copper sales, inclusive of copper in sulphate produced in Wales, increased from 57,662,789 pounds to 113,682,312 pounds, or 97 per cent. Gold sales were 21,355 ounces, compared with 23,042 ounces in 1932; silver sales were 876,303 ounces, compared with 652,638 ounces in 1932; and sales of the platinum metals were 77,198 ounces, compared with 19,300 ounces in 1932.

The current year opened far more auspiciously than the last. The company's nickel business is recovering from trade depression more rapidly, and to a somewhat greater extent, than is the case in most other basic industries. This may be attributed not alone to its international scope, but perhaps to an even greater extent to the multiplicity of comparatively recent applications of nickel. Supplementing this nickel background is an improvement in the world market for copper and the platinum metals which promises an increasing participation for your company in these industries.

While proven ore reserves as of December 31, 1933, were 204,783,399 tons, as a consequence a three-year programme of development of the Frood and Creighton mines was approved. Beginning with the second quarter of 1933 profits have been realized each month and the improvement has been well spread among all consuming fields.

Greater outputs and economies effected throughout the various plants decreased the cost of metal refining during the year. It is gratifying to report that, as a result of the larger payrolls, due to increased production, unemployment conditions in the localities in which your company operates, particularly Sudbury and Port Colborne, were greatly improved.

Dividends.—Total dividends paid to the end of 1932 and payments in 1933 are given in the table which follows. For convenience of comparison Mond figures have been converted to dollars on the basis of £1 = $4.8665. The Falconbridge company paid its first dividend in 1933.

TABLE XV.—TOTAL DIVIDENDS PAID BY NICKEL COMPANIES

Company		Period (inclusive)	Total to end of 1932	Paid in 1933
Canadian Copper Company		1894–1901	$1,975,000	.....
*International Nickel Company	Preferred	1906–1928	12,299,273	.....
	Common	1909–1928	65,811,694	.....
†International Nickel Company of Canada, Limited	Preferred	1929–1932	7,514,912.78	$1,933,898.75
	Common	1929–1932	33,085,113.56	.....
Falconbridge Nickel Mines, Limited		1928–1932	.....	812,431.27
Total		.....	$120,685,993.34	$2,746,330.02
‡Mond Nickel Company	Deferred	1906–1914	£264,043	.....
	Preferred	1904–1929	2,556,359	.....
	Ordinary	1905–1929	2,581,984	.....
Total		.....	£5,402,386 or $26,291,126	.....
Grand total		.....	$146,977,119.34	.....

*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.

†Dividends paid by the International Nickel Company of Canada, Limited, on the common stock in 1929 were 90c. 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; and 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.

‡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.

Iron Ore, Pig Iron, Steel, and Coke

As shown in the following table, foreign ore charged amounted to 182,060 long tons, the average price of which was $4.65 at lower lake ports. From this ore 110,562 long tons of pig iron were produced, including 71,977 of basic, 22,429 of foundry, and 16,156 of malleable. Figures for the past five years follow:—

TABLE XVI.—IRON AND STEEL STATISTICS, 1929-1933

	1929	1930	1931	1932	1933
Foreign ore smelted.....long tons	1,331,498	935,005	568,886	198,063	182,060
Limestone for flux.....short tons	342,776	234,309	149,454	56,880	46,944
Coke..... " "	767,420	542,094	320,133	119,064	113,102
Pig iron produced.....long tons	769,359	534,542	318,645	113,665	110,562
Value of pig iron produced.....$	17,408,514	11,465,435	6,363,101	2,558,799	2,066,049
Steel made.....long tons	899,807	639,128	444,107	244,693	258,841
Value of steel made.....$	32,393,052	22,369,480	15,099,638	8,319,562	8,800,594

At Montreal No. 1 pig iron (2.25-2.75 silicon) was quoted at $22.70, basic at $18.00, malleable at $22.70, and steel billets at $34.00 per long or gross ton.

Iron and Steel.—Not for many years has the production of pig iron in Ontario fallen to such a low ebb. The year opened with one furnace in blast at Sault Ste. Marie, which closed down during January. During the months of February, March, April, and May, all furnaces were idle. The Canadian Furnace Company at Port Colborne blew in a 350-ton unit on June 26 which was followed by the Steel Company at Hamilton blowing in a 275-ton furnace. In November the Algoma Steel Corporation at Sault Ste. Marie started a 275-ton furnace. The year closed with three active furnaces having a total capacity of 900 tons, of 2,775 tons in seven furnaces available.

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 the householders and to industries. The statistics shown in Table XVII are combined and show raw materials used with products made.

TABLE XVII.—THE COKING INDUSTRY IN ONTARIO, 1933

		Quantity	Cost at works
MATERIALS USED:			
Coal	tons	1,589,752	$7,089,258
Coke	"	49,148	326,081
Oil	Imp. gals.	7,918,232	534,930
Absorbing and wash oil	"	158,083	41,014
Caustic soda	lb.	384,452	12,643
Soda ash		.....	.....
Lime	tons	615	5,565
Water		.....	5,117
Oxide for purification	"	2,321	22,375
Sulphuric acid 66° Be. purchased	lb.	22,317,952	147,614
All other materials		.....	7,843
Total		.....	$8,173,829
GAS MADE:			
Retort coal gas	M. cu. ft.	4,357,400	.....
Coke oven gas	" "	11,447,542	.....
Straight water gas	" "	.....	.....
Carburetted water gas	" "	2,918,643	.....
Mixed coal and water gas	" "	73,446	.....
Oil gas	" "	11,080	.....
Acetylene gas for town lighting	" "	859	.....
Total	" "	18,808,970	.....
GAS CONSUMED:			
Sold	" "	8,401,715	$7,496,604
Used in producing plants	" "	5,442,466	1,495,658
Used in associated metallurgical works	" "	4,383,436	749,501
Otherwise accounted for	" "	131,311	44,640
Not accounted for	" "	530,133	527,797
Total		18,889,061	$10,314,200
COKE AND BY-PRODUCTS MADE:			
Coke, including breeze	tons	1,153,509	$8,429,660
Tar	Imp. gals.	14,075,641	766,621
Ammonia liquor	lb. NH_3	1,518,805	15,188
Ammonium sulphate	lb.	25,315,284	236,030
Benzol	Imp. gals.	2,645,649	552,595
All other products		.....	243
Total		.....	$10,000,337
COKE SOLD AND USED, AND STOCKS:		Coke	Breeze
Used by reporting companies	tons	225,942	35,481
Sold for domestic use		778,864	54,995
Other uses		101,849	.....
On hand, December 31, 1932		129,129	15,081

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

COKE STATISTICS, 1929-1933

Coke	1929	1930	1931	1932	1933
Production.....short tons	1,624,884	1,489,415	1,113,509	1,087,122	1,183,206
Imports..... " "	1,123,761	993,753	694,982	605,307	615,818
	2,748,645	2,483,168	1,808,491	1,692,429	1,799,024
Deduct exports..... " "	2,010	317	106	.....	.....
Apparent consumption.... " "	2,746,635	2,482,851	1,808,385	1,692,429	1,799,024

NON-METALLIC MINERALS

Talc, salt, feldspar, fluorspar, graphite, quartz, diatomite, mica, and petroleum of the non-metallic group showed improvement as compared with the year 1932. Export trade for such staples as mica, feldspar, and quartz has been retarded, owing principally to the depression in United States industries and the high tariffs in force. A new feature of this group was the production of nepheline syenite for the first time in Ontario, a small experimental shipment having been made from Methuen township. The total value in 1933 for the non-metallic group was $7,094,636 as against $7,361,897 during the previous year, or a decline of 4.6 per cent. The detailed quantities and values may be observed in the main table on page 3.

Arsenic

Arsenic in the native state is a metallic mineral, but since it is produced in Ontario in the oxide form, called in the trade "white arsenic," it has been customary to include it with non-metallics. The whole production is recovered in the smelting of the silver-cobalt arsenides of Northern Ontario by the Deloro Smelting and Refining Company. The production in 1933 was 1,468,022 pounds valued at $56,534, as against 2,424,342 pounds worth $98,914 in the previous year.

Barite

This mineral, which has not appeared in the production table since the year 1923, was represented in 1933 by 20 tons worth $60, which came from Tionaga. Several deposits are known to exist; and one in the Porcupine gold area, owned by Canada Nighthawk Mines, Limited, is equipped with milling facilities. The main difficulty, however, for domestic producers is the limited home market and the high duty to be met on entry into the United States. During the last half of 1932 a force of 15 men was employed in remodelling the milling equipment of the above-mentioned company and preparing to produce a marketable product. However, no production was reported in 1933.

Diatomite

Diatomite is a hydrous type of silica in the form of countless microscopic siliceous remains of aquatic plants called algae, and may be of either fresh-water or marine origin. In addition to its use as an insulator, diatomite is employed as a filtering material, as a filler, as a fine abrasive polish, and for many other uses. Ontario deposits are all of fresh-water origin. Only two firms produced diatomite in Ontario during 1933, namely: F. P. Macklem, successor to Dominion Diatomite, Limited, at Novar; and Diatomite Products Limited, at Martin's Siding. The production of 20 tons was marketed in several grades and had a selling value of $1,298. Other firms, namely Spence Lake Diatomite, Limited, and Muskoka Diatomite, Limited, with a deposit near Gravenhurst, were idle during the period. Further reference to diatomite will be found under the heading "Sand-Lime Brick."

Feldspar

This industry, which reaches its highest production when the foreign market is open, had a poor year in 1932 and also in 1933, owing to the extraordinary business slump in the United States with the consequent lessened demand. The only domestic grinding plant in the Province, that of Frontenac Floor and Wall Tile Company at Kingston, continued to supply the major portion of the home demand. The grade of spar mined in Ontario compares favourably with that of any other country, being particularly rich in potash and alumina so desirable in glazing pottery and enamel-ware, and in the porcelain insulator trade. During the period the total shipments were 4,387 tons worth $45,350, as against 3,657 tons valued at $42,920 in 1932. The main producer was T. H. Craig of Perth.

Fluorspar

The output of fluorspar from Ontario deposits has been practically negligible during the past decade. A few tons, however, have been recovered from the old ore dumps on lot 3, concession I, Madoc township. During 1930 and 1931 the production was 80 tons worth $1,240 and 40 tons valued at $620, respectively. In 1932 output was 32 tons worth $464, and 73 tons worth $1,064 in 1933.

Graphite

In 1933 the only producer of this mineral in Ontario was the Black Donald Graphite Company, Limited, of Calabogie from its property on lots 16, 17, and 18, concession III of Brougham township, Renfrew county. During the year 1933 sales totalled 362 tons valued at $16,145, as against 346 tons worth $18,483 in 1932.

Gypsum

The Ontario production of this mineral again showed a decline owing to the greatly restricted demand in the building trades. Gypsum, Lime and Alabastine Canada, Limited, at Caledonia and Lythmore, and the Canadian Gypsum Company at Hagersville, which commenced operating in October, 1932, together produced 24,460 tons in 1933 as against 35,655 tons in 1932. The Lythmore plant of Gypsum, Lime and Alabastine Canada, Limited, closed down in November, 1932, and will not be reopened.

As will be noted in the table which follows, sales in 1933 were much below those of the past four years:—

GYPSUM SALES, 1929–1933

Grade	1929	1930	1931	1932	1933
Crushed.....tons	23,533	25,130	10,263	5,656	2,753
Fine ground..... "	497	1,190	451	364	795
Calcined sold..... "	5,269	3,515	1,606	217	165
Calcined used in products..... "	71,048	65,111	41,038	29,418	20,747
Total sold or used.....tons	100,347	94,946	53,358	35,655	24,460
Total value.....$	832,689	776,069	374,469	186,176	112,319
Number of workers.....	257	*92	155	*98	*79
Wages paid.....$	311,609	92,918	87,263	85,036	46,782

*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 nickel-copper smelting was 8,196 tons worth $81,960, as against 3,332 tons valued at $33,320 in 1932. No pyrite ore was shipped.

Mica

The mica industry, which is principally in the hands of small producers, is almost entirely dependent on the electrical manufacturing business. The decline in consumption was particularly marked in 1932 and there were fewer producers than during the past two decades. By grades the shipments in 1931, 1932, and 1933 were as follows:—

Grade	1931		1932		1933	
	Quantity	Value	Quantity	Value	Quantity	Value
	lb.	$	lb.	$	lb.	$
Ground	.....	.....	.....	.....	19,000	239
Thumb-trimmed	5,593	1,876	232	224	44,219	3,287
Splittings and knife-trimmed	30,015	10,505	.....	.....	11	19
Scrap	2,062,300	10,902	536,980	2,528	1,268,200	5,820
Total	2,097,908	23,283	537,212	2,752	1,331,430	9,371

The prices for the various sizes and grades as reported by the producers covered the following in 1932. The 1933 quotations did not vary greatly.

Size	Cents, per lb.	Size	Cents, per lb.
Scrap	.0045 to .0057	2 by 3 inches	30
*Splittings	.35	2 by 4 "	53
*1 by 1 inch	5 to 10	3 by 5 "	100
*1 by 2 inches	10 to 14	4 by 6 "	175
*1 by 3 "	30	*5 by 8 "	250 to 300

*None produced in 1933—prices shown are 1931 quotations.

Mineral Waters

The output in Ontario from five or six mineral springs during the past decade has ranged from 61,000 to 309,000 Imperial gallons. During 1931 six wells, all in eastern Ontario, produced 197,540 Imperial gallons worth $8,578 at the shipping point, and in 1932 four wells produced 61,208 gallons. In 1933, the production was 29,794 gallons valued at $2,347 from three wells. The record for the past ten years follows:—

Sales	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
Imp. gals..	201,670	183,012	208,400	293,200	253,630	309,700	214,200	197,540	61,208	29,794
Value ....$	13,133	25,452	27,277	12,811	27,890	13,651	20,754	8,578	2,473	2,347

In addition to the above there are springs near Wilberforce in Haliburton county close to the uraninite deposits, which are radio-active and which possibly may have therapeutic value. Another mineral water is calcium chloride, which has been found in saline waters near Concord in York county, Burlington in Halton county, and elsewhere. These waters have had some use for medicinal purposes. It has also been tried as a dust allayer on the highways, but the ratio of calcium chloride to water was found to be too low and it could not compete with the calcium chloride in crystal form as now used. Sanatoria at St. Catharines and Preston have long been using the mineral waters at those points both for baths and drinking purposes. This consumption has not been included with the figures of output.

Natural Gas and Petroleum

The Natural Gas Commissioner of Ontario, R. B. Harkness, has supplied the following notes:—

Natural Gas.—The production of natural gas in the year 1933 was 7,166,659 M. cu. ft. the smallest in 25 years, and the value $4,523,084. This decline is due in part to the mild winter and spring of 1933, but the major cause is the decreased use of natural gas for heating purposes, the cheaper classes of coal superseding it. The decrease in production was shared by all fields excepting those of Haldimand county and Dawn township in Lambton county. Most of the drilling in the past year was done by independent producers. The distributing companies were inactive so far as exploration was concerned.

Petroleum.—The year 1933 has shown an increase in petroleum production for the third consecutive year, as noted in the table. This new production came mainly from Dawn township in Lambton county where the three wells drilled by the Union Gas Company, noted in last year's report, are situated. These wells are from 1,700 to 1,800 feet deep, whereas most of the oil produced in Ontario comes from an oil horizon at from 400 to 500 feet below the surface.

CRUDE PETROLEUM PRODUCTION,* 1929–1932

Field	1929	1930	1931	1932	1933
	Barrels	Barrels	Barrels	Barrels	Barrels
Petrolia and Enniskillen township...	56,284	55,130	57,515	58,871	57,298
Oil Springs	30,789	29,160	30,792	31,438	31,343
Moore township	1,230	1,576	3,739	3,272	2,192
Sarnia township	749	1,149	1,466	1,227	2,181
Plympton township	315	296	296	274	211
Bothwell	23,236	21,176	18,084	19,460	22,935
Dover township	715	457	891	453	763
Dawn township	.....	.....	.....	5,061	8,589
Onondaga township	243	231	34	543	946
Mosa township	6,850	7,166	8,517	8,429	8,168
Thamesville	427	447	462	534	847
Dunwich township (Dutton and Iona)	148	365	628	781	346
Tilbury East township	139	149	.....	.....	.....
Raleigh township	.....	.....	.....	.....	239
Total quantity	121,125	117,302	122,364	130,343	136,058
Value	$293,724	$235,746	$219,993	$247,468	$253,486
Average price per barrel	$2.42	$2.00	$1.80	$1.89	$1.87

*Information furnished by the Imperial Oil Refiners, Limited, of Sarnia, and others.

Quartz, Quartzite, and Silica Brick

The production of quartz and quartzite in 1933 was below that of previous years. Silica brick showed an advance in 1933 over the preceding year. Production figures for the past five years follow:—

QUARTZ, QUARTZITE, AND SILICA BRICK, 1929-1933

Schedule	1929	1930	1931	1932	1933
Rock sold or used.....tons	187,973	167,487	97,888	66,135	51,601
Value.....$	316,050	274,674	148,642	93,574	84,564
Silica brick sold or used.....M	1,566	378	279	93	183
Value.....$	80,374	19,120	13,702	4,303	7,351
Total, value.....$	396,424	293,794	162,344	97,877	91,915

Salt

During 1933 six companies produced salt, or brine which is used in the manufacture of chemicals by Canadian Industries, Limited, and Brunner Mond Canada, Limited. The Warwick Pure Salt Company was a newcomer on the list, and Kincardine Salt Limited, owned by Canadian Industries, Limited, reported no production. This industry, which is located in the southwestern part of the Province, is well organized, and the fluctuations shown in the figures of output reflect fairly closely the general progress of industry in the Province. Production figures covering a 5-year period follow:—

SALT SOLD OR USED, 1929–1933

Schedule	1929	1930	1931	1932	1933
Table and dairy.....tons	54,138	49,467	115,180	59,620	61,231
Fine..... "	49,869	52,604		59,036	63,786
Coarse..... "	22,632	21,085	17,678	15,673	14,086
Land..... "	1,949	245	513	557	283
Other grades (pressed blocks)*.. "	5,560	7,655	.....	.....	.....
Total salt.....tons	134,118	131,056	133,371	134,896	139,386
Brine (salt equivalent)..... "	168,327	114,737	97,928	96,242	104,721
Total sold or used.....tons	302,445	245,793	231,299	231,138	244,107
Value.....$	1,420,424	1,568,250	1,760,388	1,789,752	1,755,087
Wage-earners†.....No.	263	263	233	215	242
Wages.....$	303,618	288,237	259,646	253,579	261,214

*Pressed blocks included with Table and dairy grade in 1931, 1932, and 1933.
†Workers at the Sandwich salt and chemical works are included.

Talc

A fairly stable market has been developed for this mineral, both in the ground and prepared condition. The domestic consumption is steady, and exports are made to the United States and Europe. The production record as reported by two companies at Madoc in Hastings county for the last five years follows:—

TALC STATISTICS, 1929–1933

Sales	1929	1930	1931	1932	1933
Quantity marketed.....tons	15,462	11,664	11,806	12,064	15,114
Value.....$	180,492	133,213	122,044	111,585	142,134
Wage-earners, mine and mill.....	42	36	36	38	43
Wages.....$	40,055	32,718	29,419	30,587	31,813

Increased talc sales in 1933 were due partly to the gradual betterment in some lines of business using talc products, such as textiles, cosmetics, etc., and probably to the introduction of the N.R.A. in the United States, where the major portion of the Ontario talc is marketed. Some of the buying, however, may have arisen from the fear of possible higher prices, which would account for the falling off in the demand during the last two months of the year.

STRUCTURAL MATERIALS

Building Permits.—In 61 Canadian cities building permits in 1933 were valued at $21,776,496. Of this total 30 Ontario cities accounted for $9,116,743, as noted in the following table abstracted from *Annual Review of Building Permits in Canada in 1933*, issued by the Dominion Bureau of Statistics, Department of Trade and Commerce, Ottawa:—

BUILDING PERMITS IN ONTARIO, 1920–1933

Year	30 Ontario cities, value	Wholesale Prices Index (*a*)	Toronto metropolitan area, value (*b*)	Wages Index (*c*)
	$		$	
1920.....	58,636,365	144.0 (*d*)	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	100.0	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	99.0	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	158.0

(*a*) 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 67.0, dropping to a low of 60.5 in 1915.
(*b*) Includes York and East York municipalities.
(*c*) Average index numbers of wages in Canadian building trades as compiled by the Federal Department of Labour on the basis of 1913=100. (*d*) Peak year.

Construction Contracts.—The value of Canadian construction contracts awarded for 1933, reported by *McLean Building Review*, was $97,289,000 as compared with $132,872,000 in 1932. Ontario contracts in 1933 amounted to $42,573,400, or 44.0 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, recovering slightly in 1933. Figures by class follow for a five-year period:—

VALUE OF ONTARIO CONSTRUCTION CONTRACTS, 1929–1933

Classification	1929	1930	1931	1932	1933
	$	$	$	$	$
Residential	59,211,000	44,427,000	39,274,300	14,143,200	12,653,800
Business	82,949,000	52,636,400	28,819,400	16,925,600	9,716,100
Industrial	28,247,200	12,787,400	6,836,300	1,871,000	4,699,700
Engineering	45,365,900	65,608,800	50,522,300	16,352,000	15,503,800
Total	215,773,100	175,459,600	125,452,300	49,291,800	42,573,400

Cement

Portland cement production is probably one of the best yardsticks by which the building and construction industry may be measured. As might have been expected, an examination of the statistics of contracts awarded by classes, such as engineering, residential, or business, throughout the year indicated that much less cement was being marketed. During the period four plants were operated, three by the Canada Cement Company, Limited, at Port Colborne, Lakefield, and Belleville, and one by the St. Marys Cement Company, Limited, at St. Marys. In commenting on the year's operations of the Canada Cement Company, President J. D. Johnson stated, in part:—

The volume of building, according to published reports, fell to a lower level in Canada in 1933 than in any year since 1915, but due also to the lack of purchasing power of the farmer and small user, the demand for cement was less than in any year since 1906. However, the extreme low point of the decline in cement consumption would appear to have been reached in February. After that month the decline, while still very severe, was of less intensity each month until October when, for the first time in practically three years, there was a cessation of the downward trend.

Production during the past decade is given in the following table:—

PORTLAND CEMENT STATISTICS, 1924–1933

Year	No. of Operating Plants	Sales		
		Barrels (350 lb.)	Total Value	Average Price per bbl.
			$	$
1924	4	3,564,499	5,668,671	1.59
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

Cement Products.—In recent years the industry of cement products manufacture 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. The following tables give the record of materials used and products made during the past two years, also general statistics for a five-year period:—

CEMENT PRODUCTS MANUFACTURE IN ONTARIO,* 1932–1933

	1932		1933	
	Quantity	Cost at works	Quantity	Cost at works
MATERIALS USED				
Portland cement ..... bbls.	54,477	$123,965	37,900	$90,461
Quicklime ..... bush.	168	97	81	43
Sand ..... cu. yds.	14,079	16,335	13,017	14,207
Gravel ..... "	11,069	13,173	7,481	8,068
Crushed stone ..... "	2,523	5,369	2,624	4,798
Cinders ..... "	7,047	8,291	.....	9,277
Boxes, crates, lumber, etc	.....	17,465	.....	6,345
Reinforcing	.....	5,591	.....	5,707
Haydite ..... cu. yds.	5,668	19,840	4 780	16,730
Dolomite ..... tons	268	2,312	.....	.....
Brass	.....	22,077	.....	16,717
Other materials	.....	43,525	.....	39,857
Total	.....	$278,040	.....	$212,210
	Quantity	Selling value	Quantity	Selling value
PRODUCTS MADE				
Artificial stone	.....	$58,245	.....	$37,417
Cinder blocks ..... M	494	73,069	237	39,377
Cement bricks ..... "	1,243	39,664	166	4,140
Cement hollow building blocks	.....	138,177	.....	122,689
Cement laundry tubs ..... No.	4,221	30,982	2,697	19,576
Cement posts, poles, etc	.....	790	.....	694
Cement sewer,culvert, and drain pipe	.....	186,262	.....	133 300
Cement stucco	.....	8,039	.....	5,424
Burial vaults	440	16,646	.....	9,444
Crushed stone	.....	.....	.....	3,162
Garden furniture	.....	3,311	.....	.....
Haydite blocks ..... tons	3,054	25,961	835	7,103
Haydite roof slabs ..... "	349	9,893	2,352	66,414
Other products	.....	146,307	.....	98,680
Custom work and repairs	.....	.....	.....	2,765
Total	.....	$737,326	.....	$550,185

*Supplied by Dominion Bureau of Statistics, Ottawa.

PRINCIPAL STATISTICS OF CEMENT PRODUCTS INDUSTRY,* 1929–1932

	1929	1930	1931	1932	1933
Plants ..... No.	106	88	92	69	48
Wage-earners (average) ..... "	767	533	562	352	245
Salaries and wages ..... $	897,481	658,381	599,640	308,898	199,056
Cost of fuel and electricity ..... $	49,974	44,697	43,429	27,692	19,008
Capital invested ..... $	3,031,747	3,148,950	2,955,610	2,286,460	1,642,244
Value products at works ..... $	2,664,372	1,921,018	1,782,400	737,326	550,185

*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 the period 20 companies and individuals operating 24 plants reported sales which totalled 146,193 tons valued at $1,227,196 as against 166,703 tons worth $1,273,230 in 1932. Sales during the past five years follow:—

LIME STATISTICS, 1929–1933

Year	Lime marketed or used						Fuel costs	Wage-earners	Wages
	Hydrated			Quicklime					
	Tons	Value		Tons	Value				
		Total	Per ton		Total	Per ton			
		$	$		$	$	$		$
1929..	55,916	740,127	13.24	314,246	2,624,285	8.35	513,741	577	398,266
1930..	42,726	504,178	11.80	209,340	1,673,409	7.99	343,237	330	352,768
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

Distribution of the quicklime and hydrated lime sold in 1933, as reported by the producing companies, was as follows:—

Industrial consumption	Quicklime		Hydrated lime	
	Tons	Value	Tons	Value
		$		$
Building trades: finishing and masons	7,854	60,421	17,268	196,899
Sand-lime brick	2,343	15,994	387	3,675
Agriculture	32,561	243,677	572	5,877
Chemical and metallurgical Industries: Smelters	1,261	7,029	50	625
Iron and steel	10,197	71,377	5	52
Gold milling	20,342	144,683	25	200
Pulp and paper	2,095	13,378	101	1,060
Glass	5,672	56,233	.....	.....
Sugar	7,022	57,215	.....	.....
Tanneries	2,056	14,393	178	1,857
*Other chemicals	35,057	322,505	1,147	10,046
Total	126,460	1,006,905	19,733	220,291

*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 cyanamide.

Sand-Lime Brick

As in the year 1932, production and sale of sand-lime brick was again small, owing to the slackened building programme. Four companies in Toronto sold this product: the Harbour Brick Company, Toronto Brick Company, Hinde Brothers, and York Sandstone Brick Company. Experiments with diatomite were carried on during the year by the Harbour Brick Company, and a small quantity of insulation brick was marketed. The diatomite came from Ontario, British Columbia, Nova Scotia, and also from abroad. Sales of sand-lime brick totalled 6,922 M. valued at $69,785, as against 6,823 M. worth $78,398 in 1932.

The following table shows statistics for the past five years, also the comparative average values of common clay brick:—

SAND-LIME BRICK STATISTICS, 1929-1933

Year	No. of operating plants	No. of wage-earners	Wages	Sales				Average value per M. of common clay brick
				M.	Total selling value	Average value per M.	Value with lime cost deducted	
			$		$	$	$	$
1929.....	6	190	228,576	55,750	641,159	11.50	540,299	15.84
1930.....	6	129	147,827	41,576	424,178	10.20	318,037	15.08
1931.....	5	93	72,762	27,378	253,228	9.25	197,470	15.00
1932.....	3	47	32,067	6,823	78,398	11.49	58,586	16.63
1933.....	4	58	32,889	6,922	69,785	10.09	50,968	13.82

Sand and Gravel

During the past three years the production of sand and gravel fell in proportion to the decrease in the building and construction industry, upon which it is so dependent. In round figures the yearly production in 1930 was 10.2 million tons; in 1931 it was 6.7 millions, 6.6 millions in 1932, and 6.7 million tons in 1933. The figures for the past two years are shown in the following table:—

OUTPUT OF SAND AND GRAVEL, 1932-1933

Source	1932		1933	
	Tons	Value	Tons	Value
		$		$
Private pit operators.....	1,737,065	615,452	2,429,042	1,145,316
Dredged from Great Lakes and rivers.....	425,340	212,670	243,633	135,352
Department of Northern Development.....	2,497,500	301,625	1,038,108	207,624
Department of Highways.....	270,000	40,000	408,700	204,350
Miscellaneous counties and townships.....	1,660,903	830,551	1,550,547	775,274
Total.....	6,590,808	2,000,298	6,670,030	2,467,916

Stone

The quantity decline in stone production was due to the lessened programme of highway construction and heavy concrete or foundation work, as well as railway ballasting for which large quantities of broken stone are used. Quarrying was curtailed by large operators and completely suspended by many of the small individual producers. Values for a five-year period, and production figures for 1933 follow:—

VALUE OF STONE PRODUCTION, 1929-1933

Year	Marble	Limestone	Sandstone	Trap	Granite	Total
		$	$	$	$	$
1929.....	.....	3,759,357	69,898	367,590	574,771	4,771,616
1930.....	.....	3,722,196	32,664	184,191	691,919	4,630,970
1931.....	.....	2,929,885	26,186	128,258	112,968	3,197,297
1932.....	.....	1,459,224	9,435	52,659	133,698	1,655,016
1933.....	21,083	910,418	12,334	26,629	12,804	983,268

STONE STATISTICS BY VARIETIES AND USES, 1933

Uses	Limestone (a)		Granite		Trap		Sandstone		Marble		Total	
	Tons	Value	Tons	Value	Tons	Value	Tons	Value	Tons	Value	Tons	Value
		$		$		$		$		$		$
Building and ornamental	6,481	23,860	1,014	1,989			7,416	10,193	253	10,981	15,164	47,023
Flagstone	30	9	70	35			353	1 410			453	1,454
Curbstone												
Paving blocks			80	500							80	500
Roofing granules			1,193	9,544							1,193	9,544
Asphalt			92	736							92	736
Chemical—												
Cement plants		(b)										
Flux in iron and steel plants	66,248	48,170									66,248	48,170
Flux in smelters												
Glass factories												
Manufacture of lime		(a)										
Pulp and paper mills	32,427	28,686									32,427	28,686
Sugar refineries	14,636	10,980									14,636	10,980
Other chemical uses	56,167	54,560									56,167	54,560
Asphalt filler	41	178									41	178
Agricultural purposes	13,385	9,323							1,208	5,183	14,593	14,506
Poultry grit												
Stucco dash and terrazzo flooring									1,153	4,919	1,153	4,919
Rubble and riprap	2,047	677					1,120	731			3,167	1,408
Crushed stone: Concrete aggregate / Road metal / Railroad ballast	1,031,292	733,975			17,201	26,629					1,048,493	760,604
Total	1,222,754	910,418	2,449	12,804	17,201	26,629	8,889	12,334	2,614	21,083	1,253,907	983,268
Producers.....No.	(c) 35		5		2		9		4		55	
Wage-earners..... "	391		25		41		18		11		486	
Wages paid.....$	185,898		4,109		9,745		2,748		3,235		205,735	

(a) Stone used for making lime accounted for in statistics for lime.
(b) Value included with cement.
(c) Exclusive of municipalities.

Clay Products

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

HEAVY CLAY PRODUCTS MARKETED, 1933

Kind	Number or quantity	Value
		$
Fire-clay blocks and shapes	.....	90
Brick—Soft-mud process, face	M	2,292,309	38,360
Brick—Soft-mud process, common	"	6,795,738	87,644
Stiff-mud (wire cut) process, face	"	11,659,964	240,738
Stiff-mud (wire cut) process, common	"	3,191,756	46,337
Dry-press, face	"	3,302,305	72,194
Dry-press, common	"	1,834,510	29,357
Fancy or ornamental brick (including special shapes, embossed and enamelled brick)	"	6,309	387
Sewer	"	242,289	3,683
Tile, structural: Hollow blocks (including fireproofing and load-bearing tile)	tons	8,196	60,438
Roofing tile	No.	20,469	1,136
Floor tile (quarries)	sq. feet	81,808	12,490
Tile, drain	No.	8,745,559	179,015
Sewer pipe (including copings, flue linings, etc.)	.....	.....	185,048
Pottery (flower pots) from domestic clay	No.	.....	52,650
Haydite	.....	.....	15,012
Total value	.....	.....	1,024,579

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 1929–1933

Year	Brick		Pottery	Drain tile	Sewer pipe	Haydite	Total
	Common	Pressed, fancy, building tile, etc.					
	$	$	$	$	$	$	$
1913	3,283,894	1,162,860	52,875	292,767	600,297	.....	5,392,693
1922	2,614,120	2,899,205	88,889	368,180	973,824	.....	6,944,218
1929	1,281,004	3,524,358	96,394	629,322	1,167,463	131,621	6,830,162
1930	792,234	2,683,983	89,381	593,980	834,361	227,275	5,221,214
1931	662,777	1,707,297	73,860	244,368	696,694	167,533	3,552,799
1932	305,566	704,342	67,866	144,579	451,786	16,366	1,690,505
1933	167,021	425,743	*52,740	179,015	185,048	15,012	1,024,579

*Includes fire-clay blocks and shapes worth $90.

Mining Company Incorporations

A summary of mining companies incorporated and licensed in Ontario for the last pre-war year and subsequently is given hereunder:—

ONTARIO MINING COMPANIES INCORPORATED AND LICENSED, 1913–1933

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

Of the 95 companies incorporated in 1933, 74 had specified capital only, 19 were companies having shares without nominal or par value exclusively, while 2 companies had shares of both kinds.

MORTMAIN AND EXTRA-PROVINCIAL COMPANIES LICENSED IN 1933 BY ORDER-IN-COUNCIL

Name of company	Place of incorporation	Date of license (O.C.)	Capital for use in Ontario
Agaura Explorations, Ltd	Canada*	May 12	$100,000
Amalgamated Gold Fields Corporation, Ltd	Canada*	June 20	550,000
American Venture Corporation, Inc	Delaware†	July 11	40,000
Chibougamau Prospectors, Ltd	Canada*	July 21	100,000
Copperfields Developments, Ltd	Canada*	Aug. 11	100,000
Kingdon Mining, Smelting & Mfg. Co., Ltd	Canada*	June 20	200,000
McDonald Prospecting & Mining Company, Ltd., The	Canada*	Sept. 6	100,000
Rochelle Gold Mines, Ltd	Canada*	Oct. 11	100,000
Total (8 companies)	.....	.....	$1,290,000

*Incorporation under The Companies Act, Revised Statutes of Canada, 1906, Part 1 of Chapter 79. Licenses are issued pursuant to the provisions of The Mortmain and Charitable Uses Act, Province of Ontario, "to acquire, hold and assure land in mortmain in Ontario." This applies also to Quebec province.

†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.

MINING COMPANIES INCORPORATED IN ONTARIO IN 1933 HAVING SHARES WITHOUT NOMINAL OR PAR VALUE

Name of company	Head office	Date of incorporation	No. of shares
*Air-Lite Silica, Ltd	Muskoka Falls	Mar. 3	30,000
Angus Land & Mining Co., Ltd	Windsor	April 3	110,000
*Aurcana Gold Mines, Ltd	Toronto	June 14	3,730,000
Big Long Lac Gold Mining Co., Ltd	Toronto	May 23	2,000,000
Bob Tough Gold Mines, Ltd	Hamilton	Sept. 16	3,000,000
Columario Consolidated Gold Mines, Ltd	Toronto	April 1	2,500,000
Dorval-Siscoe Gold Syndicate, Ltd	Toronto	Feb. 10	7,500
Herbin Lake Gold Syndicate, Ltd	Toronto	April 12	7,500
Jupiter Gold Syndicate, Ltd	Toronto	Dec. 21	5,000
Lake Malartic Development Co., Ltd	Toronto	July 6	200,000
Lake Sapawe Mines, Ltd	Toronto	Sept. 20	2,000,000
Little Long Lac Gold Mines, Ltd	Toronto	Jan. 26	2,000,000
Matachewan Consolidated Mines, Ltd	Toronto	July 10	3,000,000
Milmac Mines, Ltd	Sault Ste. Marie	Dec. 29	600,000
Mitchell-Hearst Gold Syndicate, Ltd	Toronto	April 21	15,000
Ontario Cryderman Gold Mines, Ltd., The	Sudbury	July 4	30,000
Oro Plata Mining Co., Ltd	Toronto	June 14	40,000
Richmac Gold Mines, Ltd	Toronto	June 1	500,000
S.G.R. Mines, Ltd	Toronto	Oct. 4	3,000,000
Siville-Ferrier Syndicate, Ltd	Toronto	Sept. 28	250,000
Sunorca Exploration Company, Ltd	Toronto	July 27	140,000
Total (21 companies)			23,165,000

*Also see list with specified capital. Two companies having both specified capital and "no par" shares are included in both lists.

ONTARIO COMPANIES WITH SPECIFIED CAPITAL INCORPORATED IN 1933

Name of company	Head office	Date of incorporation	Capital
Adanac Gold Mines, Ltd	Toronto	Aug. 18	$3,000,000
*Air-Lite Silica, Ltd	Muskoka Falls	Mar. 3	200,000
Algray Mines, Ltd	Toronto	Sept. 26	40,000
Angler Granites, Ltd	Port Arthur	Jan. 21	40,000
Arbade Gold Mines, Ltd	Toronto	June 21	3,500,000
Ardeen Gold Mines, Ltd	Ottawa	Dec. 27	3,000,000
*Aurcana Gold Mines, Ltd	Toronto	June 14	270,000
Bidgood Kirkland Gold Mines, Ltd	Hamilton	Mar. 18	2,000,000
Black Gold Mines, Ltd	Fort Erie	June 6	3,500,000
Brett Lake Gold Exploration, Ltd	Oakville	July 5	2,000,000
Bruin Grand Gold & Silver Syndicate, Ltd	Toronto	Dec. 4	40,000
Burmas, Limited (Private)	Toronto	Dec. 4	30,000
Cariboo-Coronada Gold Mines, Ltd	Toronto	Nov. 10	2,500,000
Centennial Gold Mines, Ltd	Toronto	Nov. 8	2,000,000
Central Porcupine Mines, Ltd	Toronto	Dec. 26	5,000,000
Cole Gold Mines, Ltd	Pipestone Bay, Red Lake	Nov. 16	3,000,000
Continental Colombia Gold Mines, Ltd	Toronto	Nov. 8	3,000,000
Coupland Gold Mines, Ltd	Toronto	Oct. 7	3,000,000
Cuniptau Mines Development Co., Ltd	Toronto	July 17	60,000
Cuniptau Mines, Ltd	Toronto	Dec. 8	3,000,000
Dominion Asbestos, Ltd. (Private)	Toronto	Dec. 6	40,000
Dorval-Siscoe Gold Mines, Ltd	Toronto	May 16	3,000,000
Excello Mines, Ltd	Mimico	Dec. 11	3,000,000
Federal Metals, Ltd	Toronto	Sept. 12	40,000
Four Nations Consolidated Gold Mines, Ltd	Toronto	Dec. 21	5,000,000
Garry Gold Mines, Ltd	Toronto	July 20	4,000,000
Gillies Lake-Porcupine Gold Mines, Ltd	Timmins	Jan. 28	2,000,000
Glenora Gold Mines, Ltd	Toronto	June 6	3,500,000

*"No par" shares issued in addition. See list of "No par" companies.

ONTARIO COMPANIES WITH SPECIFIED CAPITAL INCORPORATED IN 1933—
Continued

Name of company	Head office	Date of incorporation	Capital
Gold Bar Mines, Ltd	Toronto	Feb. 4	$5,000,000
Goldbanks-Kirkland Mines, Ltd	Kirkland Lake	Jan. 28	3,000,000
Golden Quebec Mines, Ltd	Toronto	Dec. 7	4,000,000
Gomak Mines, Ltd	Toronto	Dec. 1	1,000,000
Goodfish Mining Company, Ltd	Kirkland Lake	Oct. 17	3,500,000
Great Bear Minerals, Ltd	Toronto	June 20	3,000,000
Greater Canada Gold Corporation, Ltd	Toronto	Feb. 25	250,000
Greenlaw Gold Mines, Ltd	Toronto	Sept. 7	3,000,000
Gunnar Gold Mines, Ltd	Toronto	Oct. 27	3,000,000
Henning Maloney Gold Mines, Ltd	Toronto	Nov. 2	3,000,000
Jobert Keefer Gold Mines, Ltd	Timmins	Sept. 9	4,000,000
Laguna Gold Mines, Ltd	Toronto	Feb. 24	3,000,000
Lindberg, Robertson & Co., Ltd	Toronto	July 14	40,000
McKenzie Red Lake Gold Mines, Ltd	Toronto	Feb. 1	3,000,000
MacLeod-Cockshutt Gold Mines, Ltd	Toronto	Sept. 22	3,000,000
Makwa Champagne Gold Mines, Ltd	Toronto	Oct. 25	3,000,000
Marbuan Gold Mines, Ltd	Toronto	Aug. 25	1,000,000
Margaret Mines, Ltd	Toronto	June 7	600,000
Mecca Gold Mines, Ltd	Toronto	Feb. 13	2,000,000
Metonic Mines, Ltd	Toronto	May 5	2,000,000
Midcour Prospectors, Ltd	Toronto	Aug. 8	100,000
Monarch Great Bear Syndicate, Ltd	Toronto	Sept. 6	150,000
Montague Gold Mines, Ltd	Toronto	Sept. 26	1,000,000
Montgomery-Ackerman Gold Mines, Ltd	Peterborough	Oct. 20	3,000,000
National Mines, Ltd	Toronto	Sept. 1	2,000,000
Norgold Mines, Ltd	Toronto	June 19	3,000,000
Norquest Gold Mines, Ltd	London	Nov. 29	400,000
North Shores Gold Mines, Ltd	Toronto	Nov. 1	3,000,000
Northern Aerial Canada Golds, Ltd	Toronto	Feb. 3	5,000,000
Northern Turnbull Gold Mines, Ltd	Toronto	June 28	2,000,000
Powell Rouyn Gold Mines, Ltd	Toronto	Dec. 28	1,500,000
Regal Kirkland Gold Mines, Ltd	Toronto	Mar. 9	3,000,000
Renfrew Minerals, Ltd	Toronto	Nov. 15	70,000
Rouyn-Swayze Gold Mines, Ltd	Toronto	April 12	250,000
St. Paul Silveradium, Ltd	Toronto	Aug. 3	4,000,000
Silver Valley Mines, Ltd	Toronto	June 14	3,000,000
Soocana Mining Company, Ltd	Sault Ste. Marie	Nov. 4	2,500,000
Stanley Gold Mines, Ltd	Wawa	Nov. 24	300,000
Sulcoe Gold Mines, Ltd	Toronto	May 2	3,000,000
Swayze Contact Gold Mines, Ltd	Toronto	July 20	3,000,000
Swayze-Great Bear Mines, Ltd	Toronto	May 4	2,000,000
Swayze-Huycke Gold Mines, Ltd	Toronto	July 20	1,000,000
Swayze-Munro Syndicate, Ltd	Toronto	July 4	45,000
Talisman Gold Mines, Ltd	Kirkland Lake	July 15	1,000,000
Triple Lake Mines, Ltd	Tisdale township	Jan. 13	50,000
Tyr-Mac Gold Mines, Ltd	Hamilton	Aug. 26	350,000
Wa Wa Gold Fields, Ltd	Toronto	April 1	1,500,000
Wendigo Gold Mines, Ltd	Toronto	Oct. 7	2,000,000
Total (76 companies)			$158,365,000

Mining Revenue and Expenditures

The revenue of the Department of Mines for the fiscal year ending October 31, 1933, was $942,721.62 as compared with $793,759.20 in the previous year. Expenditures were $292,894.68. Details of revenue follow:—

ORDINARY:		
Sand and Gravel—		
Royalties	$ 16,022.60	
Licenses	1,925 00	
		$ 17,947.60
Casual fees	$ 1,121.01	
Sale of record books—Unwrought Metal Sales Act	84.10	
Gas leases	4,100.00	
Dredging leases	69.70	
		5,374.81
Inspection—cable testing fees		3,702.05
Assessment—		
Acreage tax	$ 30,691.70	
Profit tax	679,731.07	
Gas tax	33,577.54	
		744,000.31
Chemical and assay—fees		1,717.73
Mine rentals—		
Mining leases	$ 5,920.26	
Licenses of occupation	3,424.35	
Miners' Licenses—	42,553.28	
Fees—		
Recording	73,644.16	
Miscellaneous	3,485.14	
Maps—sales	1,699.95	
Rentals—building	31.25	
		130,758.39
Natural Gas Commissioner—permits		1,425.24
Treatment and sale of gold and silver ores		158.95
		$ 905,085.08
CAPITAL:		
Mining recorders—mining land sales		37,636.54
Total revenue		$ 942,721.62

The figures of monies derived from sales and leases, divided according to district, do not agree with corresponding items of the preceding revenue statement, which records collections of monies actually received during the fiscal year. Details are given in the following table:—

MINING LANDS SOLD AND LEASED FOR FISCAL YEAR ENDING OCT. 31, 1933

District	Sales			Leases			Total sales and leases		
	No.	Acres	Amount	No.	Acres	Amount	No.	Acres	Amount
			$			$			$
Thunder Bay	7	252.17	716.68	3	200.00	247.16	10	452.17	963.84
Nipissing	2	50.00	150.00	8	468.30	46.88	10	518.30	196.88
Sudbury	65	2,663.83	6,449.75	9	349.35	93.00	74	3,013.18	6,542.75
Timiskaming	71	2,681.25	6,993.69	91	3,465.85	837.72	162	6,147.10	7,831.41
Cochrane	24	877.47	2,399.25	1	40.00	4.00	25	917.47	2,403.25
Algoma	6	220.70	606.80	....	.....	.....	6	220.70	606.80
Rainy River	4	147.00	367.50	....	.....	.....	4	147.00	367.50
Kenora	16	685.54	1,718.11	....	.....	.....	16	685.54	1,718.11
Patricia	210	6,560.72	17,932.13	....	.....	.....	210	6,560.72	17,932.13
Total	405	14,138.68	37,333.91	112	4,523.50	1,228.76	517	18,662.18	38,562.67

SUMMARY OF BUSINESS TRANSACTED IN THE SEVERAL MINING DIVISIONS DURING 1933

Schedule item	Fort Frances	Sudbury	Porcupine	Larder Lake	Sault Ste. Marie	Port Arthur	Kowkash	Timiskaming and Coleman	Gowganda	Montreal River	Kenora	Red Lake	Total
1. Letters received	716	6,056	3,017	4,505	1,382	2,058	530	1,429	764	911	1,075	2,287	24,730
2. Letters written	723	5,035	2,683	4,475	867	1,863	523	1,143	739	1,075	989	2,119	22,234
3. Miner's Licenses issued	76	682	274	608	227	285	36	234	.....	111	116	162	2,811
4. Miner's Licenses renewed	55	759	320	580	157	359	51	351	59	193	63	208	3,155
5. Mining claims recorded*	137	2,362	613	1,730	450	900	84	256	122	444	329	343	7,770
6. Mining claims cancelled	156	1,547	200	1,034	83	424	115	44	212	609	86	303	4,813
7. Agreements, Transfers, etc., recorded	34	1,478	190	627	288	567	21	68	86	103	115	272	3,849
8. Receipts for Miners' Licenses, Permits, Recording Fees, etc.....$	1,938.75	32,302.03	8,089.75	21,104.85	5,906.30	11,885.00	1,279.75	5,028.75	1,686.50	5,705.90	3,820.95	9,675.50	108,424.03
9. Receipts as Purchase Money or Rental....$	500	8,359.40	1,126.95	7,305.30	357.50	951.21	97.50	402.13	242.75	149.50	1,006.36	17,031.83	37,530.43
10. Total remitted to Department.....$	2,438.75	40,661.43	9,216.70	28,410.15	6,263.80	12,836.21	1,377.25	5,430.88	1,929.25	5,855.40	4,827.31	26,707.33	145,954.46
11. Claims of which surveyors' plans were filed	.....	142	40	125	4	81	.....	7	8	18	14	112	551
12. Disputes entered	6	1	.....	8	4	.....	.....	.....	.....	.....	1	1	21
13. Disputed cases decided by Recorders	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14. Appeals to Mining Court	.....	.....	.....	3	.....	.....	.....	.....	.....	.....	.....	.....	3
15. Extensions of time granted	94	393	223	650	128	339	47	46	79	263	127	1,144	3,533
16. Certificates of Record granted	5	232	23	78	21	11	1	8	7	4	10	228	628
17. Certificates of Performance of Work granted	6	200	23	69	9	11	1	9	7	2	10	216	563
18. Claims for which papers were forwarded to the Department for issue of title	5	80	23	77	4	11	1	7	7	2	10	186	413
19. Forest Reserve Permits issued	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20. Substitute Miners' Licenses issued	1	14	5	5	.....	1	.....	3	.....	1	1	1	32
21. Abstracts issued	174	3,024	359	1,048	257	560	73	79	210	517	331	618	7,250
22. Blue prints sold	95	1,308	422	1,723	400	253	53	133	131	366	93	132	5,109

*There were 307 claims recorded at the Department of Mines, Toronto, making a total of 8,077 as compared with 8,207 in 1929; 3,886 in 1930; 5,779 in 1931; and 4,945 in 1932.

STATEMENT OF MONIES REMITTED BY MINING RECORDERS FOR THE FISCAL YEAR ENDING OCTOBER 31, 1933

Mining Division	Name of Recorder	Address	Purchase price	Maps	Miscellaneous fees	Miners' licenses	Recording fees	Total
			$	$	$	$	$	$
Fort Frances	Alexander, J. A.	Fort Frances	500.00	40.00	419.75	607.00	550.00	2,116.75
Montreal River	Coghill, J. M	Elk Lake	102.50	57.75	131.75	1,484.00	3,374.15	5,150.15
Gowganda	Coghill, J. M	Elk Lake	242.75	56.50	75.00	341.25	1,224.00	1,939.50
Porcupine	Dixon, R	South Porcupine	1,053.95	77.50	120.00	2,770.00	3,668.00	7,689.45
Larder Lake	Ginn, H. G	Swastika	8,161.07	380.75	418.25	5,589.00	12,608.00	27,157.07
Red Lake	Holland, H. E	Sioux Lookout	15,930.71	57.25	587.50	1,802.00	6,727.00	25,104.46
Sudbury	McArthur, T. A	Sudbury	6,245.80	366.50	1,340.61	7,077.00	25,604.00	40,633.91
Timiskaming	McAulay, N. J	Haileybury	227.08	26.50	26.75	2,785.00	1,728.00	4,793.33
Port Arthur	McGregor, C. F	Port Arthur	1,156.54	66.25	150.25	3,151.00	8,364.00	12,888.04
Sault Ste. Marie	Miller, W. N	Sault Ste. Marie	489.55	101.00	73.25	1,743.00	3,061.05	5,467.85
Kowkash	O'Rourke, M. F	Tashota	97.50	14.25	17.68	469.10	620.00	1,218.53
Kenora	Smith, J. D. C	Kenora	945.36	47.75	124.35	803.00	2,389.00	4,309.46
Total			35,152.81	1,292.00	3,485.14	28,621.35	69,917.21	138,468.50

MINING CLAIMS RECORDED IN THE SEVERAL MINING DIVISIONS, 1907 AND 1914–1933

Mining division	1907	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
Timiskaming	7,860	215	222	156	269	184	244	329	159	328	971	735	634	438	875	499	346	202	78	63	256
Coleman*	291	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Sudbury	456	237	233	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
Sault Ste. Marie	291	23	92	44	135	199	90	90	216	541	498	284	451	395	735	702	487	318	276	92	450
Port Arthur	317	353	641	172	180	66	171	108	120	296	222	300	494	1,278	982	1,269	691	338	609	475	900
Kenora	.....	25	23	45	32	48	31	25	53	168	150	77	229	935	140	520	348	194	109	203	329
Parry Sound†	102	2	.....	10	25	12	39	33	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Larder Lake	3,813	718	915	783	160	423	1,015	712	918	2,344	1,736	1,219	890	1,532	3,141	1,781	891	424	628	790	1,730
Montreal River	866	28	2	56	294	293	134	81	143	174	400	471	471	290	126	156	48	661	1,127	156	444
Gowganda	.....	23	14	51	113	52	145	215	101	55	33	444	220	96	24	40	34	244	377	114	122
Porcupine	.....	240	262	401	236	48	136	192	273	760	1,424	556	620	1,297	3,127	611	650	135	307	387	613
Kowkash	.....	.....	.....	160	135	2	9	31	3	148	206	438	150	28	250	368	319	12	56	40	84
Red Lake	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5,827	2,018	1,100	973	305	298	185	343
Fort Frances	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	70	75	175	98	137
At Toronto	.....	49	92	128	95	39	231	87	145	171	116	139	226	203	795	1,576	1,186	171	142	356	307
Total	13,996	1,913	2,519	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

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

The following is a comparative statement of mining licenses and renewals issued, mining claims recorded in Ontario, and profit tax and total mining revenue during the past ten years, 1924-1933 inclusive:—

PROSPECTING ACTIVITY, PROFIT TAX, AND TOTAL REVENUE, 1924-1933

Year	Calendar Year				Fiscal Year Ending Oct. 31	
	New mining licenses issued	Mining licenses renewed	Total licenses and renewals	Mining claims recorded	Profit tax	Total mining revenue
					$	$
1924	2,676	4,466	7,142	5,222	191,982.36	593,215.14
1925	2,391	4,439	6,830	4,751	287,186.88	613,411.96
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

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 portion of this money is returned to organized municipalities for municipal government purposes.

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 fiscal year ending October 31, 1933:—

DETAILS OF PROFIT TAX

GOLD:—		
Dome Mines, Ltd	$ 54,539.87	
Hollinger Consolidated Gold Mines, Ltd	99,885.73	
Howey Gold Mines, Ltd	4,671.87	
Kirkland Lake Gold Mining Co., Ltd	805.87	
Lake Shore Mines, Ltd	305,382.05	
McIntyre Porcupine Mines, Ltd	56,555.92	
Minto Gold Mines, Ltd	772.52	
Sylvanite Gold Mines, Ltd	838.19	
Teck-Hughes Gold Mines, Ltd	104,089.58	
Toburn Gold Mines, Ltd	189.22	
Wright-Hargreaves Mines, Ltd	36,776.09	
		$ 664,506.48
SILVER:—		
Mining Corporation of Canada, Ltd. (Cobalt Lake, $3,595.56; South Lorrain, $1,258.89)	$ 4,854.45	
O'Brien, M. J., Ltd. (O'Brien mine, $640.97; Miller Lake O'Brien mine, $682.84)	1,323.82	
		$ 6,178.26
NICKEL-COPPER:—		
Falconbridge Nickel Mines, Ltd		9,046.33
Total		$679,731.07

Temiskaming Testing Laboratories

This plant, located at Cobalt and equipped for sampling and assaying, has been operated by the Ontario Department of Mines since July, 1921, under the management of A. A. Cole, Mining Engineer of the T. & N. O. Railway Commission, and George Dickson, Superintendent. The following is a comparative financial report for the years 1922 to 1933, inclusive:—

COMPARATIVE FINANCIAL STATEMENT OF THE TEMISKAMING TESTING LABORATORIES, 1922-1933

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
Gross operating profit and loss				6,765.64	19,512.93

The following is a brief summary of operations for the year 1933:—

Assaying.—Gold, 2,392 samples; silver, 579; copper, 15; silver bullion, 119; cobalt, 48; nickel, 30; zinc, 2; silica, 5; arsenic, 11; iron, 6; sulphur, 8; barium, 2; alumina, 5; antimony, 6; lime, 5; one each of platinum, manganese, and moisture.

Silver Ore Milled and Sampled.—Weight, 156.70 tons; silver content, 306,738 ounces.

Cobalt Ore Milled and Sampled.—128.70 tons.

Nickel Ore Milled and Sampled.—5.70 tons.

Base Bullion Melted.—36 bars containing 30,354 ounces of silver (gross).

Purchased Gold Ore Milled and Sampled.—8 lots, for 3 of which $115.85 was paid.

Gold Ore Sampled and Assayed.—5 lots or 14,604 pounds.

Copper Melted and Sampled.—One lot of 21 bars or 896 pounds.

Copper Melted and Sampled.—One lot of 21 bars or 896 pounds.

Coal Milled.—Two lots or 7.14 tons.

Gold Amalgam Retorted.—Produced 67.2 ounces bullion worth $882.29 (net).

Amalgamation and Cyanide Tests.—One of each.

Provincial Assay Office

As an aid in the development of the mineral resources of Ontario an Assay Office was established at Belleville in July, 1898, by the Bureau (now Department) of Mines. For convenience the office was moved to 5 Queen's Park, Toronto, in November, 1911, and again in the spring of 1927 to the new East Block, Queen's Park. The Provincial Assayer, W. K. McNeill, reports as follows for 1933:—

The Assay Office has been in operation during the entire year and the usual variety of work carried on with the assistance of T. E. Rothwell and W. F. Green, Chemists and Assayers, and William Ley, Laboratory Assistant.

The schedule of charges, effective January 1, 1930, 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.

Total free assays, under the provisions of *The Mining Act* of Ontario, numbered 1,316 in 1928, 649 in 1929, 427 in 1930, 953 in 1931, and 1,415 in 1932. Out of a total of 2,743 free assays in 1933 there were 2,443 for gold.

The following is a statement of the samples submitted by the general public for which the regulation fee was charged and those submitted by geologists and other officers of the Department of Mines:—

CUSTOMS ASSAYING AND GENERAL WORK, 1933

Assay and No. of samples		Assay and No. of samples	
Gold	1,801	Tellurium	1
Silver	125	Lime	6
Copper	35	Clays	9
Lead	16	Alumina	3
Zinc	1	Antimony	1
Nickel	5	Titanium	3
Iron	8	Chromium	1
Platinum	7	Magnesia	5
Palladium	1	Phosphorus	2
Manganese	5	Feldspar	2
Sulphur	3	Soda	1
Molybdenite	1	Potash	1
Cobalt	5	Talc	3
Arsenic	5	Insolubles	5
Uranium	7	Water	1
Identification—samples received by mail and reports issued. A large number were brought directly to the laboratory; of these no record was kept			318
Rocks—samples submitted by geologists of the Department for complete analysis			37
Total			2,423

DIRECTIONS AND TERMS

Samples will be dealt with in the order of their arrival. In every instance specimens and samples should be accompanied by statement specifying the precise locality from which they were taken.

Money in payment of fees, sent in by registered letter, post office order, postal note, or express order, and made payable to the Provincial Assayer, must invariably accompany sample to ensure prompt return of certificate, as no examination is commenced until the regulation fee is paid.

Crushed samples representing large quantities, or samples less than one pound weight, may be sent by mail as third-class matter. Write your name and address plainly on each parcel. Send instructions, with money in payment of fees in a separate letter. Samples may be sent by express, charges prepaid.

Sample bags addressed to this laboratory for sending ore pulp by mail may be obtained free on application; also canvas bags for shipping. Samples should be addressed as follows:—

PROVINCIAL ASSAY OFFICE,
East Block, Queen's Park,
TORONTO, ONT.

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, 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.

During the calendar year 1933, there were 1,601 blue-prints distributed from the North Bay office. Total receipts from this source were $426.00, and custom work amounted to $12.80. In addition maps were supplied by this office to mining recorders, who sold 5,109 blue-prints during the calendar year 1933.

LIST OF MINES, METALLURGICAL WORKS, AND QUARRIES

METALLICS

Operator	Mine	Manager	Address
COPPER			
Amity Copper and Gold Mines, Ltd.	Amity	Paul E. Doal	307 C.P.R. Bldg., Toronto.
GOLD			
Alschbach Gold Mines, Ltd.	Alschbach	Clarence Alschbach	New Liskeard.
Amalgamated Gold Fields Corp., Ltd.	Blue Quartz	C. D. Salkeld	Painkiller Lake, via Matheson.
Anglo-Huronian, Ltd.	Vipond	Robert E. Dye	Timmins.
Ashley Gold Mining Corp., Ltd. (operated by Mining Corp. of Canada, Ltd.)	Ashley	N. W. Bennett	Elk Lake.
Barry-Hollinger Mines, Ltd.	Barry-Hollinger	Colin A. Campbell	Boston Creek.
Bidgood Kirkland Gold Mines, Ltd.	Bidgood	Oscar Knutson	Kirkland Lake.
Black Gold Mines, Limited	Black	Hugh Jardine	Kirkland Lake.
Bousquet Gold Mines, Ltd.	Bousquet	Lionel Brooke	Sudbury.
Buffalo Ankerite Gold Mines, Ltd.	Buffalo Ankerite	Martin O. Knutson	South Porcupine.
Canadian Kirkland Mines, Ltd.	Canadian Kirkland	Hugh Jardine	Kirkland Lake.
Canadian Reserve Mines, Ltd	Associated Goldfields and Crown Reserve	R. W. McKay	307 C.P.R. Bldg., Toronto.
Casey Summit Gold Mines, Ltd.	Casey Summit	H. F. Fancy	Summit Lake, via Sioux Lookout.
Central Patricia Gold Mines, Ltd.	Central Patricia	A. J. Anderson	Colljns.
Cole, J. Y., Jr.	J. Y. Cole	J. Y. Cole, Jr.	Red Lake.
Coniaurum Mines, Ltd. (subsidiary of Ventures)	Coniaurum	John Redington	Schumacher.
Consolidated Mining and Smelting Co. of Canada, Ltd.	Cordova	L. W. Oughtred	Dominion Square Bldg., Montreal, Que.
De Santis Gold Mining Co., Ltd.	De Santis	Peter De Santis	Timmins.
Dikdik Exploration Co., Ltd.	Dikdik	K. W. Fritzsche	Kinghorn.
Dome Mines, Ltd.	Dome	H. P. De Pencier	South Porcupine.
Foley Syndicate (under agreement with British Canadian Mines, Ltd.)	Foley	Russell Cone	Mine Centre.
Four Nations Consolidated Gold Mines, Ltd.	Four Nations	E. D. Kindle	Kenogami Lake.
Gold Lands Syndicate of Algoma	Edwards	Geo. W. Hall	Goudreau.
Golden Summit Mines, Ltd.	Golden Summit	Wm. J. Simpson	Sesekinika.
Halcrow Swayze Mines, Ltd.	Halcrow Swayze	H. F. Strong	c/o General Airways, Chapleau.

GOLD—*Continued*

Operator	Mine	Manager	Address
Hayden Gold Mines, Ltd.	Hayden	J. S. Pierce	421 Temple Bldg., Rochester, N.Y.
Hollinger Consolidated Gold Mines, Ltd.	Hollinger	John Knox	Timmins.
Horseshoe Mines, Ltd.	Regina	George Miller	Kenora.
Howey Gold Mines, Ltd.	Howey	Edward Futterer	Red Lake.
J-M Consolidated Mines, Ltd.	Jackson Manion	D. M. Thomson	Jackson Manion, via Sioux Lookout.
Kenora Prospectors and Miners, Ltd.	Mikado	R. C. Brehaut	Kenora.
Kenty Gold Mines, Ltd.	Kenty	R. M. Williams	Brett Lake, via Sultan.
Kirkland Consolidated Gold Mines, Ltd.	Kirkland Consolidated	Ralph Hurd	Swastika.
Kirkland Gold Belt Mines, Ltd.	Kirkland Gold Belt	Howard Brassaw	King Kirkland.
Kirkland Lake Gold Mining Co., Ltd.	Kirkland Lake Gold	Wm. M. Sixt	Kirkland Lake.
La Roche Mines, Ltd.	La Roche		116 Federal Bldg., Toronto.
Lake Shore Mines, Ltd.	Lake Shore	E. W. Todd	Kirkland Lake.
Lakeland Gold Mines, Ltd.	Lakeland	Oscar Knutson	Bourkes.
Lebel Oro Mines, Ltd.	Long Lake		Room 1821, Bank of Commerce Bldg., Toronto.
Little Long Lac Gold Mines, Ltd.	Little Long Lac	A. A. Barton	Geraldton, via Long Lac.
Macassa Mines, Ltd.	Macassa	G. A. Howes	Kirkland Lake.
McIntyre-Porcupine Mines, Ltd.	McIntyre	R. J. Ennis	Schumacher.
McKenzie Red Lake Gold Mines, Ltd.	McKenzie Red Lake	W. F. Mackle	Red Lake.
McMillan Gold Mines, Ltd.	McMillan	George Dunn	West River.
Marbuan Gold Mines, Ltd.	March	Martin O. Knutson	South Porcupine.
Margaret Mines, Ltd.	Margaret	W. S. Livingston	Red Lake.
Matachewan Consolidated Mines, Ltd.	Matachewan Consolidated	Thos. L. Wells	Matachewan, via Elk Lake.
Metals Development Co.. Ltd.	Metals Development	M. F. Blue	Narrow Lake P.O., via Sioux Lookout.
Metropolitan Gold Mines, Ltd.	Metropolitan	H. M. Richardson	Savant Lake.
Minto Gold Mines, Ltd. (under option)	Minto	John Knox, Jr.	Wawa, via Hawk Junction.
Moss Gold Mines, Ltd.	Moss	J. D. Tolman	Tip Top Siding, via Port Arthur.
New York Porcupine Gold Mines, Ltd. (under lease)	New York Porcupine		South Porcupine.
North Shores Gold Mines, Ltd.	McKellar-Longworth	R. N. Palmer	Schreiber.
Northern Aerial Canada Golds, Ltd.	Pickle-Crow	Alex. Hattie	Hudson.
Northern Empire Mines, Ltd.	Beardmore	R. J. Hendricks	Empire.
Northern Metals, Ltd.	Katrine	W. Rowe	Cobalt.
Parkhill Gold Mines, Ltd.	Parkhill	R. E. Barrett	Wawa, via Hawk Junction.
Paymaster Consolidated Mines, Ltd.	Paymaster	G. R. McLaren	South Porcupine.
St. Anthony Gold Mines, Ltd.	St. Anthony	H. W. Darling	Savant Lake.
Saundary Syndicate	Headlight or Swede Boy	A. E. Saunders	Mine Centre.
Soocana Mining Co., Ltd	Holdsworth (Hawk Junction.)	B. C. Lamble	Sault Ste. Marie.
Stanley Gold Mines, Ltd.	Stanley	R. E. Parkes	Wawa.

Sylvanite Gold Mines, Ltd.	Sylvanite	C. E. Rodgers	Kirkland Lake.
Talisman Gold Mines, Ltd.	Gardner Guibord	John McPhee	Matheson.
Tashota Goldfields, Ltd.	Tashota		707 Reford Bldg., Toronto.
Teck-Hughes Gold Mines, Ltd.	Teck-Hughes	R. J. Henry	Kirkland Lake.
Toburn Gold Mines, Ltd.	Tough-Oakes Burnside	M. W. Hotchkin	Kirkland Lake.
Wa Wa Goldfields, Ltd.	Wa Wa Goldfields		437 St. James St. W., Montreal, Que.
Wendigo Gold Mines, Ltd.	Wendigo	C. L. Spencer	Kenora.
White Rock Mining Co., Ltd.	White Rock	Arthur Manley	Sudbury.
Wright-Hargreaves Mines, Ltd.	Wright-Hargreaves	M. W. Summerhayes	Kirkland Lake.
Young-Davidson Mines, Ltd. (under agreement with Hollinger Consolidated Gold Mines, Ltd.)	Young-Davidson	A. F. Brigham	Elk Lake.

MOLYBDENITE

Varin and Bellew	Chisholm (Sheffield tp.)	J. Alphonse Lemay	3678 Mentana St., Montreal.
Phoenix Molybdenite Corporation Ltd. (Idle 1933)	Phoenix (near Renfrew)	F. L. Stinson	1003 Ossington Ave., Toronto.

NICKEL AND COPPER

Cuniptau Mines, Ltd.	Cuniptau	H. A. Steven	Goward.
Falconbridge Nickel Mines, Ltd.	Falconbridge	Ernest Craig	Falconbridge.
International Nickel Co. of Canada, Ltd.	Creighton	S. J. Kidder	Creighton.
	Frood	H. J. Mutz	Frood.

RADIUM

Canada Radium Mines, Ltd.	Canada Radium (Cardiff tp.)	Frank Austin	244 Bay St., Toronto.
International Radium and Resources, Ltd.	Richardson (Cardiff tp.)	Idle in 1933	Wilberforce

SILVER AND COBALT

Alert Cobalt Mines, Ltd.	Quaker City	R. Stewart	Cobalt.
Cain, C.E., and Taylor, W. D.	Beaver	C. E. Cain	Cobalt.
Cobalt Properties, Ltd.	Coniagas	A. Brocklebank	Cobalt.
Jemmett, D. L., Ltd.	Agaunico		Cobalt.
McKinley Mines Securities Co., Ltd.	McKinley		Cobalt.

SILVER AND COBALT—*Continued*

Operator	Mine	Manager	Address
O'Brien, M. J., Ltd.	Cross Lake	W. A. O'Flynn	Cobalt.
	Miller Lake O'Brien	H. G. Kennedy	O'Brien.
Peterson Cobalt Mines, Ltd.	Peterson Cobalt		Cobalt.
Price, C. W. (under lease)	Foster	C. W. Price	Cobalt.
Sandoe, Richard, and Moyle, H. (under lease)	Temiskaming	Richard Sandoe	Cobalt.
Stuckey, Chas., and Rowe, Alfred (under lease)	Mining Corporation		Cobalt.
Windsor Cobalt Mines, Ltd.	Windsor Cobalt	Dr. A. D. McArthur	594 Sherbourne St., Toronto.
Yorkshire Cobalt Mining Co.	Yorkshire Cobalt	W. E. Seed	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	G. G. Vincent	Copper Cliff.
Deloro Smelting and Refining Co., Ltd.	Silver-cobalt refinery	S. B. Wright	Deloro.
Falconbridge Nickel Mines, Ltd.	Nickel-copper smelter	J. R. Gill	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. (idle in 1933)	Actinolite, Elzevir tp	George Seller	1111 Beaver Hall Hill, Montreal, Que.

ARSENIC

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

BARITE

Barytes Products, Ltd. (idle in 1933)	Bellew, N. Burgess tp	H. C. Bellew	Box 282, Montreal, Que.
Canada Night Hawk Mines, Ltd	Canada Night Hawk		305 Sterling Tower Bldg., Toronto.
Weaver (Minerals), Ltd	Tionaga, Penhorwood tp		34 King St. E., Toronto.
Glendinning, H. G. (idle)	Yarrow tp		387 Bloor St. E., Toronto.

DIATOMITE

Dominion Diatomite, Ltd., now F. P. Macklem	Lot 3, con. I, Perry tp., Parry Sound	F. P. Macklem	642 King St. W., Toronto.
Diatomite Products, Ltd. (idle 1933)	Martin's Siding, Muskoka	C. Lindley Wood	409 Metropolitan Bldg., Toronto.
Spence Lake Diatomite Ltd., not yet in operation	Muskoka Falls	A. J. P. Care	68 King St. E., Toronto.

FELDSPAR

Anderson & Son, James G	Britt, lots 3-5, con. I, Henvey tp	Jas. G. Anderson	Lucknow.
Bathurst Feldspar Mines, Ltd., (shipped only)	Bathurst, Bathurst tp	B. S. Hyde	230 King St. E., Toronto.
Craig, T. H	W. ½ lot 12, con. IX, Bathurst tp	T. H. Craig	Perth, Box 302.
Frontenac Floor and Wall Tile Co., Ltd	Grinding plant, Kingston	Everett Townsend	Box 178, Kingston.
McDonald, P	Hybla	P. McDonald	Hybla.

FLUORSPAR

Stoklosar, Chas. A	W. ½ lot 3, con. I, Madoc tp	Chas. A. Stoklosar	Madoc.
Wallbridge Estate	Lot 4, con. I, Madoc tp	C. M. Wallbridge	Madoc.

GRAPHITE

Black Donald Graphite Co., Ltd	Black Donald, Brougham tp	R. F. Bunting	Calabogie.

GYPSUM

Operator	Mine	Manager	Address
Canadian Gypsum Co., Ltd.	Hagersville	W. E. Allen	Hagersville.
Gypsum, Lime and Alabastine, Canada, Ltd.	Caledonia	L. V. Robinson	Caledonia.
	Lythmore*	L. V. Robinson	Caledonia.

*Mine closed permanently in 1933.

IRON PYRITES AND SULPHURIC ACID

Canadian Pyrites, Ltd.†	Caldwell mine, Flower station	O. M. Hook, Sec.	1400 Guardian Bldg., Cleveland, Ohio.
Canadian Industries, Ltd.	Acid plants, Coniston and Copper Cliff	G. G. Vincent	Copper Cliff.

†Idle in 1933.

MICA

Anderson, J. G., & Son	Wanup and Bancroft	J. G. Anderson	Lucknow.
Kent Bros. (buyers)		W. C. Kent	114 Gore St., Kingston.
Lee, W. W.	Bob's Lake mine	W. W. 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.

MINERAL WATERS

Carlsbad Ltd., (now T. R. Boyd)	Carlsbad Springs	T. R. Boyd	Carlsbad Springs.
Deneault, F.	Bourget Springs	F. Deneault	Bourget.
Gurd, Chas., and Co., Ltd.	Caledonia tp., Prescott county		1016 Bleury St., Montreal, Que.

NEPHELINE SYENITE

Morrison, Wm.	Lot 14, con. IX, Methuen tp.	Wm. Morrison	64 Tyrrel Ave., Toronto.

QUARTZ, QUARTZITE AND SILICA BRICK

Algoma Steel Corporation, Ltd.	Silica brick (quartz from Deroche tp.quarry)	.....	Sault Ste. Marie.
Dominion Mines & Quarries, Ltd.	Killarney, North shore of Lake Huron, East Neebish island (idle)	.....	40 University Avenue, Toronto.
Falconbridge Nickel Mines, Ltd.	Quarry on property	Ernest Craig	Falconbridge.
McDonald, P.	Hybla	P. McDonald	Hybla.

SALT

Brunner Mond, Canada, Ltd.	Amherstburg (Brine for chemical use)	F. Nill	Amherstburg.
Canadian Industries, Ltd.	Sandwich (Chemicals and salt)	.....	P. O. 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	A. C. Dunlop, Asst.Sec.	Goderich.
Kincardine Salt, Ltd. (idle in 1933)	Kincardine (Operated by Canadian Industries, Ltd.)	.....	P.O. Box 1260, Montreal, Que.
Western Salt Co. (idle in 1933)	Courtright (Controlled by the Dominion Salt Co., Ltd.)	.....	P.O. Box 1260, Montreal, Que.
Western Canada Flour Mills Co., Ltd.	Goderich	.....	287 MacPherson Ave., Toronto.
Warwick Pure Salt Co., Ltd.	Warwick tp., Highway No. 7	B. Witkon	R.R. 5, Watford.

TALC

Canada Talc Co., Ltd.	Connolly—Mill at mine	Roy Taylor	Madoc.
Geo. H. Gillespie Co., Ltd.	Henderson mine—Mill at Madoc	Geo. H. Gillespie	Madoc.

STRUCTURAL MATERIALS

CEMENT

Canada Cement Co., Ltd.	Belleville, Plant No. 5 (idle in 1933) Lakefield, Plant No. 7 (grinding clinker only) Port Colborne, Plant No. 8	Box 290, Station B, Montreal, Que.
St. Marys Cement Co., Ltd.	St. Marys	357 Bay St., Toronto.

LIME

Operator	Pit or Quarry and Location	Manager	Address
American Cyanamid Company	Quarry at Beachville, kilns at Niagara Falls	A. J. Kennedy	535 Fifth Ave., New York.
Bell, Harry	N. ½ lot 23, con. XII, Sullivan tp.	Harry Bell	R.R. 4, Chesley.
Biederman, Albert G	Wilberforce tp., Renfrew county	Albert G. Biederman	Golden Lake, R.R. 1.
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	F. Nill	Amherstburg.
Cameron, W. M	Ramsay tp	W. M. Cameron	Carleton Place.
Canada Lime Co., Ltd	Coboconk	Chas. R. Christie	50 King St. E., Toronto.
Canadian Gypsum Co., Ltd	Guelph	C. P. Suekla	1221 Bay St., Toronto.
Chalmers Lime Works	Owen Sound	Miss M. Chalmers	689-7th Street W., Owen Sound.
Canada and Dominion Sugar Co., Ltd	Wallaceburg	R. A. Lauper	Wallaceburg.
	Chatham	C. Moulthrop	Chatham.
Dominion Rock Products, Ltd	Eganville	J. H. Robinson	941 Dominion Square Bldg., Montreal.
Dennis, Geo. H. (formerly Jas. Gow)	Lot 5, con. XI, Eramosa tp.	Geo. H. Dennis	Rockwood.
Gallagher Lime & Stone Co., Ltd., The	*Hamilton	Raymond Gallagher	R.R. 4, Hamilton.
Gypsum, Lime and Alabastine, Canada, Ltd.	*Beachville	T. F. Robinson	Beachville.
	*Elora (idle in 1933)	J. H. Robinson	Elora.
	*Hespeler	M. M. Miller	Hespeler.
	*Milton	Robt. F. Adams	Milton.
	Limehouse (idle in 1933)	Wm. Gowdy	Limehouse.
Innerkip Lime and Stone Co., Ltd	Beachville	C. E. Downing	Beachville.
Jamieson Lime Co	Renfrew	J. A. Jamieson	Renfrew.
Morris, Stanley	Delta	S. Morris	Delta.
Shane Lime Co	Eganville	Geo. R. Shane	Eganville.
Toronto Brick Co., Ltd	Coboconk	F. Conway James	897 Bay St., Toronto.
Weppler, Henry	Lot 7, con. II, Glenelg tp	H. Weppler	R.R. 2, Priceville.

*Hydrated lime plants.

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.	Scarboro		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)

Chick, Thos., & Sons, Ltd.	St. Clair river		951 McDougall St., Windsor.
Grace, Chas. W. S.	Lake Huron		291 S. Christie St., Sarnia
Hadley's Chatham, Ltd.	Thames river		Chatham.
Lapish, F. C.	Lake Superior and St. Mary river		433 Cedar St., Sault Ste. Marie, Mich.
McLean, A. B., & Sons	Lake Superior		Brock St., Sault Ste. Marie.
Montreal Trust Co., Ltd. (Trustee for Sin-Mac Lines, Ltd.)	Lake Superior		635 Common St., Montreal.
National Sand & Material Co., Ltd.	Lake Erie		402 Harbour Bldg., Toronto.
Pyke Salvage Co	St. Lawrence river		506 Princess St., Kingston.
Ray, George (sold to Mrs. K. Cowley)	Thames river		Tilbury.
Scott, T. J. (idle in 1933)	Lake Superior		66 Marsh St., Sault Ste. Marie.
Tees, Capt. T. A. (Tees Transit Co.)	St. Clair r., Lakes Erie and Ontario, Niagara bar		123 Bold St., Hamilton.
Wallaceburg Sand & Gravel Co., Ltd.	St. Clair river		Wallaceburg.

SAND AND GRAVEL* (Pit Operations)

Barnes, Wm. R., Co., Ltd	Spring Vale, Waterdown, Brantford		243 Cumberland Ave., Hamilton.
Brantford, City of	Webster and Harold Sts		City Hall, Brantford.
Canadian Aggregates, Ltd.	Burford tp., Brant county		Burford.
Consolidated Sand & Gravel, Ltd	Paris		402 Harbour Bldg. Toronto.
Durham Stone & Sand Co., Ltd.	Durham.		
Fuller Gravel, Ltd	Fuller (idle in 1933).		
Waterford Sand & Gravel Co., Ltd.	Waterford.		
Foster, R. R.	Nepean and Gloucester tps., Carleton county		86 Spadina Ave., Ottawa.
Hinde Bros.	Northlands Ave., York tp.		134 Northlands Ave., Toronto.
A. E. Jupp Construction Co., Ltd.	Emily tp.		170 Berkeley St., Toronto.
Newall, H.	Lot 35, con. VIII, Malahide tp	H. Newall	R.R. 4, Aylmer.
Rayner Construction, Ltd	Atwood		159 Bay St., Toronto.
Towland Construction Co., Ltd.	Port Arthur		195 London Rd., Guelph.
Woollatt Fuel & Supply Co., Ltd.	Shipped for Windsor S. & G. in liquidation		201 Guaranty Trust Bldg., Windsor.

*Only operators producing 5,000 tons or over are listed.

STONE (LIMESTONE AND MARBLE)

OPERATOR	QUARRY AND LOCATION	MANAGER	ADDRESS
American Cyanamid Co.	Beachville	A. J. Kennedy	Ingersoll.
Arnprior, Town of			Arnprior.
Bertrand, J. (sold to Dibblee Construction Co.)		J. Bertrand	L'Orignal.
Bolender Bros	Haliburton	Chas. Bolender	Haliburton.
Bonter, J. W	Marmora tp	J. W. Bonter	Box 61, Marmora.
Bourgie, J. B	Gregnon, con. VIII, Russell tp	J. B. Bourgie	Box 50, Embrun.
Brule, E. D., & Sons, Ltd	Billings Bridge	A. A. Brule	Box 116, Billings Bridge.
Brunner, Mond Canada, Ltd	Lots 6, 7, 8, con. I; lots 2, 3, con. II, Anderdon tp	F. Nill	Amherstburg.
Canada Cement Co., Ltd	Thurlow tp., Hastings county	J. H. Legate	Belleville.
Canada Crushed Stone Corp., Ltd	Dundas, Town of	J. Stephens	35 Cline Cres., Hamilton.
Hagersville Contracting Co., Ltd	Walpole tp., Haldimand county	Gordon Gilbertson	Hagersville.
Puslinch Quarry, Ltd	Puslinch tp., Wellington county	H. Hill	Puslinch.
Queenston Quarries, Ltd	Niagara tp	A. Michie	Box 110, Niagara Falls.
Coldwater Crushed Stone, Ltd	Lots 19, 20, con. XIII, Medonte tp	Thos. Langton	Coldwater.
Cook, J. S	Lot 7, con. XXIV, Amabel tp	J. S. Cook	Wiarton.
Decewsville Crushed Stone, Ltd	Decewsville		52 Elgin St., Hamilton.
Dibblee Construction Co., Ltd	Bought from J. Bertrand		L'Orignal.
Dufferin Paving and Crushed Stone Co., Ltd.		H. H. Salmon	Fleet and Bathurst Streets, Toronto.
Hagersville Quarries, Ltd	Walpole tp., Haldimand county	J. S. Beck	Hagersville.
Kirkfield Crushed Stone, Ltd	Eldon tp., Victoria county	John Welch	Kirkfield.
St. Mary's Crushed Stone, Ltd. (idle)	St. Marys.		
Edgar Irvine Co., Ltd., The	Near Centreville	Geo. Miller	Bath.
Foster, R. R	Merivale Road, Nepean tp	R. R. Foster	86 Spadina Ave., Ottawa.
Gordon Crushed Stone Co., Ltd., The	Hagersville	C. F. Anderson	Hagersville.
Grenville Crushed Rock Co., Ltd	Oxford tp., Grenville county	W. H. Roberts	Oxford Mills.
Gypsum, Lime and Alabastine, Canada, Ltd	Lot 18, con. III, N. Oxford tp	T. F. Robinson	Beachville.
Hagersville Contracting Co., Ltd	*See* Canada Crushed Stone Corporation		
Hagersville Quarries, Ltd	*See* Dufferin Paving and Crushed Stone Co.		
Halliday, Fred	Lot 23, Gloucester tp	H. Halliday	Cummings Bridge
Harvey, W. H., & Sons	Hess quarry, Dundas county	D. L. Dewar	2141 Bloor St. W., Toronto.
Henniger, M. G	Kitley tp., Leeds county	M. G. Henniger	Smiths Falls.
Highways, Department of	Various quarries	R. M. Smith	Parliament Bldgs., Toronto.
Huffman Construction Co., Ltd., The R. C.	Clappison cut, Wentworth county	Darius Stringer	Waterdown.
Innerkip Quarries, Ltd	*See* Dufferin Paving and Crushed Stone Co.		
Jamieson Lime Co	Lot 5, con. II, Horton tp	J. A. Jamieson	Renfrew.

Kingston Penitentiary	Portsmouth	Samuel Donaldson	34 Pembroke St., Kingston.
Kirkfield Crushed Stone, Ltd	*See* Dufferin Paving and Crushed Stone Co.		
Limestone Products, Ltd	Con. V, Orillia tp	Geo. F. Morse	R.R. 4, Orillia.
Longford Crushed Stone Co., Ltd	Lots 20 to 24, Front con., Rama tp	R. M. Craig	Longford Mills.
Merritt, Sidney W	Saltfleet tp., Wentworth county	S. W. Merritt	Vinemount.
Noranda Mines, Ltd	Farr quarry, Haileybury		804 Royal Bank Bldg., Toronto.
Ontario Reformatory	Guelph tp., Wellington county	J. Hunter	Guelph.
Owen Sound, City of	City quarry, 8th Street West	Robt. Crannie	6th Street East, Owen Sound.
Pembroke, Corporation of	Markus quarry	J. P. Howe	Pembroke.
Pirson, John	Hydro dump, Stamford tp.	John Pirson	Stevensville.
Puslinch Quarry, Ltd	*See* Canada Crushed Stone Corp.		
Queenston Quarries, Ltd	*See* Canada Crushed Stone Corp.		
Quinton, W. Y	Kitley tp., Leeds county	W. Y. Quinton	Jasper.
Rayner Construction, Ltd	Forfar, Merrickville, Campbellford, Ivanhoe		159 Bay St., Toronto.
Routly, H. T	Rawdon tp., Hastings county	H. T. Routly	21 Dundas Square, Toronto.
Simcoe Marble & Stone Co	Rama tp., Ontario co	R. M. Craig	Longford Mills.
T. Sidney Kirby Co., Ltd., The	Gloucester tp		215 Sussex St., Ottawa.
Walker Bros., Ltd	Stamford tp., Welland county	J. G. Walker	49 Carleton St., Thorold.
Webber, John	Dunn tp	J. Webber	R.R. 9, Dunnville.
Wehman, John	Lot 24, con. II, Kingston tp., Frontenac county	John Wehman	251 Division St., Kingston.
Welland Ship Canal	Rock excavation	A. J. Grant	St. Catharines.
Wilford & Co., Ltd., R. F	Victoria county	C. Lindsay	Lindsay.
Windmill Point Crushed Stone Co., Ltd.*	Ridgeway	R. E. Law	Ridgeway.

*Subsidiary of Law Construction Company, Ltd.

STONE (GRANITE)

Bradley, Wm	Leeds county	W. Bradley	81 Garden St., Gananoque.
Building Products, Ltd	Portland tp., near Verona	A. DeWolf	Verona.
Horne, Wm	Butler	Wm. Horne	Butler, via Ignace, Ont.
McKee, Wm	Lot 2, con. VIII, Escott tp	Wm. McKee	R.R. 3, Lansdowne.
Reece-Hall, R	Mill Lake quarry, lots 24, 25, con. III, McDougall tp., Parry Sound district	R. Reece-Hall	Box 115, Parry Sound.

STONE (SANDSTONE)

OPERATOR	MINE, QUARRY, OR WORKS	MANAGER	ADDRESS
Corners, Mr	Halton county		Terra Cotta.
Eves, C	Halton co	C. Eves	Terra Cotta.
Jones, C. W	Halton co	C. W. Jones	Inglewood.
Logan, Harry	Halton co	H. Logan	Georgetown.
McAlpine Bros	Esquesing tp	K. McAlpine	Limehouse.
Norrie and McHarg	Halton county		R.R. 4, Acton.
Norton, A. W	Halton co	A. W. Norton	Limehouse.
Presswood & Gibbs	Halton co		Glen Williams.
Sykes, Thos	Halton co	Thos. Sykes	Georgetown.
Terra Cotta Quarries	Halton co	J. L. Craine	Terra Cotta.

STONE (TRAP)

Fort William, City of	Rifle Range, City quarry	City Engineer	City Hall, Fort William.
Ontario Rock Co., Ltd	Belmont and Methuen tps	H. L. Scott	Havelock, R.R. 3.

CLAY PRODUCTS

See The Ceramic Industry of Ontario, by R. J. Montgomery, Vol. XXXIX, Part 4, 1929.

MINES OF ONTARIO IN 1933

By

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

COPPER

Amity Copper and Gold Mines, Limited

The Amity Copper and Gold Mines, Limited, has a capitalization of 3,000,000 shares of $1 par value, of which 2,822,676 shares have been issued. The officers and directors are: R. S. Potter, president; Paul E. Doal, vice-president; Howard Webb, secretary-treasurer; Jacob Begg, Thomas Hall, Edward E. Potter, and Frank Gardner, directors. The secretary's office is at 307 C.P.R. Building, Toronto. The mine office is at Boston Creek.

The company owns 160 acres in Pacaud township, district of Timiskaming. After several years of idleness the mine was reopened in October, under the direction of Paul E. Doal, and closed again on December 31. During the period of operation 177 tons of copper ore from the 250-foot level was shipped. An average of 18 men was employed.

GOLD

Alschbach Gold Mines, Limited

The Alschbach Gold Mines, Limited, is capitalized at 2,500,000 shares, of $1 par value, of which 1,621,539 shares are issued. The officers and directors are: Clarence Alschbach, president; F. W. Hendry, vice-president; F. L. Hutchinson, secretary-treasurer; Wesley McKnight, Donald McLellan, Frederick Lawrence, and W. A. Taylor. The head office is at New Liskeard, Ont. The company owns 6 claims in Grenfell township, district of Timiskaming.

In May, 1933, the Hudson Bay Gold Mines, Limited, took a working option on the property, and dropped it in August, 1933. During that time the shaft was dewatered and some drifting was done on the 125-foot level. An average of 12 men was employed.

Amalgamated Gold Fields Corporation, Limited

This company owns and operates the Blue Quartz gold mine, a property of some 600 acres on the south shore of Painkiller lake in Beatty township, district of Cochrane. The officers of the company are: H. C. Crow, president; Dr. J. A. Tuck, vice-president; G. Knutt, secretary-treasurer; Hon. H. W. Laird and A. G. Parker, directors. C. D. Salkeld is manager of the mine. The mine address is Painkiller Lake, via Matheson. The authorized capital of the company is 5,000,000 shares, of $1 par value, of which 2,040,957 shares have been issued.

Between July and December, 1933, a 25-ton mill was constructed and all the buildings and machinery were repaired. The mine was dewatered to the 200-foot level, and preparations were made to start stoping. An average of 15 men was employed.

Anglo-Huronian, Limited

At a special general meeting of the shareholders of the Vipond Consolidated Mines, Limited, held in Toronto on November 24, 1933, the shareholders ratified an agreement transferring all the assets and undertakings of the Vipond Consolidated Mines, Limited, to Anglo-Huronian, Limited, in exchange for shares in the latter company.

Anglo-Huronian, Limited, has a capitalization of 2,000,000 shares of no par value, 1,252,605 shares of which have been issued. The officers and directors are: R. Home Smith, president; A. Dorfman, vice-president and managing director; J. Ingram, secretary-treasurer; John H. Black, W. H. Stafford, F. H. Hamilton, E. Turk, and Sir A. Hamilton Grant, directors. The head office is at 1204 Star Building, Toronto.

The company now owns and operates the Vipond mine in Tisdale township, district of Cochrane. The mine address is Timmins. Robert E. Dye is manager, and an average of 164 men was employed.

The following is taken from the report of the Vipond company for the fiscal year ending July 31, 1933:—

The mine and mill were in continuous operation during the year and produced bullion to the value of $478,730.90, exclusive of gold premium, representing a recovery of $4.31 per ton from 110,962 tons milled. Premium earned during the year amounted to $107,672.08, which brought the total bullion proceeds up to $586,402.98, equivalent to a recovery of $5.28 per ton, and prevented an operating loss.

The cost of production (before allowing for depreciation and writing off other charges) amounted to $532,273.06, or $4.80 per ton milled, as against $5.82 per ton in the previous year.

Results of Development

During the year the greater part of the development work was confined to an intensive investigation of the older parts of the mine which have already been opened up. The favourable exchange situation which developed early in the year served to convert considerable marginal material into ore which could be mined at a small profit. This situation also encouraged a further investigation of numerous small showings which had previously been considered of insufficient importance to deserve very serious attention. Many of these showings proved entirely disappointing but others led to small lenses of ore of minable grade. Several relatively important lenses have been found entirely between levels with little or no indication at the level of their existence.

Development work during the year has failed to keep pace with mill requirements. The mill feed during the year has come almost wholly from development work done on minor showings and from the mining of these showings by raises and prospect stopes.

Summary of Underground Operations

The following development work was carried out during the period under review:—

Operation	Feet	Total cost	Cost per foot
Drifting and crosscutting	4,030.5	$40,495.52	$10.05
Raising	2,096.5	22,722.25	10.84
Diamond-drilling	17,568	23,849.54	1.36

Mill

The mill operated continuously during the year, and the following data indicate the results obtained:—

Tons milled	110,962
Average value per ton	$4.78
Gross value (at $20.67 per ounce)	$530,523.08
Bullion recovered (at $20.67 per ounce)	$478,730.90
Average running time, per cent	97.10

Production

The following figures do not include bullion produced by the Porcupine Crown (approximately $2,871,816) before the property was acquired by this company.

From bullion produced during the year	$478,730.90
From bullion produced during former years	6,572,606.27
Total	$7,051,337.17

Cost of Production

	Total cost	Cost per ton
Development	$87,067.31	$0.78
Ore extraction	242,694.68	2.19
Crushing, conveying, milling, and refining	107,599.63	.97
Shipping and marketing bullion	4,017.69	.04
Administration and general expenses	60,140.99	.54
Taxes, municipal	3,162.90	.03
Insurance, including compensation	27,589.86	.25
Total	$532,273.06	$4.80

Conclusion

To keep up the mill feed from the ore sources now available is becoming increasingly difficult. Even a small profit from mine operations is wholly dependent upon the continuance of, or an improvement in, the present favourable exchange situation.

Ashley Gold Mining Corporation, Limited

This company has a capitalization of $3,000,000, in shares of $1 par value. The officers and directors are: J. P. Watson, president; G. C. Ames, secretary-treasurer; E. H. Rose, G. M. Clark, A. B. Stodart, C. E. Trafford, and J. G. Watson, 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 managing engineer, for the year ending December 30, 1933:—

Production of gold from this property began on a limited scale in September, 1932, the daily tonnage being maintained at a rate of 75 tons. During 1933, tonnage was gradually increased to a daily average of 120 tons by the end of the year.

Development

In the previous year a vertical winze had been sunk from the 500-foot level to open up two new levels at 625 and 750 feet. Work early in the year on these two new levels quickly disclosed the presence of a major fault with northeasterly strike and with dip 45 degrees to the east. This fault, a normal one, intersected the Ashley vein between the 500- and 600-foot levels. The Ashley vein strikes north and south and dips to the west. Later work showed the Ashley vein to have been displaced more than 200 feet to the west on the 500-foot level. When crosscuts reached the faulted section on the 500- and 625-foot levels, drifting north on the vein was started. A short section only was developed in drifting on the 625-foot level before another major fault cut off the vein. As the strike of this second or "B" fault is almost parallel to the Ashley vein, the drift north on the 500-foot level did not reach it for 700 feet. Still longer sections will be developed on the 375- and 250-foot levels before the "B" fault is reached, and this development work is now proceeding. Diamond-drilling eventually proved the combined displacement along the plane of "A" and "B" faults to be over 500 feet. While this drilling has proven the existence to the west of a third section of the vein, crosscutting has not yet reached it.

The ore so far developed, on three levels, on the first faulted section of the Ashley vein, carries more erratic gold values than the original section with average grade somewhat lower, being 0.35 to 0.4 ounce per ton calculated to a width of 30 inches.

The effect of the faulting described above has been to bring the two faulted sections of the Ashley vein up to horizons already reached by the present shaft and winze, but on the other hand necessitates long crosscuts to the west to reach them.

During the year there was completed 3,254 feet of drifting, 2,551 feet of crosscutting, 656 feet of raising, and 127 feet of sinking.

The result of the year's development work has been to place in sight and indicate approximately 50,000 tons of ore, a somewhat greater tonnage than has been milled since the inception of milling operations. The grade of this ore is estimated at 0.35 ounce per ton.

Production

The tonnage treated during 1933 was 37,975 tons with average grade of 0.456 ounce per ton From this tonnage there was produced and marketed gold bullion which realized in Canadian funds $497,969. Gold tied up in mill circuit amounts to approximately 1,800 ounces. Tailings for the year averaged 20 cents per ton indicating an extraction of approximately 98 per cent.

Owing to the narrow character of the Ashley vein, overbreak in stoping is inevitable, though stope widths are held to an average of 36 inches. Waste rock due to this overbreak of wall rock is sorted out before milling, the tonnage of such discards amounting to more than 5,000 tons, on which there was a mining, hoisting, and picking expense.

The total mill figures from inception of milling operations to December 30, 1933, are given as follows: tonnage treated 44,780 tons, with gold content of 22,431 ounces or 0.501 ounce per ton. From this tonnage gold bullion shipments realized $568,110 in Canadian funds.

General

In order to offset the lower grade of mill ore, at present being treated, a small addition to daily tonnage will be made in the coming year.

Mining and milling costs were materially reduced during 1933, though such costs per ton remain high owing to the narrow character of the vein, high development cost per ton, and comparatively small tonnage treated. During the last quarterly period of the year, when, for the first time, maximum tonnage conditions prevailed, total costs were $9.35 per ton of ore milled, these costs including all mining, milling, development, and diamond-drilling.

Development work during the coming year will be directed toward opening up the third faulted section of the Ashley vein, and also in the continuation of drifts north and south on the upper four levels.

An average of 130 men was employed during the year. N. W. Bennett is resident manager.

Barry-Hollinger Mines, Limited

The Barry-Hollinger mine is in the township of Pacaud, district of Timiskaming. The capitalization of the company is $4,000,000, in shares of $1 par value, of which 2,673,675 shares have been issued. The officers and directors are: Dr. E. H. Greene, president: E. S. Crocker, vice-president; Donald McKinnon, treasurer; M. M. Smith, assistant secretary; John P. Patterson, director. Colin A. Campbell is mine manager. The mine address is Boston Creek.

The mine was operated throughout the year with a force of 45 men. The mill operated for the first three months of the year, during which time 5,459 tons of ore was treated. The value of the production was as follows:—

Value of production at $20.67 per ounce	$60,789
Plus premium on exchange	10,977
Total	$71,766

Underground development work was as follows:—

	Feet
Sinking	377.5
Drifting	1,106.3
Crosscutting	1,213.9
Diamond-drilling	3,537
Raising	157.5

In January, 1934, the mill resumed operations, treating from 80 to 90 tons a day.

Bidgood Kirkland Gold Mines, Limited

Bidgood Kirkland Gold Mines, Limited, is capitalized at 2,000,000 shares, of $1 par value, of which 1,215,807 shares are issued. This company acquired the Bidgood Consolidated Mines, Limited, for $45,000 and 215,000 shares of the new company. Shareholders of the old company are to receive one new share for each 12 shares held. The property consists of 753½ acres in the township of Lebel, district of Timiskaming. The office of president is vacant. The other officers and directors of the company are: H. S. Whitfield, vice-president; A. W. Morris, secretary-treasurer; H. Korson, H. E. Cohen, E. G. Budd, A. L. Herbert, and Joseph Nichols, directors. Oscar Knutson is general mine manager. The head office is 32 Main Street East, Hamilton, and the mine address is Kirkland Lake.

From June to the end of the year the plant, buildings, and equipment were thoroughly overhauled and the No. 2 shaft was pumped out to the 125-foot level with steam. It is the intention of the management to build a 100-ton mill during the coming year. An average of 18 men was employed.

Black Gold Mines, Limited

This company is capitalized at $3,500,000, in shares of $1 par value. The officers are: A. E. Belcher, president; Alex. McNiven, vice-president; L. O. Dennison, Buffalo, secretary-treasurer. The head office is at Fort Erie, Ont. The mine address is Kirkland Lake.

The company owns 6 claims in Teck and Lebel townships, district of Timiskaming.

In 1933 the shaft, which is 125 feet deep, was repaired and 500 feet of drifting and crosscutting was done. Hugh Jardine was contractor, employing 15 men.

Bourkes Mine

In the early part of 1933 Oscar Knutson dewatered and sampled the Bourkes mine, in Benoit township, district of Timiskaming, employing 18 men for three months. The operation ceased in March.

From August 29 to November 8 the mine was again sampled by Douglas Mutch and Douglas Bryden. Four men were employed during this period.

Bousquet Gold Mines, Limited

This company was incorporated in 1920, with a capitalization of 2,000,000 shares, of $1 par value, of which 1,238,585 shares are issued. The property is located in Timber Berth No. 11, about six miles east of Willisville station on the Algoma Eastern railway, in the district of Sudbury. It consists of ten patented claims in the Howry Creek area.

In 1921 a shaft was put down to a depth of 107 feet, and 280 feet of lateral work was done on the 100-foot level. Work was suspended until 1927, when the plant was moved to another location some two miles west of this shaft, but operations were then suspended until 1933.

In October, 1933, work was recommenced. The plant was set up and sinking started on November 15. This vertical shaft, known as the Rivers shaft, is 7 by 11 feet, and at the end of the year had reached a depth of 40 feet.

The plant consists of an 80 h.p. boiler, a 500-cubic-foot compressor and an 8- by 10-inch single-drum hoist.

The officers and directors were: Lionel Brooke, president and managing director; W. B. McPherson, secretary-treasurer; R. R. Tough, T. B. Tough, and W. J. Hough, directors. The head office is at 171 Yonge Street, Toronto. The mine address is Sudbury.

An average of eleven men was employed, of whom three were underground, during the period of operation. Lionel Brooke was in charge of operations.

Buffalo Ankerite Gold Mines, Limited

This company has an authorized capitalization of $1,000,000, in shares of $1 par value, of which 500,007 shares have been issued. The officers and directors are as follows: Geo. R. Feine, president; Gustave R. Loesch, vice-president; Edward G. Kinkel, secretary and managing director; Henry Kobler, treasurer; Jacob Betz, Henry J. Tiedt, and R. P. Kinkel, all of Buffalo. Martin O. Knutson is manager. The mine address is South Porcupine.

The property consists of three claims situated in Deloro township, district of Cochrane. There is a complete mining plant and a 250-ton cyanide mill on the property, which up until 1929 had produced close to three-quarters of a million dollars.

In 1932 production was again started, and the property has since been in continuous operation. The mine is worked to the 600-foot level, but a winze is now being sunk from this level, and it is intended to go to the 900-foot horizon.

The development work for the year was: drifting, 1,137 feet; crosscutting, 253 feet; box-holes, 939 feet; raises, 763 feet; sub-drifts, 313 feet; winze, 383 feet; diamond-drilling, 2,518 feet.

During the year 117,265 tons were milled at a daily rate of 321 tons, with a production of $462,593.65, not including premium.

Canadian Kirkland Mines, Limited

The officers and directors are: George Tough, president; W. B. McPherson, secretary-treasurer; F. J. Carew, B. L. McLean, and J. A. Hough, directors. Hugh Jardine is manager at the mine, and the mine address is Kirkland Lake. The authorized capital is $3,000,000, in shares of $1 par value, of which 2,585,906 shares are outstanding. The company owns 6 claims in the township of Teck, district of Timiskaming.

In 1933 the No. 1 shaft was sunk from the 400-foot to the 750-foot level and is to continue to the 1,000-foot level. About 400 feet of diamond-drilling was done on the 260-foot level. An average of 15 men was employed.

Casey Summit Gold Mines, Limited

This company operates a property at Summit lake, in the district of Kenora, Patricia portion, about 100 miles due north of Sioux Lookout on the main line of the C.N.R. The property can best be reached by aeroplane from Sioux Lookout. The water route by way of Lac Seul, Woman lake, and Birch lake is about 200 miles in length and has many portages.

The property comprises some 800 acres. The first work was done by the Casey Mountain Operating Syndicate, Limited, who in 1931 did about 2,000 feet of diamond-drilling with encouraging results. The Bobjo plant was placed on the property early in 1931 and the shaft sunk 85 feet, at which elevation 140 feet of lateral work was done. The property was closed down in the fall of the same year. Work was again resumed in the late summer of 1933, when the shaft

was deepened to 200 feet and lateral work commenced. The property was in continuous operation during the rest of the year.

The officers and directors of the company are as follows: R. G. Williamson, president and general manager, Regina, Sask.; Robt. S. Banbury, vice-president; W. R. M. Williamson, secretary-treasurer; J. A. Wilson, Fraser Raney, and F. D. Reid, directors. H. F. Fancy is mine superintendent. The mine address is Summit Lake, via Sioux Lookout. The authorized capital of the company is 5,000,000 shares of no par value. It is understood that Maple Leaf Mines, Limited, has an option on 2,500,000 shares and is providing the funds for the present work.

Central Patricia Gold Mines, Limited

This company was formerly known as Central Patricia Mines, Limited. This property is situated in the Crow River area, district of Kenora, Patricia portion. It is reached best by aeroplane in either winter or summer and is about 110 miles north of Savant Lake station on the main line of the C.N.R.

The capitalization of the company is $2,500,000, in shares of $1 par value. The officers and directors are: F. M. Connell, president; J. H. C. Waite, vice-president; Alan Cocheram, secretary-treasurer; G. B. Webster, Louis Cohen, and W. H. Connell, directors. The head office is at 85 Richmond Street West, Toronto. The mine address is Collins. A. J. Anderson is mine manager.

In 1930, the shaft had reached a depth of 527 feet and levels had been opened at the 125-, 250-, 375-, and 500-foot horizons. On these levels 994 feet of cross-cutting and 1,713 feet of drifting were done. The report of the engineer for 1930 states that $12 ore to the value of approximately $500,000 was developed by the above work. The property closed down in September, 1930, and lay idle until February, 1932, when operations again started. It was decided to place on the property a 50-ton mill, using blankets and amalgamation, to be put in operation in the late summer; but, owing to the loss of essential equipment through the ice in the spring, these plans had to be laid aside until the freeze-up. It is hoped that the mill will be ready to operate in the early spring of 1934. During the summer all the mill foundations and the building were made ready. Most of the lost equipment was also recovered from the bottom of the lake. In July, there were 33 men employed on the property.

J. Y. Cole, Jr.

This property comprises 24 claims, all in one group, situated in the Pipestone Bay section of Red lake, district of Kenora, Patricia portion. Plant and camps were installed in November and December of 1932. In February, 1933, sinking of a two-compartment shaft was commenced in a quartz porphyry zone on the boundary line between claims Nos. 1,628 and 1,629. By the fall of 1933 the shaft had reached a depth of 200 feet and exploration at that level was under way. Plant equipment is capable of sinking to the 500-foot level.

It is the intention of Mr. Cole, whose private venture this is, to form a joint-stock company shortly so that more extensive operations can be carried on. During the sinking of the shaft 15 men were employed. The mine address is Red Lake.

Coniaurum Mines, Limited

This company has an authorized capitalization of 6,000,000 shares of no par value. The mine is in the township of Tisdale, district of Cochrane, and adjoins the property of the McIntyre-Porcupine Mines on its east boundary.

The officers and directors of the new company organized under Ventures, Limited, are as follows: Thayer Lindsley, president; A. L. Bishop, vice-president; H. Whittingham, secretary-treasurer; J. Gordon Hardy, D. M. Hogarth, Alex. Longwell, and T. H. Rea, directors. The head office is at 100 Adelaide Street West, Toronto. The mine address is Schumacher. John Redington is mine manager. An average of 229 men was employed throughout the year.

The following statement is taken from the report of the mine manager for the year ending December 31, 1933:—

Development

The year's development has been confined to Nos. 15 and 7 vein systems.

Lateral work consisted of two main drives on the 1,500- and 2,000-foot levels. These have partly opened up two fair-sized ore bodies, one of which is on the 1,500-foot level. The latter has been driven on for a distance of 500 feet. The ore is drift width and of fair grade. On the 2,000-foot level, another ore lens has been explored by diamond-drilling and indicated to be about 5 feet wide and about 200 feet in length. From these results it is expected this material, when mined, will grade sufficiently high for mill feed. In addition to those first mentioned, another ore body has been partly developed on the 750-foot level. This exploration was carried on from a raise that had been driven from No. 15 stope.

Bishop shaft, or the main working shaft, has been deepened from 80 feet below the 2,000-foot level to a depth of 3,150 feet, or 150 feet below the 3,000-foot level. It has four 5-foot compartments. Levels are established at 2,750 and 3,000 feet. Crosscuts have been started both north and south on the 3,000-foot level.

Summary of Development

	Feet
Drifting	1,252
Crosscutting	2,997
Raising	514
Diamond-drilling	6,976
Shaft-sinking	1,052

Footage driven in ore was 1,038 feet with an average value of $5.10 (old standard) over a width of 5.6 feet. No. 7 vein was developed on the 1,750-foot level and No. 15 vein on the 750- and 1,500-foot levels.

Broken Ore Reserves

Broken ore reserves have been diminished during the year, and are now 118,310 tons. Stoping supplied 83,842 tons, and development 5,237 tons. The mill drew 145,657 tons, leaving a carry-forward of 118,310 tons available at the end of the year. The grade is somewhat lower than last year. This is accounted for by drawing from a number of inactive stopes, which naturally results in considerable dilution.

Milling

During the year the mill treated 145,657 tons of ore with an average value of $4.603 (old standard) and extraction of 94.6 per cent. of the gold content, operating 363.89 days, or 99.69 per cent. of the possible running time.

New Equipment

During the year it has been possible to make satisfactory arrangements for installing and equipping all main mine buildings with an up-to-date sprinkler system, which will reduce our fire insurance rate approximately 50 per cent.

We have also installed a tailings disposal plant, two new 50 h.p. motors in the crushing plant to drive No. 2 rolls, as well as a dam (now under construction) to impound tailings, which when completed will serve for several years. It is expected to have this dam completed before the spring break-up.

Exploration

It is proposed to push development west on the 3,000-foot level as rapidly as possible towards the Goldale section, in order to facilitate the prospecting of the nose of the Pearl lake porphyry mass at greater depth.

Consolidated Mining and Smelting Company of Canada, Limited

Cordova Mine

This company pumped out and sampled the Cordova mine in Belmont township, Peterborough county.

L. W. Oughtred was in charge of the work, employing 62 men.

Three Nations Mine

The company had an option on the Three Nations mine in Whitney township, district of Cochrane. The mine was pumped out and sampled, after which the option was dropped.

C. D. Stevenson was in charge of the work, employing 9 men.

De Santis Gold Mining Company, Limited

This company was incorporated in 1928 under the laws of Ontario with a capitalization of $4,000,000, in shares of $1 par value. The following are its officers and directors: Peter De Santis, president; Jos. V. Friel, vice-president; Giuseppe Giustini, secretary-treasurer; Luigi De Luca, F. Prest, Biagio Ferreri, and Theodore Schulze, directors.

This company operated its property in Ogden township, district of Cochrane, for several months during the year. Previous development on the property had disclosed ore on two levels, and it was decided to mine this ore as a test as well as to help defray some of the expenses of the development of the mine. The Hayden mill situated about two miles distant was rented, and the ore was hauled to it by motor truck. Ore to the value of $18,386, including exchange, was treated. Operations ceased late in the fall.

Peter De Santis was in charge of the operation, and, on an average, 34 men were employed.

Dikdik Exploration Company, Limited

The property of this company, which includes mining claims Nos. 11,070 to 11,078, inclusive, is situated at Atigogama lake, district of Thunder Bay. This group is about 12 miles northwest of Kinghorn station, on the Long Lac–Port Arthur branch of the Canadian National railway.

In October, 1933, work was started on cutting out a winter road from Kinghorn. Mining operations commenced late in December. An open cut was started on a narrow high-grade vein, from which it is planned to ship ore to Flin Flon for treatment.

The equipment used consisted of a 320-cubic-foot gasoline compressor, a small hoist, and a tractor. About 16 men were employed under the direction of K. W. Fritszche.

This company is under the engineering management of Alderson and Mackay, Incorporated, Dominion Square Building, Montreal.

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 is in the township of Tisdale, district of Cochrane.

The officers of the company are: Jules S. Bache, president and treasurer; H. P. De Pencier, 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, Morton F. Stern, New York; G. C. Miller, Buffalo; Dwight B. Lee, Detroit; G. H. Harris, Innis P. Allen, Rochester; Alex. Fasken, Frank E. Maulson, Frederick Burnett (who fills the vacancy caused by the death of R. F. Segsworth), Toronto.

H. P. De Pencier is the general manager of the company, and J. H. Stovel is general superintendent.

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 the year there was an average of 660 men employed at the works, about 378 of whom are employed underground.

The following is taken from the report of the president for the year ending December 31, 1933:—

The net profit or income for the year was $3,851,008.22. Your directors are pleased to report that the net excess of current assets (bonds at market price, shares at cost) over current liabilities (including dividends payable February 1, 1934, $476,667.00) is the sum of $7,139,840.60, which includes the sum of $2,192,952.43 set apart as a dividend assurance fund. Dividends, however, were paid for the year out of the general fund and not out of the dividend assurance fund.

East Geduld Mines, Limited, declared a dividend of three shillings and three pence per share in June, and in December a further dividend for the year of three shillings and nine pence per share, payable to shareholders of record December 31, 1933. The results of operation and development of this property throughout the year have continued to be extremely satisfactory. A portion of our holding in this company has been sold at a profit.

The following is from the report of the general manager:—

During the year 566,400 tons were hoisted; of this 546,500 tons was ore which was sent to the mill and treated, and 19,900 tons was waste which was dumped on the surface. In addition, 28,500 tons of waste was dumped into old stopes.

The 546,500 tons milled yielded bullion worth $4,453,166.87 at $20.67 per ounce; the yield per ton milled being $8.1485. In addition, there was recovered from the re-treatment of by-product the sum of $71,140.04. The total recovery, including excess over $20.67 per fine ounce received for bullion (December estimated), was $6,266,957.14.

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 expenditures for the year under review.

EARNINGS STATEMENT

for the year ended December 31, 1933

EARNINGS:		
Bullion production		$6,266,957.14
Non-operating revenue		144,969.67
		$6,411,926.81
OPERATING AND MAINTENANCE EXPENDITURE:		
Development and exploration	$402,964.94	
Mining, including hoisting	746,914.86	
Crushing and conveying	96,788.07	
Milling	528,310.35	
Bullion expense	24,609.49	
Fire protection	8,160.58	
Warehouse expense	10,957.51	
Auditing expense	2,574.68	
Administrative expense:		
Mine office	105,394.03	
Executive offices	22,677.09	
Registrar and transfer fees and expenses	34,643.19	
Municipal taxes	37,982.28	
Insurance	15,831.87	
	$2,037,808.94	
Reserve for provincial and income taxes	523,109.65	
		2,560,918.59
PROFIT FOR THE YEAR		$3,851,008.22

Development

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

SUMMARY OF DEVELOPMENT WORK FOR YEAR 1933

Level	Stations	Drifts	Cross-cuts	Drifts and cross-cuts, slashing	Raises	Winzes	Box-holes	Raises, winzes, and box-holes, slashing	Total	Diamond-drilling
	feet	feet	feet	feet	feet	feet	feet	feet	feet	feet
1st	.....	.....	.....	7	34	.....	159	11	211	.....
3rd	.....	52	.....	10	22	.....	.....	.....	84	.....
5th	.....	.....	340	14	.....	.....	.....	.....	354	2,271
6th	.....	81	.....	14	42	.....	136	6	279	.....
7th	.....	22	268	2	72	.....	.....	.....	364	1,619
9th	.....	95	.....	6	.....	.....	49	3	153	.....
10th	.....	810	125	180	80	112	617	143	2,067	2,378
11th	.....	1,248	402	186	684	.....	1,038	203	3,761	3,344
12th	.....	944	128	81	255	4	701	99	2,212	1,881
13th	.....	809	57	69	360	8	328	31	1,662	3,674.5
14th	.....	691	168	51	559	.....	115	56	1,640	2,421
15th	.....	114	387	26	177	.....	93	18	815	2,860
16th	.....	80	.....	6	.....	.....	.....	.....	86	83
17th	.....	.....	87	6	.....	.....	.....	10	103	.....
18th	.....	.....	.....	.....	17	.....	.....	11	28	4,289.5
23rd	.....	460	629	140	284	150	.....	35	1,698	7,923.5
24th	27	735	696	133	44	150	18	22	1,825	1,505
25th	20	506	457	50	194	36	.....	30	1,293	2,351
Total	47	6,647	3,744	981	2,824	460	3,254	678	18,635	36,600.5

Approximately 17,000 feet of drifting, crosscutting, raising, winzing, and box-holing and 36,600 feet of diamond-drilling has been done in the course of searching for and opening up the various ore bodies.

Above the 10th level, the small amount of work done was of an exploratory nature or was done in connection with known ore bodies.

From the 10th to the 16th levels, the work done was mostly in connection with known ore bodies or extensions of same. While some of this work was done around the eastern edge of the greenstone where it contacts with the sediments, the greater part of the work was done in the greenstone areas.

At the 23rd level, 1,548 feet of drifting, crosscutting, and raising and 7,923.5 feet of diamond-drilling was done in the area described in the 1932 report. The work done did not disclose ore of economic importance on this level. In this area, a winze was sunk to a depth of 336 feet below the 23rd level, and stations were cut at the 24th and 25th levels at 150 and 300 feet below the 23rd level.

At the 24th level, 1,675 feet of drifting, crosscutting, and raising and 1,505 feet of diamond-drilling was done. An ore body was disclosed in the sedimentary measures, which proved to be very irregular both as regards occurrence and ore values. This ore body has an extreme length of 300 feet and an extreme width of 120 feet, with an area of 21,300 square feet. For the most part, the ore is quite different from that found in the sedimentary measures in the upper part of the mine, the values depending to a large extent on the presence of visible free gold.

At the 25th level, 1,257 feet of drifting, crosscutting, and raising and 2,351 feet of diamond-drilling was done. Ore disclosed in the sediments on this level has a length of 100 feet, a width of about 55 feet, and an area of approximately 5,000 square feet. A fault cuts the eastern end of this ore.

Drift No. 2,504 was driven east through this fault to cut an ore section disclosed in diamond-drill hole No. 1,564. This drift cut ore a few feet east of the fault, and this ore was drifted on for 210 feet (to end of January, 1934; when work was stopped to permit of further sinking in the winze, the face of drift being still in ore). This ore lies on a porphyry-greenstone contact on the southern edge of the porphyry. This drift averaged considerably higher than other areas on the 24th and 25th levels, the average grade being 15.82 dwt. per ton over a probable width of at least 12 feet. The values on this level also depended largely on the presence of visible free gold.

As the work on the 23rd, 24th, and 25th levels has not sufficiently disclosed the trend or importance of this ore, the winze is to be sunk a further 300 feet and two more levels will be developed. The work done to date indicates a possibility of securing 250,000 tons of ore from the 24th and 25th levels, and this ore apparently averages at least 7 dwt. per ton.

Of the tonnage milled, the stopes yielded 487,600 tons, averaging 8.58 dwt. per ton, and development work yielded 58,900 tons, averaging 4.58 dwt. per ton, a total of 546,500 tons, averaging 8.15 dwt. per ton.

Ore from stopes wholly in the sedimentary area yielded 160,990 tons, averaging 8.77 dwt. per ton. Ore from stopes wholly in greenstones and partially in greenstones yielded 326,610 tons, averaging 8.24 dwt. per ton.

The expenditure on mining was $746,914.86, or $1.37 per ton milled. The expenditure on development and exploration work charged to operation was $402,964.94, or $0.74 per ton milled.

Ore Reserves

The ore reserves are estimated at 2,025,000 tons. This includes 718,600 tons of broken ore but does not include the 250,000 tons indicated as possible ore on the 24th and 25th levels. Ore in the sediments is estimated at 194,000 tons, and the ore in the greenstones is estimated at 1,831,000 tons.

Exploration

Your engineers have continued to examine and consider properties and prospects. Nothing has been found, however, that warranted our becoming interested. The expenditure in connection with this work for the year amounted to $21,925.37. The option held on a group of claims in the Swayze district of Ontario was dropped as the results of the work done on these claims were unsatisfactory.

Mill

The following are the results of the mill operations during the year:—

	Value per ton	Extraction per cent.
	dwt.	
Heads	8.0303	.....
Recovery	7.8881	98.23

Mr. C. W. Dowsett was engaged as consulting metallurgist and has made many improvements during the year, which resulted in the percentage extraction being raised from 95.08 to 98.23 per cent., while for the past several months the extraction figure has been around 98.37 per cent.

On Mr. Dowsett's recommendation, a small plant was erected during the year to recover gold from old fine iron waste from the mill. The bulk of this material which had accumulated over a period of years has been treated and has produced approximately 3,400 ounces of gold.

General

Operating costs for the year were $3.729 per ton. During the year, four mining claims adjoining our property to the northeast were purchased.

A new change-house was erected and put into operation in the latter part of the year. This has given much satisfaction.

Foley Syndicate

In November, 1932, British Canadian Mines, Limited, turned over the Foley mine near Mine Centre, in the Rainy River district, to a syndicate composed mainly of its bondholders, under an operating agreement.

A small amalgamation mill was first assembled, consisting of a jaw-crusher, two gravity stamps, amalgam plates, a gas engine, and a 15 h.p. boiler. Most of this equipment was already on the property.

The old south shaft, which is a vertical, two-compartment shaft, 200 feet deep, was then dewatered to the 50-foot level and stoping started on a narrow high-grade vein. This shaft is not connected to the principal workings of the Foley mine.

By the end of 1933 a total of about 350 tons of ore had been mined by open stoping on the 50-foot level, transported to the amalgamation mill by truck, and milled.

The mining plant used consisted of the 546-cubic-foot compressor, driven by one of two 110 h.p. Diesel engines on the property, and a 4- by 6-inch air hoist.

On an average, 8 men were employed, of whom 4 were underground. Russell Cone was in charge of operations.

Four Nations Consolidated Gold Mines, Limited

Four Nations Consolidated Gold Mines, Limited, have a capitalization of 5,000,000 shares of $1 par value. The shareholders of the old syndicate are to get one share of the new company for 10 shares of the old. The property is at Kenogami Lake, in Grenfell and Gauthier townships, in the district of Timiskaming. The officers and directors are: H. W. Waters, president; H. Don Miller, vice-president and general manager; Max Kaplan, treasurer; J. R. Jarvis and Roderic H. Rae, directors. E. D. Kindle is manager. The head office is at 372 Bay Street, Toronto.

Work was started in November, 1933. The buildings were repaired and the machinery was put in shape to operate. In January, 1934, two machines started crosscutting and drifting on the 500-foot level. About 37 men are employed.

Gold Lands Syndicate of Algoma

In 1933 this syndicate took over a group of 9 claims, known as the Edwards property, near the centre of township 48, range 27, district of Algoma. The property is six miles southwest of Lochalsh station on the Canadian Pacific railway. The trustees of the syndicate are: H. C. Miller, 901 Atlas Building, Toronto; Raymond N. Bond; and M. C. Van Der Voort. The capitalization is $33,000.

A 7- by 11-foot shaft, inclined at 80 degrees, was started on September 30 and completed to a depth of 100 feet. Crosscutting was in progress on the 100-foot level at the end of the year.

The plant consists of a 110-cubic-foot IR gasoline compressor and a small gasoline hoist. Buildings include a power-house, a blacksmith shop, and a bunk-house.

A crew of fifteen men was employed, of whom 5 were underground. Geo. W. Hall was in charge of operations.

Golden Summit Mines, Limited

The Golden Summit Mines, Limited, owns 460 acres in Maisonville and Grenfell townships, district of Timiskaming. The officers and directors are: W. J. Simpson, president and general manager; Benjamin Kerr, Jr., vice-president; Gordon Belyea, secretary-treasurer; Dr. J. J. Matheson, J. G. Jarvis, J. M. Calder, and Charles Ling, directors. The head office of the company is at 2422 Bloor Street West, Toronto. The mine address is Sesekinika. The authorized capital is $2,500,000, in shares of $1.

The main shaft is down to the 142-foot level, and about 1,000 feet of drifting and crosscutting has been done on the 125-foot level. The shaft is to be sunk to the 500-foot level, and stations will be cut at the 250-, 375-, and 500-foot levels. The average number of men employed during the year was 10.

Halcrow Swayze Mines, Limited

This company was incorporated in November, 1932, with an authorized capitalization of 2,500,000 shares, of $1 par value. The head office is at 38 King Street West, Toronto. The officers and directors are: Horace F. Strong, president; H. A. Butt, vice-president; J. B. Allen, secretary-treasurer; W. J. Yeoell and Martin Shunsby, directors.

The property consists of some 35 claims located in Halcrow township, in the Swayze area, district of Sudbury.

A mining plant was taken into the property in the early spring of 1933, and included a 310-cubic-foot Gardner Denver gasoline compressor, an 8¼- by 10-inch hoist, and a 25 h.p. boiler.

Sinking was started on June 23, and a vertical two-compartment shaft, 7 by 11 feet, was sunk to a depth of 212 feet, and a level was established at 200 feet. To the end of the year a total of 435 feet of drifting and 253 feet of crosscutting had been accomplished on this level.

An average of 17 men was employed during the year, of whom 4 were underground. Horace F. Strong was in charge of operations. The mine address is care of General Airways, Chapleau.

Hayden Gold Mines, Limited

This company is capitalized at $5,000,000, in shares of $1 par value. There are approximately 4,000,000 shares issued. Jas. S. Pierce is president, and the head office is at 421 Temple Building, Rochester, N.Y.

The company's holdings of 8 claims are in the townships of Ogden and Deloro, district of Cochrane.

The mine is one of the oldest in the Porcupine area and the undertaking was revived in 1927, when a complete new mining plant was placed in operation. The shaft was sunk many years ago to the 700-foot horizon and work started on six levels. The new company continued this work with more or less success, finding new veins to the south of the early workings, which showed consistent though rather low values. In 1932, a 25-ton mill using flotation and amalgamation was constructed and operated for a short time before the mine was closed down. Late in 1932 a cyanide unit was added to the mill, and the property again operated during the early part of 1933. Results from the mill were indifferent, and the property was again shut down. An assignment was made in May, 1933. Late in the year the property was bought by a Rochester syndicate. Subsequently a company called Naybob Gold Mines, Limited, was formed to take over the property.

Hollinger Consolidated Gold Mines, Limited

The authorized capital of this company is $25,000,000, in 5,000,000 shares of $5 par value; 4,920,000 shares were outstanding on December 31, 1933. The head office is at Timmins, Ont.

The officers of the company are: Noah A. Timmins, president; Jules R. Timmins, vice-president; John B. Holden, secretary-treasurer; A. F. Brigham, consulting engineer; John Knox, general manager. The directors are: Noah A. Timmins, John B. Holden, Jules R. Timmins, Wilson Bell, Senator W. L. McDougald, Leo H. Timmins, Allen A. McMartin, James Y. Murdoch, and John I. Rankin.

Ore broken during 1933 amounted to 1,644,338 tons, none of which came from stopes below the 2,700-foot level. The following is a summary of development work: drifting, 63,308 feet; crosscutting, 24,372 feet; diamond-drilling, 147,533 feet. Some 12,857 lineal feet of stope timbering was placed.

The construction of a new change-house, embodying the most up-to-date features, was under way late in the year. There will be accommodation for about 1,350 men, as well as mine clerks' offices, etc.

The following is taken from the president's report to the shareholders for the year ending December 31, 1933:—

The company had a highly successful year. The value of gold and silver produced was $13,778,683.49, and interest on investments and other income amounted to $161,760.99, making

total income $13,940,444.48, applied as follows: general, mining, and milling charges, $6,791,675.62; Dominion, provincial, and municipal taxes, $699,741.06; reserve for contingencies, silicosis, etc., $453,248.77; depreciation, $258,602.80; leaving net profit from operations of $5,737,176.23, out of which the regular 13 dividends of 5 cents each and four extra dividends of like amount (85 cents in all) were paid, and $1,555,176.23 added to surplus.

The main items comprised in general, mining, and milling charges consist of (a) pay-roll, $4,102,775.11; (b) material and supplies (practically all produced and purchased in Canada), and miscellaneous, $2,278,967.97.

For the year under review, the estimated requirements for Dominion, provincial, and municipal taxes amount to approximately $700,000, as against $527,000 during the preceding year, an increase of $173,000.

Shareholders will note that the company's interest in its subsidiary, International Bond and Share Corporation, has been written down to its actual value at the end of the year. Heretofore the cost of this interest has been set up in the balance sheet with a notation of the market value. That company's portfolio, as in the past, consists chiefly of listed securities, which are readily marketable. The securities of your subsidiary, based on market value, are subdivided as follows: bonds, 20.4 per cent.; preferred stock, 7.3 per cent.; common stock, 72.3 per cent.

The securities in other companies and the bonds held by your company appear in the balance sheet at cost, which is considerably less than their market value.

During the year the policy of your management to explore and investigate outside properties has been continued. A competent field force has been constantly in touch with developments in the various mining areas, and an option on the Brennan group of claims in Hislop township, Ontario, has been secured.

Last year your company took an option on the Young-Davidson claims in the Matachewan district, which has been actively followed up. A mill is now in course of erection, and it is expected that the property will be in production in the early summer.

A progress report by your consulting engineer, Mr. Brigham, on the Brennan and Young-Davidson claims, forms part of this report.

Hollinger Consolidated remains predominantly Canadian. The outstanding 4,920,000 shares are distributed among nearly 9,000 shareholders, as follows: 7,050 shareholders residing in Canada hold 4,554,362 shares; 1,545 shareholders in the United States hold 330,658 shares; 94 shareholders in Great Britain hold 18,136 shares, and 128 shareholders elsewhere hold 16,844 shares.

The following is taken from the report of the general manager for the year ending December 31, 1933:—

PROFIT AND LOSS STATEMENT

SOURCES OF 1933 INCOME:			
Gold and silver produced			$13,778,683.49
Interest on investments and other income			161,760.99
			$13,940,444.48
DISPOSAL OF 1933 INCOME:			
General charges		$477,119.80	
Mining charges		5,240,318.38	
Milling charges		1,074,237.44	
			6,791,675.62
Operating profit			$7,148,768.86
DEDUCT:			
Taxes—			
Province of Ontario	$126,064.93		
Royalty to Town of Timmins	43,420.60		
Municipal to Town of Timmins	77,769.97		
Royalty to Township of Tisdale	1,944.29		
Municipal to Township of Tisdale	3,131.88		
Dominion of Canada re 1932	2,409.39		
Dominion of Canada and Province of Ontario, reserve for	445,000.00		
		$699,741.06	
Reserve for contingencies—silicosis, etc		453,248.77	
			1,152,989.83
Net profit from operations before depreciation			$5,995,779.03
Depreciation:			
Plant		$195,300.17	
Investments in other companies and properties written down		2,744.01	
Expenditures on properties abandoned		60,558.62	
			258,602.80

Net Profit from Operations	$5,737,176.23
Paid Out in Dividends	4,182,000.00
Added to Surplus	$1,555,176.23

BULLION STATEMENT

Inventory, January 1, 1933:		
Solutions		$131,931.40
Slags, litharge, and miscellaneous		880.00
Precipitates held over		8,141.00
Total		$140,952.40
Values Produced in 1933:		
Ore milled	$14,266,789.19	
Tailings loss	488,105.70	
		13,778,683.49
		$13,919,635.89
Inventory, December 31, 1933:		
Solutions		104,257.24
Slags, litharge, and miscellaneous		880.00
Precipitates held over		2,435.00
Gold in process to scavenger		14,500.00
Silver		11,802.83
		$133,875.07
Bullion Shipped during 1933		13,785,760.82
		$13,919,635.89

Yearly Average Costs

Account	Sundries	Labour	Stores	Total	Per ton ore milled
General miscellaneous charges and administration		$256,834.88	$85,598.77	$342,433.65	$0.1982
Surface services		51,035.24	28,085.68	79,120.92	.0458
Insurance	$17,458.91			17,458.91	.0101
Marketing bullion	38,106.32			38,106.32	.0221
Workmen's compensation		73,248.77		73,248.77	.0424
Milling charges		431,942.69	642,294.75	1,074,237.44	.6220
Mining charges		3,717,329.61	1,522,988.77	5,240,318.38	3.0342
Contingent reserve for silicosis, etc		380,000.00		380,000.00	.2200
Total charges	$55,565.23	$4,910,391.19	$2,278,967.97	$7,244,924.39	$4.1948

Employees

The average number of men employed during the year has been 2,527, distributed as follows:—

Miners:		Mechanics:		General:	
Exploration	29	Operation	109	Mill and refinery	202
Development	390	Maintenance	175	Engineering staff	70
Production	1,380			Clerical staff	39
				Miscellaneous	133
Total	1,799	Total	284	Total	444

The Mill

Milling results were as follows:—

Ore milled	tons	1,727,102
Average value per ton		$8.26
Gross value	$14,266,789.19	
Deduct loss in tailings	488,105.70	
Net value recovered		$13,778,683.49

Average tons per day		4,758
Per cent. of possible time run		88.8
Tons per 100 per cent. running time		5,358
Solution precipitated per ton ore	tons	1.04
Value per ton in tailings		$0.28
Cyanide consumed per ton of ore	lbs.	0.496
Zinc consumed per ton of ore	lbs.	.050
Zinc consumed per ton of solution	lbs.	.048
Lime consumed per ton of ore	lbs.	2.147
Lead acetate per ton of ore	lbs.	.010
Average value of pregnant solution		$7.71
Average value received per ounce of gold sold		$28.61

There have been no changes in the metallurgy during the year, but better control has resulted in a decrease of 4 cents per ton in the tailing.

Ore Reserves

Our ore reserves on the 31st of December, 1933, consisted of 6,487,559 tons of a total value of $48,430,451.00, having an average value of $7.47 per ton. These figures compare with 6,049,548 tons on the 31st December, 1932, of a total value of $45,492,076.00, having an average value of $7.52 per ton. 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.

The Mine

During the year operations have been carried on on all levels from surface to the 3,950-foot level. Below the 2,750-foot level, however, the operations are confined to development only. About 34 per cent. of the ore milled came from above the 800-foot level. During the year 811,000 tons of backfill were placed.

Development.—Exploration in the backfilled areas has been increased, and a large number of comparatively small, lower-grade, but profitable ore bodies have been developed. As noted above, the operations in the block from the 2,750-foot level to the 3,950-foot level are still confined to development only, and an additional $3,000,000 of ore of a $9 grade was put in sight during the year.

The extension of the ore zone to the west, mentioned in the last annual report, has continued to a point 1,600 feet west of Schumacher shaft. We are now driving a ventilation drift west of the above point, the objective being a connection with Central shaft, a further distance of 1,400 feet. This drift will be used as a base for further exploration to the west. A shaft has been started below the 3,950-foot level. The location of this shaft is 100 feet south of Schumacher shaft. No sinking objective has been set up for 1934, the progress being governed by other operating conditions.

The following is taken from the report of the consulting engineer:—

YOUNG-DAVIDSON PROPERTY

Surface sampling on this property [in Powell township, district of Timiskaming] was completed during last July, the results of which, together with data from the records of the former optionees, determined the Hollinger to proceed with the exploitation of this property. Based on satisfactory metallurgical tests, a mill of a nominal capacity of 500 tons per day has been designed and is presently being built. The excavation and foundations are completed and ready for the steel building, material for which is on the site. A contract has been completed with the Hydro-Electric Commission of Ontario for all power requirements.

It is proposed to mine the ore by open-cut methods to the greatest safe depth, and it is expected that further tonnages of ore, below such level, may be mined by stoping, should the values be maintained. The amount thus available is upwards of 2,500,000 tons, valued at $2.30 a ton (gold at $20.67). Based on this figure, a profit of about 70 cents a ton was indicated. The new price of gold, however, relieves the project of any speculative features. The plant is expected to be in production by early summer. Access to this mine is by rail to Elk Lake followed by 26 miles of good roads.

BRENNAN PROPERTY

An option to examine this property [in Hislop township, district of Cochrane] was taken up late in the year. Trenching and diamond-drilling are giving encouraging assays, but the work is not far enough advanced to report anything reliable either as to the form or value of the ore body, which is likely to prove low-grade and has this and other features in common with the Young-Davidson.

Horseshoe Mines, Limited

This company has an authorized capitalization of 4,500,000 shares of $1 par value. The officers and directors are: W. A. Lamport, president; C. M.

Chandler, secretary-treasurer; A. Kelly-Evans, J. H. Lumbers, and Dr. W. B. Kendall, directors. The head office is at 302 Royal Bank Building, Toronto. The mine address is Kenora.

The property is located about 40 miles southeast of Kenora, on the Lake of the Woods, in the district of Kenora, and includes the old Regina mine. Work at the Regina mine was suspended in December, 1932, and resumed in July, 1933. A two-compartment winze was started on the old ninth level at a point on the vein 75 feet from the shaft. This level is at a vertical depth of 516 feet. By the end of the year the winze had reached a depth of 132 feet. It is intended to continue it to 250 feet, then to explore the vein.

The plant in use consisted of a 120 h.p. boiler, a 185-cubic-foot Sargent compressor, a 220-cubic-foot IR gasoline compressor, a 12- by 16-inch single-drum hoist on surface, and a 6- by 8-inch hoist at the winze.

During the period of operation an average of 25 men was employed, of whom 10 were on surface. George Miller was in charge of operations.

Howey Gold Mines, Limited

The company is capitalized at 5,000,000 shares of $1 par value. They are all issued. The head and mine offices of the company are at Red Lake. The executive office is at 717 Federal Building, Toronto. The following are the executive officers and directors: R. T. Birks, president; W. S. Cherry, vice-president; H. C. McCloskey, secretary-treasurer; J. E. Hammell and John A. Northway, directors. Fraser D. Reid is general manager.

The company's holdings lie at the southeastern corner of the lower part of Red lake and include the following claims situated in Dome and Heyson townships, district of Kenora, Patricia portion: K. 740-43, 1,400-406, 1,364-72, 1,397-99, and 867. These claims lie directly north of Favel on the Canadian National railway.

The following is an extract from the president's report to the shareholders for the year 1933:—

The interruption of the usual routine by the installation of the new equipment, along with a major shutdown owing to a serious break in the hoisting equipment, seriously affected the profits from the year's operations. Notwithstanding these facts your directors were enabled to fulfil your expectations and declare the first dividend.

The general manager's report shows ore reserves for approximately four years' duration The grade of the ore is low, but under the prevailing costs will show a substantial profit.

An extensive exploration programme is being carried on, and further additions to the known ore reserves are confidently expected.

Your attention is especially directed to the operating costs for the year. These low costs are an eloquent tribute to the efficiency and co-operation of Mr. Reid, Mr. Futterer, and their excellent staff.

The following is taken from the general manager's report for the year ending December 31, 1933:—

SUMMARY OF WORK ACCOMPLISHED

	1933	1932	1931
Drifts, crosscuts, raises, etc.....feet	1,879	3,562.5	3,117
Shafts and winzes.....feet	200	430.5	.....
Shaft stations, slashing, etc.....cu. yds.	3,860	1,550	2,225
Diamond-drilling (underground).....feet	1,837.6	1,856.6	2,030.9
Diamond-drilling (outside exploration).....feet	.....	701	.....
Box-holes.....feet	1,883	830.5	1,560
Ore broken.....tons	414,611	339,675	323,289
Low-grade material discarded by sorting.....tons	53,170	44,585	15,324
Milled after sorting.....tons	290,965	284,664	211,522
Broken reserves in stopes (Jan. 1, 1934).....tons	276,526	206,150	195,724

EARNINGS STATEMENT

	1933	1932	1931
Total receipts from sale of gold and silver	$1,158,470.03	$1,268,780.07	$914,290.58
Total operating cost, including Toronto office expenses	770,010.56	813,368.11	709,111.29
Operating profit	$388,459.47	$455,411.96	$205,179.29

MISCELLANEOUS OPERATING DATA

	1933	1932	1931	Total from start of operations
Tonnage milled and sorted	344,135	329,249	226,876	1,011,490
Tonnage discarded by sorting	53,170	44,585	15,324	113,871
Tonnage milled	290,965	284,664	211,552	897,619
Value a ton hoisted	$2.73	$3.70	$4.20	$3.58
Value a ton material discarded by sorting	$0.54	$0.42	$0.60	$0.52
Value a ton of ore milled	$3.12	$4.21	$4.45	$3.94
Loss in tailings a ton milled	$0.24	$0.27	$0.35	$0.28
Loss a ton of ore hoisted (in milling and sorting)	$0.286	$0.29	$0.37	$0.31
Net percentage recovery a ton of ore hoisted	89.5	92.4	91.5	91.4
Total net recovery of gold and silver	$1,158,470.03	$1,268,780.07	$914,290.58	$3,801,969.04

ANALYSIS OF COSTS

	1933 (344,135 tons)		1932 (329,249 tons)		1931 (226,876 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	$445,033.50	$1.293	$425,094.74	$1.292	$371,396.72	$1.637
Outside exploration	484.39	.002	2,089.95	.006	1,803.00	.008
Crushing and conveying	34,918.07	.102	38,866.59	.118	38,894.55	.172
Ore sorting	15,612.00	.045	12,820.98	.039	4,616.05	.020
Milling	198,877.14	.578	216,049.24	.656	176,358.66	.777
General expense	48,277.67	.140	59,337.36	.180	44,990.64	.198
Total plant cost	$743,202.77	$2.160	$754,258.86	$2.291	$638,059.62	$2.812
Toronto office salaries, general expenses and taxes	27,578.92	.080	45,313.19	.138	34,598.27	.152
Interest charges	.....	.....	13,796.06	.042	36,453.40	.162
Total operating expenses before depreciation, Dominion and provincial taxes, and pre-operating charges	$770,781.69	$2.240	$813,368.11	$2.471	$709,111.29	$3.126
Dominion and provincial taxes	13,016.83	.038	.....	.....	.....	.....
Depreciation (on 10 per cent. basis)	119,108.64	.346	115,333.90	.350	108,266.64	.477
Pre-operating charges	103,240.50	.300	197,549.40	.600	126,931.20	.560
Total cost	$1,006,147.66	$2.924	$1,126,251.41	$3.421	$944,309.13	$4.163

CAPITAL EXPENDITURES

MISCELLANEOUS ADDITIONS:	
Dwelling	$395.47
Addition to dwelling	335.53
Underground miscellaneous equipment	1,613.55
Crushing plant	846.26
Machine and blacksmith shop equipment	2,325.54
Power-house (compressor)	7,739.38
Miscellaneous surface equipment	1,035.28
Total	$14,291.01
ADDITIONS IN CONNECTION WITH INCREASED TONNAGE AND DEPTH DEVELOPMENT:	
New storehouse	$3,390.77
Machine-shop extension	1,553.41
Addition to steel and pipe warehouse	153.40
Shaft-house equipment	1,155.06
Milling equipment	74,223.11
Sorting plant-feed control	674.44
New hoist motor and switchboard equipment	11,454.39
Three 200 k.v.a. transformers, 44,000 v.—2,300 v	7,426.96
Three 100 k.v.a. transformers, 2,300 v.—575/287 v	1,858.42
Surface waste rock haulage equipment	12,578.88
Underground equipment	4,291.15
Total	$118,759.99

Plant Expansion

During the past year the capacity of the mill was increased from 900 tons to 1,350 tons a day. This increase in capacity was made in order to mine and mill, at a profit, a large tonnage of low-grade material located west of the shaft above the 1,000-foot level, and also the ore developed below this level. Enough ore was treated at this increase to demonstrate that the total operating cost could be reduced to at least $1.85 a ton. This reduction in cost, coupled with the increase in the price of gold, enables us to make a substantial profit on this low-grade material.

Ore Reserves

The broken ore reserves in the mine as of December 31, 1933, amounted to 276,526 tons. The unbroken reserves amounted to 1,751,755 tons. It is practically impossible to arrive at the value of these ore reserves by underground sampling methods, owing to the extremely erratic distribution of the gold. We estimate, however, that the ore has a value of between $3.50 and $4.00 a ton at the current price of gold.

Exploration

During the past year exploration work was confined to extending the limits, above the 1,000-foot level, of the known ore body. A substantial tonnage of low-grade material was developed. Shaft-sinking below the 1,315-foot level was commenced and will be continued to the 1,500-foot level, where further exploratory work will be done. The east drift on the 1,000-foot level is also being driven into unexplored ground, and this area will be thoroughly prospected by diamond-drilling.

An average force of 210 men was employed throughout the year. Edward Futterer is superintendent.

J-M Consolidated Mines, Limited

This company was incorporated in Ontario in February, 1933, and took over the holdings of the Jackson Manion Mines, Limited, and Mint Ore Mines, Limited. The capitalization is $2,500,000, in shares of $1 par value. The officers and directors are as follows: J. E. Day, president; Charles Taylor, vice-president; T. J. Day, secretary-treasurer; J. D. Chapman, and J. B. Tudhope, directors. D. M. Thomson is consulting engineer. The head office of the company is at 1116 Federal Building, Toronto, and the mine office is at Jackson Manion, via Sioux Lookout.

The property consists of 32 claims in the Woman Lake area, Patricia portion of Kenora district, and is best reached by aeroplane from Sioux Lookout. The water route is from Hudson, through Lac Seul, Packwash lake, Trout Lake river, and Woman river, to Woman lake.

During the years 1928 and most of 1929, active development of the Jackson Manion was carried on. A shaft was sunk 404 feet with levels at the 125-, 250-, and 375-foot horizons, upon which a total of about 1,800 feet of development work was done, most of it on the vein. There was also some 5,000 feet of diamond-drilling done. Since August, 1929, the property has been idle.

In October, 1933, work was again resumed at the property, at which time further underground development was started. It is expected that a small mill will soon be placed on the property.

D. M. Thomson is in charge of operations. Thirty-two men are employed.

Kenora Prospectors and Miners, Limited

The property of this company includes the old Mikado gold mine, situated in Bag bay, Shoal lake, in the Lake of the Woods area, district of Kenora. It is 45 miles by water from Kenora.

Operations at the Mikado mine were started by this company in November, 1932, and continued throughout 1933. In January, 1933, sinking was started in an old 87-foot inclined winze situated on the 4th level, near No. 1 shaft. This winze was sunk an additional 211 feet on the incline to reach the 9th-level horizon, which is at a vertical depth of 522 feet from surface. A total of 1,651 feet of drifting and 264 feet of crosscutting was done at this horizon from the winze. During the latter part of 1933 work was started on the 10th level, from the old Mikado inclined shaft, where 266 feet of drifting and 78 feet of crosscutting was accomplished.

The plant consists of an 8- by 12-inch Beatty hoist at No. 1 shaft, a 6- by 8-inch Jenckes hoist at the winze, two 88 h.p. boilers, and a 500-cubic-foot compressor.

An average of 29 men was employed, of whom 15 were underground. R. C. Brehaut was in charge of operations.

Kenty Gold Mines, Limited

This company was incorporated in September, 1932, with an authorized capital of 3,000,000 shares, of $1 par value. The officers and directors were: F. L. Trethewey, president; J. B. Tyrrell, vice-president; S. W. Black, secretary-treasurer; R. G. O. Thomson and E. T. Corkill, directors. The executive office is at 43 Victoria Street, Toronto. The mine address is Brett Lake, via Sultan.

The property consists of 16 claims situated in the northeast corner of Swayze township, district of Sudbury. It is 21 miles by road from Sultan station on the main line of the Canadian Pacific railway.

Operations were started in October, 1932. No. 1 shaft was commenced on January 3, 1933, and No. 2 shaft a month later. Both are vertical two-compartment shafts, 6½ by 10 feet, and are 1,800 feet apart.

During 1933, No. 1 shaft was sunk to a depth of 510 feet, and levels were established at 250, 375, and 500 feet. A total of 370 feet of drifting and 74 feet of crosscutting was accomplished on the 250-foot level; 458 feet of drifting and 183 feet of crosscutting on the 375-foot level; and 166 feet of drifting and 202 feet of crosscutting on the 500-foot level. No. 2 shaft was sunk to a depth of 534

feet, and levels were established at 290 and 525 feet. A total of 458 feet of drifting and 576 feet of crosscutting was accomplished on the 290-foot level, and 137 feet of drifting and 516 feet of crosscutting on the 525-foot level.

The equipment used included two 6- by 8-inch IR air hoists, a 610-cubic-foot air compressor driven by a 105 h.p. engine, and a 322-cubic-foot compressor driven by a 55 h.p. oil engine. The compressors were situated at No. 1 shaft and compressed air was piped over to No. 2 shaft for hoisting and drilling.

Buildings erected included a hoist and compressor house, blacksmith shop with power sharpener and oil furnace, and a dry-house at No. 1 shaft; a hoist-house and dry-house at No. 2 shaft; three bunk-houses, a two-storey staff office-building, and a cookery at the camp.

An average of 39 men was employed, of whom 22 were underground. E. T. Corkill was in charge, with R. M. Williams as superintendent.

Kirkland Consolidated Gold Mines, Limited

The officers and directors are: J. W. Rudhard, president; C. C. Tyx, Tonawanda, N.Y., secretary-treasurer; E. B. Wood, Ed. J. Meyer, Sr., Kelvin Killeen, R. W. Langford, N. R. Davis. The head office is at 1717 Metropolitan Building, Toronto. The mine address is Swastika. Ralph Hurd is manager. The company owns 14 claims in Gauthier township, 4 claims in McVittie township, and 12 claims in Grenfell township, district of Timiskaming. The authorized capital is 7,000,000 shares of $1 par value, and there are issued 3,500,000 shares.

In 1933 the shaft on the Grenfell claims was sunk from 60 feet to the 250-foot level, where a crosscut is being driven to cut the vein. At the end of January, 1934, the crosscut was advanced 46 feet.

During the year the following construction work was done: cookery, 18 by 32 feet; bunk-house, 18 by 32 feet; office, 20 by 26 feet; blacksmith shop, 16 by 20 feet; dry-house, 16 by 16 feet; boiler-house, 18 by 34 feet; and powder-house, 8 by 10 feet. In November a steam plant consisting of a 60 h.p. boiler and a 350-cubic-foot steam compressor was installed. Operations were started in August, 1933, and an average of 20 men was employed to the end of the year.

Kirkland Gold Belt Mines, Limited

Kirkland Gold Belt Mines, Limited, have an authorized capital of 3,000,000 shares of no par value. The officers and directors are: G. W. Morris, president; Jas. E. Day, vice-president; Roy Weldon, secretary; M. C. Smith, treasurer; Dr. W. H. Bennett, Adam L. Beck, H. P. Armstrong, Walter B. Robb, directors. The company owns 292 acres in the township of Lebel, district of Timiskaming. The head office is at 504 Kent Building, Toronto. The mine address is King Kirkland.

The work done during the year consisted of 250 feet of sinking, 1,749 feet of drifting, and 266 feet of crosscutting. At the end of the year the shaft was 518 feet deep, and 462 feet of crosscutting and 2,292 feet of drifting had been done.

Howard Brassaw is manager. An average of 26 men was employed during the year.

Kirkland Lake Gold Mining Company, Limited

The officers and directors of this company are: J. B. Tyrrell, president and managing director; R. Graham, secretary; R. G. O. Thomson, vice-president; Wm. M. Sixt, mine manager; A. C. Matthews, J. A. Dalton, R. V. Le Sueur, W. S. Walton, and J. C. Haight, 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 the Bank of Commerce Building, Toronto. The mine address is Kirkland Lake. The average number of men employed during the year was 125.

The following is taken from the president's report to the shareholders for the year ending December 31, 1933:—

The energies of the staff during the past year were largely devoted to searching for ore on or in the vicinity of the rich Kirkland Lake vein, to extracting ore which had been located in previous years, and also some of that which was found during the year under review.

The profit for the year amounted to $141,720.47, after providing for cost of operations, including depreciation and taxes, amounting in all to $398,831.69, or $8.19 to the ton milled.

Ore mined and milled amounted to 49,487 tons, and the recovery from this tonnage produced $524,046.77. Of this ore, 782 tons were taken from the property of the Grozell Kirkland Gold Mines, Limited, which produced $2,636.71, leaving 48,705 tons from the company's property, for which $521,410.06 was received, an average rate of $10.70 to the ton. Rather more than one-third of this ore came from above the 3,600-foot level, another third came from the four levels below 3,600 feet, while the remainder came from below 4,150 feet.

During the year No. 2 winze was completed to a depth of 5,477 feet, after which lateral exploration was undertaken at the new levels opened up by this winze.

The great Kirkland Lake fault was followed on the 1,600-, 4,450-, 4,900-, 5,050-, 5,325-, and 5,450-foot levels in search of payable ore. Ore was found on most of these levels, the two bodies that seem to be the most important being on the 5,450-foot level. Diamond-drilling was also carried on from these levels, both laterally and vertically, ore being located by drill cores laterally from the 5,050-foot level, and vertically below the 5,450-foot level.

In addition to stoping, the following development work was done: 4,479 feet of drifting; 1,465 feet of crosscutting; 34 feet of sinking; 226 feet of raising; 9,150 cubic feet of station-cutting; 8,800 cubic feet of slashing, and 2,733 feet of diamond-drilling.

By making some comparatively slight alterations in the mill, the grinding capacity has been materially increased, and the mill capacity has been brought up to about 170 tons per day.

In pursuance of the agreement with the Grozell Kirkland Gold Mines, Limited, drifts were driven for 872 feet in its property at the 4,900-foot level, and mining was done laterally wherever indications pointed to possible favourable results, but no volume of commercial ore was found on this level, and work was discontinued.

Your company has purchased 400,000 shares of stock in Kenty Gold Mines, Limited, and has disposed of 140,000 of these shares, leaving it with 260,000 shares, which with your shares in Kirkland Basin Gold Mines, Limited, Ursa Major Mines, Limited, and Grozell Kirkland Gold Mines, Limited, are included in the company's list of assets under "Shares in other companies." In addition to the stock in the Kenty Gold Mines, Limited, already purchased, the company has an option to purchase a further 900,000 shares.

Your mine is well equipped, has no debt, and now has available liquid resources amounting to $401,021.69.

The increased value of gold, which has now attained a price of $35 per fine troy ounce for gold mined in or delivered to the United States, has been, and will be, of material assistance to the company's operations, and should have an important influence on our results.

Your directors record with deep regret the death on December 4, 1933, of Mr. A. M. McQueen, who had served on the board since March 22, 1929. Mr. R. V. Le Sueur was appointed a director to fill the vacancy.

The following is taken from the report of the manager for the year ending December 31, 1933:—

During the year work was done on the following levels: 500, 700, 1,600, 2,225, 2,475, 2,725, 2,850, 2,975, 3,600, 3,750, 3,875, 4,000, 4,150, 4,300, 4,450, 4,750, 4,900, 5,050, 5,325 and 5,450. A much larger tonnage was made available on the upper levels than was indicated at the end of the previous year, due to the prevailing price of gold.

Parts of the ore zone, which previously were unprofitable, are now being worked. Due to the increased price of gold a greater tonnage per foot of depth will be recovered than would have been possible otherwise.

The ventilation system has been improved by the installation of a large fan in the downcast air passage. This has improved the working conditions in the lower levels.

Development work proved up a number of small ore bodies on intermediate levels, but the main development of ore was on the 5,450-foot level. This 5,450 ore body has a good width, a good grade, and a fair length. Work was in progress at the end of the year to determine the extent of this ore body.

The formation and structure on the lowest level, 5,450 feet, are favourable, and ore should also be found at greater depth. A diamond-drill hole was drilled below the 5,450-foot level in the central section of the mine, near No. 2 winze. The hole cut ore at 5,650 feet on the main ore system. Assays from the drill core have indicated high-grade ore. While more work is

being done on the upper levels, plans are being made to sink No. 2 winze below the 5,450-foot level to prove up the downward extension of the 5,450-foot level ore bodies and to develop the ore indicated by the diamond-drill at 5,650-foot depth.

Development work on the 5,050-foot level located the downward extension of the 4,900-foot level ore body.

Work on the 5,325-foot level was started near the end of the year to locate the upward extension of the 5,450 ore body.

Some changes were made in the mill which slightly improved the extraction and decreased the power cost per ton ground in the mills.

La Roche Mines, Limited

This company has a capitalization of $3,000,000, in shares of $1 par value. The officers and directors are: Jas. E. Day, president; Jas. Savage, vice-president; R. R. Brown, managing director; F. L. Cohen and Jas. E. McMahon, directors. The head office is at 116 Federal Building, Toronto.

The property consists of two claims about 2 miles southeast of Timmins in the township of Tisdale, district of Cochrane. It was shut down during the early part of 1932 after a shaft had been sunk 140 feet and about 500 feet of lateral work on the 125-foot level had been done.

Noranda Mines, Limited, optioned the property in the spring of 1933, and besides thoroughly sampling the property did some work on the veins shown up in the long crosscut driven by the original company. The property was closed down in midsummer. During the period of the Noranda option, about 26 men were employed under the direction of A. L. Dempster.

Lake Shore Mines, Limited

This company is capitalized at $2,000,000, in shares of $1 par value. The executive officers and directors are: Harry Oakes, president; W. H. Wright, vice-president; A. L. Blomfield, managing director; Dr. W. P. St. Charles, treasurer; Kirkland Securities, Limited, secretary; Albert Wende and Ernest Martin, directors. The mine and works are at Kirkland Lake, Teck township, district of Timiskaming.

The total tonnage of ore milled during the year was 808,917. During 1933, Nos. 1 and 3 shafts were completed to their respective objectives of 4,450 and 3,950 feet. Loading pockets were installed at the bottom level of each shaft. A spillage raise was driven from the 4,075-foot level to the No. 3 shaft sump to facilitate the removal of spillage.

During the latter part of the year preparations were made for the sinking of a new shaft, No. 4. This shaft will be a duplicate of No. 1 shaft as regards size and equipment. The hoist for this shaft will be located on the 4,325-foot level in a concrete and steel-lined station, already prepared.

Following a policy of reducing the fire hazard underground, particularly on the lower levels, which have required considerable timber support, extensive use of gunite has been made with highly successful results. It has been found possible to practically eliminate the use of timber in all main crosscuts. In addition to the use of gunite, considerable steel and concrete has been used in supporting ground in such workings as shaft stations, etc.

In further consideration of fire hazard, and to increase the life of necessary timber in the mine, an investigation was made in 1933 into timber treatment processes, with the result that construction of a zinc-chloride treatment plant was started in November. At the end of the year this plant was practically complete and the first charge was put through the plant on January 15, 1934.

The block of ground between the 2,950- and 3,950-foot levels was partly developed during the year, the lowest drifting being on the 3,850-foot level,

No. 2 vein, with average results as regards ore occurrences. Development of this lower block of levels was not pushed, owing to the discovery of large volumes of ore above the 2,000-foot horizon.

At the end of the year approximately 50 per cent. of the mill feed was being derived from operations above the 2,000-foot level, No. 1 vein, which hitherto has been a relatively unimportant source of ore, supplying approximately 20 per cent. of the production of the mine.

An average of 1,294 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, 1933:—

During the period, bullion valued at $11,406,307.59 was produced from 797,673 dry tons of ore treated in the mill. The recovery per ton of ore milled was $14.30.

DEVELOPMENT FOOTAGE FOR THE YEAR

Level	Drifting	Cross-cutting	Raising	Shaft-sinking	Shaft-raising	Shaft slash	Sub-drifting	Ore and waste passes	Total footage	Diamond-drilling	Station-cutting
	feet	feet	feet	feet	feet	feet	feet	feet		feet	cu. ft.
100-foot	.....	.....	.....	.....	.....	.....	.....	.....	.....	111.5	.....
200-foot	354.8	5	219.6	.....	.....	.....	81	.....	660.4	790	.....
400-foot	152.5	82.2	293.9	.....	.....	.....	161.4	253.2	943.2	1,044.5	.....
600-foot	503.3	97.7	326.9	.....	.....	.....	333	262.4	1,523.3	1,318.7	.....
800-foot	306.7	92.2	733.4	.....	.....	.....	244.6	.....	1,376.9	877	.....
1,000-foot	347.5	70.8	543.3	.....	.....	.....	613	.....	1,574.6	2,622.8	.....
1,200-foot	.....	.....	585.9	.....	.....	.....	379	.....	964.9	534	.....
1,400-foot	.....	.....	300.8	.....	.....	.....	434.7	.....	735.5	474	.....
1,600-foot	469.3	.....	16	.....	.....	.....	264.1	.....	749.4	130	.....
1,800-foot	118.7	.....	574.6	.....	.....	.....	275.8	.....	969.1	173	.....
2,000-foot	501.1	259.7	227.9	.....	.....	.....	134.4	.....	1,123.1	1,304	.....
2,200-foot	281.8	149.9	1,000.3	.....	.....	.....	591.7	.....	2,023.7	2,239	.....
2,325-foot	921.7	.....	444.3	.....	.....	.....	96.1	.....	1,462.1	153.5	.....
2,450-foot	688.1	.....	320	.....	.....	.....	76.3	.....	1,084.4	666.3	.....
2,575-foot	593.6	47.1	764.4	.....	.....	.....	172.3	.....	1,577.4	1,605	.....
2,700-foot	610	24.5	827.3	.....	.....	.....	9	.....	1,470.8	3,048	.....
2,825-foot	687.3	12.7	74	.....	.....	.....	.....	13	787	1,543.8	.....
2,950-foot	667.3	.....	110	.....	.....	.....	.....	266	1,043.3	507.5	.....
3,075-foot	4,236.4	250.1	110.5	.....	.....	.....	.....	126.7	4,723.7	1,726.5	1,560
3,200-foot	3,341.7	110.4	105	.....	.....	117.3	.....	29	3,703.4	380	2,340
3,325-foot	941.6	269	.....	.....	117	125	.....	272	1,724.6	.....	5,760
3,450-foot	1,127.1	208.3	116.5	.....	116.4	125	.....	299.1	1,992.4	.....	7,476
3,575-foot	223	281.7	.....	.....	116	125	.....	309	1,054.7	.....	7,416
3,700-foot	242.9	414.5	.....	123	116.5	125	.....	279.5	1,301.4	.....	13,572
3,825-foot	1,146.9	542.2	.....	137	96.6	51.5	.....	305.5	2,279.7	161	55,512
3,950-foot	.....	423.5	.....	164	96.5	92	.....	426.8	1,202.8	.....	11,520
4,075-foot	.....	417.3	.....	173.5	.....	.....	.....	230.5	821.3	.....	16,140
4,200-foot	.....	.....	.....	49.7	.....	.....	.....	.....	49.7	.....	4,380
4,325-foot	.....	259.6	.....	121.3	.....	.....	.....	.....	380.9	410	13,656
4,450-foot	.....	.....	.....	81.5	.....	.....	.....	.....	81.5	.....	9,300
Total	18,463.3	4,018.4	7,694.6	850	659	760.8	3,866.4	3,072.7	39,385.2	21,820.1	148,632

PRODUCTION RECORD

Period	Months	Tons milled	Bullion production	Dividends paid
Mar. 1, 1918, to Nov. 30, 1918	9	14,948	$369,680.31	$100,000
Dec. 1, 1918, to Nov. 30, 1919	9	11,907	294,513.72	100,000
Dec. 1, 1919, to Nov. 30, 1920	12	18,889	483,701.93	80,000
Dec. 1, 1920, to Nov. 30, 1921	12	21,681	460,186.37	120,000
Dec. 1, 1921, to June 30, 1923	19	36,825	833,664.89	160,000
July 1, 1923, to June 30, 1924	12	24,223	578,242.59	160,000
July 1, 1924, to June 30, 1925	12	96,838	1,812,494.66	600,000
July 1, 1925, to June 30, 1926	12	125,676	2,235,184.40	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	5,504,858.64	2,000,000
July 1, 1929, to June 30, 1930	12	467,648	6,576,780.45	2,600,000
July 1, 1930, to June 30, 1931	12	698,624	9,152,935.08	3,600,000
July 1, 1931, to June 30, 1932	12	834,434	12,356,759.00	6,000,000
July 1, 1932, to June 30, 1933	12	797,673	11,306,307.59	6,000,000
Total	.....	3,968,678	$58,699,675.05	$25,020,000

STATEMENT OF COSTS FOR THE YEAR

	Cost per ton milled
Development	$1.113
Mining	2.871
Milling and refining	1.256
Marketing bullion	.082
General and administrative expense	.313
Operating cost	$5.635
Depreciation	.980
	$6.615
Provision for taxes	1.156
Total cost	$7.771

SUMMARY OF ORE AND WASTE HOISTED FOR THE YEAR

Level	Ore from development	Ore from mining	Waste hoisted
	tons	tons	tons
200-foot	925	4,254	.....
400-foot	1,585	12,713	.....
600 foot	3,223	15,166	.....
800-foot	3,378	52,085	.....
1,000-foot	2,960	31,970	.....
1,200-foot	2,521	28,949	.....
1,400-foot	2,395	25,568	.....
1,600-foot	1,324	19,200	.....
1,800-foot	1,869	63,937	.....
2,000-foot	1,085	48,395	.....
2,200-foot	6,161	170,000	.....
2,325-foot	5,616	72,756	.....
2,450-foot	3,105	68,167	.....
2,575-foot	3,848	63,240	170
2,700-foot	4,123	41,203	1,912
2,825-foot	1,505	7,358	2,581
2,950-foot	1,612	1,240	1,038
3,075-foot	7,700	245	14,036
3,200-foot	5,590	38	11,911
3,325-foot	2,234	.....	8,542
3,450-foot	3,866	209	9,343
3,575-foot	1,236	.....	7,877
3,700-foot	205	.....	12,208
3,825-foot	2,800	.....	16,378
3,950-foot	49	.....	17,271
4,075-foot	59	.....	6,690
4,200-foot	.....	.....	2,633
4,325-foot	.....	.....	5,222
4,450-foot	.....	.....	3,206
Total	70,974	726,699	121,018

SUMMARY OF DEVELOPMENT WORK PERFORMED SINCE THE BEGINNING OF OPERATIONS

	Feet
Drifting	99,570
Crosscutting	24,745
Raising	65,086
Sub-drifting	6,276
Ore and waste passes	10,046
Sinking	7,983
Shaft-raising	1,182
Shaft slashing	761
Winze	1,151
Diamond-drilling	76,600
	cu. ft.
Box-holing	258,826
Station-cutting	718,869
Sumps	48,728

Development

During the period, the No. 1 shaft was extended to a depth of 4,503 feet and stations were established at 125-foot intervals to the 4,450-foot level. Raising and slashing in No. 3 shaft were completed to the 3,950-foot level, and the system of ore passes, waste passes, and loading pockets was established to this horizon. Excavation for a crusher station on the 3,825-foot level was completed during the year, and a large sump and pumping station established on the 3,200-foot level.

Exploration of levels above the 2,950-foot was continued with satisfactory results, and development work has indicated that all upper horizons will continue to yield appreciable tonnages of ore for a further considerable period of time. A start was made on the development of a block of ground between the 2,950- and 3,825-foot levels. According to past experience, the ore exposed in drifting will be augmented by further disclosures in the drift walls and in subsidiary parallel or branching veins.

ORE EXPOSED ON DRIFTS DURING THE YEAR ENDING JUNE 30, 1933

Level	No. 1 vein			No. 2 vein			Totals		
	Length	Width	Assay value per ton	Length	Width	Assay value per ton	Length	Width	Assay value per ton
	feet	inches		feet	inches		feet	inches	
200- to 2,200-foot....	1,414	65	$10.08	748	71	$19.84	2,162	67	$13.63
2,325- to 2,950-foot....	1,252	57	19.23	1,571	69	26.57	2,823	64	23.66
3,075- to 3,825-foot....	1,095	59	13.25	4,773	61	14.35	5,868	61	14.15
Totals.....	3,761	61	$13.84	7,092	64	$17.92	10,853	63	$16.56

Broken ore reserves stood at 219,859 tons, valued at $3,847,550. Reserves of blocked ore were increased during the year.

Lakeland Gold Mines, Limited

The Lakeland Gold Mines, Limited, owns a property of 1,120 acres at Wolfe lake, Maisonville township, district of Timiskaming, about 4 miles southeast of Bourkes station. The officers and directors are: F. A. Pollard, president; Robert Johnston, vice-president; A. R. Timmins, Wm. Brittain, Thos. Pope, Luther Davison, directors; A. W. Morris, secretary-treasurer. Oscar Knutson is manager. The capitalization is 4,000,000 shares, of $1 par value, of which 3,726,052 shares are issued.

The head office is at 19 Sun Life Building, Hamilton. The mine address is Bourkes.

The following development work was done in 1933:—

Level	Stations	Drifting		Crosscutting		Raising	Total drifting	Total cross-cutting
		South	North	East	West			
		feet	feet	feet	feet	feet	feet	feet
50-foot.....	.....	.....	.....	20	115	.....	.....	135
150-foot.....	15–20	307	145	82	.....	.....	452	82
300-foot.....	13–24	238	52	143	.....	.....	290	143
450-foot.....	15–24	523	392	332	.....	155	915	332
575-foot.....	15–24	28	69	144	.....	.....	97	144
700-foot.....	15–24	100	217	186	.....	.....	317	186
825-foot.....	15–24	11	24	231	.....	.....	35	231
Total.....	.....	1,207	899	1,139	115	155	2,106	1,253

The average number of men employed during the year was 27. The shaft was sunk 377 feet to the 850-foot level in 1933. Underground operations ceased on December 28, 1933. The shaft is being kept pumped out.

Lebel Oro Mines, Limited

The officers and directors of this company are: B. O. Jones, president; W. E. Hurd, vice-president; W. G. Chipp, secretary-treasurer; A. J. Bolton, W. H. Englebright, J. Savage, and W. J. Yeoell, directors. The authorized capital was increased during 1933 from 1,500,000 to 3,000,000 shares, of $1 par value. The executive office is at Room 1821, Bank of Commerce Building, Toronto.

During 1933 this company acquired the old Long Lake gold mine, situated about 6 miles due south of Sudbury, in Timber Berth No. 69, district of Sudbury. It was operated from 1910 to 1916 by the Canadian Exploration Company.

A small plant, consisting of two vertical boilers, totalling 65 horse-power, and a No. 9 Cameron sinking pump, was taken into the property in September. By the end of the year the mine had been dewatered and sampled to the 180-foot level. The rest of the mine was dewatered and sampled in January and February of 1934. Operations were then suspended pending a decision as to whether sampling results warranted further work.

About 12 men were employed during the period of operation, under the direction of James Crowe.

Little Long Lac Gold Mines, Limited

This company was incorporated in February, 1933, with a capitalization of 2,000,000 shares, of $1 par value. The officers and directors were: Joseph Errington, president; S. J. Fitzgerald, vice-president; L. A. Macdonald, secretary-treasurer; D. M. Morin, A. B. Gordon, and Percy Hopkins, directors. The head office is at 15 King Street West, Toronto. The mine address is Geraldton, via Long Lac.

The property consists of some 33 claims around Little Long Lac in the district of Thunder Bay. It is situated two miles south of the Long Lac–Port Arthur branch of the Canadian National railway and 21 miles west of Long Lac Station.

The company began operations in March, and a three-compartment shaft, 7 by 16 feet, was sunk to a depth of 450 feet. Levels were established at 200 and 300 feet. A total of 300 feet of drifting and 100 feet of crosscutting was accomplished on the 200-foot level, and 20 feet of drifting and 30 feet of crosscutting on the 300-foot level.

The plant consists of two boilers, totalling 175 horse-power; an 8- by 11-inch IR double-drum steam hoist; a 650-cubic-foot compressor, driven by a 105 h.p. Diesel engine, a steel sharpener; and an oil furnace; as well as oil storage tanks of 10,000 gallons capacity. A boiler-house, hoist and compressor house, change-house, blacksmith shop, office, two-storey bunk-house, and cook-house were constructed.

An average of 53 men was employed during the period of operation, of whom 19 were underground. A. A. Barton was in charge.

Macassa Mines, Limited

This company owns six claims in Teck township, district of Timiskaming, adjoining the Kirkland Lake Gold mine on the west. In August, 1933, control of the United Kirkland Gold Mines, Limited, was acquired by exchanging one Macassa share for five United Kirkland. To permit this, Macassa reduced its

capitalization to 3,000,000 shares and gave the shareholders one of the new shares for two of the old.

The officers and directors of the company are: Robert A. Bryce, president; Arthur G. Slaght, James Cowan, Joseph Caldwell, and Thomas Riggs, directors. L. Soliague is secretary-treasurer. The mine address is Kirkland Lake. G. A. Howes is superintendent, and about 100 men were employed.

The following is taken from the report of the superintendent for the year ending March 31, 1934:—

I herewith submit report of operations for the fiscal year ending March 31, 1934. Since the previous fiscal year ended on April 30, 1933, this report entails eleven months of work.

Construction

After the decision was made early last year to start mill construction and the other plant and building increases which necessarily accompany it, excavation for mill was commenced on June 9.

The crusher plant and mill commenced operation on October 16 at approximately 100 tons per day and was gradually stepped up so that in January we milled 168 tons, in February 191, and in March 193 tons per day. The plant is now up to capacity, namely 200 tons per day.

Apart from mill construction, a machine shop, new miners' dry-house and a staff-house were built with ample capacity for immediate future needs.

This plant enlargement programme during the fiscal year entailed the following cost:—

Mill, crusher-house, ore bins, conveyor way, assay office, refinery, and equipment	$204,126.95
Water line and sprinkler system	31,625.01
Addition to compressor building and equipment	2,758.13
Machine shop, dry-house, staff-house, warehouse, and equipment	16,141.13
Underground equipment	12,002.32
Miscellaneous	13,063.66
Total	$279,717.20

Production

Milling commenced on low-grade ore until the mill was tuned up. To date, 24,624 tons have been milled, from which $402,797.84 was recovered, including premium. Bullion recovery amounted to $16.36 per ton milled. An extraction of 92.8 per cent. has been obtained to date with present extraction at 94.1 per cent.

During the tuning-up period, several adjustments and alterations were necessary. These were charged direct to mill operation and, consequently, increased the mill operating cost above what can normally be expected during the coming year.

Development

Until it was decided to build the mill, mine work was confined to development and exploration From July until November, backs were taken down and the mine prepared for production. Since then both mining and development have been carried on, and changes in the hoisting capacity are under way which will result in more development work being done during the coming year than in the past.

During the year new ore was developed on the 1,850-, 2,000-, and 2,175-foot levels. Work recently started at the 1,725- and on the 1,500-foot level. Neither has advanced sufficiently to reach expected ore. No work was done west of the shaft during the past year. After the skips are installed in the shaft this spring, this work will be started.

Development work accomplished for the year, and the total to date is as follows:—

	1933-34 (11 months)	Total to date
	feet	feet
Drifting	3,483.5	9,980
Crosscutting	349	1,419.5
Raising	744	1,359
Station-cutting	30	173
Diamond-drilling	2,701.5	4,648.5
Shaft-sinking	.....	2,489

Ore Reserves

It is difficult to arrive at correct figures both for tonnage and value per ton in a mine like this, just starting production. Tonnage of broken ore in stopes will naturally be low at the start but this will increase monthly from now on. We have only included tonnage figures showing fully developed ore and are not at this early stage trying to estimate possible or indicated ore.

	Tons	Value per ton	
		At $20.67 per oz.	At $35.00 per oz.
Unbroken ore	63,125	$11.60	$19.64
Broken ore	13,200	10.25	17.32
Surface ore dump	7,871	9.00	15.00

Operating Costs

Until milling commenced, all work was charged to the preliminary exploration account, now being written off, on a tonnage basis. Since October 15, all costs have been charged against tons milled and are as follows:—

	Cost per ton milled
Development and exploration	$1.06
Mining	3.33
Milling	2.03
General charges	.35
Administrative charges	.46
Total	$7.23

It is expected that above costs will be lowered during the coming year. Mill construction and the bringing of the Macassa into production was done at an advantageous time as regards cost of material and labour.

McIntyre-Porcupine Mines, Limited

The authorized capital of this company is $4,000,000, divided into 800,000 shares of a par value of $5, of which 798,000 are issued.

The officers of the company are: J. P. Bickell, president; W. J. Sheppard, vice-president; E. D. Fox, secretary; Balmer Neilly, treasurer. The directors are: J. P. Bickell, W. J. Sheppard, J. B. Tudhope, D. H. McDougall, Strachan Johnston. R. J. Ennis is general manager.

The mines and plant are at Schumacher, in the township of Tisdale, district of Cochrane. The head office of the company is at Schumacher, and the executive offices are at 15 King Street West, Toronto.

A daily average of 975 men was employed on the property during the year.

The following is taken from the report of the general manager for the fiscal year ending March 31, 1934:—

Production

Ore treated	tons 776,845	
Value per ton (0.339 ounces at $31.50)	$10.68	
Gross value	$8,296,704.60	
Bullion recovered:		
Gold (251,985.231 ounces at $31.50)		$7,936,872.10
Silver (48,967.95 ounces at $0.418)		20,380.44
Total value		$7,957,252.54
Recovered per ton (0.325 ounces)	$10.24	
Bullion marketing costs		55,970.01
Net value of bullion recovered		$7,901,282.53

PRODUCTION SINCE THE BEGINNING OF MILLING OPERATIONS IN 1912

Period	Months	Tons milled	Value per ton	Gross value	Recovery per ton	Total value
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
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	8.00	5,239,822.90	7.63	4,997,461.80
Apr. 1, '32, to Mar. 31, '33	12	736,300	7.70	5,669,510.00	7.37	5,427,211.15
Apr. 1, '33, to Mar. 31, '34	12	776,845	7.02	5,449,862.06	6.73	5,227,102.39
Total		7,528,863	$8.64	$65,077,213.23	$8.20	$61,740,864.98

The above figures are computed on the basis of $20.67 per ounce.

For the fiscal periods ending in 1932, 1933, and 1934 the average prices per ounce received for gold amounted to $21.95, $22.79 and $31.50, respectively.

Mining

	Tons
Ore broken in stopes	684,579
Ore from development	93,054
Ore from dump	5,780
Ore hoisted	785,135

Development

Development work amounted to 24,956 feet. This includes 17,738 feet of drifts, of which 2,035 was on line and 15,703 in vein material; of this 7,747 feet was in ore averaging 0.381 ounces per ton over drift width.

ORE RESERVES, 1933–34

	Tons	Fine ounces gold	Value at $20.67
Estimated	2,867,859	1,007,923	$20,833,771
Broken	196,279	58,905	1,217,567
Total	3,064,138	1,066,828	$22,051,338
Average per ton		0.3482	$7.20

SUMMARY OF DEVELOPMENT AND EXPLORATION, 1933–34

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		cu. ft.	feet
1	1,354	430	.....	.....	155	22,056	.....	.....	1,939	22,056	2,979
2	1,453	573	55	.....	171	25,230	.....	.....	2,252	25,230	3,509
3	1,230	590	.....	.....	200	5,840	.....	.....	2,020	5,840	3,533
4	1,343	349	.....	.....	194	5,880	.....	.....	1,886	5,880	3,262
5	1,476	196	26	.....	188	13,920	.....	.....	1,886	13,920	3,561
6	1,465	355	32	.....	184	7,536	.....	.....	2,036	7,536	3,509
7	1,351	759	.....	.....	219	7,440	.....	.....	2,329	7,440	2,827
8	1,487	61	.....	.....	197	9,924	.....	.....	1,745	9,924	2,967
9	1,512	546	.....	.....	98	28,236	.....	.....	2,156	28,236	3,396
10	1,993	373	.....	.....	12	28,896	.....	.....	2,378	28,896	3,336
11	1,566	331	22	.....	72.5	11,880	.....	.....	1,991.5	11,880	2,671
12	1,508	655	175	.....	.....	9,208	.....	.....	2,338	9,208	3,884
Total	17,738	5,218	310	.....	1,690.5	176,046	.....	.....	24,956.5	176,046	39,434
Previous to date	199,116.3	97,037.8	21,282.9	612.7	12,858.9	816,204	55,039	139,699	330,908.6	1,010,942	353,714
Total to date	216,854.3	102,255.8	21,592.9	612.7	14,549.4	992,250	55,039	139,699	355,865.1	1,186,988	393,148

Operating Costs

	Total cost	Cost per ton ore milled
MINING:		
Exploration	$92,767.57	$0.1194
Development	335,353.96	.4317
Breaking and stoping	2,029,997.10	2.6131
	$2,458,118.63	$3.1642
Milling	618,107.62	.7957
Heating and maintenance—buildings and camps	69,778.70	.0898
Administration and general expense	106,202.87	.1367
Total	$3,252,207.82	$4.1864

ANALYSIS OF MINING COSTS PER TON MILLED

	Stoping	Drifting	Cross-cutting	Raising	Shafts and winzes	Stations and sumps	Total cost	Cost per ton
Labour	$930,924.81	$132,213.62	$31,907.80	$2,461.93	$62,305.67	$35,366.78	$1,195,180.61	$1.5385
Explosives	127,163.16	53,112.34	13,397.64	657.66	12,984.11	4,496.84	211,811.75	.2727
Supplies	86,148.50	8,597.95	3,987.81	200.62	12,128.06	7,843.90	118,906.84	.1530
Power	63,052.56	11,869.99	3,007.33	506.50	2,629.32	996.33	82,062.03	.1056
Timbering	208,155.74	.....	.....	.....	15,090.02	4,670.18	227,915.94	.2934
Shaft repairs	2,673.41	.....	.....	.....	.....	.....	2,673.41	.0034
Back-filling	170,713.82	.....	.....	.....	.....	.....	170,713.82	.2198
Steel-sharpening	35,381.99	12,236.77	3,205.63	251.03	2,467.50	958.84	54,501.76	.0702
Drill repairs	24,266.03	4,734.83	1,160.00	146.94	904.86	420.57	31,633.23	.0407
Surveying and engineering	30,561.34	5,928.95	1,497.32	252.36	1,171.90	503.78	39,915.65	.0514
Sampling and assaying	40,921.22	3,249.48	833.34	125.13	.....	.....	45,129.17	.0581
Pumping	9,371.29	1,730.95	447.50	57.99	366.48	147.93	12,122.14	.0156
Ventilating	9,747.87	1,773.93	453.95	60.43	371.22	145.60	12,553.00	.0162
Fire protection	311.51	.....	.....	.....	.....	.....	311.51	.0004
Underground lighting	3,388.94	.....	.....	.....	.....	.....	3,388.94	.0044
Tramming	87,216.28	15,338.78	3,875.92	589.77	.....	.....	107,020.75	.1377
Underground crushing	7,457.81	601.33	.....	.....	.....	.....	8,059.14	.0104
Hoisting	192,540.82	14,880.44	.....	.....	22,852.58	3,205.92	233,479.76	.3005
Total	$2,029,997.10	$266,269.36	$63,774.24	$5,310.36	$133,271.72	$58,756.67	$2,557,379.45	$3.2920
Less undistributed development	.....	.....	.....	.....	.....	.....	192,028.39	.2472
							$2,365,351.06	$3.0448
Exploration	.....	.....	.....	.....	.....	.....	92,767.57	.1194
Total	.....	.....	.....	.....	.....	.....	$2,458,118.63	$3.1642
Unit cost per ton	$2.6131	$0.3428	$0.0821	$0.0068	$0.1716	$0.0756	.....	.....

SUMMARY OF MILLING COSTS

	Labour	Supplies	Shop repairs and maintenance	Power	Total	Cost per ton
Crushing and conveying	$34,084.32	$26,021.14	$4,209.40	$20,193.75	$84,508.61	$0.1087
Flotation	43,811.36	145,161.44	10,773.35	70,177.81	269,923.96	.3475
Cyanidation	40,736.30	159,914.57	4,845.69	26,073.25	231,569.81	.2981
Refining	6,585.26	8,530.55	313.12	859.93	16,288.86	.0210
Assaying	6,214.03	2,857.16	1,779.23	1,274.96	12,125.38	.0156
Mill alterations	.....	2,260.90	1,430.10	.....	3,691.00	.0048
Total	$131,431.27	$344,745.76	$23,350.89	$118,579.70	$618,107.62	$0.7957

ADDITIONS TO PLANT BUILDINGS AND EQUIPMENT

Miscellaneous surface buildings and equipment	$19,248.31
Underground equipment:	
No. 12 internal shaft equipment	95,572.19
Miscellaneous underground equipment	18,466.30
Total additions	$133,286.80

General

The development of new ore throughout the mine has been satisfactory, and especially so in the north contact zone, where wide lenses of average-grade ore are being developed.

On all levels of the mine are to be found appreciable and important footages of vein material hitherto considered as below the economic limit. At the present price of gold, a new importance attaches to these areas, and when conditions permit they will be actively explored during the coming year. The stopes are already being extended to include portions of this class of ore, and while the natural result is lower-grade ore to the mill, it does greatly extend the life of the mine to the advantage of our shareholders and to the community dependent upon the benefits to be derived from continued mine activity.

The internal (No. 12) shaft has been completed to a depth of 1,710 feet below the 3,875-foot level, with stations at 150-foot intervals. Crosscuts are now being driven on the 4,175-, 4,475-, 4,925-, and 5,375-foot levels to develop veins intersected by diamond-drilling and to explore other favourable areas between the porphyry stocks.

McKenzie Red Lake Gold Mines, Limited

This company is incorporated under the laws of Ontario with the following officers and directors: W. G. Armstrong, North Bay, president; J. W. Shaw, North Bay, managing director; G. W. Quin, Toronto; F. D. Reid, Toronto; H. M. Anderson, North Bay. The head office is at 305 National Building, Toronto. The authorized capital is 3,000,000 shares, of $1 par value, 1,500,000 shares of which were issued for the property

The property consists of 8 claims situated in the northern section of McKenzie island, about four miles north of the Howey gold mine in Red Lake, district of Kenora, Patricia portion. The property was formerly known as the Martin-McNeeley claims. Surface work and trenching were done in 1928 by McNeeley, Red Lake Holdings, Limited; and in 1931 some surface work was done by the J. Monroe interests, who sold their option to Coniagas Mines, Limited. Coniagas did 3,500 feet of diamond-drilling over a length of about 2,000 feet, and gave up the option. The present company was organized in May of this year and immediately equipped the property with a set of camps and a plant in preparation for underground exploration. The plant was put in operation about August 1, when the sinking of a three-compartment shaft was commenced, with an objective of 250 feet to allow the starting of two levels. Work was carried

on continuously to the end of the year. W. F. Mackle is superintendent. The post-office address is Red Lake. In July, 30 men were employed on the property.

McMillan Gold Mines, Limited

This company was incorporated in 1926, with an authorized capital of 3,000,000 shares of $1 par value. The officers and directors are: Dr. J. H. Banks, president; G. A. Foot, vice-president; F. C. Fraser, secretary-treasurer; D. P. Wood, F. Davidson, A. B. Bryson, C. A. Durkee, R. Martin, and G. M. Miller, directors. The head office is at Sudbury.

The property is about 60 miles southwest of Sudbury and comprises some 34 claims in Mongowin township, district of Sudbury.

Up to November, 1929, when operations were suspended, a two-compartment vertical shaft had been sunk on claim No. 6,225 to a depth of 550 feet, levels established at the 325-, 425-, and 525-foot horizons, and considerable lateral work accomplished.

Operations were resumed on June 15, 1933, when dewatering of the workings was commenced. Development work was started in September. The shaft was sunk an additional 100 feet, to a depth of 650 feet, and a new level started at 625 feet. To the end of the year a total of 302 feet of drifting and 53 feet of crosscutting had been accomplished on this level.

The plant used consisted of a 125 h.p. boiler, a 9- by 12-inch Jenckes single-drum hoist, and a 345-cubic-foot Sullivan steam-driven compressor. A large bunk-house was erected.

An average of 13 men was employed during the period of operation, of whom 7 were underground. George Dunn was in charge of operations

Marbuan Gold Mines, Limited

This company is capitalized at $1,000,000, in shares of $1 par value. It was formed to take over the holdings of March Gold, Limited, in Deloro township, district of Cochrane. The officers are: Edward G. Kinkel, president; Henry Kobler, secretary-treasurer; Everett Bristol, vice-president; Geo. R. Feine, Gustave R. Loesch, and R. Grant Gordon, directors. Martin O. Knutson is manager. The head office of the company is at 902 Lumsden Building, Toronto. The mine office is at South Porcupine.

Dewatering of the workings was started in December, and it is the intention of the company to operate both mine and mill during 1934. Work on the property is being done by agreement with the Buffalo Ankerite Gold Mines, Limited.

Margaret Mines, Limited

This property was formerly known as the Red Mammoth and more recently as the Nortricia. J. W. Gerrard, 57 William Street, New York, is the president of the Cinco Mines Company, who are financing the development work. The Margaret Mines, Limited, is incorporated in Ontario and has a capitalization of 600,000 shares, of $1 par value. The head office of the company is at 302 Bay Street, Toronto. The officers and directors are: W. F. Spence, president; L. Dillon, secretary; A. K. Roberts, L. R. MacTavish, Chas. Price Green, directors.

The property consists of 52 claims in one group, some 12 of which are patented. It is situated about four miles north of the Howey Gold Mines, Limited, in Red Lake, district of Kenora, Patricia portion.

The erection of camp buildings, headframe, etc., and some 80 feet of sinking and 50 feet of drifting was done by the Red Mammoth in 1928. The present company repaired the camps and dewatered the workings in the early summer of 1933. A small steam plant was installed in the late summer to take the place of the portable equipment used in dewatering. When the property was shut down in December the shaft had reached a depth of 188 feet, and a total of 300 feet of drifting and crosscutting had been done on the 175-foot level.

W. S. Livingston was in charge of the operations, and five men were employed.

Matachewan Consolidated Mines, Limited

The Matachewan Consolidated Mines, Limited, owns 22 claims, comprising 880 acres, in Powell and Cairo townships, in the district of Timiskaming. The authorized capital is 3,000,000 shares of no par value; 1,200,000 shares are issued to the Matachewan Canadian Gold, Limited, shareholders. The remaining stock is optioned by Ventures, Limited, of which 500,000 shares have been issued. The officers and directors are: W. J. Boland, president; H. H. Sutherland, vice-president; W. B. McHenry, B. H. Hopkins, and J. F. Boland, directors. The head office is at 217 Bay Street, Toronto. The mine address is Matachewan, via Elk Lake. Thos. L. Wells is manager. The average number of men employed for the year was 28.

Operations were started on April 10, 1933. The following work is reported for 1933 : drifting, 1,285 feet on the 170-foot level ; diamond-drilling, 3,821 feet underground. A powder magazine, shaft-house, carpenter shop, core shop, portable compressor shed, and an addition to the office were constructed.

Metals Development Company, Limited

This company is capitalized at $5,000,000, in shares of $1 par value. The officers and directors are: Dr. M. H. Lebel, president; C. H. Ackerman, vice-president; M. F. Blue, secretary; P. A. Lavallée, treasurer; J. L. Tetreault, E. De Gaspé Power, B. G. Flaherty, W. R. Salter, W. G. Scarrow, Edouard Simard, directors. The head office is at 14 King Street West, Toronto. The mine address is Narrow Lake P.O.

The company owns a group of 27 claims in the North Clearwater Lake section, district of Kenora, Patricia portion. The property is best reached from Woman lake.

During 1933 the mine was operated from January to the end of June and from September to the end of December.

An average force of 15 men was employed under the management of M. F. Blue.

Minto Gold Mines, Limited

This company was incorporated in 1930, with an authorized capital of 8,000 shares of no par value. It holds a working option on the Minto, Jubilee, and Cooper properties, situated near Wawa in the Michipicoten area, district of Algoma. John Knox, Jr., was president, and Marion E. Knox, secretary.

Production from the Minto property was continued without interruption during 1933. Mining operations were confined to stoping, the development work having been done by previous operators. During the year a total of 23,671 tons of ore was mined and milled. Of this total 2,367 tons was obtained from the first level, 8,285 tons from the second level, and 13,019 tons from the third level.

An average of 38 men was employed, of whom 20 were underground. John Knox, Jr., was in charge of operations, with William Hosking as mill superintendent and Frank McLennan as mine captain.

Moss Gold Mines, Limited

The property of this company is situated in Moss township, district of Thunder Bay. It is reached by an 18½-mile road from Tip Top, on the Fort Frances branch of the Canadian National railway.

The officers and directors were: C. G. Greenshields, president; James Cooper, secretary-treasurer; R. Blackburn, J. D. Paterson, R. W. Steele, W. T. Proctor, A. C. Barker, and A. R. Martin, directors.

The lateral work accomplished during 1933, and the total done to the end of 1933, on the various levels, was as follows:—

Level	Drifting		Crosscutting	
	1933	Total	1933	Total
	feet	feet	feet	feet
125-foot	.....	1,499	.....	222
250-foot	134	1,820	9	329
375-foot	68	2,327	.....	610
500-foot	501	1,387	37	159
625-foot	1,219	1,906	129	279
750-foot	870	1,561	72	240
Total	2,792	10,500	247	1,839

Development work was suspended in September, when the company went into receivership, but stoping was continued. A total of 2,244 feet of diamond-drilling was accomplished during the summer. A total of 36,352 tons of ore was hoisted during 1933, and 35,140 tons was treated in the cyanide mill.

A 1,225-cubic-foot compressor, driven by a 220 h.p. Diesel engine, and a 500-cubic-foot electrically driven compressor were added to the plant. The steam-driven compressors and three boilers were discarded. New buildings erected included a machine shop, blacksmith shop, and warehouse.

An average of 146 men was employed, of whom 81 were underground. Operations were under the direction of R. W. Howe, with J. D. Tolman as superintendent, G. R. McLaren as mine captain, and J. E. Sullivan as mill superintendent.

At the end of the year a new company, Ardeen Gold Mines, Limited, was formed to take over the properties and assets of this company, as at December 1.

New York Porcupine Gold Mines, Limited

This property, in Tisdale township, district of Cochrane, was worked under a lease from A. G. Lyons, trustee for the property, during October, November, and part of December. The ore from the dump was steam-shovelled into trucks, which hauled it to the property of the Marbuan Gold Mines, Limited, where it was milled by the Buffalo Ankerite Gold Mines, Limited, who had a lease on the mill at this property. Three thousand tons were treated.

North Shores Gold Mines, Limited

During the first six months of 1933 the claims of the Schreiber Gold Mines, Limited, 3½ miles south of Schreiber, in the district of Thunder Bay, were worked by R. N. Palmer, under an operating agreement with the company. The claims include T.B. 10,946 and 10,947, and B.J. 122-3, formerly known as the McKellar-Longworth property.

About 225 feet of drifting was accomplished on the first level. No stoping was done after January.

In November a new company, North Shores Gold Mines, Limited, was formed to take over the operation of the claims. It has a capitalization of $3,000,000, in shares of $1 par value. The officers are: R. N. Palmer, president; Ernest E. Watts, vice-president; W. G. Bennett, secretary-treasurer; James A. Ross, director. The Toronto office is at 372 Bay Street. The mine address is Schreiber.

Northern Aerial Canada Golds, Limited

This company has an authorized capitalization of $5,000,000, in shares of $1 par value. There are 2,556,150 shares outstanding, to be issued to shareholders of Northern Aerial Minerals Exploration, Limited. The following are the officers of the company: John E. Hammell, president; A. L. Smith, vice-president; Robt. Fennell, secretary-treasurer. The head office is at 100 Adelaide Street West, Toronto.

All the assets of the Northern Aerial Minerals Exploration, Limited, were purchased by the above company for 2,556,150 shares, to be distributed to N.A.M.E. shareholders.

Properties of the company are all in the exploration stage and lie in almost every active camp in the Dominion. The property in the Pickle-Crow area, Patricia portion of Kenora district, is the only one operating in the province. This property consists of 62 claims, practically all in one group, situated about six miles east of the property of the Central Patricia Gold Mines, Limited.

Work on the property was first done in 1928 by the original company and consisted of trenching on the vein for a distance of about 1,100 feet. Since this time the property has been idle. Plant and equipment was freighted to the property in April, 1933, and on May 1 construction of a 42- by 25-foot power-house and other camp buildings, which will accommodate about 50 men, was commenced. The plant consists of two 60 h.p. locomotive-type boilers, an 800-cubic-foot compressor, and an 8¼- by 10-inch SSR-IR reversing steam hoist.

In July the shaft had been sunk to a depth of 20 feet. The erection of a head-frame was rendered difficult by the scarcity of suitable timber. It is the intention of the management to sink the shaft 500 feet and to do exploratory work on four levels. The property was worked continuously throughout the year. Alex. Hattie is superintendent. The post-office address is Hudson.

Northern Empire Mines, Limited

This company is a subsidiary of the Empire Star Mines Company of California, which in turn is controlled by the Newmont Mining Corporation of New York. It was incorporated in 1932 under the laws of Ontario, with a capitalization of 10,000 shares of $10 par value. The officers are: Fred Searls, Jr., president; H. E. Dodge, secretary-treasurer; Geo. B. Agnew, and David E. Thomas,

vice-presidents; Carroll Searls and Archibald Douglas, directors. The executive office is at 14 Wall Street, New York.

The company took over the holdings of the Beardmore Gold Mines, Limited, just east of Beardmore station on the Port Arthur–Long Lac branch of the Canadian National Railway, and added several other groups of claims to them. The property now consists of mining locations T.B. 4,803, 4,804, 4,804A, 4,805, 4,805A, 4,830, 4,831, 4,831A, 4,834, 4,881, 4,947, 4,948, and 5,003, in Thunder Bay district.

During 1933 work was continued on the Beardmore property. The 2-compartment vertical shaft was sunk an additional 350 feet, giving it a total depth of 502 feet. The old section of the shaft was enlarged and retimbered to correspond with the new work. Levels were established at the 300- and 400-foot horizons. A shaft, 6 by 7 feet, inclined at 18 degrees from the horizontal, was driven from surface to the 75-foot level, a distance of 127 feet. It is intended to utilize it for a conveyer belt from an underground crusher to the mill.

Other development work accomplished was as follows:—

Level	Drifting	Crosscutting	Raising
	feet	feet	feet
75-foot	.....	.....	63
150-foot	2,276	168	160
300-foot	.....	50	.....
450-foot	.....	47	.....
Total	2,276	265	223

Electric power from Cameron Falls, 55 miles away, was delivered by the Hydro Commission to the property on August 26. The old steam-driven plant was discarded and replaced by electrical equipment, including a double-drum hoist and 1,200-cubic-foot IR compressor.

New buildings erected included a hoist and compressor house, transformer house, blacksmith shop, dry-house, two bunk-houses, and cookery.

Work was started in September on a 125-ton stamp mill. By the end of the year the mill building was practically completed, and foundations were being poured for the machinery.

An average of 56 men was employed, of whom 22 were underground. Robert J. Hendricks was in charge of operations, with P. Corrin as mine captain. The mine address is Empire.

Parkhill Gold Mines, Limited

This company was incorporated in 1929 with an authorized capital of 3,000,000 shares, of $1 par value. The officers are: Sir Thomas Tait, president; C. F. Elderkin, vice-president; G. S. Andrews, secretary-treasurer; Geo. M. McKee, and Chas. Adams, directors.

The property is located six miles from Wawa in the Michipicoten area, district of Algoma.

During 1933, the two-compartment, 40-degree shaft was sunk an additional 390 feet, and two new levels were established, the sixth and seventh. Shaft-sinking was in progress at the end of the year, and the shaft had then reached a depth of 977 feet on the incline.

Development footages accomplished and the tonnage of ore removed by open stoping on the various levels during 1933 were as follows:—

Level	Drifting	Crosscutting	Stoping
	feet	feet	tons
3rd	.....	.....	24
4th	63	61	68
5th	603	397	6,548
6th	1,024	324	3,599
7th	892	32	1,318
Total	2,582	814	11,557

The cyanide mill, which was operated only 234 days in 1933, treated a total of 11,565 tons of ore. A tube mill and a second table were added to the mill circuit to obtain better extraction.

A 1,200-cubic-foot IR compressor was added to the mining plant to replace two 320-cubic-foot units, which were used with a 720-cubic-foot unit.

An average of 69 men was employed, of whom 39 were underground. Wm. T. May was in charge of operations until May, when he was succeeded by R. E. Barrett. The mine address is Wawa, via Hawk Junction. The property is under the management of Canadian Enterprises, Limited.

Paymaster Consolidated Mines, Limited

This company was incorporated in Ontario with a capitalization of $9,000,000, in shares of $1 par value. The officers and directors of the company are as follows: A. S. Fuller, president; E. H. Walker, vice-president; E. L. O'Reilly, secretary-treasurer; H. D. Rothwell, R. K. Grant, C. E. Cook, and A. W. Hodgetts, directors. The head and mine offices of the company are at South Porcupine. The executive office is at 204 McKinnon Building, Toronto.

The company is a consolidation of the United Mineral Lands Corporation, the West Dome Lake Gold Mines, and several intervening undeveloped claims. The two former companies were once producers and together owned about 2,000 acres in Tisdale township, district of Cochrane.

The properties have been idle for three years, but in the summer of 1933 work was commenced at the old Heinze inclined shaft, on what used to be known as the West Dome. A new headframe was put in place, the old buildings were remodelled, and a small mining plant was put in operation in November, when the shaft was dewatered and drifting commenced.

G. R. McLaren is manager.

St. Anthony Gold Mines, Limited

This company is capitalized at 3,000,300 shares, of $1 par value. The officers are: H. P. Bellingham, president and general manager; R. F. Taylor, vice-president; T. S. Giles, secretary; R. F. Cairns, treasurer; D. M. Bellingham and D. K. E. Fisher, directors. Lawrence B. Wright is consulting engineer, and H. W. Darling is operating mine manager. The head office is at 19 Melinda Street, Toronto. The mine address is Savant Lake.

The property is in the Sturgeon Lake area, district of Thunder Bay. It is 12 miles south of Savant Lake station on the Canadian National railway. In summer it is reached by a 3½-mile road from Savant Lake to the north end of Sturgeon lake, and from there by water for about 8½ miles.

The property was dormant from 1929 to the summer of 1933, when new financing took place and operations were resumed.

There are five levels, and stoping has been done on the four upper ones. The deepest working is the 500-foot horizon.

When the mine was visited in October, a 125-ton mill and an electric power plant were in course of construction. The mine had not been dewatered. The old mill building, which contained 10 stamps and 4 James tables, is being utilized to house the new 125-ton cyanide equipment. The old equipment had been removed and foundations were being prepared for the new equipment, which will consist of a jaw crusher, 6- by 7-foot ball mill with Dorr rake classifier, 28- by 12-foot Dorr thickeners, 4 Pachuca tanks, American filter, and a Crowe-Merrill continuous precipitation unit.

The electric power plant is located about 8 miles from the mine. The plant equipment will consist of two 600 h.p., 25-cycle turbo-generator units and six 250 k.v.a. transformers. Power will be transmitted at 13,200 volts and stepped down to 550 volts at the mine. About 7 miles of the transmission line has been cut out.

Approximately 70 men were employed at the property during the latter part of the year.

Saundary Syndicate

This syndicate in November, 1932, took over six claims located on Little Turtle lake, two miles west of Mine Centre, on the Fort Frances branch of the Canadian National railway, district of Kenora. The property includes the old Headlight or Swede Boy mine.

The old workings consisted of an 85-foot, 2-compartment shaft and 192 feet of lateral work on the 50-foot level. During 1933 this shaft was reconditioned and a small mining plant was installed, which included a 15 h.p. boiler and a 6- by 8-inch hoist. Twenty-five feet of crosscutting was accomplished on the 50-foot level.

Towards the end of the year a small amalgamation mill was being constructed, consisting of a pair of rolls, a small stamp, and corduroy blanket tables.

Two or three men were employed intermittently during the year. A. E. Saunders was in charge of operations.

Stanley Gold Mines, Limited

This company was incorporated in November, 1933, with an authorized capital of 300,000 shares of $1 par value. The head office is at 231 St. James Street West, Montreal. The mine address is Wawa.

The property consists of mining claims S.S.M. 7,338, 7363, and 7366, on the west side of Wawa lake, in township 29, range 23, in the Michipicoten area, district of Algoma.

Work was started on September 1 by the Stanley Siscoe Extension Gold Mines, Limited, who turned the property over to the newly incorporated company in November.

Some 1,500 feet of trenching was done first; then a shaft, 7 by 12 feet, at an inclination of 35 degrees, was sunk by hand steel to a depth of 30 feet, when work was discontinued to await the arrival of machinery.

A power-house, boiler-house, change-house, bunk-house, cookery, office, and stable were erected. A power line, 2 miles 700 feet in length, from the Jubilee mine to the property was under construction by the Great Lakes Power Company.

Thirty men were employed at the property, under the direction of R. E. Parkes.

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 223 men was employed during the year.

The following is taken from the general manager's report for the fiscal year ending March 31, 1934:—

Production

TONS MILLED AND YEARLY PRODUCTION FOR FISCAL YEARS ENDING MARCH 31

Year	Tons	Production	Average recovery, Troy ounces per ton
1929	70,833	$737,573.12	0.50
1930	75,408	690,400.14	.44
1931	83,034	837,013.97	.49
1932	94,276	948,926.13	.49
1933	96,140	912,377.15	.40
1934	98,311	1,558,912.87	.52

The figures under "Production" for the years 1932, 1933, and 1934 include exchange on bullion. The average price received for the year ending March 31, 1934, was $30.778 per ounce.

Mining

Year	Ore broken			Waste broken			Total ore and waste broken
	In stopes	From development	Total	Hoisted to surface	Used for backfill	Total	
	tons	tons	tons	tons	tons	tons	tons
1932	80,678	27,417	108,095	6,658	16,369	22,937	131,032
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

Considering all drifting and subdrifting footage as a unit, approximately 2,300 feet of work was done through ore estimated to be slightly higher than the last 3-year mill average.

Ore Reserves.—Reserves of broken ore were intentionally reduced 13 per cent., to 82,735 tons, which was considered adequate, having regard to the year's milling requirements and the mine's ore position.

Operating Costs

	Total cost	Cost per ton ore milled
1931:		
Development and exploration	$212,792.08	$2.563
Mining	267,376.14	3.220
Milling	106,575.54	1.283
General charges	34,187.94	.412
Administrative charges	21,213.75	.255
Total	$642,145.45	$7.733

Operating Costs—*Continued*

	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	49,478.61	.525
Administrative charges	24,594.16	.261
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	48,907.65	.509
Administrative charges	23,437.97	.244
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	48,073.77	.489
Administrative charges	34,774.84	.353
Total	$647,283.00	$6.584

Development and Exploration

Class of work	Year ending March 31, 1934	Year ending March 31, 1933	Year ending March 31, 1932	Total from beginning of operations to March 31, 1934
	feet	feet	feet	feet
Drifting	4,399.5	6,681	4,225.5	39,405.5
Crosscutting	2,347	4,201	1,638	22,137.5
Raising	2,464.5	3,029	1,128	11,833
Sublevel drifting	1,473.5	1,436	904.5	8,022
Box-hole raising	429	1,179	1,163	6,292.5
Winzing	97.5	.....	.....	97.5
Shaft-sinking	612	.....	695.5	5,654
Total	11,823	16,526	9,754.5	93,442
Per cent. of crosscutting to total of crosscutting and drifting	34.8	38.7	27.8	35.9
	cu. ft.	cu. ft.	cu. ft.	cu. ft.
Shaft stations and sump excavations	19,140	5,610	37,359	205,018
	feet	feet	feet	feet
Diamond-drilling	6,713	11,945	4,674	61,074

No. 2 Shaft.—During the year, No. 2 shaft was continued to a vertical depth of 3,642 feet, with four levels established to 3,600 feet. There, on the first vein found north of the shaft, 450 feet of drifting was completed. This disclosed a continuing southerly dip, favourable vein structure, and a small amount of ore. In addition, diamond-drilling still farther north indicated a parallel vein offering fair ore possibilities.

Exploration on the south side of the shaft was confined to diamond-drilling. This cut what was assumed to be the main south vein. A north dip was shown, and the structure resembled that on the 3,000-foot level, where values were low.

Work on both sides of the shaft is being continued on the 3,600-foot level. It is also in progress at 3,150 feet on the downward extension, north of the shaft, of ore of importance already found between 2,500 and 3,000 feet, either in sediments or at the contact with porphyry.

Sediments, in proportion to porphyry, were encountered to a greater extent on the lowest level than at higher horizons. It is too early, however, to estimate what influence, if any, this may have on ore occurrences, as by the year end insufficient exploration had been done below 3,000 feet to afford a definite indication.

The 700- to 1,000-foot and 2,500- to 3,000-foot level developments showed considerable improvement, both as to tonnage and grade. This is particularly true immediately above, on, and below the 800-foot in No. 2 shaft section. Here, an important tonnage of better than average grade was developed.

No. 4 Shaft.—This section produced a large but decreasing quantity of ore, 48 per cent. of the mill feed for the year having been obtained from this source.

Mill Expansion

General mine conditions were carefully considered, having special reference to estimates based on a gold price of $35.00 per ounce and on what was considered by the mining industry to be positive assurance against any further increase of any extent in mine taxation. These factors definitely indicated profitable treatment of a large tonnage of low grade on which much development had been completed. Accordingly, just before the fiscal year end, mill equipment was ordered to increase average capacity to about 350 tons per day.

New Buildings and Equipment

These included a new steel headframe 125 feet high, a 600-ton steel ore bin, combined cases and skips, hoist motor, etc., to replace the old equipment at No. 2 shaft. These rather costly improvements were fully justified as they greatly increased bin capacity, increased hoisting capacity, especially from lower levels, and at the same time reduced fire risk.

The crusher station was altered by the addition of mechanical ore feeders, the substitution of larger, heavy-duty crushing rolls, and other improvements. In the mill, an additional slime filter and other smaller equipment were purchased and put in service.

Other additions comprised: A storehouse, pipe for a duplicate tailings disposal line, and the installation of an extensive sprinkler system to reduce fire hazards and cost of insurance.

Summary

The ore position at Sylvanite was well maintained. This was accomplished notwithstanding the fact that broken reserves were purposely decreased, being replaced by an estimated equal and fully blocked-out tonnage.

Operating costs were slightly lower, with tons milled and gross production higher than 1933. Greater sums were required for dividends, and after meeting these, $234,540.12 was added to profit and loss balance, making a total in that account of $713,137.98.

Major discoveries of ore were made on upper levels; lower down, veins in the sediments produced a considerable tonnage. Judged as a whole, mine conditions remained satisfactory, with large and promising areas yet undeveloped.

ERIE CANADIAN MINES, LIMITED

Activities of the Erie Canadian Mines, Limited (a subsidiary company wholly owned by Sylvanite), consisted of the examination of a large number of properties, and several new options were taken during the year. Prospecting was practically continuous, and intensive. It included much surface trenching and sampling. Diamond-drilling was also carried on in certain instances. The year ended, however, with no definite mine-making possibilities having been proved at any property, although some gave considerable promise and warrant further work under favourable conditions.

Talisman Gold Mines, Limited

This company is capitalized at $1,000,000, in shares of $1 par value. The officers and directors are: James E. Grant, president; Hugh McIntyre, vice-president; G. D. O'Meara, secretary-treasurer; R. L. Lillico, B. L. H. Symmes, and John McPhee, directors. The head office is in the Gibson Block, Kirkland Lake. The mine address is Matheson.

The property consists of 6 claims, containing some 240 acres, in the township of Guibord, district of Cochrane, and was part of the former holdings of the

Gardner Guibord Mines, Limited. It is about 13 miles east of Matheson and 2 miles southeast of the Croesus mine.

The work done by the former owners was as follows: sinking, 108 feet; drifting, 92 feet on the 100-foot level and 30 feet on the 60-foot level; crosscutting, 359 feet on the 100-foot level.

The present company started operations in August, 1933. During the remaining part of the year the mining plant and buildings were repaired and a 65 h.p. boiler and 500-cubic-foot steam compressor were installed. About 2,000 feet of surface trenching was done on the two veins.

By January, 1934, the mine had been dewatered and underground operations were begun. John McPhee was manager, and about 14 men are employed.

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; Conrad E. Wettlaufer, secretary; K. P. Emmons, treasurer; P. Nugent Tapley, assistant-treasurer; John F. Lash, William W. Reilley, 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 737 men was employed during 1933 at the mine in Teck township, district of Timiskaming.

Production for 1933 was as follows:—

Ore hoisted	tons	474,700
Value of gold (at $20.67 per ounce)	$4,548,547.45	
Exchange	1,608,438.34	
Value of silver	9,633.40	
Total value of production		$6,166,619.19

The following is an extract from the report of the president for the twelve months ending August 31, 1933:—

Our fiscal year ended August 31, 1933. During this period of world-wide business depression, the gold standard was abandoned, at least temporarily, by the United States of America. Gold has since then commanded more than the old fixed price in terms of the monetary units of Canada and the United States when sold on the London market. The average price received for the equivalent of the 241,042 ounces of gold produced during the year was $25.47 per ounce. Since the end of the fiscal year to date the average price has been slightly over $30 per ounce. Now that we have a fluctuating price for our product it has become advisable to record our assays and refer to grades of ore in terms of gold content rather than in Canadian currency. Comparisons with the operating results of earlier years, when the fixed price of gold was $20.67183 per ounce, should be made now with allowance for the change in the price of our product and it should be remembered that certain grades of mine rock that were formerly considered waste can, under the present conditions of price of gold and operating costs, be regarded as ore.

While the total tonnage of ore treated was only 1,200 tons less than that of the previous fiscal year, gross revenue declined $577,653.09, due principally to a lower average gold content in the ore treated. "Positive ore" reserves were increased by 53,492 tons, but their average gold content dropped from 12.66 dwt. to 11.04 dwt. per ton.

Depth development continued to give encouraging results in the finding of new ore as far down as levels were opened up, and the average grade of ore on the 40th or deepest level compares favorably with that of any level below the 25th. While indications are that the quantity of gold to be obtained per block of five levels decreases below the 25th level with increasing depth, the development of the next block of levels from 40 to 45 will be continued in the confident expectation that the return will be such as to warrant development being continued to greater depths.

In pursuance of our policy of acquiring outside mining properties, the sum of $14,993.38 was spent in examination, research, claim-staking, and preliminary prospecting at various places

in Ontario and Quebec, while two Quebec properties, namely the Hughes and Read-Authier, were taken over by allied companies called respectively Vicour Gold Mines, Limited, and Lamaque Gold Mines, Limited, the control of which companies was retained under option agreements covering the purchase of treasury shares during the development of their properties. Up to the end of the fiscal year, the sum of $271,704.09 has been invested in these companies to provide funds for exploration and development. The result to date of work done on the property of the Vicour Gold Mines, Limited, is not encouraging, but exploration and development on the property of Lamaque Gold Mines, Limited, has been rewarded with the finding of ore of fair grade and with indications of some large lenses and many scattered irregular ore bodies, the development of which to depths of 400 to 500 feet will be proceeded with as rapidly as possible and in advance of requirements under existing agreements with the vendor companies.

The Lamaque property consists of a compact group of forty-four claims and fractions, containing 2,452.3 acres, in the northwest quarter of Bourlamaque township. From the commencement of operations in the spring of 1933 until the end of August, 16,467 feet of diamond-drilling and 1,995 feet of shaft-sinking and lateral development were carried out, together with the construction of camps, steam-power plants, water supply, shops, roads, etc., under the supervision of J. G. McMillan, our exploration superintendent, and Lindsay Foss, superintendent of Lamaque Gold Mines, Limited.

The following is taken from the report of the general superintendent for the twelve months ending August 31, 1933:—

During this period 474,500 tons of ore were treated. The recovery of bullion and precipitate was the equivalent of 241,041.82 troy ounces of fine gold, valued at $6,139,174.72. After the addition of other income the gross revenue was $6,246,585.89, or $13.16 per ton of ore milled.

Including the sum of $293,631.56 charged for depreciation on buildings and fixed plant, the total operating cost was $2,643,564.51, or $5.57 per ton. After making provision of $374,012.35 for taxes, the surplus was $3,229,009.03. From this surplus was paid dividends amounting to $2,884,286.40 and a special silicosis assessment of $36,856.19 for operations in former years. Additional provision for Federal income taxes for 1932, amounting to $21,000 was necessary, due to a retroactive increase of rate.

Following is an analysis of operating costs:—

	Total cost	Cost per ton of ore treated	Cost per ounce of gold produced
Development and exploration	$491,714.20	$1.04	$2.04
Mining	1,113,274.65	2.35	4.62
Milling	459,409.44	.97	1.91
General expense	270,541.28	.56	1.12
Examination of new properties	14,993.38	.03	.06
Depreciation	293,631.56	.62	1.22
Total	$2,643,564.51	$5.57	$10.97

No new construction was charged to capital account, but mining claims purchased for tailings disposal absorbed $18,016.48.

At the end of the fiscal year the south shaft extension had been sunk to a depth of 5,515.6 feet, and a station cut at the 45th level. During the year the No. 2 winze was completed to the 40th level, and the No. 3 winze started, reaching at August 31 a vertical depth of 5,074 feet.

Development resulted in the finding of ore on all new levels. The block from the 30th to the 35th level had all lateral development practically completed by the end of May, 1933, and yielded a total length of 3,775 feet, with an estimated average grade of 9 dwt. per ton. The block of levels from 35 to 40, as partly developed at August 31, had combined ore lengths totalling 2,172 feet, with an estimated average grade of 10 dwt. per ton.

Classified under the usual headings the year's development work was as follows:—

	Feet
Drifting	9,974.5
Crosscutting	2,459
Raising	3,608
Winzing	571
Shaft-sinking	651.5
Total development	17,264

Diamond-drill exploration amounted to 15,077.7 feet. Ore produced from development amounted to 29,151 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	274,481	151,764	11.06
Blocked ore	405,500	223,731	11.03
Total	679,981	375,495	11.04

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. J. 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 1933 an average of 106 men was employed. M. W. Hotchkin, Kirkland Lake, is superintendent.

The mining and development work for 1933 was as follows:—

MINING

	Tons
Ore broken in stopes	41,792
Ore broken in development	5,898
Total	47,690

DEVELOPMENT

	Feet
Crosscutting	735
Drifting	2,012
Raising	864
Sub-level drifting	718
Sub-level crosscutting	104
Box-holing	203
Total	4,636

The mill treated 36,913 tons of ore. The production was $477,114.25, and the premium amounted to $189,779.92.

Wawa Goldfields, Limited

This company was incorporated in April, 1933. The officers and directors were: A. P. Earle, president; J. E. Wilder, vice-president; Gordon Payne, secretary; Gordon Webster and S. C. Melkinen, directors. The head office is at 437 St. James Street West, Montreal. The capitalization is $1,500,000 in shares of $1 par value.

The property consists of four mining claims, located on the west side of Wawa lake, in township 29, range 23, in the Michipicoten area, district of Algoma.

Operations were started in April, 1933. A shaft, 6 by 6 feet, was sunk to a depth of 70 feet on a 65-degree incline, and a level started at the bottom

of it. A total of 340 feet of drifting and 65 feet of crosscutting was accomplished on this level, which is at a vertical depth of 50 feet. An adit was then started in the hillside, 115 feet below the shaft collar, and driven for a distance of 340 feet.

The plant consisted at first of a 220-cubic-foot gasoline compressor, and later of a 375-cubic-foot Diesel compressor.

An average of 10 men was employed, of whom 5 were underground. Operations were suspended late in December. Chas. L. Coleman was in charge.

Wendigo Gold Mines, Limited

This company was incorporated October 5, 1933, with an authorized capitalization of $2,000,000, in shares of $1 par value. The officers are: A. J. Trebilcock, president; K. V. Stratton, vice-president; E. M. Tustin, secretary-treasurer; John Elliott and M. M. Baker, directors. The head office is at 372 Bay Street, Toronto. The mine address is Kenora.

Operations were commenced in October at the old Wendigo mine, on the Lake of the Woods, in the district of Kenora.

The plant installed included a 100 h.p. boiler, an IR steam-driven compressor, and an 8¼- by 10-inch hoist. A powder-house and bunk-house were added to the buildings already on the property.

The old 100-foot shaft, 6 by 12 feet, was dewatered and shaft-sinking was started. By the end of the year 17 feet of sinking had been accomplished.

An average of 19 men was employed during the period of operation, of whom 6 were underground. C. L. Spencer was in charge of operations.

White Rock Mining Company, Limited

The property of this company is located in Macmurchy township, in the West Shining Tree area, district of Sudbury. It is twenty miles north of Westree Station on the main line of the Canadian National railway.

After some years of inactivity the underground workings were dewatered early in the spring of 1933, and drifting was started on the 165-foot level. After accomplishing 700 feet of drifting, operations were again suspended. Tom Linton was in charge of operations.

Arthur Manley, Sudbury, is secretary of the company.

Wright-Hargreaves Mines, Limited

The 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: Oliver Cabana, Jr., president; W. H. Wright, vice-president; Gerard F. Miller, treasurer; E. L. Miller, secretary and managing director; James Y. Murdoch and Oliver G. Donaldson, directors. The head office is at Fort Erie, Ont. The mine address is Kirkland Lake.

M. W. Summerhayes is general manager, and 440 men were employed during the year, at the mine in Teck township, district of Timiskaming.

During the year 1933 there were 285,465 tons of ore hoisted and milled. Production for 1933 was as follows:—

Value of gold	$3,662,837.40
Exchange	1,283,431.14
Value of silver	9,691.89
Total	$4,955,960.43

The following is taken from the report of the general manager for the eight-months' period ending August 31, 1933:—

It is to be noted the reason for this report covering a period of only eight months is due to the fact that at the last annual stockholders' meeting, the fiscal year was changed to end August 31 instead of December 31, as heretofore.

During this period 193,441 tons of ore, having an average grade of $13.56 per ton, were treated in the mill, producing bullion to the value of $2,443,759.95, or a recovery of $12.63 per ton, being 93.15 per cent. extraction.

ANALYSIS OF OPERATING COSTS

	Total	Cost per ton milled
Development and exploration	$289,906.84	$1.498
Less: Excess of tons developed to tons milled	55,807.62	.288
Development cost	$234,099.22	$1.210
Stoping	454,476.66	2.349
Transporting ore (hoisting, etc.)	159,722.92	.826
Milling charges	226,572.35	1.171
Marketing bullion	13,984.86	.072
New road construction and general surface	24,352.51	.126
Stock transfer and registrar charges	8,762.67	.045
General and undistributed charges (storehouse, maintain. misc. mine buildings, administration and management, property taxes, insurance, interest and exchange, legal expenses, miscellaneous)	119,372.43	.617
Depreciation plant and equipment	141,088.10	.729
Total	$1,382,431.72	$7.145

SUMMARY OF DEVELOPMENT AND EXPLORATION

August 31, 1933

	Drifting	Shaft-sinking	Cross-cutting	Raising	Total footage	Diamond-drilling	Excavation
	feet	feet	feet	feet		feet	cu. ft.
December 31, 1932	111,821	10,191	37,051	6,647	165,710	78,654	209,968
8 months to Aug. 31, 1933	7,643	490	5,441	1,340	14,914	9,151	154,970
August 31, 1933	119,464	10,681	42,492	7,987	180,624	87,805	364,938

PRODUCTION RECORD, 1921–1933

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.)..	193,441	13.56	2,623,456	12.63	2,443,760	550,000[1]
Total.....	2,196,803	$12.14	$26,675,433	$11.02	$24,213,943	$7,081,250

[1]April and July dividend payments only.

MILLING STATISTICS

January 1 to August 31, 1933

Ore milled	tons	193,441
Average value per ton		$13.56
Gross value		$2,623,455.69
Loss in tailings		179,695.74
Net value recovered		$2,443,759.95

Average tons milled per day		796.05
Per cent. of possible running time		96.54
Tons 100 per cent. running time		825
Solution precipitated	tons	474,643
Solution precipitated per ton of ore	tons	2.45
Value per ton in tailings		$0.9289
Per cent. extraction		93.15
Cyanide consumed per ton of ore (K.C.N.)	lbs.	.392
Zinc consumed per ton or ore	ounces	1.272
Zinc consumed per ton of solution	ounces	.518
Lime consumed per ton of ore	lbs.	3.016
Average value of pregnant solution		$5.16
Average h.p. consumed per day		1,712
Average h.p. consumed per ton milled		2.15
Power cost per h.p. consumed		$65.92

ORE RESERVES ESTIMATE

	Tons	Grade	Value
On hand January 1, 1933	951,939	$13.54	$12,888,042
Developed in 1933 (8 months)	239,563	14.47	3,467,208
	1,191,502	$13.73	$16,355,250
Milled in 1933 (8 months)	193,441	13.59	2,628,441
Ore reserves, August 31, 1933	998,061	$13.75	$13,726,809

ADDITIONS TO PLANT, BUILDINGS, AND EQUIPMENT

January 1 to August 31, 1933

Power-house equipment	$21,585.10
Substations equipment	17,959.69
No. 4 shaft-house and hoist equipment	167,899.18
Mill structure and equipment	368,006.41
Steel shop and equipment	23,462.44
General buildings	2,073.04
Shops and equipment	4,934.44
General surface and tailings disposal	9,304.61
Underground equipment	57,853.17
Total	$673,078.08

Development

A large part of our efforts during the period under review were concentrated on completing the shaft-sinking programme of shafts Nos. 3 and 4 to 4,000 feet in depth, then making the necessary connections, cutting stations and ore pockets so as to be in a position to carry out the development of the veins on the six new levels. This work has now been practically completed and a small amount of drifting has been done on some of these new levels. There were 239,563 tons of new ore developed, having an average grade of $14.47 per ton. After deducting 193,441 tons milled, there were 46,122 tons added to our reserves. Some 7,643 feet of drifting was done, of which 3,721 feet, or 48.7 per cent, was on ore.

The most important feature of the development work during this time has been the intersection of our north vein on five out of six of the new levels, the lowest of which is the 3,900-foot level. On the 3,750-foot level a strike fault has cut the north vein with a displacement of something over one hundred feet vertically. The grade of ore shown at the intersections, and that in the small amount of drifting so far done, has been well above the run of mine grade. In sinking the No. 4 shaft, the north vein was intersected just above the 4,000-foot horizon. There were two branches of the vein, each showing excellent values.

Of the 3,721 feet of ore developed, 536 feet was between the 550-foot level and the 1,125-foot level; 1,439 feet between the 1,500- and 2,000-foot levels; 1,222 feet between the 2,125- and 2,850-foot levels, and 524 feet between the 3,150- and 3,900-foot levels.

Shaft-Sinking

During the eight months' period, No. 3 shaft was deepened to 4,089 feet, and No. 4 shaft to 4,000 feet.

Milling

The early part of the year was taken up with the work of changing over from the old flow-sheet to the new one. This work entailed a great deal of close planning so that current production would not be seriously curtailed. In May, the new flow-sheet was finally put into operation and has since been giving every satisfaction. It was necessary to have this work accomplished before the work of reconstruction of the mill building and the new enlargement started.

The new all-steel frame mill building has now been finished, and about 65 per cent. of the enlargement to the mill is completed. During the making of the various alterations and changes to the mill, the tonnage and extraction were to some extent temporarily affected. However, the better grade of ore counterbalanced this handicap.

General

Our future programme of development has in mind the completion of all exploration, development, and mining of the levels above the 1,200-foot horizon as soon as possible, so that it will be unnecessary to maintain and keep open an excessive number of levels in the mine. At the same time, the lower levels will be steadily explored and developed.

The extensive programme of shaft-sinking and underground development work, together with the improvements and extensions to surface plant and equipment, planned some two years ago, have now been essentially completed. It is a great satisfaction to be able to report that the underground developments are fully warranting these expenditures and more than meeting our expectations.

Young-Davidson Mines, Limited

The officers and directors of this company are: Gideon Grant, president; C. G. Knott, vice-president; F. M. McKay, secretary-treasurer; Jacob A.

Davidson, A. Calvin Ross, Colin M. McLean, 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 75 of this report. The mine address is Elk Lake.

GRAPHITE

Black Donald Graphite Company, Limited

The Black Donald graphite mine in Brougham township, Renfrew county, was operated from October 20 to December 31. During this period 1,234 tons of ore were mined and milled.

R. F. Bunting was manager, employing 19 men. R. A. Telfer is secretary of the company. 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 1933 an average of 25 men was employed. W. E. Allen, Hagersville, is superintendent. There were no new developments in 1933.

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

This company 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 100 men.

There were hoisted 19,922 tons of rock. Of this, some 2,085 tons were sold and the rest was manufactured into landplaster, 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.

NICKEL AND COPPER

Cuniptau Mines, Limited

This company owns 20 claims in Strathy township, district of Nipissing, 4 miles west of Goward. The company has an authorized capital of 3,000,000 shares, of $1 par value, of which 1,795,505 shares are issued. The officers and directors are: B. W. Watkins, president; E. P. Muntz, vice-president; Walter G. Watkins, secretary. The head office is in the Dominion Building, Toronto. H. A. Steven is mine manager. The mine started operating in July, 1933, and employed an average of 12 men to the end of the year. During that time the following work was done: A shaft was sunk 115 feet, and a station 9 by 16 feet was cut on the 100-foot level; six diamond-drill holes totalling 1,250 feet were put down; a road was cut out to Goward, a distance of three miles, and camps were built. At the present time a steam plant is being installed to carry on with the underground work.

Falconbridge Nickel Mines, Limited

The officers and directors of this company are: Thayer Lindsley, president; Halstead Lindsley and J. Gordon Hardy, vice-presidents; N. F. Parkinson, secretary-treasurer; W. S. Morlock, director. The authorized capital is 5,000,000 shares of no par value. The head office is at 100 Adelaide Street West, Toronto. The mine address is Falconbridge.

The company operates a property in Sudbury district. Ernest Craig is general superintendent; J. R. Gill, smelter superintendent; and R. Oliver, mine engineer. During 1933 an average force of 236 was employed underground, 155 in the concentrator and smelter, and 45 on construction work.

The following is taken from the report of the general superintendent, for the year ending December 31, 1933:—

During the first three months of the year, operations were carried on at the rate of capacity developed through alterations and additions effected in December, 1932. Over this period, all ore was treated by direct smelting.

Upon completion, on April 1, of the concentrator and sintering plant, a shut-down was required to permit tying-in with the existing smelter plant. Operations were then resumed on April 16, with the flow-sheet increased by the addition of the new units. Since that time, interruptions to production have been occasioned solely by repair campaigns, which form a part of our regular routine.

To show the daily tonnage rate for the year would be misleading when compared with future figures; however, it should be noted that the ore treated per day was increased from 544 tons during the first three months to 779 tons after the additional units were put in operation in April.

Mine Development

Combined development footages attained on all levels during the reviewed period distribute as follows:—

Drifting and crosscutting	feet	3,083
Raising	feet	909
Stope entrances	feet	340
Box-holes		64
Diamond test drilling	feet	3,071

Practically all development work during the year was carried out within the area in which ore reserves for the report of 1932 were computed.

Of the total of 3,083 feet of drifting and crosscutting, 852 feet was driven west, and 434 feet driven east on the 500-foot level. The last 300 feet of the west drive indicated narrow and very erratic ore, and is, therefore, not included in ore reserves. Faulted ground characterized the last 200 feet of the east drive, the fault cutting across the ore-bearing contact in a south-easterly direction. Here, too, the ore encountered in the fault is very erratic and is not considered in the compilation of ore estimates.

Driving on the 750-foot level was continued east and west of the main crosscut, following the ore zone, for a distance of 800 feet. The 500 feet driven west indicated an average ore width of 30 feet, while fair widths were shown in the east drive. Both east and west faces are in ore at the present time.

Ore Reserves

Below is a tabulation of ore reserves computed as at December 31, 1933:—

	Tons
Ore reserves as at December 31, 1932	2,920,457
Plus new ore added 1933	160,000
Total	3,080,457
Less: hoisted during 1933	267,573
Balance	2,812,884
Plus addition to disseminated ore on surface dump	5,000
Total ore reserves (averaging 2.23 per cent. nickel and 0.93 per cent. copper), December 31, 1933	2,817,884

Mining

The following table sets forth the results of mining activities during the year:—

Broken Ore in Stopes

	Tons
Balance December 31, 1932	227,321
Broken during 1933	430,645
Total	657,966
Less: hoisted from stopes during 1933	249,186
Broken ore reserves December 31, 1933	408,780

Ore Hoisted

From stopes, 1933	249,186
From development, 1933	18,387
From development dump, 1933	7,690
From concentrating dump, 1933	2,653
Total ore to crushing plant during 1933	277,916

Crushing, Sorting and Transportation

From the 277,916 tons of ore delivered to the crushing plant, 16.6 per cent, or 45,624 tons, of waste was eliminated by sorting during the various stages of crushing. The balance, consisting of 232,292 tons, was transported by the aerial tram to the treatment plant bins.

Reduction Plants

The entire reduction plant was in operation a total of 324 days during the year. Of the time lost, 19 days is attributable to the synchronization of the new units, while the remaining 22 days were occupied in carrying out routine repairs. Results of operation tabulate as follows:—

Total ore treated	short tons	232,661
Matte produced	short tons	8,297
Nickel produced in matte	short tons	4,671.5
Copper produced in matte	short tons	2,103.5
Metals per ton in ore:		
Nickel	lbs.	43.31
Copper	lbs.	19.72
Metallurgical losses per ton of ore:		
Nickel	lbs.	3.15
Copper	lbs.	1.64

Construction

Completion of the construction items set out in the report of 1932 as having been authorized and then under erection, i.e. 250-ton concentrator, two-unit sintering plant, and extensions to smelter building, crushing plant, and ore bins, was effected during the early part of the year. Essential additions to facilities and equipment directly and indirectly serving the new and extended units consisted principally of the installation of motor haulage both underground and on the smelter charge floor; flue-dust conveying equipment; new disposal system for waste slag; 25,000-cubic-foot mine ventilating fan; further waste disposal facilities on surface; and a new and completely equipped machine shop.

An increase in housing facilities was made during the year, along with such extensions to water and sewerage systems as were thus made necessary. Together with the erection of a central office and warehouse, some alterations and additions were made to mine buildings.

The following is an extract from the report of the consulting metallurgist for the year ending December 31, 1933:—

Smelter

The smelter operated with the normal minor interruptions throughout the year with the exception of a two weeks' shutdown in April at the time of starting up the concentrating and sintering plants, which were under construction at the end of the previous year. The starting of these new departments gave very little trouble and the results obtained have justified our expectations both technically and economically. While the changes have resulted in slightly increased smelting losses, much lower grades of ore than before can be treated with advantage, so the net result is a very complete utilization of the mine. The capacity of the smelter turned out to be larger than expected and larger than the planned increased capacity of the refinery.

Refinery (Norway)

The refinery operated satisfactorily without any closedown during the year, although until arrival of the increased smelter production in May it occasionally suffered from shortage of matte. The construction work going on at the end of the previous year for increasing the capacity started to show results in increased production in the first quarter of the year. However, the unexpectedly large capacity of the smelter after starting of the new departments and notice given about increased deliveries of custom matte necessitated some additional construction work to what was originally contemplated, and the complete extension programme was, therefore, only completed in November, since which time the refinery has operated at a rate corresponding to 6,000 short tons annually.

Delivery of custom matte took place according to the contract and without interruptions during the year. At the end of the year construction work was going on in preparation for separating the precious metals at the refinery. The high quality of the nickel was further improved during the year.

For the year 1933, the amount of matte received from the smelter, the refinery production, the metals in process, and the matte on hand at the end of the year is set out in the following table:—

	Short tons	Contents	
		Nickel	Copper
		lbs.	lbs.
Falconbridge matte received	8,281.288	.....	.....
Metal content, less refining losses	.....	9,051,497	3,940,094
Produced in marketable form during the year	.....	7,468,320	3,282,113
Metals in process at end of year	.....	2,165,915	688,436
Matte on hand at end of year	671.859	729,638	325,180

International Nickel Company of Canada, Limited

The officers of this company 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 1934 are: John P. Bickell, Hon. H. Cockshutt, Wm. E. Cory, Wm. N. Cromwell, D. Owen Evans, Wm. J. Hutchin-

son, Sir Harry McGowan, Wm. W. Mein, Rt. Hon. Lord Melchett, Sir Robert L. Mond, Thomas Morrison, Seward Prosser, and Grant B. Shipley.

The directors whose term expires in 1935 are: James L. Ashley, John F. Dulles, Reg. Halladay, Charles Hayden, J. W. McConnell, R. S. McLaughlin, Britton Osler, J. A. Richardson, Robert 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 City, and the general offices of the mining and smelting division 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 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 authorized capital of this company 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 following information is extracted from the annual report of the company covering the year ending December 31, 1933:—

General

After three successive reports dealing with trade recession and diminishing profits it is a pleasure to report for 1933 a substantial upturn in your company's business. Since May, 1932, there has been a gradual increase in the volume of nickel sales and, beginning with the second quarter of 1933, profits have been realized each month. The most encouraging feature of the year's improvement is that it has been well spread among all consuming fields and that nearly every buyer took more nickel than in 1932.

The revival in sales of mill products, both from Huntington and Birmingham, lags behind the revival in sales of refinery products. Furthermore, the business of both mills was restricted in respect to exports by changing tariffs and exchange fluctuations. Copper and platinum metals' sales during the year under review were substantially greater, and better prices were obtained than in the preceding year.

Greater outputs and economies effected throughout the various plants decreased the cost of metal-refining during the year. It is gratifying to report that, as a result of the larger pay-rolls due to increased production, unemployment conditions in the localities in which your company operates, particularly Sudbury and Port Colborne, were greatly improved.

All of your company's plants and dwellings have been kept in first-class condition. Expenditures for such maintenance also served to enable your management to render practical relief during a period of forced curtailment of operations.

For convenience, as well as to afford ready comparison with previous reports, the financial figures recorded herein are in terms of United States dollars. It should be noted further that, beginning last May, prices quoted by your company outside of the United States and Canada were based on sterling as the most practical means of minimizing currency fluctuations.

The financial statements record a net profit of $9,662,583.64 exclusive of exchange adjustments and profit of $1,739,617.06, which was carried to reserve. This net profit is after all charges, including provision of $3,551,653.32 for depreciation and mine depletion. After disbursing $1,933,898.75 of preferred dividends, there remained $7,728,684.89, equal to 53 cents per share on the common stock.

The year closed with your company's cash position strengthened and with current business in satisfactory volume. A summary of the various activities of your company for the calendar year 1933 follows:—

Sales

Sales of nickel in all forms, including nickel in alloys, amounted to 74,356,969 pounds, compared with 34,406,953 pounds in 1932, an increase of 116 per cent. The world's consumption of nickel in all forms aggregated 96,000,000 pounds, compared with 57,000,000 pounds in 1932 and 73,000,000 pounds in 1931.

Your company's nickel sales were as follows: sales of nickel in refinery products of Port Colborne, Canada, and Clydach, Wales, amounted to 61,353,495 pounds, compared with 24,776,420 pounds in 1932, an increase of 148 per cent. Sales of nickel (including nickel contents of Monel metal, rolled nickel, and alloys) in products of the rolling mills at Birmingham, England, Glasgow, Scotland, and Huntington, West Virginia, and of the foundry at Bayonne, New Jersey, totalled 13,003,474 pounds as compared with 9,630,533 pounds, an increase of 35 per cent.

Sales of Monel metal, a product made direct from Creighton ore, totalled 9,101,219 pounds, compared with 7,624,298 pounds in 1932, an increase of 19 per cent.; and sales of rolled nickel, 6,287,991 pounds, were up 60 per cent.

Copper sales, inclusive of copper in sulphate produced in Wales, increased from 57,662,789 pounds to 113,682,312 pounds, or 97 per cent.

Gold sales were 21,355 ounces, compared with 23,042 ounces in 1932; silver sales were 876,303 ounces, compared with 652,638 ounces in 1932, and sales of the platinum metals were 77,198 ounces, compared with 19,300 ounces in 1932.

Mines

During 1933 there were shipped 1,336,040 tons of ore from the Frood and Creighton mines. The former furnished 952,725 tons, and the latter 383,315 tons. The Frood mine was operated throughout the year and mining was resumed at Creighton during June, after a prolonged shutdown.

Only such development work was done during the year as was necessitated by production requirements. Ten new stopes and eight pillar stopes were brought to the production stage in the Frood mine, thus making available for mining 72 stopes rated at 150 tons each daily and 8 pillar stopes rated at 50 tons each daily. Mining costs generally were satisfactory and capital and maintenance expenditures very low during the year.

Smelters

Operations at the concentrator were increased during the year, the total ore milled amounting to 996,515 tons. Improvement in metallurgy continues and is reflected in better recoveries and lower costs. Experimental process investigations and microphotography on the occurrence of the precious metals in ores are now receiving attention.

The Copper Cliff smelter produced 53,186 tons of bessemer matte and 61,385 tons of blister copper. Two reverberatory furnaces were operated on mill concentrates until the end of June, and three for the balance of the year. One blast furnace was used continuously for the Orford process. This was the first full year of operation for the new Orford process plant and the results were so satisfactory from the standpoint of costs and quality that the wisdom of moving from Port Colborne to Copper Cliff has been proved.

The Coniston smelter resumed operations in June with two blast furnaces and two converters and treated 328,640 tons of ore and produced 20,645 tons of bessemer matte. The smelter stack was rebuilt during the year, and the plant generally shows a high degree of maintenance.

Refineries

Port Colborne Refinery.—This refinery produced 41,496,664 pounds of nickel in the form of electrolytic cathodes and nickel in oxide. Operations were resumed in May when three electrolytic circuits were started, followed by two additional circuits in June and a sixth in August. All six circuits remained in operation during the balance of the year. Minor alterations to equipment were made to provide for more efficient handling of materials, though no large expenditures for capital account were necessary. The principle of spreading labour at Port Colborne continued, and your management was able to provide work for all former married employees, and new employees were restricted to married men with families. As a result of the increased operations, employment conditions in the town at the close of the year were much improved.

Ontario Refining Company, Limited.—Operations were governed entirely by the tonnage of blister copper received from the Copper Cliff smelter, as no outside copper was refined. The operations were increased from 4,000 tons of blister copper per month at the beginning of the year to 6,500 tons per month during the last quarter. The total output for 1933 was 58,098 tons of refined copper and the substantial increase in production resulted in lower refining costs. Research work was continued throughout all departments of the plant, resulting in numerous improvements and economies.

Your company's stock interest in the Ontario Refining Company, Limited, was increased to 67.79 per cent. during the year and may be further increased, as referred to in the annual report for 1931, upon termination of the copper purchase contract therein mentioned.

Ore Reserves

Proven ore reserves on December 31, 1933, were 204,783,399 tons. With the resumption of mining on a substantial scale, development and exploratory work must be resumed. In consequence a three-year development programme for the Frood and Creighton mines has been approved.

Outlook

Judging from the gradual improvement in the world's nickel industry, which has been in progress since the spring of 1932, it would appear that your company has weathered the severe

industrial storm. Furthermore, it may be observed that your company's nickel business is recovering from trade depression more rapidly, and to a somewhat greater extent, than is the case in most other basic industries. This may be attributed not alone to its international scope, but perhaps to an even greater extent to the multiplicity of comparatively recent applications of nickel. Supplementing this nickel background is an improvement in the world market for copper and the platinum metals, which promises an increasing participation for your company in these industries.

All circumstances considered, 1933 was a relatively satisfactory year in that there was a general resumption of activity in the nickel industry, and, moreover, substantial net profits were realized by your company.

The current year begins far more auspiciously than did 1933 and with the further advantage that your entire organization is now endowed with the valuable experience gained during the past three years of trade distress, which called constantly for rigid economy, efficiency, and resourcefulness. Thus, should the optimism now apparent, both here and overseas, reflect permanent trade recovery, your management believes that your company is entering a period of prosperity.

Employees

The total number of employees at the year-end was 8,297, distributed as follows: Canada 4,772, Great Britain 2,339, United States 1,138, other countries 48. Employees on December 31, 1932, numbered 4,654. The increase, amounting to 78 per cent., is due in the main to the increased scale of operations necessitated by the growing demand for your company's metals. The employees of Ontario Refining Company, Limited, are, for the first time, included in these figures.

It is gratifying to report that there was a further decline in the accident rate in the mining and smelting division during the year. The number of accidents per 10,000 shifts worked in 1933 was 1.84, compared with 1.86 in 1932, and the number of shifts lost per 10,000 shifts in 1933 was 78.8, as compared with 111.7 in 1932.

An average of 2,761 men was employed in the Sudbury area during 1933, distributed as follows: Creighton, 436; Frood, 948; Garson, 5; Levack, 9; Copper Cliff, 1,167; and Coniston, 196.

Donald MacAskill is general manager; E. A. Collins, assistant to the general manager; and R. D. Parker, general superintendent of mines.

RADIUM

Canada Radium Mines, Limited

Canada Radium Mines, Limited, has a capitalization of 2,500,000 shares of no par value. The property consists of 750 acres in Cardiff township, Haliburton county. The officers and directors are: Kenneth W. Wright, president; George F. McCandless, vice-president; A. M. Barry, secretary-treasurer; Frank Austin, managing director, and E. W. Austin, director. The head office is at 244 Bay Street, Toronto. M. B. R. Gordon is consulting engineer.

The mine operated throughout 1933, with an average force of 15 men. At March 1, 1934, the shaft was 250 feet deep, and 610 feet of lateral work had been completed on the 125- and 250-foot levels.

SILVER AND COBALT

Alert Cobalt Mines, Limited

The Alert Cobalt Mines, Limited, owns 40 acres in the township of Coleman, district of Timiskaming. This property was formerly known as the Quaker City. The officers and directors are: Dr. E. H. Porch, president; A. Morgenthaler, vice-president; F. J. Jockers, secretary; and R. Stewart, manager. The head office address is care of F. L. Smiley, Haileybury. The company is capitalized at $1,500,000, in shares of $1 par value.

An average of 8 men was employed from August, 1933, to January, 1934, when the mine was closed. During the time of operating, 340 feet of drifting and 154 feet of crosscutting was done on the 145-foot level.

Cain and Taylor

The Beaver mine in Coleman township, district of Timiskaming, was operated throughout 1933 by the owners, C. E. Cain and W. D. Taylor.

Ore having a value of $32,480.11 was shipped to Deloro. An average of 12 men was employed.

Cobalt Properties, Limited

This company is capitalized at $25,000, in shares of $1. The officers are: Ambrose Murphy, president; H. E. Tomney, secretary-treasurer; Thos. H. Wainwright, A. Brocklebank, and Mrs. A. Brocklebank, directors. The head office is at Cobalt.

In 1933 the company bought the Coniagas mine, in Coleman township, district of Timiskaming. The property was operated from July to December, with an average force of 27 men. During this period production amounted to 64 tons of ore, containing 154,553 ounces of silver, having a value of $68,590.

D. L. Jemmett, Limited

The Agaunico mine in Bucke township, district of Timiskaming, is owned by the Estate of D. L. Jemmett, Limited. No development work was carried on during the year. From May 20 to September 30, rock was picked from surface dumps and milled. An average of 10 men was employed.

Values of $7,430 in cobalt and nickel were obtained from 79 tons of ore shipped to Hamburg, Germany.

McKinley Mines Securities Company, Limited

The McKinley mine is in Coleman township, district of Timiskaming. No work was done on the property during the year, but ore picked from the dump by the caretaker yielded a value of $1,215.14 in silver.

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 is general manager.

The property at Cobalt was not operated during the year, but a clean-up at the various plants resulted in a shipment of 39 tons of ore, containing 39,959 gross ounces of silver. Shipments of base bullion contained 39,781 fine ounces of silver, valued at $17,940. In addition, approximately 875,000 ounces of bullion, having a value of $375,000, was sold from New York stocks.

M. J. O'Brien, Limited

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 1933 report is as follows:—

Drifting and crosscutting			feet 1,969
Raising			feet 145
Sinking			feet 60
Ore broken in stopes			tons 12,936
Ore hoisted			tons 30,932
Shipments:			
High-grade	tons	15.5	
Concentrates	tons	349.2	
Total shipments			tons 364.7

The average number of men employed was 89.

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. The mine address is Cobalt.

There were no operations at the O'Brien mine. About 105 men are employed.

The development and production for the year is as follows:—

Drifting	feet	3,587
Raising	feet	593
Ore stoped	tons	24,264
Ore and waste broken	tons	41,066
Ore hoisted	tons	28,751
Silver shipped	ounces	1,184,347

Peterson Cobalt Mines, Limited

This company's property in Coleman township, district of Timiskaming, was not operated in 1933, but two short leases were given to Frank Barnet and Charles Dean. Ore picked from the dump by these men yielded $987.66 in silver.

C. W. Price

The Foster mine in Coleman township, district of Timiskaming, was operated under lease by C. W. Price, who employed 2 men. Shipments of ore and concentrates yielded 8,696 ounces of silver, having a value of $3,753.

Sandoe and Moyle

The Temiskaming mine in Coleman township, district of Timiskaming, was leased to Richard Sandoe and H. Moyle.

Some 9 tons of ore shipped to the Temiskaming Testing Laboratories for treatment yielded 10,430 ounces of silver. Two bars of bullion sold to the Deloro Smelting and Refining Company, Limited, contained 2,000 ounces of silver.

Stuckey and Rowe

The property of the Mining Corporation of Canada, Limited, in Coleman township, district of Timiskaming, was leased to Charles Stuckey and Alfred Rowe during 1933.

No development work was done. Some 15,474 pounds of concentrates and bullion, shipped to Deloro, yielded a value of $10,645 in silver.

Windsor Cobalt Mines, Limited

The officers of this company are: Dr. A. D. McArthur, Toronto, president; D. C. Walmsley, secretary. Colin MacGregor, B. L. Wrench, and Dr. J. A. McArthur are directors. The property in Coleman township, district of Timiskaming, was operated from May to November, with a force of 6 men.

There are three shafts on the property, 65 feet, 55 feet, and 95 feet deep. During the period of operation about 600 feet of drifting was done from the 95-foot shaft, making a total of 900 feet of drifting.

Yorkshire Cobalt Mining Company

The Yorkshire Cobalt Mining Company owns 120 acres 7 miles west of Cobalt, in Bucke township, district of Timiskaming. W. E. Seed is manager. The total amount of work done on the property is as follows:—

	Feet
Depth of shaft	210
Drifts:	
47-foot level	111
118-foot level	35
156-foot level	290
210-foot level	60

The average number of men was 7. There was no ore sold or shipped.

TALC

Canada Talc Company, Limited

The mine and mill of the Canada Talc Company, Limited, in Hastings county, were operated throughout the year. The officers and directors of the company are: W. S. Morden, president; Roy Taylor, secretary; E. S. James, director.

The ore was mined from the 3rd and 7th levels. A total of 6,584 tons was hoisted, and 7,015 tons were milled.

Roy Taylor, Madoc, is manager, employing an average of 14 men in the mine and 10 in the mill.

Geo. H. Gillespie Company, Limited

The officers and directors of this company are: Geo. H. Gillespie, president; M. H. Ludwig, secretary-treasurer; Alexander Longwell, director.

The Henderson mine in Huntingdon township, Hastings county, was operated throughout the year. Development consisted of driving east on the 400-foot level to the end of the ore body, and the opening up of a stope. Some 7,353 tons of ore were hoisted and treated at the Gillespie mill.

Geo. H. Gillespie, Madoc, is manager. Six men were employed at the mine and 10 at the mill.

METALLURGICAL WORKS

Algoma Steel Corporation, Limited

During 1933 only one blast furnace of this corporation, located at Sault Ste. Marie, was operated. No. 4 furnace was in blast from January to February 1, and from November 8 to December 31. It produced a total of 27,708 long tons.

Jas. H. Bell was blast furnace superintendent.

Canadian Furnace Company, Limited

The Canadian Furnace Company, Limited, at Port Colborne, operated the furnace from June 25 to December 25, 1933, with an average force of 80 men.

The production for the year was as follows:—

	Gross tons
Pig iron	33,053
Spiegeleisen	10,103
Total	43,156

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.

Canadian Industries, Limited

During 1933, the sulphuric acid plant of this company, located at Copper Cliff, was in continuous operation.

There are three 50 ton per day units, which manufacture acid from the converter gases produced at the smelter of the International Nickel Company. One unit only was in operation for the first six months of the year, then the second unit was put in service. The nitre cake plant resumed operations on August 16, and the third acid unit was put in service to supply the acid used in the process.

An average of 33 men was employed. G. G. Vincent was works manager.

Deloro Smelting and Refining Company, Limited

The plant at Deloro operated throughout the year. The silver output for the year amounted to approximately 2,821,000 ounces.

The officers of the company are: M. J. O'Brien, president; J. A. O'Brien, vice-president; F. A. Bapty, secretary-treasurer; S. F. Kirkpatrick, managing director. S. B. Wright is general manager, and R. A. Elliott is superintendent.

International Nickel Company of Canada, Limited

The refinery at Port Colborne was operated continuously throughout the year. An account of the operations appears on page 48 of this report.

Ontario Refining Company, Limited

The copper refinery of this company, situated at Copper Cliff, was operated continuously during 1933. Operations were continued on the reduced tonnage basis established in 1932 until June, when a gradual improvement started; and at the year end the plant was operating at about 55 per cent. of its rated capacity.

Shipments of copper to both Canadian and European destinations showed a substantial increase over 1932. The usual shapes and sizes required by the trade, including wire bars, cakes, billets, ingots, and cathodes, were furnished.

In addition to copper, refined gold and silver were produced. The production of selenium was resumed and shipments increased over 1932.

An average of 336 men was employed, in comparison with 310 men during 1932. F. Benard was plant manager.

Steel Company of Canada, Limited

The Steel Company of Canada, Limited, operated one furnace for 181 days, with a production of 77,801 gross tons of pig iron.

The average number of men employed was 88. 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, R. G. Wells, and H. T. Diplock, vice-presidents; H. H. Champ, vice-president and treasurer; H. S. Alexander, secretary; S. E. Le Brocq, comptroller.

MINING ACCIDENTS IN 1933

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

Accidents during 1933

During the year 1933 at the mines, metallurgical works, quarries, and clay, sand, and gravel pits regulated by the Mining Act, there were 1,538 accidents to employees reported to the Department of Mines up to January 16, 1934. Twenty-five fatalities arising out of 24 separate accidents were reported.

These returns represent an increase of 63 in the total number of accidents, and the same number of fatalities as recorded for the previous year.

The report shows a fatality rate of 1.57 per thousand men employed, which is 1.27 per thousand lower than the average for the past twenty-five years.

There were 95 non-fatal accidents per thousand men employed, which is a decrease of 3 per thousand from the rate of 1932.

The percentage of non-fatal accidents followed by infection increased from 6.5 in 1932 to 7.3 in 1933.

Fatal Accidents

A comparison of fatal accidents for the past five years is given in the following table:—

Distribution	1929	1930	1931	1932	1933
Mines, underground	33	30	21	17	20
Mines, surface	2	3	8	0	1
Metallurgical works	2	11	1	1	1
Quarries	3	4	2	1	0
Clay, sand, and gravel pits	8	6	4	4	2
Total	48	54	36	23	24

By months the fatal accidents occurred as follows:—

Month	No. accidents	No. men killed
January	2	2
February	4	4
March	0	0
April	3	3
May	1	1
June	1	1
July	2	2
August	2	2
September	3	4
October	2	2
November	2	2
December	2	2
Total	24	25

Classifying the fatalities according to industries gives the following:—

Gold mines	17
Nickel mines	3
Silver mines	1
Copper-lead-zinc mines	0
Talc mines	1
Metallurgical works	1
Quarries	0
Sand, gravel, and clay pits	2
Total	25

ANALYSIS OF FATALITIES AT MINES, 1929–1933

Cause	1929	1930	1931	1932	1933
	per cent.	per cent.	per cent.	per cent.	per cent.
Fall of ground	14.3	45.6	31	21	23
Run of ore or rock	11.9	8.6	3.5	5.3	9
Shaft accidents	14.3	8.6	17.2	15.8	9
Explosives	28.6	8.6	6.9	31.6	9
Miscellaneous, underground	28.6	20	13.8	26.3	45
Surface	2.3	8.6	27.6	....	5

TABLE OF FATAL ACCIDENTS IN MINES, METALLURGICAL WORKS, QUARRIES, AND GRAVEL, SAND, AND CLAY PITS, 1909–1933

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
1909	49	8,505	2,000	10,505	4.66
1910	48	10,862	2,000	12,862	3.73
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

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	11,830	22	1.86
Metallurgical works	2,551	1	.39
Quarries	863	.....	.....
Clay, sand, and gravel pits	640	2	3.13
Total	15,884	25	1.57

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-Slovak	Finn	Jugo-Slav	Pole	Ukrainian	Total
Boilermaker's helper	.....	.....	.....	.....	.....	1	1
Cage-tender	1	.....	.....	.....	.....	.....	1
Cage-tender's helper	1	.....	.....	.....	.....	.....	1
Carpenter	1	.....	.....	.....	.....	.....	1
Car sampler	1	.....	.....	.....	.....	.....	1
Chute-blaster	.....	1	.....	.....	.....	.....	1
Chute-blaster's helper	1	.....	.....	.....	.....	.....	1
Driller	.....	.....	.....	4	.....	.....	4
Drill helper	2	.....	.....	.....	.....	.....	2
Farmer	1	.....	.....	.....	.....	.....	1
Labourer	1	.....	.....	.....	.....	.....	1
Mine foreman	1	.....	.....	.....	.....	.....	1
Pumpman	.....	.....	1	.....	.....	.....	1
Scaler	1	.....	.....	.....	.....	.....	1
Shaft leader	1	.....	.....	.....	.....	.....	1
Shift boss	.....	.....	.....	.....	1	.....	1
Timberman	.....	.....	2	1	1	.....	4
Trammer	.....	.....	.....	1	.....	.....	1
Total	12	1	3	6	2	1	25

The ages of the men killed are as follows:—

17–20	21–25	26–30	31–35	36–40	41–45	46–50	Over 50	Total
1	3	4	5	4	4	2	2	25

Non-fatal Accidents

The causes of non-fatal accidents at mines are shown in the following table:—

Cause	Surface	Underground	Total
Falling objects	41	134	175
Fall of rock or ore at face	.....	162	162
Fall of persons	60	96	156
Crushed between two objects	22	76	98
Fall of rock or ore from face, back, etc	.....	91	91
Rock or ore at chute	.....	81	81
Flying objects, sledging, etc	20	61	81
Tramming	.....	80	80
Hand tools	31	38	69
Handling rock or ore	.....	68	68
Nails or splinters	19	36	55
Strain while lifting	5	39	44
Running into or striking objects	5	34	39
Drilling machines	.....	27	27
Machinery	16	8	24
Air or rock blast	.....	20	20
Cage, skip, or bucket	.....	17	17
Fall down shaft, winze, or stope	.....	15	15
Burns	13	1	14
Explosives	2	8	10
Explosion from carbide	1	4	5
Gas	.....	4	4
Poisoning from cyanide, mercury, etc	2	.....	2
Unclassified	2	1	3
Total	239	1,101	1,340

The causes of non-fatal accidents at metallurgical works were:—

Falling objects	37	Hand tools	3
Burned by slag, matte, or scrap	15	Strain while lifting	2
Crushed between two objects	12	Machinery	2
Fall of persons	11	Cranes, ladles, hooks	2
Burns	9	Electricity	2
Flying objects, sledging, etc	6	Running into or striking objects	1
Transportation	3		
Burns by acid	3	Total	108

The causes of non-fatal accidents at quarries were:—

Handling material	11	Falling objects	2
Fall of persons	6	Running into or striking objects	2
Flying objects, sledging, etc	6	Fall of rock	1
Transportation	4	Unclassified	4
Hand tools	3		
Crushed between two objects	3	Total	44
Machinery	2		

The causes of non-fatal accidents at sand, gravel, and clay pits were:—

Machinery	4	Electric	2
Falling objects	3	Strain while lifting	1
Fall of material	3	Running into or striking objects	1
Handtools	3	Transportation	1
Fall of persons	2		
Crushed between two objects	2	Total	22

Infection

Records show that infection followed in 111 cases out of a total of 1,514 non-fatal accidents.

Location	No. of accidents	Accidents followed by infection	Per cent. infection
Mines, underground	1,101	73	6.6
Mines, surface	239	29	12.1
Metallurgical works	108	5	4.6
Quarries	44	3	6.8
Sand, gravel, and clay pits	22	1	4.5
Total	1,514	111	7.3

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
Returned too soon to blast	2	2	.....	.....	2	2
Charge detonated by falling rock	1	2	.....	.....	1	2
Delayed too long at blast by falling	1	1	.....	.....	1	1
Striking car with cap	1	1	.....	.....	1	1
Remained too long at blast	2	2	1	1	3	3
Cut fuse too short	1	2	.....	.....	1	2
Unexplained	.....	.....	1	1	1	1
Total	8	10	2	2	10	12

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:—

1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	Total
1	3	.....	2	1	.....	6	.....	.....	.....	13

The following table shows the total number of non-fatal electric accidents during the last ten years:—

1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	Total
9	6	5	10	4	14	10	7	3	4	72

Classifying the accidents according to the industry shows the following:—

Metallurgical works	2
Grave pits	2
Total	4

There were 4 non-fatal electric accidents in 1933, two of which happened in the operation of disconnecting switches.

There were no fires caused by electric apparatus underground, with the exception of two ruptures of trailing cables, due to injury, at the slusher hoists. In both cases the insulation ignited, but the fire was immediately extinguished.

There are at present approximately 15 miles of 2,200-volt cables in service underground and no ruptures have occurred.

The first 2,200-volt cable was installed underground at the Creighton mine in 1917, and has been in continuous service since then.

Mine Fires

Hollinger Consolidated Gold Mines, Limited

A small fire occurred underground at the Hollinger mine on the morning of March 21, when, in some manner, a cotton overall smock left hanging on a post in the 1,100-foot level station of No. 11 shaft was ignited and completely burned, without, however, setting fire to the post on which it was hanging.

While the fire itself was of insignificant extent, it well illustrated the magnitude of the effects of fire underground, as dense smoke was spread over a considerable area of the mine in an incredibly short time.

The alarm was first raised about 8 A.M. when the cage-tender, on a trip to the 2,300-foot level, noticed smoke as he passed the level. Efforts to locate the cause of the smoke being at first unsuccessful, orders were issued to inject the stench-warning gas into the air lines and a call was put in to the mine rescue station for equipment.

Within about 15 minutes of the receipt of the call, the rescue equipment was at the shaft, and trained rescue men were assembling. The origin of the fire was located about the same time and the smock was found to have been completely consumed.

A check-up of the number of men reached by the stench showed that 90 per cent. were warned in their own working places, in spite of the fact that the alarm was given at a time believed to be one of the most ineffective periods for transmitting a warning of this nature during the entire twenty-four-hour cycle of operations, as very few crews of workmen would be using compressed air at that time of day.

Vipond Consolidated Gold Mines, Limited

A small fire occurred under ground at the Vipond mine about 8 A.M. on April 22. A pump on the 500-foot level of the old Crown workings, driven by a 6-inch rubber belt from an electric motor, was the seat of the trouble. The belt was slipping toward the motor side of the pulley sufficiently to allow the edge of the belt to rub against the motor housing and finally to be ignited by friction. The belt was burned through, with the exception of about two inches, and the fire had burned out before the source of the smoke was discovered.

About 8 A.M. on the morning of the fire, men on the 1,000-foot level west smelled and saw smoke coming into the Vipond workings through the crosscut connecting with the Crown workings on that level. Mine Captain McQuarrie was notified, and he went to the 1,000- and 1,400-foot levels and ordered all men out of these areas, and then went to surface and had the ethyl mercaptan stench introduced into the air lines. All men working from the 600-foot level to the bottom of the mine were hoisted to surface. Men on the upper levels came out to the shaft, but as the smoke had ceased to come into the mine by the time the lower levels were evacuated they were not taken to surface.

A call for rescue equipment was put through to the mine rescue station and to the Hollinger mine for rescue men to assist. The rescue equipment was at the shaft within about 20 minutes of the time the call was received.

After giving the alarm Captain McQuarrie, accompanied by two other men, had returned to the 1,000-foot level and, finding the smoke clearing up, had proceeded into the Crown workings and climbed up the Crown shaft to the pump, a climb of approximately 400 feet. It was thought that this apparatus was the source of the trouble as the pump could not be heard running nor was it discharging water to surface. Some concern was felt for the safety of these men as they were in the return air from the pump level and any new outbreak of fire was liable to place them in considerable danger. A rescue party of three men, equipped with Burrell masks and accessories, went to the 1,000-foot level to look for McQuarrie and his companions and met them shortly after leaving the shaft. They reported the fire out and the area fairly clear of smoke.

The effectiveness of the stench warning was practically complete. Every man underground got the warning but a few did not recognize it as such. The four regular 10 c.c. stench bombs used in the equipment at this mine were broken into the line, shortly followed by two others. The mine was well flooded with the stench, yet all men were back at work within about one and a half hours, at which time no trace of the stench could be detected.

Yorkshire Cobalt Mining Company

A fire of unknown origin occurred at the Yorkshire Cobalt mine on August 24, causing extensive burns to Adelard Leonard and death to J. Kennedy, aged 39.

The fire broke out about 5 A.M. Kennedy and Leonard were the only men underground. Leonard climbed the ladders and ran out through the blazing shaft-house, but efforts to get Kennedy out were unavailing. About 50 men, including the manager, Wm. E. Seed, engaged in rescue attempts. Gas masks were sent out from Cobalt, but proved useless owing to the dense smoke and lack of oxygen in the air. Four members of the mine crew were overcome in their efforts to reach the trapped man.

A call for assistance, sent to the Kirkland Lake Rescue Station, was received at 10.20 A.M., and P. C. Smith, the superintendent, set out at once with two rescue men and the necessary apparatus. A right-of-way was established with the co-operation of the police along the route and a rapid run was made to the mine. Before the Kirkland Lake rescue party arrived the fire had burnt itself out, destroying the shaft-house, headframe and mill. A break-through trip was first attempted on the 45-foot level, west, with Burrell All-Service masks, but, owing to a deficiency of oxygen and a great accumulation of carbon monoxide, the party was forced to return to surface. The gas masks were discarded and oxygen breathing apparatus was used. The rescue crew found it necessary to chop away the landings in the manway to clear a passageway. The party first explored the west section on the 45-foot level without finding Kennedy. They then went to the eastern section, where the drift was obstructed by a large muck pile. They crossed this with difficulty and found Kennedy's body lying on the other side, about 60 feet from the station. Life was extinct and *rigor mortis* had been established.

Owing to the dense smoke and the difficulties experienced in reaching Kennedy, the party leader decided to leave the body and try to establish ventilation so that removal could be effected by men using gas masks.

Steam was used to ventilate the mine, and P. C. Smith and Fire Chief Matheson of Kirkland Lake, both wearing gas masks, recovered the body and brought it to surface at 6.10 P.M.

Tribute is due to the bravery of the men composing the rescue crew, and to those men who, knowing the dangers they would incur in attempting the exploration of smoke-filled workings without proper respiratory protection, nevertheless made the first efforts at rescue before the arrival of the Kirkland Lake crew. While the bravery of these men must be admired, the foolhardiness of their action should not be lost sight of. Such rashness may be the cause of unnecessary loss of life when there is a mine fire.

Summary of Rope Tests, 1933

The following is a summary of the tests made in the Wire Rope Testing Laboratories of the Department of Mines during 1933:—

Tests for Ontario mines under Act	243
Special informative tests for mines	8
Tests for wire-rope manufacturers	15
Tests for other manufacturers	2
Tests for mines outside Ontario	17
Other tests	3
Total	288

CLASSES FOR PROSPECTORS, 1933-34

By E. M. Burwash

Introduction

The classes were held as usual this season following the methods developed and used during the last 14 years by Dr. W. L. Goodwin and the present writer. Fifteen centres were chosen for the work, including Pembroke and Hornepayne, which had never been visited before, and Schumacher, which had not received attention for a number of years. At the two new points the attendance was unexpectedly good; the class at Pembroke had a registration of 74, and that at Hornepayne 114. The latter was the largest class held this season outside of Toronto. The grand total of the 15 places reached the sum of 1,253 registrations, the largest on record with the exception of last season (1932-33) when two classes were held in Toronto, each of which had a registration of over 450. The point seems well sustained that the condition of general business depression combined with inflation of currency and consequent increased activity in gold mining attracts the attention of many unemployed men to the possibilities of prospecting. The attention of the men to their class work was also remarkably good, as shown by an average attendance of over 62.37 per cent. of the entire registration. This is high for such classes, since men can often reach the classroom only when off shift, or can remain in town for only part of the 9 or 10 days through which the work is carried on.

Analysis of Class Attendance

The following table will furnish more detailed information as to the work of the classes for prospectors in the various localities in which they were held.

TABLE OF ATTENDANCE, 1933-34

Place	Dates	Mineralogy		Geology		Total student periods
		Registration	Average attendance	Total attendance	Average attendance	
	1933					
Ottawa	Nov. 9–17	44	29.43	154	30.8	360
Sudbury	Nov. 20–28	37	20.25	88	17.6	250
Chapleau	Nov. 30–Dec. 8	21	9.75	34	6.8	112
Sault Ste. Marie	Dec. 11–19	91	55.9	170	34	617
	1934					
Toronto	Jan. 4–12	466	320	1,380	276	3,940
Pembroke	Jan. 15–23	74	39.37	151	30.2	466
Fort William	Jan. 25–Feb. 2	64	47.6	134	26.8	514
Port Arthur	Feb. 5–13	46	36	185	37	473
Fort Frances	Feb. 15–23	39	20.62	107	21.4	272
Kenora	Feb. 26–Mar. 6	38	23.37	68	13.6	255
Sioux Lookout	Mar. 8–16	23	12.85	110	22	213
Schumacher	Mar. 19–27	26	14.75	113	22.6	231
Kirkland Lake	April 9–17	100	57.75	395	79	657
Haileybury	April 19–27	70	35.87	94	18.8	381
Hornepayne	April 30–May 8	114	58	0	0	464
Totals	.....	1,253	.....	3,183	.....	9,205

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Box #2

PROVINCE OF ONTARIO
DEPARTMENT OF MINES

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

FORTY-THIRD ANNUAL REPORT

OF THE

ONTARIO DEPARTMENT OF MINES

BEING

VOL. XLIII, PART II, 1934

Sudbury Nickel Field Restudied

By

A. G. BURROWS and H. C. RICKABY

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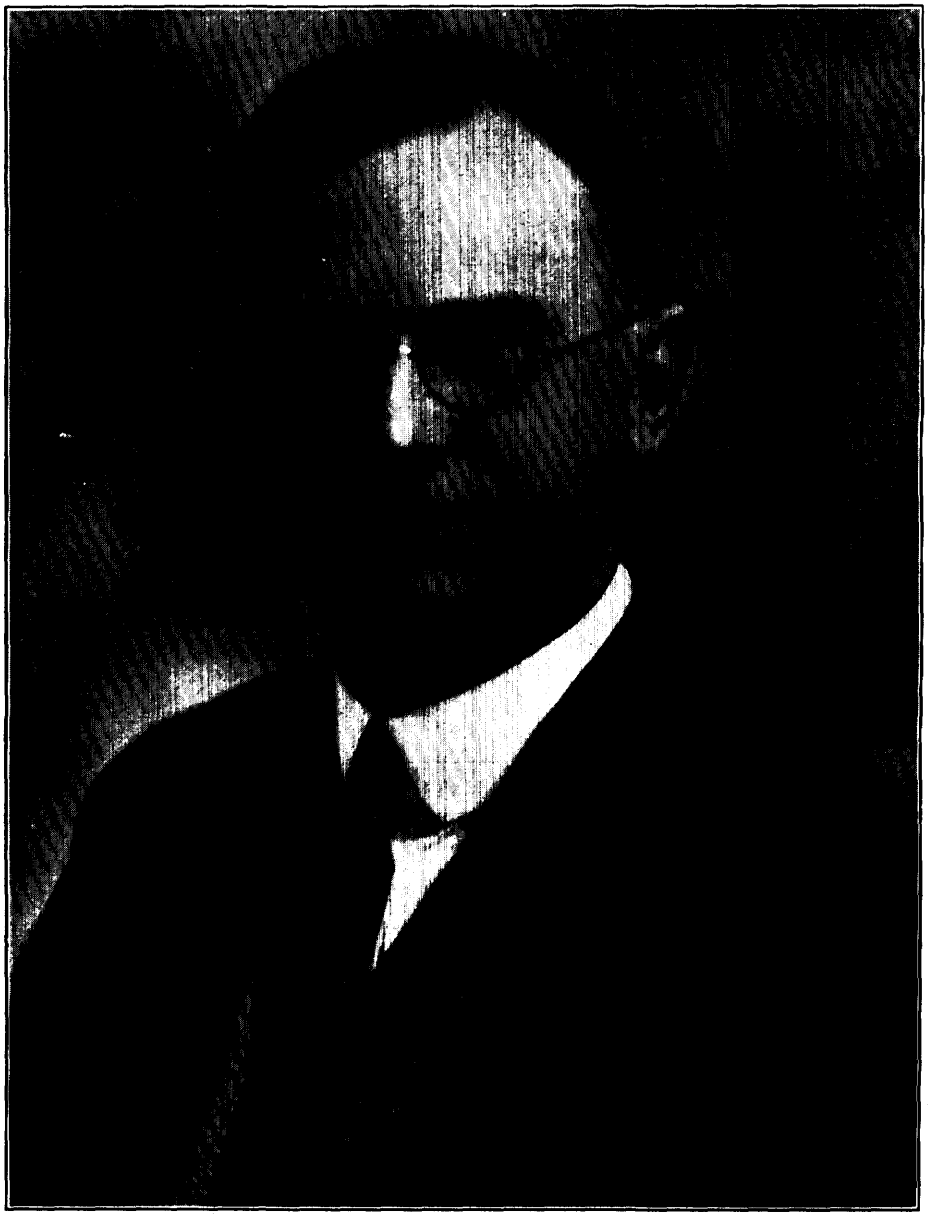
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COLOURED GEOLOGICAL MAP AND PLANS AND SECTION
(In pocket at back of report)

Map No. 43*d*—Part of the Sudbury Nickel Area, District of Sudbury, Ontario. Scale, ¾ mile to the inch.

Sheet No. 43*e*—Falconbridge Nickel Mine, Township of Falconbridge, District of Sudbury, Ontario, Plans and Section Showing Geology of Workings. Scale, 60 feet to the inch.



ALFRED GRANVILLE BURROWS M.A., B.Sc., LL.D. (Queen's), F.R.S.C., 1878–1933

Gold Medallist Queen's in Master's Degree; Provincial Assayer, 1902–1907; Geologist, Ontario Bureau of Mines, 1906–1919, and Department of Mines, 1920–1925; Provincial Geologist, 1925–1933

SUDBURY NICKEL FIELD RESTUDIED

By A. G. Burrows and H. C. Rickaby

CHAPTER I

Introduction

Introductory Remarks

The following report on Sudbury is essentially the work of the late A. G. Burrows, LL.D., who was Provincial Geologist of the province of Ontario from 1925 till his death, September 2, 1933. The junior author assisted in the early part of the field work and in part of the petrographic studies of the rocks.

The field work in connection with the report was begun by the authors in 1929 and continued in 1930. Further field work was carried on, mainly by the senior author, in the summers of 1931 and 1932. At the time of his death, Dr. Burrows had almost completed the map (No. 43*d*) and had assembled most of the detailed geological data contained in the report. It has remained for the junior author to round up the memoir, and for this purpose some further field work was necessary in the summer of 1934.

History

The reports of Barlow and Coleman and that of the Royal Ontario Nickel Commission[1] contain splendid historical descriptions of the discoveries and the development of the many nickel-copper deposits of the area, and the reader is referred to them for detailed information.

The presence of magnetic ore was first indicated in 1856 during the running of a meridian line, which passed a few hundred feet west of the Creighton deposit, where A. P. Salter, provincial land surveyor, observed abnormal variations of the compass readings. The first actual discovery of the valuable sulphides was the deposit that later came to be known as the Murray mine, a few miles northwest of the town of Sudbury. The clearing of the right-of-way for the Canadian Pacific railway in 1883 revealed the gossan or oxidized tops of an ore body. Later a rock cut was made there, and the gossan and ore may still be seen at this point.

In the following years, prospectors from Sudbury searched for the gossan and quickly observed that they were near the diorite, as the norite was then called. Nearly all the present known deposits were found in 1884, 1885, and 1886. The early prospecting must have been difficult, as the area was then thickly wooded, but repeated forest fires and lumbering operations have so exposed the rocky ridges that at present the red surfaces of the gossans are visible from a distance. The famous Frood was discovered in 1884, and the great Creighton in 1886. These properties show very large gossans at the outcrops.

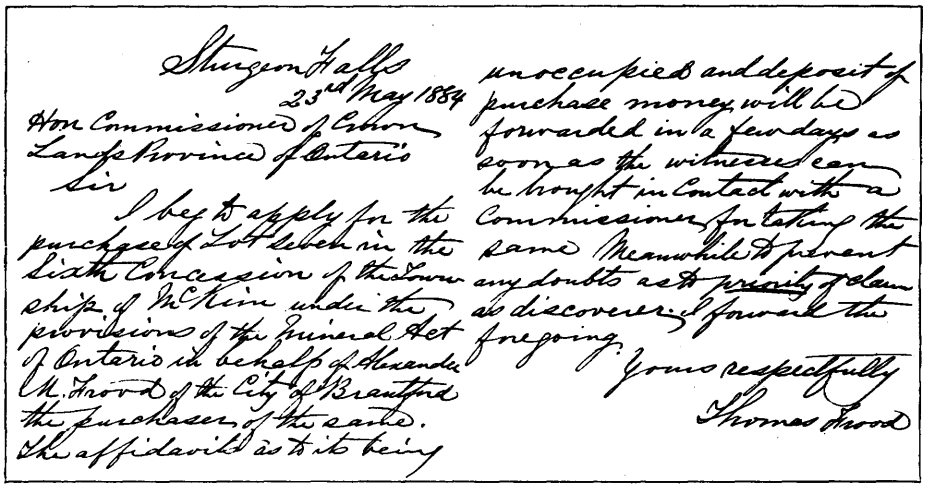
In the early history of the field well-known names of prospectors were those of Henry Ranger, Rinaldo McConnell, Thomas Frood, F. C. Crean, James Stobie, Robert J. Tough, Wm. McVittie, and J. T. Cryderman.

[1]See Appendix to this report.

Literature

The nickel deposits of the Sudbury area have been the subject of numerous reports and papers over a long period of time. A summary of these up to the year 1917 is given in the report of the Royal Ontario Nickel Commission. A complete list of the more important papers on the Sudbury ore deposits appears in the Appendix to this report. Many of the articles were the result of a few days' visit in the area, and were on some special phase of the geology or deposits and unaccompanied by geological maps.

Extended reports were published by the Ontario Department of Mines, the Mines Branch of the Canadian Department of Mines, and the Geological Survey of Canada, including those by Bell, Barlow, Coleman, and Knight. The map and report by A. P. Coleman[1] in 1905 was the first to show the continuity of the norite-micropegmatite in its elliptical form with the nickel deposits impinging



Sturgeon Falls
23rd May 1884

Hon Commissioner of Crown
Lands Province of Ontario

Sir

I beg to apply for the
purchase of Lot 58 in the
Sixth Concession of the Town-
ship of McKim under the
provisions of the Mineral Act
of Ontario on behalf of Alexander
M. Frood of the City of Brantford
the purchaser of the same.
The affidavit as to it being
unoccupied and deposit of
purchase money will be
forwarded in a few days as
soon as the witnesses can
be brought in contact with a
Commissioner for taking the
same Meanwhile to prevent
any doubts as to priority of claim
as discoverer I forward the
foregoing.

Yours respectfully
Thomas Frood

Facsimile of the original application for the Frood mine.

on the norite or only a short distance away in the adjacent rocks. This map, together with a later one published by the Canadian Department of Mines,[2] has been a great aid to those interested in exploratory work and diamond-drilling, and also to those having a scientific interest in the rock relationships. The deposit at the Falconbridge mine was discovered by using Coleman's map, on which the norite contact had been projected for some miles across a drift-covered area. Drilling was done through a thick mantle of drift, and the contact, which was ore-bearing, was readily found.

Scope of the Present Report

During the summers of 1927 and 1928 the authors of this report made a detailed geological examination of the sediments and associated rocks in the interior of the Sudbury basin. Following this it was thought advisable to make a similar and more detailed study of the rocks along the "southern nickel range," where important developments in connection with the nickel-copper ores were taking place. The area studied in detail comprises a strip of territory approxi-

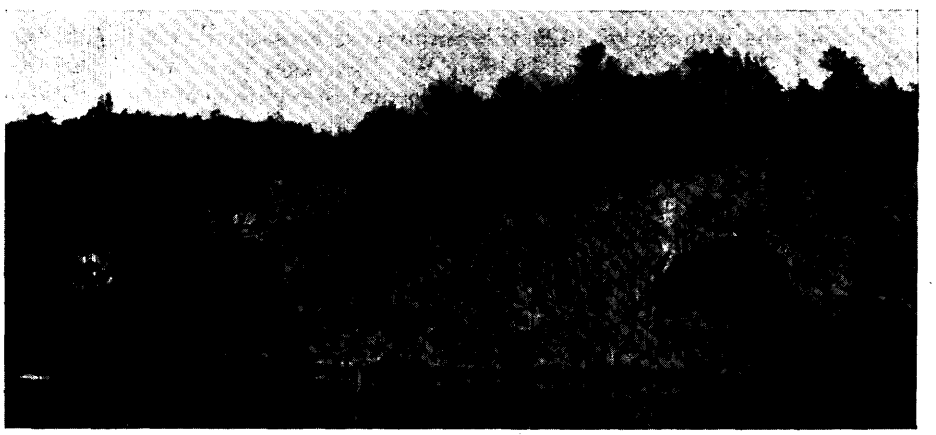
[1]A. P. Coleman, "The Sudbury Nickel Field," Ont. Bur. Mines, Vol. XIV, pt. 3, 1905.
[2]Map No. 171, Mines Branch, Bull. No. 170.

mately six miles in width, extending from the east boundary of Falconbridge township in a southwesterly direction to the Worthington mine in Drury township. The northern boundary of the area lies along the outer edge of the norite.

This report, and the map (No. 43d) accompanying it, is not intended in any way to be a substitute for the much more extensive reports of A. P. Coleman, which covered the entire Sudbury nickel region. The accuracy of his maps and their wide application by the various companies operating in the field bear abundant testimony to the importance of Coleman's work.

Field Methods

The Sudbury area shows a complex assemblage of rock types, and detailed survey work was found to be necessary. The concession and lot lines, together with the numerous surveyed roads, afforded tie lines. Aerial maps with photographs were obtained from the Department of the Interior at Ottawa and were



Open pit and crosscuts, Stobie mine.

of considerable assistance. The nature of the topography lends itself admirably to plane-table surveying, and this method was extensively used in conjunction with carefully made traverses. The general scale used in the plane-table work was 400 feet to the inch, but in important sections a larger scale was used.

Acknowledgments

Throughout the course of the work the authors had the co-operation of the mining officials at the various mines in the area. It is a pleasure to acknowledge the assistance and courtesy extended by these gentlemen on many occasions.

Thanks are due to the following officials of the International Nickel Company of Canada: the late John L. Agnew, formerly vice-president; Donald MacAskill, general manager; J. C. Nicholls, assistant to the president; E. A. Collins, assistant to the general manager; R. D. Parker, mines superintendent; and many of the engineers at the various mines of the company. A. B. Yates, chief geologist, and members of the geological staff, who have been engaged in detailed geological mapping of the properties in which the International Nickel Company is interested, have been consulted and have given many valuable suggestions.

At the Falconbridge mine, E. Craig, general manager, and members of his staff, including F. M. Galbraith, R. Oliver, and C. Boehm, supplied underground

plans, and otherwise assisted in every possible way. H. J. Conolly, formerly of the geological staff, furnished valuable information.

C. W. Knight spent a few days in the field with the senior author during the summer of 1931. The junior author of the report, appreciating Mr. Knight's extensive knowledge of the Sudbury area, has consulted with him in the completion of the report and wishes to acknowledge his indebtedness for suggestions. Similar assistance has been rendered the junior author by the following members of the staff of the University of Toronto: T. L. Walker, E. S. Moore, and A. McLean.

W. H. Collins, Director of the Geological Survey at Ottawa, who has been making a study of certain features in connection with the geology of the Sudbury area, has been consulted and has given valuable suggestions.

Thos. W. Gibson, formerly Deputy Minister of Mines, and the late W. R. Rogers, Director of Publications and Statistics, of the Ontario Department of Mines, assisted in the preparation of the report, particularly in the chapter on the growth of the nickel industry.

During the summer of 1929 the authors were assisted in the field by S. Perry and J. Sutherland, and in 1930 by W. S. Savage, V. B. Meen, and C. H. Knight. Most of the plane-table surveying and draughting of the preliminary maps was done by Mr. Savage, who assisted the junior author in the final work on the report in 1934.

Topography

The Sudbury area is named from the city of Sudbury, which is the centre for the mining, agricultural, and lumbering industries in the district, as well as being a railroad centre.

While the area is very rugged in detail, rock ridges alternating with flat, drift-covered valleys, it is not one of high relief. The general average elevation is not more than 1,000 feet above sea-level. The area has been so severely burned over, following lumbering operations, that bare ridges stand up prominently, especially around Sudbury. Gradually a second growth is replacing the former forest and softening the desert-like appearance in parts of the area. The elimination of roast-yards and the increased height of the sulphur fume disposal stacks is ameliorating the damage to vegetation. All flat areas of clay land that are not too low and swampy have been taken up as farm land, and the valleys are now dotted with farm buildings. The success in growing farm products is indicated by the splendid market at Sudbury.

The general alignment of the rocky ridges is usually northeast and southwest, which is the general strike of the schistose formations. Where there are intrusions of massive rock there is more irregularity in the strike of the ridges.

The hills of hard massive gabbro near Sudbury are prominent topographic features, as are the ridges of arkose and granite. One of the highest elevations is the ridge of greenstone south of the Elsie mine, which reaches a height of 1,162 feet. This point has been chosen by the Forestry Department as the location of a lookout tower, and also by the Geodetic Survey of Canada as a triangulation station.

The softer greywackés and other schistose formations are less elevated, but still form conspicuous ridges.

Several narrow canyon-like depressions are evidently the loci of faulted areas. Their general strike is northeast and southwest. One is indicated a half mile north of Naughton. They are usually swampy and may carry a small meandering creek. Due to the extensive alteration of the ancient rocks it is

difficult to show the existence of faulted relations, especially as crushing has occurred so frequently in the area.

Stratified clay occupies much of the flat plains, as seen along the "Soo" road southwest of Sudbury and also north and northeast of this city. North of Sudbury Junction on the Canadian National railway the stratified clay gives place to deposits of sand and gravel. This area of glacial deposits extends northeastward to Wanapitei lake. The topography is of a rolling character, and many kettle-like depressions occur in the sand and gravel. The nickel-copper ores of the Falconbridge mine were discovered by magnetic surveys followed by drilling through deposits of sand and gravel as much as 50 to 250 feet in thickness. Such deposits furnish an abundant supply of building and road materials, and some layers of sand are used as flux in the smelter at the Falconbridge mine.

CHAPTER II

Growth of the Nickel Industry

Introduction

The growth of the nickel industry is reflected in the table given below showing the production statistics. Early in the twentieth century Sudbury took a place of importance in the production of nickel and in a short time assumed the leadership that it still maintains. World consumption of nickel received a great impetus during the war years, 1914–1918, owing largely to its use in the armour-plate industry. Following the war there was a sharp falling-off in the demand for nickel, as a result of which careful research was undertaken by the nickel-producing companies to find other uses for the metal. The success that attended these efforts is reflected in the many uses to which nickel is now put and the consequent steady increase in consumption. A second decrease in consumption accompanied the recent industrial depression, but this depression appears to have been passed as far as nickel is concerned and there seems no apparent reason why the demand for the metal should not continue to increase.

Production Statistics

In the Report of the Royal Ontario Nickel Commission, published in 1917, there appears a tabulation by years, from 1887 to 1916, inclusive, showing the tonnage of ore smelted, together with the nickel and copper content of the resulting matte.[1] The table below gives a summary for this period and one for the subsequent years, 1917 to 1934, inclusive. The figures throughout are tons of 2,000 pounds.

NICKEL AND COPPER PRODUCTION OF SUDBURY, 1887–1934

Period	Ore smelted	Nickel	Copper
	tons	tons	tons
1887–1916	10,866,392	284,839	175,003
1917–1934	24,701,752	665,250	566,013
Total	35,568,144[2]	950,089	741,016

Figures for platinum metals recovered as a by-product in nickel refining are available from 1920 onwards. Grouping nickel, copper, and platinum metals, the combined valuation nearly equals that of gold, the most valuable metal industry in the province, as will be noted from the tabulation below:—

PRODUCTION OF THE CHIEF METAL INDUSTRIES IN ONTARIO

Industry	Total to end of 1933	1934	Total to end of 1934
Nickel	$359,383,615	$32,139,425	$391,523,040
Copper	145,225,872	14,822,704	160,048,576
Platinum metals	24,806,192	6,187,992	30,994,184
Total	$529,415,679	$53,150,121	$582,565,800
Gold	514,241,986	72,656,345	586,898,331
Silver-cobalt	283,615,892	3,192,259	286,808,151

[1]Page 495.

[2]All of this ore came from the Sudbury area, with the exception of that shipped to the Mond Nickel Company from the Alexo mine in Dundonald township. From 1912 to 1919, inclusive, a total of 51,857 tons was raised and shipped from this mine. It was readily salable, as it averaged 4.4 per cent. nickel and 0.6 per cent. copper.

In order to appraise the relative importance of the nickel industry a complementary statement is presented showing the record of dividends and bonuses paid by the metal-mining groups of Ontario.

DIVIDENDS AND BONUSES PAID BY THE METAL-MINING INDUSTRIES OF ONTARIO

Industry	Total to end of 1933	1934	Total to end of 1934
Nickel-copper	$149,723,449	$10,126,014	$159,849,463
Gold	153,107,392	26,841,466	179,948,858
Silver-cobalt	97,691,281	260,000	97,951,281

The details presented in the following table of nickel-copper production from 1887 to 1916, inclusive, have been abstracted from the Report of the Royal Ontario Nickel Commission:[1]—

NICKEL AND COPPER PRODUCTION OF SUDBURY, 1887–1916

Year	Ore smelted	Nickel	Copper
	tons	tons	tons
1887–1889[2]	80,000	2,400	2,240
1890	59,329	1,780	1,661
1891	71,840	2,155	2,012
1892	61,924	2,082	1,936
1893	63,944	1,653	1,431
1894	87,916	2,570	2,748
1895	86,546	2,316	2,365
1896	73,505	1,948	1,868
1897	96,094	1,999	2,750
1898	121,924	2,784	4,187
1899	171,230	2,872	2,834
1900	211,960	3,540	3,364
1901	270,380	4,441	4,197
1902	233,388	5,945	4,066
1903	220,937	6,998	4,005
1904	102,844	4,729	2,042
1905	257,745	9,503	4,524
1906	340,159	10,776	5,260
1907	359,076	10,602	7,003
1908	360,180	9,563	7,501
1909	462,336	13,141	7,873
1910	628,947	18,636	9,630
1911	610,788	17,049	8,966
1912	725,065	22,421	11,116
1913	823,403	24,838	12,928
1914	947,053	22,759	14,448
1915	1,272,313	34,039	19,608
1916	1,521,689	41,299	22,430
Total	10,322,515	284,838	175,003

For the subsequent period, 1917 to 1934, inclusive, similar figures are given in the following table, with the addition of the output from New Caledonia and Norway. The figures for New Caledonia, with the exception of the production for 1934, were obtained through the courtesy of the International Nickel Company of Canada, Limited. The production for 1934 is calculated from returns

[1]Page 495.
[2]Estimated.

published by the Bulletin du Commerce,[1] which reports for that year an output of 6,550 metric tons of matte. The figures for Norway were obtained from "Mineral Industry"[2] edited by G. A. Roush, in which the annual article on nickel has been prepared by Thos. W. Gibson, former Deputy Minister of Mines for Ontario. Some of the figures for nickel production are only approximately correct since, in many cases, the amount of nickel reported is based on the nickel content of ore or matte produced. Minor producers of nickel include the United States, Greece, India, and others, but their total production is small.

SUDBURY NICKEL AND COPPER PRODUCTION, AND NEW CALEDONIA AND NORWAY NICKEL PRODUCTION, 1917–1934

Year	Sudbury			New Caledonia	Norway
	Ore smelted	Nickel	Copper	Nickel	Nickel
	tons	tons	tons	tons	tons
1917	1,453,661	41,887	21,196	4,650	465
1918	1,559,892	45,886	23,483	3,025	467
1919	754,567	22,035	12,099	1,998	245
1920	1,087,531	30,557	16,000	2,464	465
1921	393,768	9,128	6,323	1,670	21
1922	314,120	8,678	5,421	2,310	102
1923	1,141,160	31,029	15,769	1,732	78
1924	1,307,694	34,638	18,490	2,365	.....
1925	1,258,849	36,596	19,636	3,700	.....
1926	1,309,782	39,038	24,159	4,200	.....
1927	1,350,214	39,623	25,969	3,700	34
1928	1,476,704	43,393	29,704	4,500	451
1929	2,033,457	58,095	46,315	4,500	487
1930	2,357,154	61,112	70,800	5,600	718
1931	1,689,874	40,643	38,811	4,600	587
1932	793,552	16,936	16,176	3,200	747
1933	1,523,814	41,632	72,750	3,400	860
1934	2,896,959	64,344	102,530	5,800[3]	1,092
Total	24,702,752	665,250	565,631	63,414	6,819

From the above table it may be deduced that Ontario, between the years 1917 and 1933, inclusive, produced approximately 90 per cent. of the nickel of the world.

Refining Operations

Prior to 1918 all refining operations were carried on outside of Canada. The Mond Company shipped nickel-copper matte to Clydach, near Swansea, in Wales, for refining, and the International Nickel Company of Canada, Limited, shipped its matte to Bayonne, N.J. Some of the latter was converted into Monel metal, a nickel-copper alloy containing approximately two-thirds nickel and one-third copper. To-day the Coniston smelter supplies all the matte of Monel grade, the ore coming from the Creighton mine. Monel metal is made at Huntingdon, W.Va.; Bayonne, N.J.; and Birmingham, England.

In September, 1918, the new electrolytic refinery of the International Nickel Company at Port Colborne commenced operations. This voluntary act met the agitation for the home-refining of nickel, which was more or less active for years, particularly during the Great War. A change in practice was effected at the close

[1]Issue of June 12, 1935.
[2]Published by McGraw-Hill Book Company of New York and London.
[3]Estimated.

of 1931 by the transfer from Port Colborne to Copper Cliff of the Orford process (i.e. the first separation of matte into copper "tops" and nickel "bottoms"). This operation requires large quantities of nitre cake, which is now manufactured at Copper Cliff, using sodium sulphate from Saskatchewan and sulphuric acid, which is produced in large quantities at the plant of Canadian Industries, Limited, from sulphur fumes recovered in the ore-smelting operations. Now nickel "bottoms" only are shipped to Port Colborne for electrolytic refining, where, in addition to nickel, there is a recovery of gold, silver, and platinum metals in the form of slimes. These are shipped to Acton, a suburb of London, England, where the International Nickel Company, through its subsidiary the Mond Nickel Company (a retention of the old name for the operations in Britain), refines all its precious and platinum metals. This refinery handles as well the precious and platinum metal slimes recovered at the Mond nickel-copper smelter located at Clydach, near Swansea, in Wales.

In July, 1930, an electrolytic copper refinery at Copper Cliff was placed in operation by the Ontario Refining Company, Limited; the control of its stock is held by the International Nickel Company of Canada, Limited. It is a customs refinery and treats blister copper from Manitoba as well as from Ontario. Beginning in 1932, copper "tops" resulting from the Orford process operation at the Copper Cliff smelter, after being blown to blister copper, were sent to this refinery, which also treats blister copper resulting from direct smelting of Frood ore. Great economies in freight charges have been effected by carrying out the Orford process operation at Copper Cliff rather than at Port Colborne.

The British America Nickel Corporation, Limited, the controlling interest in which is held by the British Government, commenced raising ore from the Murray mine in 1918. The smelter, however, was not blown in until January, 1920. Their refinery, which employs the Hybinette electrolytic process, commenced operations in 1920 at Deschênes, Que., but owing to the lack of a post-war market for nickel was closed down in July, 1924. In 1925 the Murray mine was purchased by the International Nickel Company from the bondholders of the defunct British America Nickel Corporation.

Another company in the Sudbury area, Falconbridge Nickel Mines, Limited, completed its smelter of 100 tons daily capacity in 1930. A nickel refinery at Kristiansand, Norway, was acquired and remodelled, and under the agreement Norwegian nickel ore is treated on a customs basis in addition to the matte shipped from Canada. It also commenced operations in 1930, and uses the Hybinette process of separation. The nickel is marketed chiefly in European countries.

The following table gives the production figures for platinum and precious metals resulting as by-products from the smelting and refining of Ontario nickel-copper ores. Statistics for platinum metals are available only from 1920; prior recovery is estimated at $1,500,000.

PLATINUM AND PRECIOUS METALS RECOVERED FROM NICKEL-COPPER REFINING, 1918–1934

Year	Platinum metals		Gold		Silver	
	ounces		ounces		ounces	
1918	.....	.....	58	$1,152	2,704	$2,724
1919	.....	.....	328	6,562	20,570	23,864
1920	10,056	$1,996,535	290	5,805	37,957	33,884
1921	13,418	862,034	2,358	48,637	49,515	30,953
1922	11,788	924,712	2,094	43,187	50,239	33,695
1923	15,625	1,418,633	3,574	73,223	100,982	64,966
1924	18,697	1,891,497	4,125	84,646	122,889	81,843
1925	16,980	1,675,706	4,016	82,437	134,390	92,682
1926	19,495	1,559,527	4,447	91,367	151,429	90,980
1927	22,762	1,270,843	4,866	99,908	188,180	105,759
1928	23,539	1,309,923	3,850	79,586	222,924	129,688
1929	29,615	1,646,381	7,802	161,282	429,541	227,625
1930[1]	68,040	2,436,683	22,867	472,703	1,067,154	407,161
1931	91,643	2,812,834	23,381	483,328	822,971	230,702
1932	64,897	1,998,911	22,675	468,727	663,795	200,080
1933	55,755	1,501,233	36,983	764,508	1,026,370	388,303
1934	200,109	6,187,992	60,370	2,082,483	1,882,293	864,646
Total	662,419	$29,493,444[2]	204,084	$5,049,541	6,973,903	$3,009,555

Properties and Uses of Nickel

Nickel possesses a number of inherent properties, quite distinct from each other, but all of great importance for manufacturing and industrial purposes. It is mostly used in alloying with other metals, and confers special properties upon the products. It is magnetic, and in one alloy (Permalloy), because of its higher magnetic permeability, it increases five-fold the number of messages capable of transmission by cable. Nickel is practically incorrodible and is not affected by sea-water, alkalies, or acids. A small proportion, say 2½ or 3 per cent., added to steel greatly increases its strength and elastic limit. Nickel-steel is the most important of the nickel alloys and has become the standard material for construction wherever a maximum of strength and a minimum of weight are required. Nickel offers powerful resistance to the effects of heat in the annealing or heat-treatment of other metals. It is equally resistant to cold, its alloys remaining unaffected by low sub-zero temperatures. It acts as a catalyst in the hardening of fats and oils. It forms alloys with ferrous and non-ferrous metals alike. In fact, the properties of nickel are such as to render it invaluable for a host of purposes, not only in the advances constantly being made in the fields of engineering and construction, but in many applications of other kinds which modern research has opened up.

It would be tedious to enumerate all the uses to which nickel and its alloys are put, but a few of them may be mentioned, particularly those that are of recent introduction. The largest consumer of nickel is the automobile industry in the construction and equipment of cars, trucks, and buses. A variety of alloys is required for such purposes, including nickel-steel, stainless steel (of which nickel is a constituent), Monel metal, and nickel-chromium alloys; pure nickel is also used for nickel-plating. It is estimated that about 30 per cent. of the nickel used in the United States and Canada is so employed. The use of nickel in cast iron is of recent origin but is rapidly increasing, both on this continent and in the

[1]Includes 5 ounces of gold, 62 ounces of silver, and 18 ounces of platinum from Strathy township.

[2]If the estimated production of $1,500,000 to the end of 1919 is included, the total platinum production from refining operations would amount to $30,993,444.

countries of Europe. An outstanding development is the adoption of welded nickel-steel for the pressure vessels and equipment used for the dewaxing process in the refining of oil. This process requires a temperature of about 75 degrees below zero, Fahrenheit, and nickel steels have proved to be exceptionally suitable under such conditions, which engender brittleness and fragility in ordinary steel. In railway equipment nickel-steels and nickel-irons find much use, as in axle and locomotive rod forgings, and in frame and other castings. "Ni-hard" metal, another alloy, is being increasingly used in the mining industry for the wearing parts of crushing and grinding machinery. Two hundred and fifty automobile rail cars have been made in France of nickel steel-welded frame construction, and this alloy appears to be supplanting heat-treated carbon steel forgings for electric locomotives. Pure nickel, as well as nickel-clad steel, are preferred for equipment used in the manufacture of caustic soda; and in the brewing industry, tanks, containers, and other apparatus are being made of stainless steel to guard against rust. Stainless steel has also been used in constructing a sea-plane for the Mediterranean service, capable of carrying 75 passengers.

Monel metal, an alloy of about 64 per cent. nickel, 33 per cent. copper, and a little iron, has come into much favour, especially in Europe, where it is used for house equipment and many other purposes. In the present home-modernizing campaign in the United States and Canada, Monel-metal sinks, hot-water heaters, storage tanks, etc., are meeting a favourable reception, the alloy, like the parent metal, being rust-proof. Heavier coats of nickel, which retain their brightness and require no polishing, are coming into use, particularly for outdoor service. The Edison storage battery constructed with nickel elements is being adopted among other uses for the air-conditioning of passenger cars. In such diversified fields as alkali, rayon, and plastic manufacture, nickel is essential because of its resistance to corrosion and its strength. It is now finding use in the chemical and fruit-products industries, and experience has shown that citric, malic, and other fruit acids may be used in contact with nickel without harmful effect. Much malleable nickel is used in the auxiliary apparatus, including hoppers, sinks, conveyors, etc.

Ore Reserves

Proved ore reserves of the International Nickel Company of Canada, Limited, on December 31, 1934, were 204,399,463 tons, according to their last annual report. The last annual report of the Falconbridge Nickel Mines, Limited, shows ore reserves of 2,960,238 tons on December 31, 1934.

CHAPTER III

Geology of the Sudbury Area

Introduction

The general geology of the Sudbury area, with which this report is concerned, has been described by various authors in earlier reports and is too well known to require more than brief mention. The oldest rocks of the area comprise a complex series of lavas, intrusives, and sediments lying along the south side of the nickel irruptive and forming the lowest member of the Sudbury series, which is considered to be Timiskaming in age. The remainder of the rocks classed as Sudbury consist of arkose, greywacké, conglomerate, and quartzite, which are mapped and referred to in the report as Copper Cliff arkose, McKim greywacké, Ramsey Lake conglomerate, and Wanapitei quartzite, respectively, according to Coleman's nomenclature. These members of the Sudbury series form a monoclinal structure extending to the southeast in the order given from the oldest, the lavas and associated sediments, to the youngest member, the quartzite. The quartzite is in intrusive contact with the granite along its south side.

The most important structural feature of the Sudbury area is the Sudbury basin, which takes the form of a spoon-shaped trough, approximately 37 miles long by 17 miles wide. The centre of the basin is occupied by a series of volcanic fragmental rocks and sediments, known as the Whitewater series, which is presumed to be Animikean in age. The series consists of the Onaping volcanics, Onwatin slate, and Chelmsford sandstone. They are comparatively flat-lying, dipping gently toward the centre of the basin in conformity with the main structure. The series lies outside the map area of this report, but its mention is necessary to any consideration of the geology of the Sudbury area. Following the deposition of the Whitewater series came the intrusion of the nickel irruptive in the form of a sill or sheet-like mass along the floor of the Whitewater series. The nickel irruptive, or norite-micropegmatite, is considered to be Keweenawan in age. There are a number of other intrusive rocks, which occur most widely in the area south of the "southern nickel range" and consist of gabbro, granite, and dikes of trap and olivine diabase, all probably Keweenawan in age. The gabbro appears to be older than the norite-micropegmatite, but most of the granite is younger, as are all the basic dikes.

Table of Formations

KEWEENAWAN:	Olivine diabase. Trap dikes. Granite. Sudbury nickel irruptive. Quartz diorite. Norite-micropegmatite. Gabbro.
	Intrusive contact
WHITEWATER SERIES: (Animikean?)	Chelmsford sandstone. Onwatin slate. Onaping tuffs and agglomerates.
	Unconformity
ALGOMAN (?):	Granite, gneiss.

Intrusive contact

SUDBURY SERIES: (Timiskaming?)	Wanapitei quartzite. Ramsey Lake conglomerate. McKim greywacké. Copper Cliff arkose. Basic intrusives: amphibolite, gabbro, diabase. Greenstone-sediment complex of basic to acid lavas and tuffs with associated sediments, including greywacké, quartzite, arkose, staurolite-bearing sediments, tuffs, and agglomerate.

Sudbury Series

The general relations of the various sediments and included greenstones in the large area lying southeast of the nickel irruptive has always been an exceedingly difficult problem for geologists. The rocks are much altered and highly inclined, and clearly defined relationships in which great age distinctions can be recognized are not found.

Coleman has placed the bulk of the ancient sediments in the Sudbury series,[1] but the greenstones are considered by him as largely intrusive.[2]

The lavas are confined to a zone that roughly parallels the nickel irruptive, and included with them are many old sedimentary bands consisting of staurolite-bearing sediments, greywackés, quartzites, arkose, tuffs, and agglomerate. In places the lavas are interformational with some of the sediments, consequently it is difficult to assign different ages to the two types of rock. In the southwestern part of the area, near the Sultana mine, Collins[3] has grouped the greenstones, lavas, etc., with the Keewatin. These greenstones have been followed northeastward for many miles, their formational arrangement with the sediments being everywhere visible; consequently, whichever age is assigned to the greenstones would of necessity include a number of the sediments also.

Owing to the great similarity of the greenstones south of the nickel irruptive to those lying to the north, e.g. at Moose mountain only a few miles away, the designation Keewatin in the classification seems warranted. But if these rocks are called Keewatin, it is difficult to choose a horizon above which the rocks could be placed in the Sudbury series, since there is no decided evidence of an unconformity at points lying south of the complex of lavas (greenstones) and sediments. No lavas are found, however, with the sediments above the south or upper edge of the prominent band of recrystallized arkose, which Coleman calls the Copper Cliff arkose.[4] The only basic rocks found with these sediments are the green-weathering gabbro and the later basic dikes.

An arbitrary break, largely lithological, could be placed at the south side of the arkose, leaving to the south the greywacké, conglomerate, and quartzite.

The examination of these rocks is also complicated by the presence of huge masses of breccia here and there in the formations. The fragments are chiefly varieties of greenstone and sediments recognized in the area. Such rocks occur frequently along the contacts of the various formations and may be so irregular in outline as to obscure contact relations.

A few hundred feet northwest of the Stobie mine there are large exposures of breccia and several masses of lava, showing pillows, which are too large to be inclusions. There is a considerable variety of fragments in the breccia, which suggests that it may be volcanic *ejectamenta*, with which there is some lava,

[1] A. P. Coleman, "The Nickel Industry," Mines Branch, Can. Dept. Mines, Bull. No. 170, 1913, pp. 5, 6.
[2] Ibid, p. 5.
[3] W. H. Collins, Geol. Surv. Can., Sum. Rept., 1928, pt. C, p. 13.
[4] A. P. Coleman, "The Sudbury Nickel Field," Ont. Bur. Mines, Vol. XIV, pt. 3, 1905, p. 14.

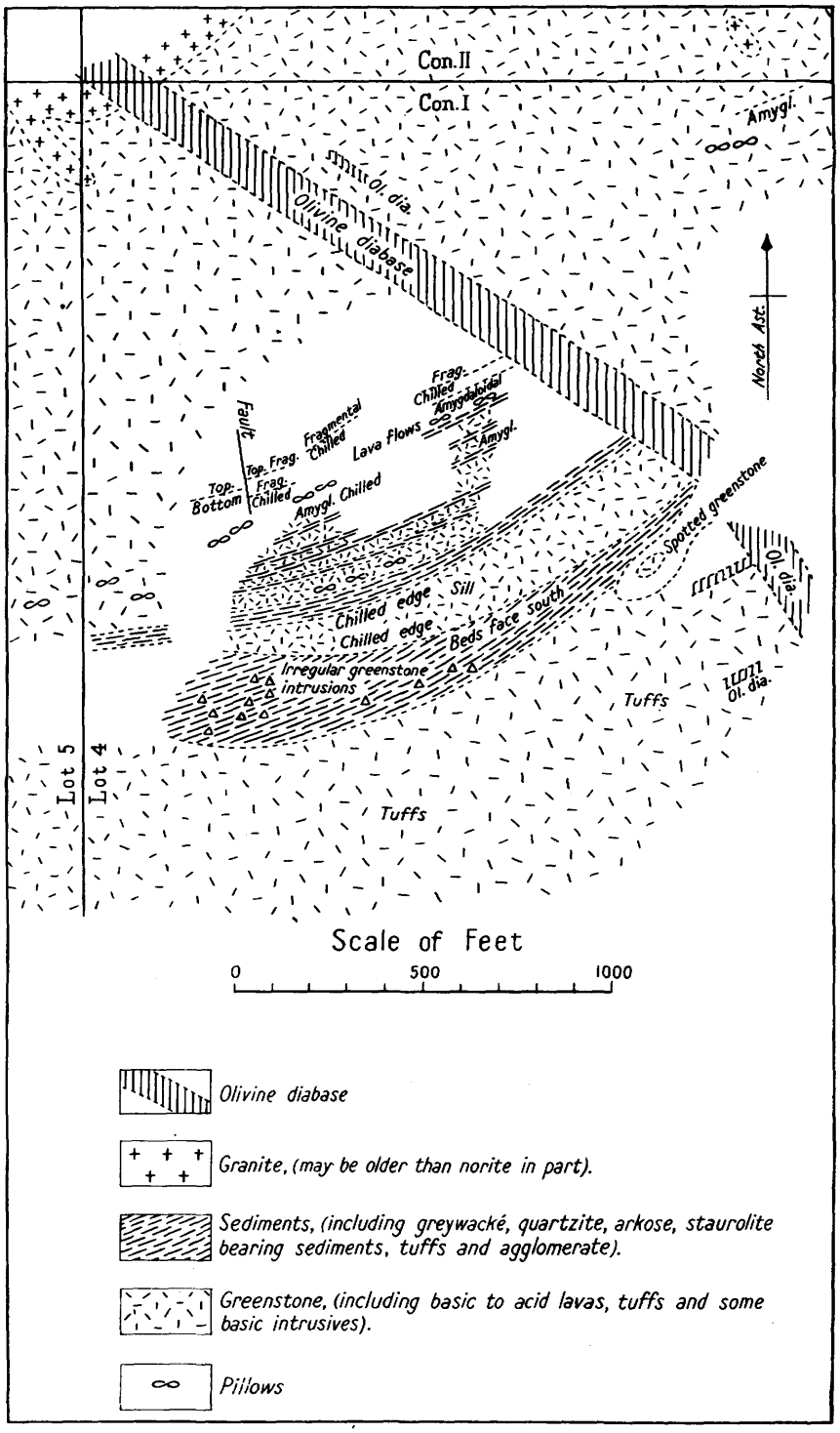


Fig. 1—Geological sketch map showing the alternation of flows and sediments in the northwestern part of lot 4, concession I, Snider township.

represented by the material showing the pillow structure and amygdules. The irregular distribution of the lavas in this locality seems to indicate that they are of cone origin rather than fissure eruptions like the lavas lying north of the Copper Cliff–Creighton road.

GREENSTONE-SEDIMENT COMPLEX

The name "greenstone-sediment complex" is given to a band of rocks comprising essentially interbedded lava flows and sediments, which are the oldest rocks of the area. They lie adjacent to and along the south side of the norite of the southern range. At the bottom or north side the greenstone predominates, whereas at the top the rock is largely sedimentary in character. The change takes place with the appearance in the greenstone of narrow sedimentary or tuffaceous bands, which increase in width and extent as the greenstone bands become narrower. Coincident with the change from lavas to sediments there is also a change in the greenstones from basic types at the bottom to more acid types at the top. The greenstones and sediments are intruded by basic rocks consisting of diabase, gabbro, and amphibolite. On the map accompanying the report these various types are only partially differentiated, since in many cases the detailed separation is impossible except in large-scale mapping.

Greenstone

The name greenstone is given to a great variety of green-weathering igneous rocks, which occur principally along the south margin of the nickel irruptive, or south of the granite masses. As already mentioned, they are intermingled with old sediments that are well stratified, or with an abundance of coarse breccias composed mostly of old rocks that occur in the field. Included under the general head of greenstones are certain pillow lavas, amygdaloidal lavas, and basic rocks showing porphyritic structure, together with some volcanic fragmental tuffs and agglomerates.

The pillow and amygdaloidal lavas are surface flows that have been tilted on edge, so that cross-sections show nearly their original thickness. The continuity of the lava flows is interrupted by intrusions of igneous rocks, mostly basic, and drift areas make it impossible to be positive of the continuity of certain beds for any great distance. In addition the flows in places alternate with well-stratified sediments, which range in width from a few inches up to 100 feet or more. In this association there appear to have been periods of vulcanism, with fairly thin flows, alternating with sedimentation in shallow water, for most of the bedded sediments are comparatively coarse in grain. Probably the best locality in which to see the alternation of flows and sediments is lot 4, concession I, Snider township. A study of this locality shows that the flows all face southeast, and the sediments with them also face southeast, as indicated by their grain.

The pillow structures and amygdaloidal character of these lavas are wonderfully shown when it is considered that the mineral composition is entirely changed from that of the primary rocks. All the lavas are characterized by a preponderance of hornblende, an alteration from pyroxene, and the feldspars are altered to secondary feldspar, quartz, zoisite, and epidote. These lavas are probably of fissure eruption origin. Some of the thin beds of sediment with them may be volcanic mud, although the thicker sediments are well stratified and are more likely the result of erosion.

The lavas frequently show a chilled edge at the bottom and a breccia at the top. Pillow structure was observed both at the bottom and the top of the

lava flow. The structure often grades into the non-pillow type of lava. Amygdules are more frequent near the top of a flow, but large ones were observed near the bottom of some flows.

Igneous rocks of composition similar to the lava flows occur in the sediments. They are either dikes or highly inclined sills, since they show chilled edges against the sedimentary beds. They also vary greatly in size of grain from coarse to fine. Under the microscope they are predominantly hornblendic like the lavas. Lavas and sediments, together with intrusive rocks, form a band lying between the norite and the Copper Cliff arkose.

In some places the intrusive basic rock distinctly cuts across the bedding of the sediments; in others it is parallel to the beds. Generally the outcrops of lavas, sediments, and intrusives have their long dimension in a northeast and



Eye and eyebrow structures occurring in rhyolite southwest of the Stobie mine.

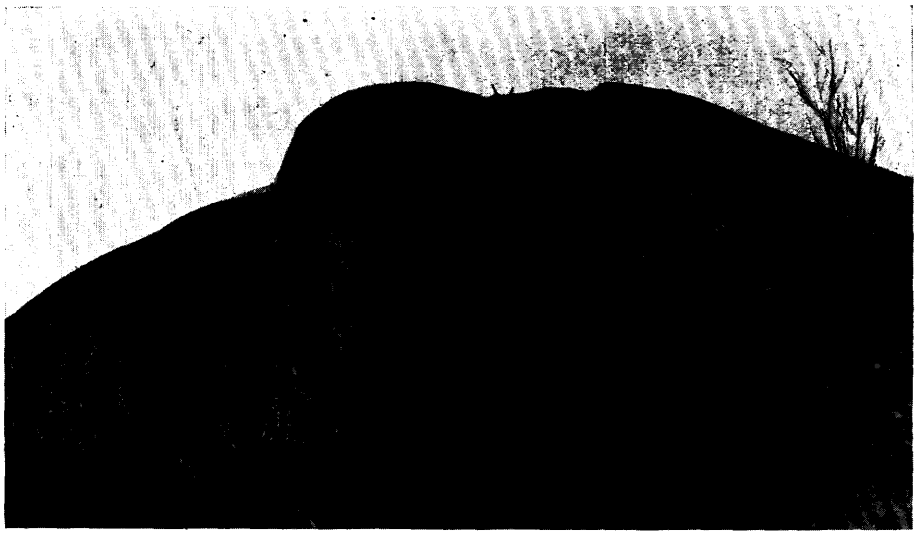
southwest direction. This linear arrangement can be seen in bands several miles long.

Basic Lavas

The basic rocks of the greenstone complex present many features in common. They are dark-green or black in colour. Microscopically, the common type consists principally of green hornblende, either in frayed crystals of the actinolite variety or of compact hornblende, showing good cleavage and crystal outline, together with a mosaic of recrystallized clear feldspar (albite). Other minerals are chlorite, quartz, zoisite, epidote, apatite, magnetite, and garnet. Some of the minute feldspar grains show fine twinning. Small lens-like white spots in some of the lavas resemble amygdules in hand specimens. Microscopically these are now mosaics of clear feldspar, possibly an alteration from original phenocrysts. Such terms as green schist and amphibolite are applicable to some of the greenstones where these are schistose or coarse-grained. On the general map many types of basic rocks are grouped under one colour. Their resemblance suggests that most of them have been derived from some common magmatic source, either as surface flows, dikes, or sills.

Acid Lavas

Acid rocks of the composition of rhyolite are of frequent occurrence in the greenstone-sediment complex and have been only partially differentiated on the map from the basic greenstones. They are distinguished from the basic greenstones by their lighter colour, which is due to the fact that they consist essentially of minerals of the acidic type, such as quartz and feldspar, and from the sedimentary rocks by the absence of structure, such as bedding. In some cases they show suggestions of flow structure, but in most cases they have been so highly metamorphosed that flow lines have been obliterated. One peculiar structure noted in some of the rhyolitic rocks consists of crescent-shaped bodies of quartz associated with rounded pea-like inclusions, also of quartz. The crescents are from 3 to 6 inches long and the smaller pea-like masses are approximately an inch in diameter. In many cases the two are together with the smaller



Staurolite-bearing sediments along the road southwest of the Frood mine.

mass from one to three inches from the crescent and always on the concave side. In the same flows these crescents assume always the same attitude with respect to the flow, that is, with the convex side toward the flow top. An excellent outcrop showing these structures lies about 200 yards north of the No. 4 shaft of the Frood mine.

Sediments Associated with the Greenstone

Most of the sediments associated with the greenstone, which are the oldest in the area, lie adjacent to the granite and norite on the south side. They are much intruded by greenstone and are dislocated and otherwise disturbed. These sediments are now largely altered to schist. They include light-coloured, bedded sericitic rocks, with conspicuous altered crystals of staurolite or chiastolite, either single or twinned, varying in size from very minute ones to crystals several inches in length. The outlines of the original crystals show up distinctly on a weathered surface, but in freshly broken material they are difficult to recognize. The authors believe from their examination of the crystals that the material was originally staurolite, but other workers in the area suggest that they are pseudomorphs after chiastolite. Excellent exposures of the rock may be seen

in many parts of the area, especially just southwest of the Frood mine. Well-bedded greywacké, quartzite, and arkose are also prominent, together with beds of tuff and agglomerate. Black-weathering pitted rocks, which frequently have the appearance of conglomerate and grade into a rock that resembles arkose, occur in the area. Crystals of feldspar are conspicuous in many outcrops of this rock, which shows no indication of bedding lines.

A narrow band of conglomerate with well-rounded and elliptical pebbles, clearly suggesting a water-worn origin, occurs south of the gossan between the Frood and Stobie mines. It is linear and outcrops at intervals for a mile or so. A duplication of this bed of conglomerate has not been recognized to the north or south, and the bed is seemingly a monoclinal structure with the other sediments and lavas.

These sediments are prominent in the area northwest of Sudbury. With them is a profusion of basic igneous rocks. As this zone of rocks is followed



Greenstone-sediment complex cut by a granite dike north of Meat Bird lake, Snider township.

southwest towards Worthington there is an increasing volume of igneous rocks, and the sedimentary beds occur here and there as narrow strips in the lavas and associated basic intrusives. An attempt was made to separate the small occurrences on the map. Areas of sediments a few hundred feet long and 50 feet or so in width frequently occur. In some places the greenstone truncates the bedding at small angles; in others it may be parallel to the stratification. Field work failed to find any repetition of characteristic beds which would indicate close folding. The tops of the lava flows, when they could be deciphered, appeared always to face the south or southeast.

A prominent band of these old sediments, interbedded with greenstones, forms part of the Creighton granite mass. This band extends from Meat Bird lake northeastward to Clarabelle lake with an average width of three-quarters of a mile. It is typical of the sediments described above, showing staurolite schists, tuffs, etc., with good bedding. The sediments are highly contorted, brecciated, and intruded by numerous dikes of granite. Northward it becomes more highly metamorphosed and merges into gneiss near the contact with the norite.

BASIC INTRUSIVES

Amphibolite

There are numerous outcrops of a usually coarse-grained igneous rock, which intrudes the greenstone-sediment complex lying to the north of the Copper Cliff arkose. This rock is now dominantly hornblende and may be called amphibolite. On part of the map it has been differentiated from the lava type of rock. Owing to its coarse grain it can generally be distinguished from the extrusive type of basic rock and it always shows a fine grain at its contact with the sediments. Often there is a crush breccia along the contact, many fragments



Rhyolite tuff occurring with Copper Cliff arkose,
lot 5, concession VI, Waters township.

of which are rounded. Bundles of hornblende crystals, frequently an inch in length, form a confused aggregate. This rock is definitely intrusive into the old sediments and greenstones, but was not observed in intrusive relationship with any of the later formations.

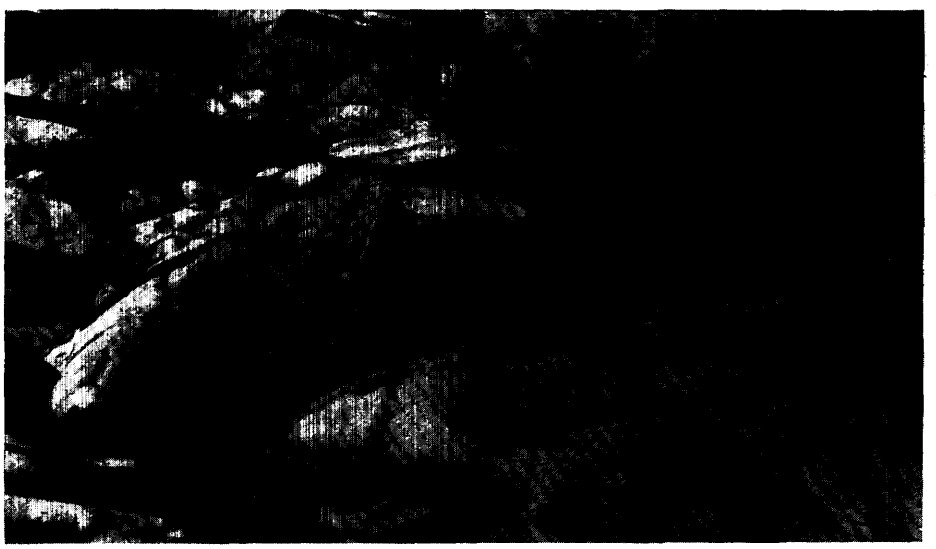
Other Basic Intrusives

Under this heading are included a variety of rocks consisting of gabbro, diabase, and "older norite," which are thought to be later than the greenstones, but actual age relationships are doubtful. They have not been differentiated on the map. Some of them may be Keweenawan in age, while others may be highly altered phases of the greenstones. Examples are to be seen at various points along the southern range near the norite, e.g. at the Mount Nickel mine, the Murray mine, and elsewhere.

COPPER CLIFF ARKOSE

A rock that has always puzzled geologists occurs in a high range of hills, which roughly parallels the nickel irruptive a few miles to the south. Between it and the nickel irruptive there is the complex of granite, greenstone, greywacké, quartzite, and schists of doubtful origin. This rock has been called by Coleman a recrystallized arkose,[1] and with respect to part of the band this interpretation appears to be tenable.

The rock is light in colour, from white and grey to pink and red. It shows on the whole an absence of structures for its identification as a sediment and usually has a felsitic or rhyolitic appearance. Prominent bleached feldspars are nearly always present on the surface. Brecciated structures and conglomerate-like inclusions are frequently observed. The rock is conveniently seen in ridges stretching southwestward from Copper Cliff for some miles, near the Copper



Bedded structures in Copper Cliff arkose, lot 5, concession VI, Waters township.

Cliff–Creighton road, and to the northeast crossing the railroads and the Sudbury-Frood road. Vague suggestions of bedding are found in places, but these may be pressure lines in the rock. On lot 5, concession VI, Waters township, there is a considerable area where good bedding may be observed and layered structure may be followed for a few hundred feet. The alternate banding is well brought out on the weathered surface. The bedded material consists of light-greyish fragments, up to an inch or more in length, of rhyolitic nature, alternating with finer material. The rock is probably an acid tuff.

Definite evidence of the rhyolitic character of at least part of the Copper Cliff arkose is to be seen on the south end of lot 6, concession V, McKim township, a few yards to the east of the Sudbury-Frood road and south of the dump where garbage is being burned. Here, there is a large outcrop of the rock with flow lines and spherulitic texture, well preserved. A photograph of a hand specimen of the rock is shown on page 21. At the same outcrop may be seen some basic lavas with good pillow structure interbedded with the rhyolite.

[1]A. P. Coleman, Ont. Bur. Mines, Vol. XIV, pt. 3, 1905, p. 8.

Microscopic examination does not afford much information as to the origin of the rock. Sections usually show a mosaic of interlocking grains of microcline, orthoclase, plagioclase, and quartz, with scattered biotite or hornblende, and an occasional large feldspar, like a phenocryst. Some of the small interlocking grains of quartz look like parts of a larger grain that has been broken up by pressure. Such original grains may be irregularly distributed in a section, suggesting a fragmental character for the rock.

It has been thought desirable to retain the name arkose, introduced by Dr. Coleman, even though recent studies seem to indicate the probability that much of it is of volcanic origin.

This band of arkose appears to be conformable with the sediments on either side of it. Other workers in the area state that the lower contact definitely bevels the beds of the underlying sediments, but this was not observed by the authors.



Polished specimen (one-half natural size) of rhyolite, showing flow structures, which forms part of the Copper Cliff arkose, lot 6, concession V, McKim township.

At its east end, on lot 8, concession II, Garson township, it is decidedly quartzitic in character, showing good bedding interformational with the greywacké. The southwestward extension of the band becomes narrow in Graham township, and in concession III of that township immediately north of the Vermilion river it appears to be interbedded with basic lavas showing good pillow structure.

McKIM GREYWACKÉ

In contrast to the arkose, the greywacké, which lies to the southeast, is well bedded. Its contact with the arkose is on the whole steeply inclined, as is also the dip of the individual beds. The beds in general dip to the south, but in some cases they are vertical or dip steeply to the north. Where it is possible to study the grain of individual layers it is apparent that the tops of the beds face southeast, indicating that the greywacké is a younger rock than the arkose. In only a few places is there a low dip to the beds, and at most of these places there is local folding.

The beds at many points are also much disturbed and drag-folded. Under the microscope this rock, like the arkose, shows recrystallization, giving it in places the appearance of a mica gneiss. It is evidently part of a very ancient sediment. It is intruded by the gabbro south and east of Sudbury. None of the greenstone types of rocks, including lava beds, such as occur in the sediments north of the greywacké, were noted in the greywacké itself.

The greywacké is conformable with the Ramsey Lake conglomerate, and both are evidently a part of a thick series of sediments which has lava flows in the lower part and none in the upper members of the series.

RAMSEY LAKE CONGLOMERATE

Rocks of this group outcrop prominently along the north shore of Ramsey lake, hence the name, introduced by Coleman[1] in his classification of the rocks of Sudbury. Similar rocks occur to the northeast and southwest for many miles. Owing to the amount of drift it is not always possible to determine how continuous and connected the several outcrops are. Fine exposures are seen on lot 7, concession II, McKim township. Here the conglomerate rests conformably on the McKim greywacké. The contact is exposed in several places, and the bedding of the greywacké is quite conformable to the overlying conglomerates. In fact just below the main contact there are thin strata of conglomerates interbedded with the greywacké, which are quite similar in character to the thick deposits of conglomerate above. Here the greywacké beds strike N. 30° E. and dip 50° S.E. There are, however, abrupt changes of strike in nearby localities, and both greywacké and conglomerate are crumpled.

The relation of the quartzite beds, which carry thin beds of greywacké and lie southeast of the conglomerate, to the conglomerate is obscured by drift, but the indications are that here the quartzite overlies the conglomerate at a high angle. Lenses of quartzite in the conglomerate usually assume a high angle of dip. The contacts of conglomerate with the greywacké or quartzite are always linear, and suggest beds that are conformable. In some localities the conglomerate lies between the greywacké and quartzite; in other places it has quartzite or greywacké on both sides, the contacts usually being fairly steep. It is evident that such rock as the Ramsey Lake conglomerate may occur at several horizons in the greywacké-quartzite series. In the area south of Kelley lake there are numerous narrow beds of greywacké intercalated with the quartzite and also zones of crushed rock composed of both types of rock, which clearly shows that all these types of rock belong to the same series. If the writers' observations are correct, the unconformity stated by several authors to be below the Ramsey Lake conglomerate does not exist, and the conglomerate is not a separate series but a portion of a thick series of sediments all belonging to the Sudbury series (Timiskaming).

The area of conglomerate east of Sudbury was also carefully examined, and while at one place there is a suggestion of a break below the conglomerate, the contacts on the whole are the clear-cut relations of two rocks occurring in a linear manner, the contacts varying from low angles to vertical. Again, there are thin beds of conglomerate with the greywacké, some of these being a foot in thickness. The structure is complicated by the presence of autoclastic rocks, which occur along contacts in place and give the impression of a structural break.

The conglomerate is much disturbed and, like the other members of the series, shows alteration and secondary minerals. It is characterized by a gritty

[1]Op. cit., p. 14.

matrix in which black, glistening fragments of quartz are visible to the eye or with a lens. The included pebbles or fragments are usually not large and in places are scarce. Many of the inclusions are granite. Some of the fragments of quartzite are several feet in width. Occasional masses of quartzite are a hundred or more feet in length and suggest beds or lenses of sand originally laid down in the conglomerate.

Bedding in the conglomerate is almost entirely absent. Its attitude is indicated by the lenses of quartzite, which now stand at high angles, and by its relation to the original greywacké or quartzite. This conglomerate is quite distinct from that which shows in a thin bed lower down in the series, near the Stobie mine. The latter is packed with pebbles, largely quartz, a few inches in diameter. The Ramsey Lake conglomerate is also distinguishable from the conglomerate-like breccias which are present at many horizons in the sedimentary series.

Cyril W. Knight, who spent a few days with the authors in the field, was of the opinion that the Ramsey Lake conglomerate was conformable with the McKim greywacké. Knight[1] and Coleman[2] in earlier reports suggested that the Ramsey Lake conglomerate is a younger series unconformably above the greywacké and quartzite of the Sudbury (Timiskaming) series. The writers had the same impression when the rocks were first examined. Collins[3] placed the Ramsey Lake conglomerate and the quartzite lying to the southeast in the Bruce series. He states[4] that he traced both formations westward toward Sault Ste. Marie, in which direction the McKim greywacké disappears and the Ramsey Lake conglomerate lies unconformably upon granite gneiss and the volcanic schists usually classified as Keewatin. The Ramsey Lake conglomerate, according to Collins, is overlain conformably by the Mississagi quartzite, Bruce conglomerate, and other formations of the Bruce series and is evidently the basal formation of the Bruce series.

WANAPITEI QUARTZITE

Lying southeast of the Ramsey Lake conglomerate there is a wide area of quartzite, which extends for several miles to the granite gneiss contact. The quartzite is light-coloured, greyish or whitish, and is usually highly tilted to the southeast. Locally it may be flatter with minor anticlines and synclines, as around Ramsey lake. The quartzite occurs in thick beds and occasionally shows cross-bedding. A dark-coloured slaty greywacké usually separates the thick-bedded layers of quartzite, and breccias and conglomerate-like bands are distributed throughout the quartzite in lens-like form.

The granite on the south side of the quartzite is in intrusive contact with the quartzite, and in places a *lit par lit* structure is developed. In addition there are irregular, usually connecting masses of greenish-weathering gabbro, similar to that south of the city of Sudbury, cutting the quartzite. Such masses have been shown on the accompanying geological map.

While the Ramsey Lake conglomerate south of Sudbury lies between greywacké and quartzite, that in Falconbridge township is flanked by highly tilted beds of quartzite on the northwest and southeast sides, indicating an overlapping of the greywacké by the quartzite to the northeast of Sudbury before the deposition of the Ramsey Lake conglomerate. The Wanapitei quartzite is the upper

[1]Rept. of the Royal Ontario Nickel Commission, 1917, p. 108.
[2]Op. cit., p. 9.
[3]Map 155A, Lake Huron Sheet, Geol. Surv. Can., pub. No. 1553.
[4]Personal communication.

member of the Sudbury series, as described by Coleman.[1] This rock and the conglomerate in Falconbridge township are classified by Collins as the Mississagi quartzite[2] and the Bruce conglomerate,[3] respectively.

Algoman(?)

Two small areas of granite are shown on the map as Algoman in age, one lying to the southeast of Sudbury across the Dill-Neelon boundary and the other in Falconbridge township at the east end of the map area. The actual age relationship of the former is not known with certainty. On map 155A of the Dominion Geological Survey it is shown as Keweenawan in age. No detailed work was done on the granite in Maclennan township.



Granite in contact with the southeast margin of the Wanapitei quartzite, strips of which have been caught up by the granite.

Whitewater Series

The Whitewater series, believed to be Animikean in age, does not lie within the map area. A detailed description of this series is given in a former report.[4]

Keweenawan

GABBRO

Gabbro appears in prominent ridges just south and east of Sudbury. The rock extends from the west end of Kelley lake in a northeasterly direction into Falconbridge township. Coleman has referred to the rock as "the Sudbury chain of laccolithic hills . . . of gabbro."[5] North of Coniston there are several masses of the gabbro cutting the quartzite and the Ramsey Lake conglomerate, and although in places drift conceals any evidence of the continuation of the

[1]A. P. Coleman, "The Nickel Industry," Mines Branch, Can. Dept. Mines, Bull. No. 170, 1913, pp. 6, 7.
[2]W. H. Collins, "North Shore of Lake Huron," Geol. Surv. Can., Mem. 143, 1925, p. 22.
[3]Personal communication.
[4]A. G. Burrows and H. C. Rickaby, "Sudbury Basin Area," Ont. Dept. Mines, Vol. XXXVIII, pt. 3, 1929.
[5]A. P. Coleman, op. cit., p. 7.

outcrop, these masses are probably all connected. South of Sudbury there is evidence of a sill-like structure, the gabbro dipping to the southeast under greywacké. The overlying greywacké has been altered and hardened, and some of it has the appearance of adinole, a contact type of rock.

Here and there in the exposures of gabbro there are light-coloured masses that are evidently xenoliths, or roof pendants of older sediments, which have been altered by the gabbro. Masses of quartz and crystals of hornblende are observed in the altered inclusions. These structures have been described in detail by W. A. Jones.[1]

The gabbro has a greyish-green weathered surface, is medium- to coarse-grained in texture, and always shows evidence of being an intrusive, with no indication of pillow or amygdaloidal texture, such as occurs in the greenstone near the nickel irruptive. Thin sections of the rock examined under the microscope usually show the ferromagnesian mineral to be hornblende, probably secondary after augite. Certain sections contain quite fresh augite in addition to the basic plagioclase, a small amount of quartz, and occasional grains of opaque metallic minerals.

This rock has some resemblance to the norite, but it is always green-weathering. On the south half of lot 9, concession I, Falconbridge township, the rock is rusty-weathering and shows a deposit of nickel-bearing sulphides, on which a pit was sunk and some drilling done several years ago. The rock in this locality intrudes conglomerate and quartzite.

THE SUDBURY NICKEL IRRUPTIVE

Norite-Micropegmatite

In 1905, Coleman completed his first map of the Sudbury area[2] showing the nickel irruptive in the form of an oval surrounding a basin of volcanics and sediments. Coleman's work had been preceded by that of Bell,[3] Walker,[4] and Barlow,[5] who first advanced some of the ideas embodied by Coleman in his map and elaborated in his report. Walker was the first to show that there was evidence of a gradational change in the irruptive from an acid rock at the inner edge, which he called micropegmatite, to a basic rock at the outer edge, which he called norite, and he considered that the two rocks were gravity differentiates *in situ* from an originally homogeneous parent magma. Coleman showed this condition to exist in a completed oval and elaborated the theory originally suggested by Walker and Barlow that the nickel-copper deposits were due essentially to the same process of magmatic segregation.

The idea of the more or less uniform gradational change in the nature of the irruptive from one side to the other was later questioned by geologists working in the area, including C. W. Knight[6] and T. C. Phemister.[7] Knight collected a series of specimens across the irruptive in the southern range and had these speci-

[1]W. A. Jones, "A Study of Certain Xenoliths Occurring in Gabbro at Sudbury, Ontario," Univ. of Toronto Studies, Geol. Series No. 29, 1930, p. 61.

[2]"Geological Map of Sudbury Nickel Region," Ont. Bur. Mines, Vol. XIV, pt. 3, 1905.

[3]R. Bell, "Report on the Sudbury Mining District," Geol. Surv. Can., Vol. V, pt. F, 1890-91.

[4]T. L. Walker, "Geological and Petrographical Studies of the Sudbury Nickel District of Canada," Quart. Jour. Geol. Soc., London, 1897, Vol. 53, pp. 40-65.

[5]A. E. Barlow, "Report on the Origin, Geological Relations and Composition of the Nickel and Copper Deposits of the Sudbury Mining District, Ontario, Canada," Geol. Surv. Can., Vol. XIV, pt. H, 1901.

[6]C. W. Knight, "The Chemical Composition of the Norite-Micropegmatite, Sudbury, Ontario, Canada," Econ. Geol., Vol. XVIII, 1923, pp. 592-594.

[7]T. C. Phemister, "Igneous Rocks of Sudbury and Their Relation to the Ore Deposits, Ont. Dept. Mines, Vol. XXXIV, pt. 8, 1925.

mens chemically analysed. The results were considerably at variance with what might be expected according to the original theory of Walker. Working along the same idea Phemister made careful study of ten sections of the irruptive taken at intervals around it. His work consisted of a careful petrographic study of specimens taken across the sections and tended to show that the irruptive consisted of two portions of fairly uniform composition corresponding to the norite and micropegmatite with a narrow transition zone contact between. He concluded from his work that the micropegmatite and norite represented two separate intrusions, the norite being the earlier, followed by the micropegmatite, with little time interval between.

Following the work of Phemister, a further study of the nickel irruptive was made by Coleman, Moore, and Walker[1] in the course of which they made a large number of chemical analyses of suites of specimens taken at intervals from a number of sections across the intrusive. The results in their opinion tended to substantiate the theory of gravitative differentiation of the norite-micropegmatite.

Recently, Collins[2] made a further important contribution to the literature on Sudbury, which tends to reconcile the observations and conclusions of Coleman, Walker, Barlow, and Moore with those of Knight and Phemister. Collins noted the more or less uniform nature of the norite and micropegmatite, and paid particular attention to the transition zone between the two types. He states that this zone is present at a definite horizon all around the nickel irruptive with widths from 250 to 800 feet and shows a regular gradation chemically and mineralogically from norite to micropegmatite. He combines the various chemical and mineralogical analyses of the nickel irruptive made by previous writers with further analyses and a series of specific gravity determinations. As a result of his studies he shows himself to be in agreement with Coleman and Walker on the theory of gravitative separation in place of the norite and micropegmatite from an original homogeneous parent magma, and reasons further "that separation of the two layers had been completed, or nearly completed, before crystallization began and must, therefore, have taken place in the liquid state."[3]

The foregoing is an attempt to summarize the development of the various ideas on the nickel irruptive. The marginal deposits of the nickel-copper ore are usually confined to a distance of a few hundred feet from the actual contact of the norite with the outlying rocks, and the writers did not attempt to make a systematic examination of the norite for any distance from the contact, except in a few instances.

The Offsets (Quartz Diorite)

The term "offsets" was applied by Coleman to the dike-like intrusive bodies extending out from the main body of the norite.

The offsets examined by the writers were those known as the Frood, Copper Cliff, Worthington, and Foy. These offsets have been described in considerable detail by Coleman, Knight, and Howe,[4] and further discussed by Phemister, and Coleman, Moore, and Walker. Part of Collins' recent paper is devoted to the offset rocks, with descriptions, analyses, and discussion on their probable relationship with the norite.

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[1]A. P. Coleman, E. S. Moore, and T. L. Walker, "The Sudbury Nickel Intrusive," Univ. of Toronto Studies, Geol. Series No. 28, 1929.

[2]W. H. Collins, "Life History of the Sudbury Nickel Irruptive. I. Petrogenesis," Trans. Roy. Soc. Can., Vol. 37, sec. IV, 1934.

[3]Ibid, p. 125.

[4]E. Howe, "Petrographical Notes on the Sudbury Nickel Deposits," Econ. Geol., Vol. IX, 1914, pp. 505-522.

Certain characteristics may be said to apply to all the above-mentioned offsets: They occur in a dike-like form; they show the spotted rusty-weathering surface due to the presence of sulphides; and each has one or more commercial deposits of ore connected with it.

The rock most commonly found in the offsets is a quartz diorite. Macroscopically, it is a dark-grey, medium-coarse to fine-grained rock, usually showing blebs of pyrrhotite scattered uniformly throughout. In thin section, it is seen to consist essentially of plagioclase, hornblende, biotite, and quartz, with apatite, magnetite, and ilmenite as accessory constituents. The plagioclase, which is the most abundant mineral, is of the andesine variety, as determined by extinction angles. It is usually quite fresh looking and free from the fine, dust-like inclusions so characteristic of the plagioclase of the main norite. Hornblende is the next mineral in order of abundance. Two varieties occur, one a greenish-blue hornblende with good cleavage and outline, which is probably primary, and the other a faint-green to colourless fibrous variety of a uralitic nature, which is secondary. Biotite is present in the form of irregular flakes and shows a marked development of pleochroic haloes. Quartz is usually interstitial to the other constituents, but micrographic intergrowth with feldspar is quite common. Chlorite, epidote, and leucoxene are present as secondary minerals.

Frood Offset.—The Frood offset forms a ridge running parallel to the norite from a point just below the Frood mine to the Stobie mine. The country rock consists mainly of greywacké and greenstone, including acid and basic types, which have been much sheared and fractured and are highly metamorphosed to mica and hornblende schists. They are intruded by the quartz diorite and another rock of a gabbroic nature. The parts of the ridge that contain the ore bodies of the Frood and Stobie mines are capped by heavy gossans with the result that it is impossible to show the actual boundaries of the different rocks along it. The widest parts of the offset occur at the gossan zones and are indicated on Coleman's map by pronounced bulges with intervening narrower sections, which are, however, not continuous. The width of these wide sections is probably not over 800 feet.

The gabbroic rock outcrops in irregular patches in the wide sections mentioned above. In hand specimens the rock is medium fine grained and greyish-coloured and differs from the quartz diorite in the absence of blebs of sulphides. It has a porphyritic appearance and consists essentially of coarse augite more or less replaced by secondary hornblende, biotite, and plagioclase in the form of a fine mosaic of crystals. Its actual relationship with the quartz diorite was not determined, but recent work indicates that it occurs as inclusions in the quartz diorite and is, therefore, the older rock.

Above ground the quartz diorite of the offsets is most easily recognized on a weathered surface. Apparently this rock is more susceptible to alteration or replacement by the sulphides or other minerals accompanying the ores than the greenstones or sediments of the wall rocks. Consequently it is difficult to recognize the quartz diorite with certainty in the underground workings of the Frood mine. The ore contains a great number of inclusions of greenstone and sediments, most of which are still recognizable as such, along with more highly altered inclusions of a chloritic or micaceous character, which may represent the altered quartz diorite of the offset.

Copper Cliff Offset.—The Copper Cliff offset, according to Coleman,[1] extends from the northwest shore of Lady Macdonald lake, north of Copper Cliff, south-

[1]A. P. Coleman, Mines Branch, Can. Dept. Mines, Bull. No. 170, 1913, pp. 61-69.

ward a distance of 14,400 feet, of which distance less than 5,000 feet can be followed on the surface. It outcrops as a series of four or five dike-like bodies with the intervening areas largely covered by drift. Approximately 800 yards south and slightly east of the Evans mine another body of rusty quartz diorite is to be seen cutting the gabbro. It is 100 feet wide and 200 feet long, and some pits have been sunk in the gossan. From here the offset can be traced almost continuously for another 700 yards south to the north shore of Kelley lake, where it passes under the lake. This is probably the southern limit of this series of diorite outcrops, which might be included in the Copper Cliff offset. Notwithstanding the possibility of some connecting sections underlying the drift, the several outcrops are apparently discontinuous. As with the other offsets, quartz diorite is the prevailing rock in all the outcrops.

The offset joins the norite in a bay, and as far as can be seen there is no definite boundary between the norite and the quartz diorite. With respect to this bay, W. H. Collins[1] states that there are gradations from fine-grained offset material around the edges to coarse offset rock in the middle. Southeast of Lady Macdonald lake the Copper Cliff offset clearly cuts a porphyritic granite typical of the Creighton granite mass, which is believed by Knight,[2] Phemister,[3] and the authors to be later than the norite. No definite information that would explain this anomalous condition was obtained.

Worthington Offset.—This offset has been described in considerable detail by Coleman,[4] and Knight.[5] It extends from the small lake on lot 3, concession I of Drury township, in a northeasterly direction to the centre of lot 9, concession IV of Denison township, a distance of approximately 5 miles. Beyond this to the east there are several lens-like bodies of the same rock on the north side of Ethel lake, lot 7, concession IV of Denison township, as well as a small mass at the Vermilion mine; but since these masses are off the strike of the main offset it is possible that they are not connected with it. Allowing for the drift-covered areas the offset is seen to be fairly continuous with definite breaks to the east of the Worthington No. 2 pit, to the east of the Gersdorffite mine, and at its eastern end north of the Algoma Eastern railway. The country rock consists of greenstone, gabbro, greywacké, and quartzite, and the offset varying in width up to 300 feet appears to occupy a fissure cutting these rocks. At the southwest end the fissure is almost parallel to the strike of the beds of sediments, but farther east it cuts the bedding at an angle.

The rock of this offset and the masses to the east are entirely of the quartz diorite type previously described. Both Knight and Coleman have remarked on the large proportion of fragments of greenstone and sediments included in the diorite. These are especially noticeable in the section between the Howland and Robinson pits, where the inclusions appear to constitute 60 or 70 per cent. of the rock. A number of olivine diabase dikes striking northwest-southeast cut across the diorite in the vicinity of the Worthington mine and south of the Howland pit.

Foy Offset.—The Foy offset, which lies outside the map area, has been mapped and described by Coleman,[6] and only a short examination of a stretch

[1]Op. cit., p. 162.
[2]C. W. Knight, Roy. Ont. Nickel Com., 1917, p. 124.
[3]Op. cit., p. 29.
[4]Op. cit., pp. 46-48.
[5]Op. cit., pp. 174-179, 189, 190.
[6]Op. cit., pp. 88, 89.

of about 2 miles at the western end of the offset was made. A good description of this offset is given by Collins:[1]—

> The Foy offset exemplifies somewhat more strikingly than the others the characteristics of all. Its base at the nickel irruptive is about 1,200 feet wide but tapers quickly to 400 feet, like the root of a tree. Thence for the length of 6 miles that it has been traced its course is somewhat crooked, with occasional angular turns. Where last seen it enters a marshy valley in which it probably ends. It branches at one place, and at others there are little lateral protrusions like rootlets that ramify crookedly for a few feet or yards into the rock on either side. The main stem varies in width from 800 feet down to 20 feet. In these respects the offset differs from ordinary dikes, which have fairly direct courses and even walls. Its contents also, unlike those of ordinary dikes, consist of a breccia of older rocks cemented together by the offset igneous rock. The proportion of breccia varies fron nothing up to three-fourths and comprises a greater variety of materials than the adjoining country rock locally affords. The fragments vary in size from masses yards in diameter to coarse grit and from sharply angular to rude boulder shapes.

Thin sections of the rock from this offset show it to be a quartz diorite or quartz gabbro. Augite is prominent in some sections. Porphyritic textures also occur, in which fine-grained plagioclase and quartz form the groundmass, with coarser augite and hornblende phenocrysts.

Other Offsets.—Besides the four main offsets described above, other smaller ones were noted. One of these occurs about 500 yards southeast of the old Kirkwood mine on the boundary line between concessions II and III of Garson township. It is about 300 feet long by 150 feet wide and shows gossan, on which some trenching has been done. Another occurs at the north end of lot 5, concession I, Blezard township, about 300 yards south of the old Mount Nickel mine. Collins[2] mentions the occurrence of one of these dikes within the nickel irruptive in lots 3 and 4, concession III of Levack township. There are probably other occurrences in the rocks surrounding the basin.

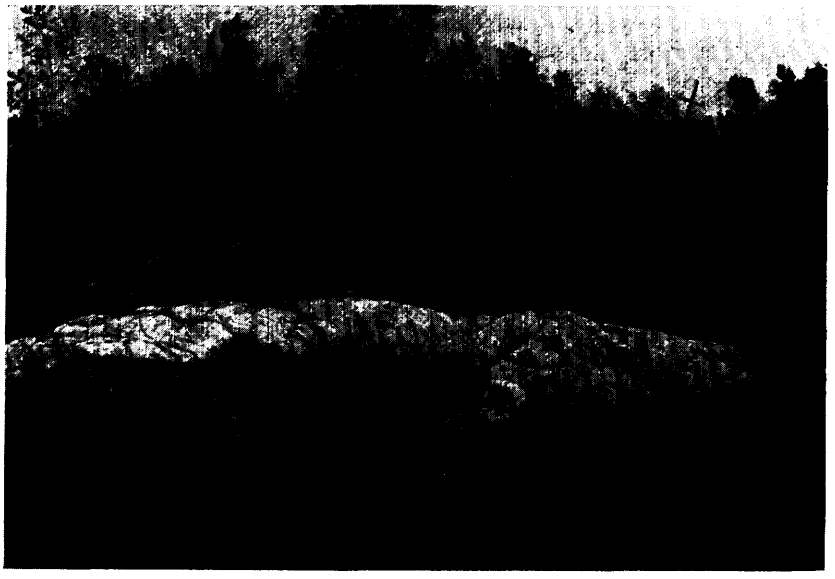
Collins[3] also mentions the fact that the offset rock is not confined to the offset dikes but may occur around the edge of the irruptive. At the Creighton mine about 300 yards north of the old open pit and at the contact between the gossan zone and the granite there is a quartz dioritic rock much like the offset rock in appearance. Underground at the Creighton, as well as at other mines, the geologists of the International Nickel Company drew attention to a rock with the composition of a quartz diorite that may be the equivalent of the offset type.

Genesis of the Offsets.—Coleman[4] believed that the offset rock was closely related to the norite and that the parallel offsets, such as the Frood, originally had either underground or overhead connections with the main norite mass. Phemister[5] believed that the quartz diorite of the offsets was later than the norite. Collins made a careful study of the offsets, especially from the standpoint of their chemical relationship with the norite. As a result of a large number of analyses of specimens from several of the offsets he observes that the chemical compositions fall within a sufficiently narrow range to indicate that they are all derived from the same magmatic source.[6] He observes also that an average of the offset analyses differs only in a slight degree from the average of the available analyses of the norite.[7] He states:[8] "It seems plain that the offsets are parts of the nickel irruptive. The Foy and Copper Cliff offsets join the main irruptive by means of wide mouths. The offset rock grades into norite." His conclusion is that near

[1]Op. cit., p. 161.
[2]Ibid, p. 162.
[3]Ibid, p. 168.
[4]Op. cit., pp. 35, 73.
[5]Op. cit., p. 36.
[6]W. H. Collins, op. cit., p. 174.
[7]Ibid, p. 173.
[8]Ibid, p. 169.

the end of the process of the separation of the nickel irruptive into norite and micropegmatite some of the norite magma escaped into the floor to form the offsets.[1]

The authors of this report paid considerable attention to the Copper Cliff offset in the section where it joins the norite, and it certainly appeared to them that this offset rock grades into the norite. There are two breaks in the exposed parts of the offset occupied by Lady Macdonald and Clarabelle lakes, but the exposed parts adjoining and beyond the lakes do not appear to indicate any sudden marked change in the rock either petrographically or chemically. Certain features of the offsets, however, suggest that they may be later than the norite. For example, Collins mentions the occurrence of one of these dikes which cuts the transition zone with sharply defined walls.[2]



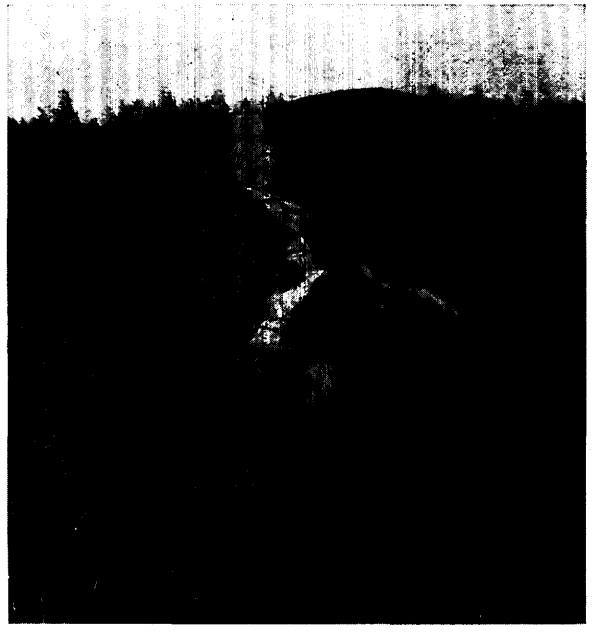
Dike of pink fine-grained granite cutting norite east of the old North Star mine.

GRANITE

Several areas of granite other than those included under the Algoman are shown on the accompanying map. All the granite masses intrude the older sediments and associated greenstones. The largest mass, commonly called the Creighton granite, extends from a point near the Crean Hill mine to Copper Cliff and averages about 2 miles in width. In places it is directly in contact with the nickel irruptive, but on its north margin it is commonly intermingled with older greenstones in an intricate pattern. The granite of this mass appears to be of a number of types. It is principally represented by a pinkish porphyritic phase, showing crystals of feldspar averaging about one-third of an inch in length. There is also a fine-grained red variety, which in places vaguely intrudes the porphyritic type. Numbers of granite dikes, chiefly of the fine-grained type, intrude the norite from Creighton to Crean Hill.

[1] W. H. Collins, op. cit., p. 174.
[2] Ibid, p. 162.

There is some difference of opinion as to the relative ages of the norite and the main mass of the Creighton granite. Even where the main granite and norite are in contact it is difficult to decide which is the younger. In several places blocks of porphyritic granite occur with the norite at or near the contact, but the shearing of the rocks along the contact has obscured the evidence that would allow a positive statement that such fragments are caught up by the norite or are faulted parts of a dike. In one place, 2 miles east of Crean Hill, about 100 feet from the contact, there is in the norite a mass of porphyritic granite, about 12 feet across, containing fragments of greenstone, but the drift to the south hides the evidence which would determine whether the granite is an inclusion or a broad part of a granite dike. Near by, in the norite, there is a narrow porphyritic granite dike



Dike of grey porphyritic granite cutting norite east of the old North Star mine.

which has been step-faulted. Evidence of a similar condition may be observed just east of the pit at the old North Star mine on lot 9, concession III, Snider township, where a dike of the porphyritic granite 2 feet wide clearly cuts the norite. These occurrences suggest that the porphyritic granite is younger than the norite. Along the contact of the granite and norite many dikes of granite may be seen cutting the norite, but few of these are the porphyritic type that makes up the major portion of the Creighton granite. Phemister[1] believes these types, with the possible exception of the pink fine-grained granite, to be contemporaneous with the porphyritic granite.

On the other hand, the quartz diorite offset at Copper Cliff, on the east side of Lady Macdonald lake, clearly cuts a granite that somewhat resembles the typical Creighton granite. This offset is thought by many observers to join the norite lying to the north. There is a possibility that there may be a contact

[1]Op. cit., p. 28.

between the offset and the norite and that the offset may be later than the norite, but the field evidence, as previously stated, does not point that way.

It would seem, therefore, that there is conflicting evidence as to the relationship of the norite and granite as a whole. Coleman[1] believes the granite to be mostly older, while Knight[2] and Phemister[3] make it younger. Barlow and Coleman[4] have suggested the possibility of an overlapping in the intrusion of norite and granite. Barlow[5] suggests as a reasonable explanation of their intrusive relationship "that their periods of intrusion were so closely synchronous, that they overlapped in their time of crystallization, and that the later secretions from the slower cooling granite magma forced or ate their way into the norite in certain places."

The outcrop mapped as granite is not a homogeneous unit, but contains several types of granite, some of which is gneissoid, blocks of greenstone, and



Granite dike cutting norite northeast of the Murray mine.

remnants of sediments. The wide band of sediments northeast of Creighton village already described lies within the Creighton granite.

The biotite granite area, known as the Murray granite, is more uniform, and its relation with the norite more definite. Numerous apophyses of the reddish granite penetrate the norite one mile northeast of Murray mine, where the two rocks are in contact. From Murray to the Cameron mine there are masses of greenstone here and there between the granite and the norite. A peculiar feature is that where the greenstone occurs between the granite and norite, it is often riddled by a network of granite dikes, which only occasionally have extended into the norite. Another feature along this contact is the presence of many small patches of gossan on which pits have been sunk. The gossan may occur in both norite and granite, indicating that the sulphides were formed after the intrusion

[1]A. P. Coleman, Ont. Bur. Mines, Vol. XIV, pt. 3, 1905, p. 123.
[2]Roy. Ont. Nickel Com., 1917, pp. 108, 123-125.
[3]Op. cit., p. 29.
[4]Op. cit., p. 123.
[5]A. E. Barlow, Geol. Surv. Can., Vol. XIV, pt. H, 1901, p. 53.

of the granite. On the whole, the granite intrusion has had little effect on the norite at the contact, except for the occasional lightening of colour of the norite.

Small masses of granite occur between the Frood and Stobie mines along the prominent gossan-bearing ridge. This granite is slightly porphyritic and is not stained with iron rust. It is likely, however, that it was injected before the occurrence of shearing, which is evident along the ridge. The geologists at the Frood mine directed attention to the occurrence of a granite dike on the 2,800-foot level of the Frood mine. The dike can be seen in the hanging-wall side of the ore body, where it is cut off by the ore, and can be picked up again on the footwall side. This dike is similar in appearance to the Murray granite. Two granite dikes, apophyses of the Murray granite, occur in the low swampy area just northwest of the Frood Mine hill, but could not be traced continuously to the gossan-covered ridge. In addition, there are several small masses of the granite in the norite, northwest of Murray mine, near Whitson lake in Blezard township, and elsewhere.

TRAP DIKES

Several narrow, fine-grained trap dikes of the composition of uralitic diabase occur at the Creighton mine and westward to Crean Hill. They may be seen

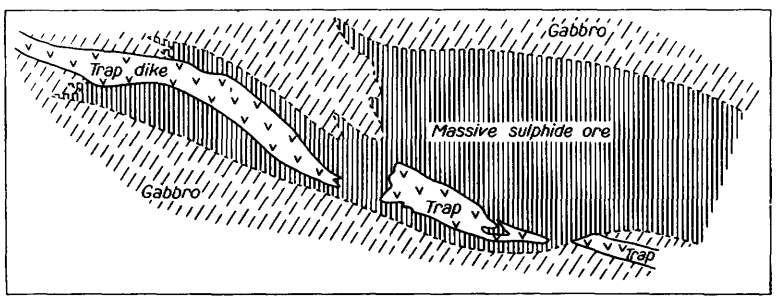


Fig. 2—Section of the north ore body, 37th level, Creighton mine, showing the relationship of the trap dike to the sulphides. Scale, 20 feet to the inch (approx.).

cutting the greenstone, granite, and norite. A good example of one of these dikes is to be seen at the old No. 1 mine west of the town of Copper Cliff on lot 1, concession II, of Snider township. Two pits have been sunk in the ore, and the dike, which is about 10 feet wide, cuts across the ore zone between the pits. The dike has been fractured, and the fractures are filled with sulphides. Similar conditions may be noted in numerous places in the underground workings of the Creighton mine. Hitherto the trap dikes have been considered as later in age than the ore, and the anomalous situation of the ore being in the dikes has been ascribed to later penetration of the ore following the cooling of the dikes. A number of instances at the Creighton mine strongly indicate, however, that the ore is later than the dikes. Fig. 2 shows an example of this, where the sulphides definitely cut across the dike and have caught up a large fragment of it. There are several other examples in widely separated parts of the underground workings showing angular fragments of trap, large and small, completely cut off from nearby dikes and enclosed in ore. It has been suggested as a possible explanation of this relation that later deformation acting on both trap and ore, at great depths and under great pressure, may have produced different effects on the trap and ore, causing fracturing of the former and flowage of the latter. Unless the evidence can be accounted for in some such manner it seems reasonable to conclude that

the ore is later than the trap dikes. This relationship has an important bearing on the genesis of the Sudbury ores.

In a description of the Creighton ore body by Dickson[1] occurs the first mention of the possibility that the ore is later than the trap dikes, where he states:—

> There are also two dense fine-grained diabase dikes cutting sharply through the ore body and having well-defined contacts. These are considered as among the youngest rocks of the district. While they are usually considered to have cut through the ore after its formation, there is a possibility, if the theory of igneous origin is left out of the question, of their having existed previous to the formation of the deposits.
>
> They do not include fragments of the ore, and their only mineralization is along fissures and joint-planes, the introduction of the sulphides being very evidently later than the intrusion. There has also been a movement in the dikes themselves since their formation, as they are composed of numerous vertical and parallel divisions with smooth polished faces, along which sulphides at times occur. If the dikes were in place previous to the formation of the ore, their compact fine-grained texture would be unfavourable to the action of the ore-bearing solutions, except along parting-planes, while the more coarsely crystalline and crushed diorite would offer an easy passage for the circulating waters.

OLIVINE DIABASE

The last important intrusion in Keweenawan times was that of the series of olivine diabase dikes. They generally strike from 20° to 40° north of west and can be traced for miles, cutting the rocks below the norite, the norite, and those lying above, namely, the Whitewater series. These dikes evidently filled large fractures of a tensional type. Olivine diabase dikes with a similar strike are found in many parts of northeastern Ontario, at Porcupine, Gowganda, and elsewhere. They range in width from a few feet to over 200 feet and are remarkably fresh under the microscope, particularly the feldspars, olivine, and pyroxene.

The black trap dikes that cut the norite at the Creighton mine are intruded by an olivine-bearing dike, as seen on the surface just north of the large open pit.

[1] C. W. Dickson, "The Ore-Deposits of Sudbury, Ontario," Trans. Amer. Inst. Min. Eng., Vol. XXXIV, 1904, p. 51.

CHAPTER IV

Description of the Mines

Creighton Mine

The Creighton mine is situated in lot 10, concession I, of Snider township. In this part of the area the norite forms a broad bay in the footwall rocks of granite and greenstones, the norite bulge facing southeast. Large areas of gossan are seen near the contact and smaller areas in the norite away from the contact. The norite stands up prominently from the lower land around it where the ore body had its outcrop. It includes masses of greenstone and is cut by dikes of trap and diabase.

The copper pyrites in the ore led to the staking of the property in 1885, but it was not until 1900 that production began. The first mining was done in an open pit to a depth of 300 feet, after which the main ore body was stoped by shrinkage. This huge ore body, occurring along the contact of the norite and granite, but largely in the latter rock, was found to extend to the 20th level(1,300 feet vertically). It was irregular in shape but of enormous size laterally, being from 500 to 1,000 feet in length and 50 to 300 feet in width. A detailed description of this ore body with photographs of a model of it is given by Knight in the Report of the Royal Ontario Nickel Commission.[1]

What is called the hanging wall or west ore body lay in behind the bottom of the main ore body, extending from the 16th to the 28th level. It may be considered the downward extension of the main ore body. The general dip of these bodies is to the west at 45 degrees. The pattern of the outlines of the ore varies considerably on different levels.

A third ore body, known as the North ore body, is located about 1,100 feet north of the hanging-wall ore body. Its upper portion is in the norite, but it passes outward into the footwall rocks at depth. This ore body strikes N. 20° E., dips to the northwest at angles varying from 35 to 60 degrees, with an average of 55 degrees, and has a length of from 300 to 700 feet. The ore is associated with a shear zone in the norite above, which passes into the underlying rocks. The norite along the ore body is much fractured and sheared in places and in parts of the zone there is a development of quartz. The structural evidence points to the conclusion that the norite was rigid before being subjected to pressure and shearing. The shearing was followed by penetration of the massive ore and quartz of the deposit.

Frood Mine

The Frood mine is situated on lots 6 and 7, concession VI, McKim township, and is about 2½ miles north of the city of Sudbury. It lies at the southwest end of a mineralized zone stretching for 2 miles to the northeast. This zone has been referred to by Coleman as the Frood-Stobie offset. The offset is characterized by the large gossans at the Frood and Stobie mines, with lesser ones showing here and there between these mines. The surface between the properties indicates a zone of fracture, but offset rocks that may be related to the ore bodies cannot be followed continuously. No typical norite like that in the large laccolithic mass is recognized, but there are masses of gabbro and quartz diorite here and there

[1]Pages 142 to 152.

along the zone which are younger than the recognized greenstones. Spots of rusted sulphides frequently occur with the quartz diorite.

The gossan is so heavy and the rocks so decomposed in places that the determination of the underlying rock is extremely difficult.

The greatest width of gossan is that displayed on the surface at the Frood mine, where it is 800 feet. In places along the zone, gossan patches are only a few square yards in extent. The rocks of the immediate area are predominantly ancient sediments, greywacké, and quartzite, and greenstones of varied grain. Later rocks like gabbro and diorite are best exposed near the mines. The rocks are highly tilted, about 65° N., with a general strike of N. 35° E. The greenstone intrusions or flows with the sediments are irregular in outline, but are influenced by the strike and dip of the sediments.

The Frood mine was worked only intermittently until seven years ago. From 1889 to 1903, about 100,000 tons of ore were mined from open pits; in 1913-1914, 175,000 tons were mined from the 200- and 300-foot levels from the No. 1 shaft. The ore extracted was of the "rocky" type—disseminated ore, which in that area contained numerous unmineralized fragments of the older rocks. The first drilling of the deposit to a depth of 1,200 feet indicated about 45,000,000 tons of copper-nickel ore, averaging about 2.05 per cent. nickel and 1.45 per cent. copper.

A campaign of deep drilling, begun in 1925 by the International Nickel Company, indicated that the zone from 2,000 feet to 2,800 feet had a much higher metal content than the upper levels. For the purpose of developing this ore, No. 3 shaft was sunk below the 2,800-foot level, and on several levels crosscuts were run northwest to the ore body.

In the mean time the Mond Nickel Company was working a property that covered part of the Frood ore body on the dip, and they sank a shaft through the ore body to the 2,000-foot level and from long crosscuts drilled the downward extension of the rich ore body to the 3,100-foot horizon. The shaft was then continued to 3,300 feet, and development of the ore body was undertaken on the lower levels.

There were thus two separate companies developing the largest nickel-copper deposit in the world. An amalgamation of the companies was effected in 1929, under the name of the International Nickel Company of Canada. The magnitude of the deposit is indicated in statements in the annual report of the company for 1929, which give an ore reserve of 134,673,000 tons, of which 43,562,000 tons are high-grade. Below the 1,400-foot level, the ore average is given as 2.39 per cent. nickel and 3.62 per cent. copper. In addition the ore carries an appreciable amount of precious metals. In 1930, Robt. C. Stanley, president of the company, stated that Bessemer matte from Frood ore below the 1,600-foot level would net a return in the value of precious metals of approximately $50 per ton at the prices then prevailing.

The ore body, where determined by diamond-drilling and underground work in the upper part of the mine, has a maximum thickness of about 600 feet, whereas the higher-grade ore indicated in the lower levels is narrower and contains larger masses of clear sulphides. Even in the richer parts of the ore body, however, there may occur masses of rocky ore with blebs of sulphides scattered through the rock. The huge deposit might be called a series of lenses, thickening and thinning both horizontally and vertically. For instance, on the 2,800-foot level the work indicated two wide portions, formerly called the Frood and the Mond ore bodies, and between them several smaller masses of ore along the strike of the shear zone. Parts of the ore bodies on lower levels may be as wide as 200 feet, and widths of

100 feet are common on the 2,800-foot level. Between the ore bodies there is recognized a definite shear zone, containing a little quartz and sulphides. This shear zone has been the locus for the large ore bodies along it.

The ore zone dips to the northwest at about 65 degrees, which is the general attitude of the sediments, the predominant rocks. With the sediments there are some intrusions of greenstones, either bodies of sill-like character or dikes. Along the locus of the ore body there have been such intrusions, and in places the adjacent wall rock is greenstone. The greenstone is comparatively resistant to replacement by the sulphides, and along the fracture there are often large masses of the rock enclosed by ore. Blocks of greenstone are sometimes fractured, and vein-like masses of sulphides intersect the rock. Masses of sediments also occur in the ore.

The contact between solid sulphide ore and the country rock is usually sharply defined. In a few places at the contact there is a development of garnet and hornblende needles, suggesting contact action such as would be produced by an igneous rock. This strongly suggests that the ore was intrusive, and supports the theory of some authors that the sulphides have been injected as a sulphide melt. There is, however, a small amount of quartz along the fracture zone, especially where the ore is quite narrow or where sulphides have not been developed, and this is indicative of hydrothermal action. It seems probable that replacement by the ordinary hydrothermal processes will account for at least part of the Frood ore body.

Search was made underground for evidence of a rock corresponding to the quartz diorite of the offset as it occurs on the surface. Positive identification of such rock was not possible. On the surface near the large gossan areas it can, however, be recognized, but only in small patches owing to the amount of alteration and replacement that has taken place. The difficulty of recognizing the quartz diorite in the underground workings may be due to the fact previously mentioned that the quartz diorite is especially susceptible to replacement by sulphides and other hydrothermal minerals. The geologists at the Frood state that the quartz diorite in a more or less altered form is present and recognizable as such from the surface down to the bottom levels of the mine.

Garson Mine

The Garson mine is located on lots 4 and 5, concession III, Garson township. The mine, first known as the Cryderman property, has been in operation for over 25 years, and formed part of the mining group of the Mond Nickel Company before amalgamation with the International Nickel Company of Canada.

It is located along the main contact of the norite in the greenstone and sediments, but has characteristics distinct from other marginal deposits on the southern nickel range.

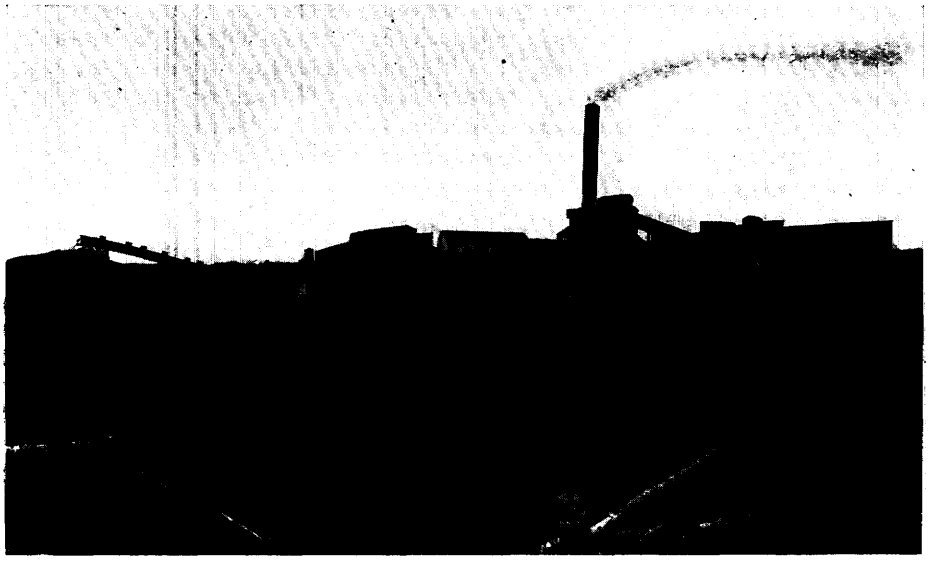
There has been much shearing and faulting in or near the ore zone, and rocks ordinarily massive are now quite schistose. Coleman[1] advanced the idea that faulting of rocks along the contact may have occurred, with a possible horizontal throw of 750 feet. A wedge of brecciated greenstone and sediment now lies between the main mass of the norite to the north and one to the south, which forms a deep bay, disappearing at the surface southeast of the mine under sand and gravel. The main ore zone is stated by him to lie partly along the contact of the greenstone and sediments and partly in the norite.[2] Some of the ore

[1]A. P. Coleman, Mines Branch, Can. Dept. Mines, Bull. No. 170, 1913, p. 82.
[2]Ibid.

bodies underlie the norite and have brecciated wall rocks and a hanging wall of norite, this being similar to the ordinary marginal deposit. Blocks of greenstone, sediments, and norite occur in the ore. However, the evidence is convincing that the shearing and brecciation antedated the formation of the ore, as stated by Knight.[1]

An authoritative description by Oliver Hall, formerly general superintendent of the Mond Nickel Company, who had a long association with the mine, is as follows:[2]—

Garson mine is a series of bodies with a somewhat complex relation. The main ore zone has a northeast-southwest strike, and dips southeast at about 55 degrees, and the dip is still definitely in this direction at the deepest level, the 1,400. This abnormal dip is apparently due to sharp folding in the norite-quartzite and norite-greenstone contact. This main zone has the shape of an arc approximately one-quarter of a circle. The dip is to the centre of the circle; the hanging wall occupies the inside of the arc. Along this zone the ore is irregular in width, pinching out vertically



Concentrator, sintering plant, and smelter, Falconbridge Nickel Mines, Limited.

and horizontally at intervals, and opening to widths of over 100 feet between pinches. Four other zones contain extensive ore areas: A northwest zone, ore body 16, an east-and west zone with vertical walls at the southerly limit of the main zone, and a similar parallel zone at the northeast end of the main zone.

Three bodies have been mined along a radial zone outside the main zone, called the northwest zone. Ore body 16 has been mined down to the 800 level and is a high-grade vein-like body outside of the main zone, with strike and dip similar thereto. The two vertical shear zones with east-and-west strikes and nearly vertical walls have been important sources of ore. In these the ore rakes east. The southerly zone contained only a short ore body near the surface, but the ore zone in this is over 700 feet long at the 800 and 1,000 levels.

Widths vary from pinches to over 100 feet. The northerly zone was first found to be important at the 800, and has a width of 20 to 100 feet and a length of over 600 feet up to the 600 level. . . . At Garson the various bodies are irregular, and the unravelling of the ore zones at each level usually takes from two to three years.

Operations have been carried to the 1,400-foot level. The complexity of the ore bodies is exemplified on the mine model, which shows the irregularity of the occurrence from level to level, the more or less interlocking character of the several

[1]Roy. Ont. Nickel Com., 1917, p. 158.
[2]Oliver Hall, Eng. and Min. World, Vol. 1, 1930, p. 586.

ore bodies, and the relationship of the east-west vertical bodies to the southward-dipping crescent-shaped main ore zone.

The schistosity and alteration of most of the rocks along the ore bodies have made their determination underground extremely difficult and uncertain in many places where schistose norite, greenstone, and sediments are almost indistinguishable. Recent study of the Garson ore bodies indicates that they are related to a brecciated and sheared contact, which is irregular in outline and is cut by a major thrust fault, which marks the contact for some distance. The fault has an east-west strike and dips to the south. The ore occurs along the fault and along the brecciated margin of a large mass of norite lying south of the fault.

Falconbridge Nickel Mines

The property of the Falconbridge Nickel Mines is situated in concessions III and IV of the townships of Falconbridge and Garson. Mining claims cover the contact between the norite and the older sediments and greenstones for 3 miles. In lots 9, 10, 11, and 12, concession IV, Falconbridge, the contact is nearly east and west in a broad curve. This part of the nickel range is covered by a deep mantle of glacial sand and gravel. The topography is rolling plain, broken by ridges and deep kettle-holes, with several spring lakes. On Coleman's map[1] the norite contact with the older rocks was projected from a point just northeast of the Garson mine to lot 7, concession IV, where the contact swings to the north. The projected contact was approximately near the actual contact as determined by the E. J. Longyear Company, which did extensive diamond-drilling in 1916 in an effort to prove a nickel-copper deposit in this part of the area. Their work determined a deposit on a length of 1½ miles, varying from 10 to 150 feet in thickness. Drilling determined ore as deep as 580 feet, the metallic content of which ranges from 1 to 5 per cent. combined nickel and copper.[2]

The property lay dormant until 1928, when the Lindsley interests secured it and after doing further drilling organized a company known as the Falconbridge Nickel Mines. Since that time work has been actively carried on, and the nickel-copper deposit has developed into a mine. A shaft was sunk below the 1,000-foot level, levels were opened up at 225, 350, and 1,000 feet, and shrinkage stoping was carried on. The latest work has been the development of the 500- and 750-foot levels. In addition, considerable diamond-drilling has been done to determine the downward extension of the ore. At the end of 1932 an ore reserve of 2,920,457 tons was announced by the company. The bulk of this is above the 1,000-foot level, at which depth one stope length of 1,300 feet has already been indicated. Only a relatively small part of the contact that is on the company's property has yet been touched by underground work. Most of the work has been done to the west of the shaft, since northwest-southeast faulting interrupted the continuity of the deposit toward the east. Ore reserves at the end of 1934 were given as 2,960,238 tons, averaging 2.04 per cent. nickel and 0.90 per cent. copper.

The ore zone is related to the contact of the norite intrusion with the sediments and greenstones lying to the south. The ore follows along slip planes, but for the most part lies between recognizable norite and older rocks. The massive type of ore is fine-grained, like matte, and carries numerous inclusions of rock, both rounded and subangular. The inclusions vary in size, but many of them are from one to two inches in diameter. They consist essentially of the neighbour-

[1]"Geological Map of Sudbury Nickel Region," Mines Branch, Can. Dept. Mines, pub. No. 171, 1913.

[2]Roy. Ont. Nickel Com., 1917, p. 187.

ing country rock but include numerous fragments of clear quartz. This quartz appears to have been formed before the main sulphides were deposited. The ore minerals are largely pyrrhotite, pentlandite, and chalcopyrite, with local occurrences of nickel and cobalt arsenides. Amongst the latest minerals are calcite and a second generation of quartz, and in places these are quite abundant vein-filling minerals. There are a considerable number of masses of disseminated ore consisting of rock, either norite or sediments, with scattered grains of sulphides.

The geological plans and section of the Falconbridge mine (map No. 43e) accompanying this report were prepared by the mine geologists. The general relationship of the ore body to the contact and fracture planes is well shown on the plans. In places along the north side of the ore, there are masses of reddish pegmatitic-looking rocks, usually with indefinite contacts with the norite. They are believed to be the result of a felspathic alteration of the norite. The rock designated as jasperoid is a highly siliceous alteration of norite or other country rock. There is a considerable volume of this rock in or near the ore zone, showing that there has been much replacement of the wall rocks by silica. The wall rocks are highly sheared and in many places difficult to distinguish from each other. The norite in places is altered to schist and is unlike the massive norite farther away. The ore body was evidently formed along the sheared and fractured rocks at or near the contact.

The dip of the deposit varies from steeply north to steeply south, but is actually only a few degrees from vertical. From the surface down to the 350-foot level at the main shaft the deposit dips to the north, but below that level and as far as the 1,000-foot level it dips steeply to the south. The width of the deposit varies considerably. One bulge of ore at the 225-foot level is over 100 feet wide, but on the whole the deposit is linear with widths mostly not over 30 feet. The attitude of the contact does not indicate that the formation of the deposit was the result of gravitative differentiation from the norite, but rather that it is more in the nature of a vein deposit formed along a shear zone.

During the summer of 1934 a new 5-compartment shaft was commenced approximately 2,400 feet east of the old shaft. It is the intention to sink this shaft to a depth of 1,500 feet to explore what is known as the east ore body, which was located by diamond-drilling.

CHAPTER V

Genesis of the Sudbury Ores

Introduction

The origin of the Sudbury ore deposits has been the subject of much controversy over a number of years. The following theories of origin have been put forward by various writers as a result of extensive studies of the deposits, either in the field or in the laboratory: (1) Magmatic segregation;[1] (2) Formation by hydrothermal processes;[2] (3) Sulphide injection.[3]

These theories or their modifications cover a wide range of the possible explanations for the origin of the Sudbury deposits. The authors of this report offer no new theories nor modifications of theories previously advanced. Some observations bearing on the main theories advanced for the genesis of the deposits were made during the course of the work, and these will be briefly reviewed.

Magmatic Segregation

The branch of the theory of magmatic segregation that has provoked the most discussion is the gravitative differentiation theory of Adams, Barlow, and Coleman, according to which the sulphides separated from the nickel irruptive by the action of gravity on an immiscible silicate-sulphide melt. All of the geologists who have studied the Sudbury ores agree that the ores are closely associated with the norite or the quartz diorite of the offsets. Practically all the deposits known at present were staked many years ago by prospectors working with that idea in mind. In the paper by Coleman, Moore, and Walker[4] the following statement is made:—

> The arguments for direct differentiation from the norite are based on the close asscciation of the ores everywhere with the norite. There is no nickel ore where there is no norite or related basic rock. The differentiation in place of the sheet, as a whole, into a basic phase and an acid micropegmatitic phase . . . is an indication of the extent to which differentiation has been carried *in situ*.

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[1]A. E. Barlow, "The Nickel and Copper Deposits of Sudbury, Ontario," Geol. Surv. Can., Vol. XIV, pt. H, 1901.

A. P. Coleman, "The Sudbury Nickel Field," Ont. Bur. Mines, Vol. XIV, pt. 3, 1905; "The Nickel Industry: with Special Reference to the Sudbury Region, Ontario," Mines Branch, Can. Dept. Mines, Bull. No. 170, 1913.

A. P. Coleman, E. S. Moore, and T. L. Walker, "The Sudbury Nickel Intrusive," Univ. of Toronto Studies, Geol. Series No. 28, 1929.

H. M. Roberts and R. D. Longyear, "Genesis of the Sudbury Nickel-Copper Ores, as Indicated by Recent Explorations," Trans. Amer. Inst. Min. Eng., Vol. 59, 1918.

[2]C. W. Dickson, "The Ore-Deposits of Sudbury, Ontario," Trans. Amer. Inst. Min. Eng., Vol. XXXIV, 1904.

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T. C. Phemister, "Igneous Rocks of Sudbury and Their Relations to the Ore Deposits," Ont. Dept. Mines, Vol. XXXIV, pt. 8, 1925.

[3]E. Howe,' 'Petrographical Notes on the Sudbury Nickel Deposits," Econ. Geol., Vol. IX, 1914.

A. M. Bateman, "Magmatic Ore Deposits, Sudbury, Ont.," Econ. Geol., Vol. XII, 1917.

[4]Op. cit., p. 47.

Walker's original theory that the norite and micropegmatite were formed as a result of gravitative differentiation *in situ* from an originally homogeneous magma still seems the most probable to those who have studied the problem. The weight of evidence behind this theory has always been one of the strongest arguments in favour of inferring similarly the gravitative differentiation of the sulphides from the same magma.

Another feature in favour of this idea much stressed by Coleman is the spotting of the norite by the sulphides. Opponents of the theory of separation by gravity point to the fact that other rocks, including granite and greenstones, also show spotting. This spotting of rocks other than the norite is common, but the nature of the distribution of the spots of sulphides is quite different. Within the norite, outside of areas affected by shearing, the distribution is uniform, the norite showing a decrease in the amount of sulphides from its outer to its inner margin. This condition can be observed especially well in the area northeast of the Murray mine, but is also present along many sections of the norite rim. The distribution of the sulphides in the footwall rocks is quite irregular in comparison. This uniform distribution of sulphides within the massive norite with comparative slight alteration of its other mineral constituents suggests that these sulphides are primary, and, if so, can best be accounted for by some process of magmatic segregation. This generation of sulphides would belong to the "first phase of mineralization" suggested by Bateman.[1]

When, however, the ore bodies or any extensive concentrations of the sulphides of nickel and copper are studied, it is evident that these sulphides have no direct connection, such as magmatic segregation, with the norite or related rocks. The contact of the norite with the adjacent rocks on the south side was located chiefly by plane-table survey from the vicinity of the Garson mine southwestward beyond the Victoria mine. Along the contact there are numerous gossans, both large and small, on which pits and shafts have been sunk. It was observed that the heavier gossans are almost always in the greenstone and other rocks adjacent to the norite. Brecciation of the rocks carrying the ore is a striking feature. Heavy gossans commonly lap around fragments of rock of varying size. The norite itself is brecciated and shows fragments with ore around them. This feature has been repeatedly emphasized by Knight, either by description or diagram. In regard to the norite Knight[2] states:—

> It has, for example, been found that in many deposits fragments and blocks of norite are found cemented together by sulphides. . . . It is, therefore, evident that the norite had solidified before the sulphides were introduced.

In addition, in places along the contact both the norite and the adjacent rock have been sheared and are now schistose, whereas the ore may be quite massive.

At the Creighton mine the ore occurs in granite believed by Knight[3] and others, including the authors of this report, to be later than the norite. Granting, however, that there is some doubt as to the age relationships of the granite and norite, there is very little doubt as to the age of the trap dikes previously described. These dikes may be seen on the surface clearly intruding the norite and granite. Underground it is evident that they have been fractured, and fragments of the dike are to be seen clearly surrounded by sulphides. There is, therefore, at the Creighton mine convincing evidence of a considerable interval of time between the consolidation of the norite and the formation of the Creighton ore bodies.

[1]Op. cit., p. 420.
[2]Op. cit., p. 131.
[3]Ibid, pp. 122-125.

At the Frood mine there is a similar situation with respect to the granite and the ore. In this case a dike of granite, probably an offshoot of the Murray granite, has been fractured and ore deposited along the fractures. The Murray granite is admitted by all observers to be later than the norite.

At the Garson and Falconbridge mines there is abundant evidence that the shearing and fracturing of the rocks antedated the deposition of the sulphides. The importance attached to the careful study of structural features in following the extensions of known ore bodies or in the search for new ones is being emphasized at present to a much greater extent than would be justified if gravitative differentiation were believed to be a major controlling factor in the deposition of the ore bodies. Phemister[1] states:—

> The only relation which can be held to exist between the ores and the norite is a structural one. The majority of the ores have been formed in the planes of weakness which, though existing prior to the intrusions of the norite and micropegmatite, have been emphasized by the latter. Movements along the edge of the block containing the norite and micropegmatite have produced other planes of weakness steeply inclined to the contact of the norite, and along these planes also ores have been formed.

Other Hypotheses

The sulphide-melt injection hypothesis and the formation by hydrothermal processes are rather fully discussed by Phemister.[2] The strongest arguments put forward in favour of the former and opposed to the latter hypothesis are the presence within the ore bodies of angular fragments of various types of country rock and the absence of alteration in the wall rocks of certain of the larger deposits, especially the Creighton and Frood. In the case of the former argument, Phemister points out that many of the fragments show evidences of hydrothermal action, but he believes that some intrusive power, as exemplified in the ore magma theory of Spurr, has been operative in the isolation of these fragments.

With regard to the absence of wall rock alteration Phemister[3] states:—

> At a late stage of the mineralization, quartz and quartz-feldspar veins have been formed. The conditions of pressure and temperature under which the majority of the sulphides were deposited, therefore, must have been more intense than those represented by the quartz and quartz-feldspar veins. If the latter is regarded as a variety of pegmatite, then the conditions of formation of the ores may be taken as corresponding more to those obtaining during the solidification of an acid or intermediate igneous rock. There is no reason, therefore, why the solutions depositing the sulphide should effect any alteration beyond the deposition of sulphides in the country rock, if the composition of the latter is acid or intermediate.

Quartz and calcite, the minerals usually associated with replacement by hydrothermal processes, are present in varying quantities at all the deposits. It has been shown that hydrothermal replacement is widespread at most of the offset deposits. Extensive wall-rock alteration characterizes such deposits as the Falconbridge, Garson, and Victoria. At the Falconbridge mine the ore occurs in a zone showing intense alteration of the country rock by circulating solutions which have replaced the constituents of the wall rock by silica, resulting in the formation of the rock known as jasperoid. This alteration has apparently been accompanied or followed by deposition of the sulphides and a later generation of quartz and calcite. To the authors there seems no significant feature in connection with the genesis of the Falconbridge ore body that is not readily explained by the ordinary processes of replacement, mainly through hydrothermal action.

The importance of structural control in all the deposits is stressed by Knight, Phemister, and others, including the authors, and this feature is as well marked

[1]Op, cit., p. 50.
[2]Ibid, pp. 50-56.
[3]Ibid, p. 54.

at the Creighton and Frood mines as at any of the Sudbury deposits. The ore bodies confined to zones of shearing or brecciation show a wide variation in the proportion of sulphides to silicates. The original Frood ore body down to the 1,000-foot level was considered to be a large body of medium- or low-grade ore, consisting of disseminated sulphides in quartz diorite or gabbro. These sulphides can most readily be explained as due to the replacement of the silicates of the rocks in which they occur. Between these upper levels and the 2,800-foot level, where the rich sulphide ores occur, there is a marked gradation in the proportion of sulphides to silicates without any definite break in the change from low-grade to high-grade ore.

To describe the different types of ore in the Sudbury deposits, certain terms have been used, e.g. massive sulphides, disseminated sulphides, and breccia ore. In some of the deposits all three types are present in varying proportions, but the relationships are not such as to suggest different methods of origin for different types. In this connection Wandke and Hoffman[1] make the following statement: "Our belief is that the ore bodies occurring about the nickel eruptive form a unit. Any explanation offered for one of the deposits must explain the others." The same idea is implied in the studies of Knight, Phemister, and others. The authors of the report are in agreement with this idea, and further assert their belief that the Sudbury ores have been formed along sheared and fractured zones by metasomatic processes, in which hydrothermal action has played the most important rôle. The allowance of some intrusive power to the ore-bearing solutions in explanation of the angularity and abundance of the inclusions, as suggested by Phemister, merely modifies, but does not detract from, the hydrothermal theory of origin for the Sudbury deposits.

[1]Op. cit., p. 182.

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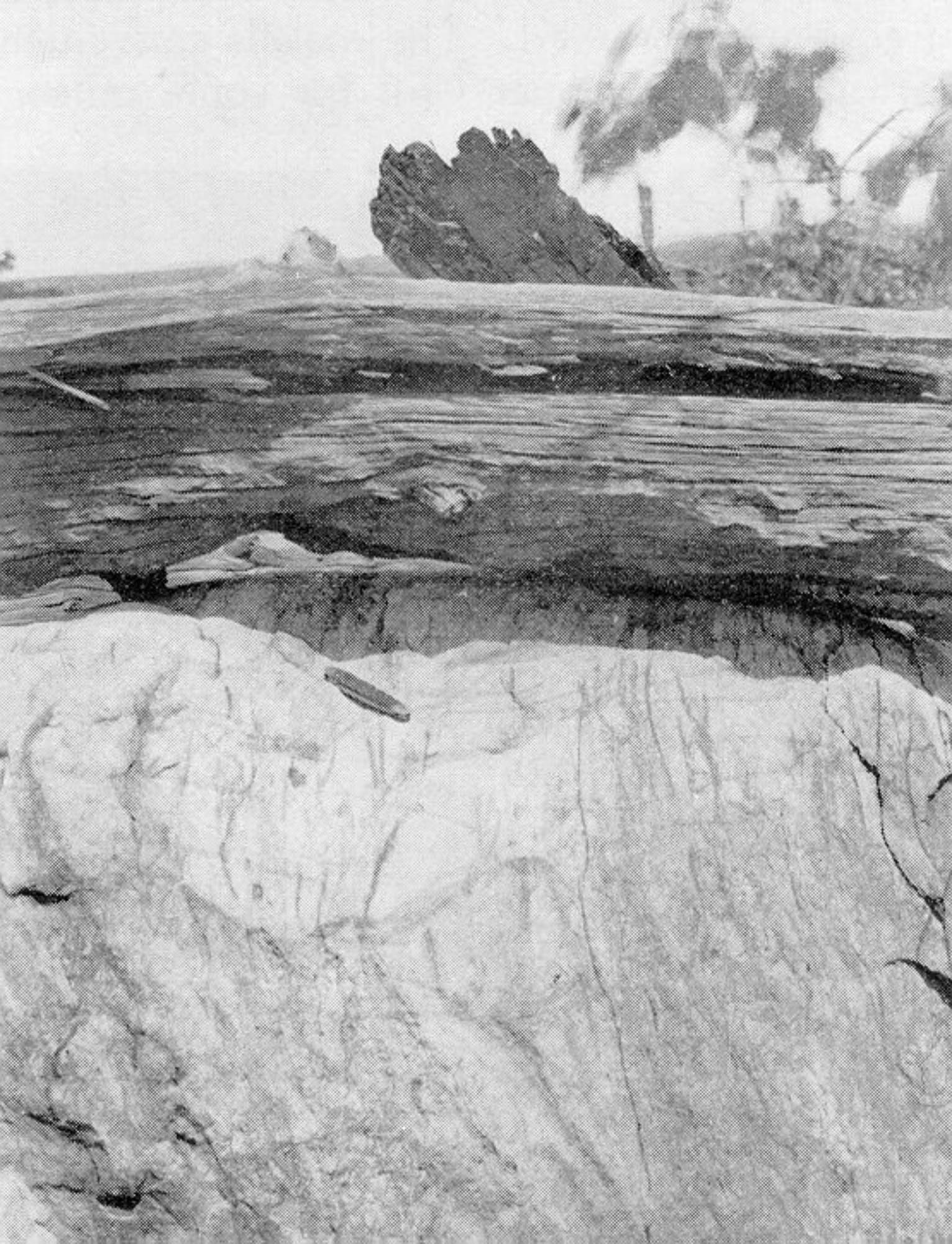
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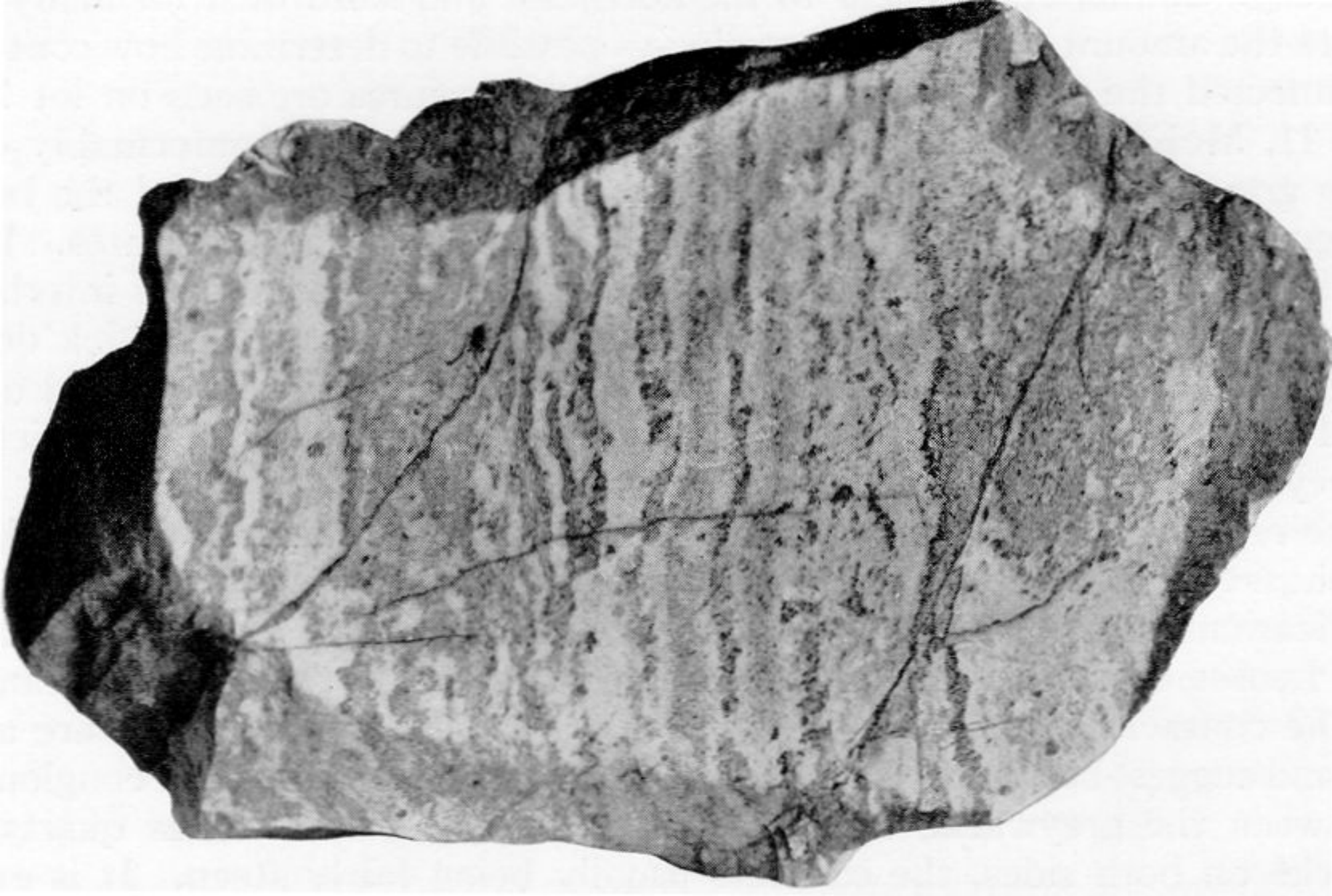












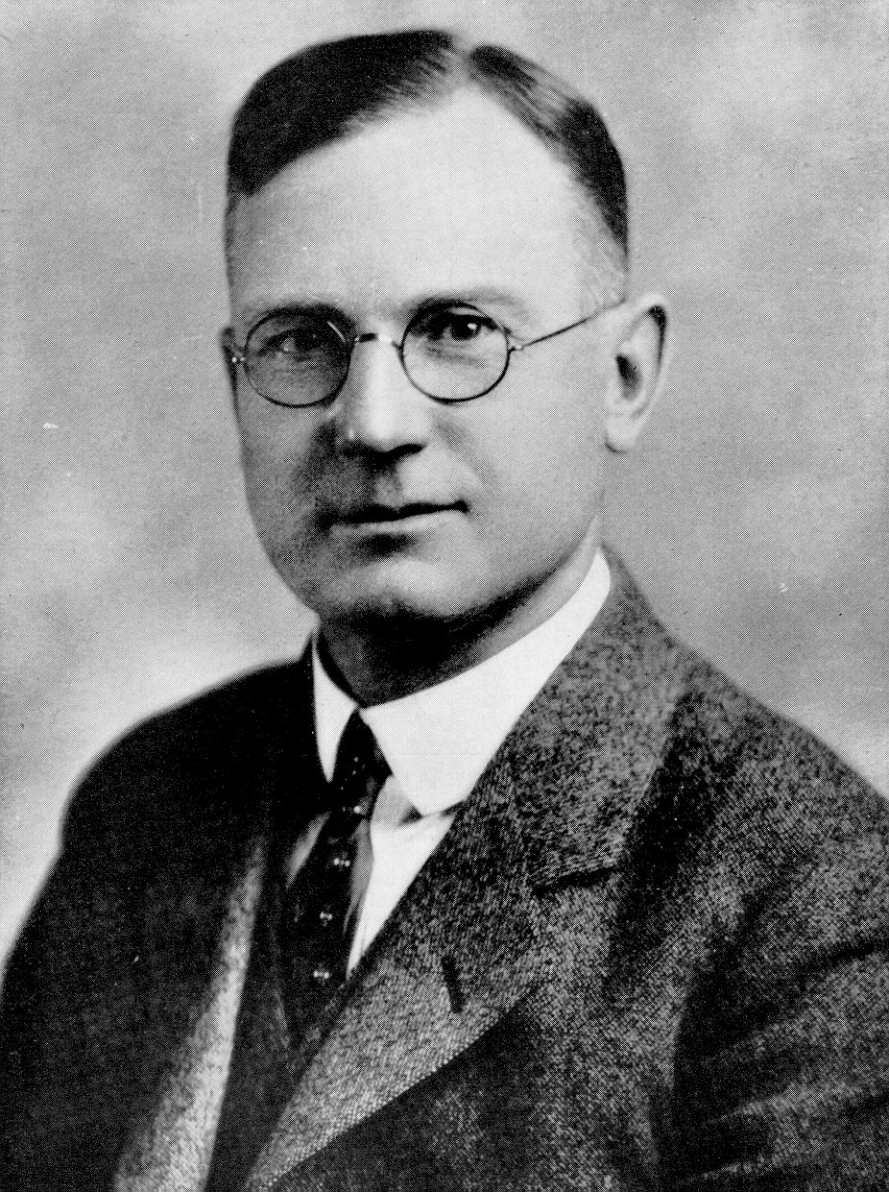












PROVINCE OF ONTARIO
DEPARTMENT OF MINES

HON. PAUL LEDUC, *Minister of Mines* THOS. W. GIBSON, *Deputy Minister*

FORTY-THIRD ANNUAL REPORT

OF THE

ONTARIO DEPARTMENT OF MINES

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Geology of the Swayze Gold Area, by H. C. Rickaby - - 1-36
Geology of the Makwa-Churchill Area, by H. C. Laird - 37-80

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COLOURED GEOLOGICAL MAPS

(In pocket at back of report)

Map No. 43*b*—Swayze Gold Area, District of Sudbury, Ontario. Scale, 1 mile to the inch.
Map No. 43*c*—Makwa-Churchill Area, District of Sudbury, Ontario. Scale, 1 mile to the inch.

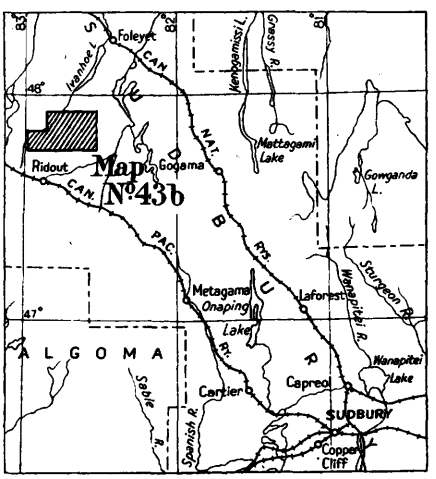
Geology of the Swayze Gold Area

By H. C. Rickaby

INTRODUCTION

The township of Swayze, from which the Swayze gold area derives its name, is in the district of Sudbury, approximately 150 miles northwest of Sudbury. This area is situated at the southwest corner of a triangle whose northeast and southeast corners lie at Porcupine and Shiningtree, respectively, and whose sides are between 70 and 90 miles in length. Belts of Keewatin greenstones and sediments form the sides of this triangle, and a large granite mass occupies the centre.

Prior to the summer of 1931, the Swayze corner of this triangle had probably been less carefully prospected than the other parts, and comparatively little was



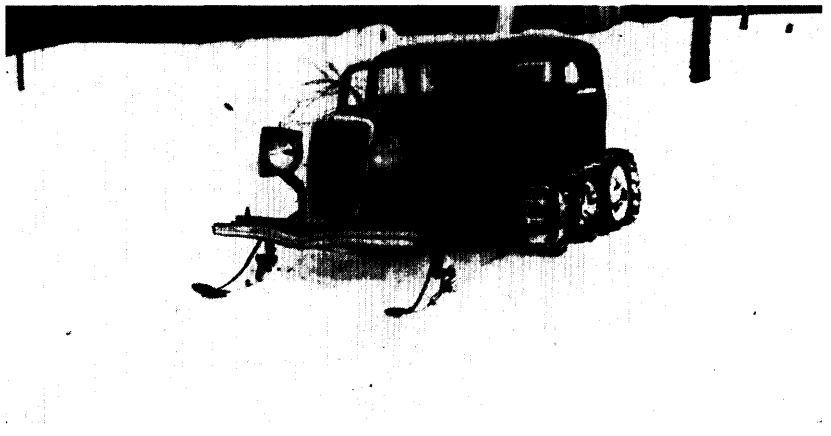
Key map showing the location of the Swayze gold area. Scale, 60 miles to the inch.

known of it from the standpoint of gold-mining possibilities. The extensive belts of iron formation to the south and east of the Swayze area received some attention about the year 1909; and during the years 1927 and 1928, some prospecting was done in the townships of Greenlaw and Cunningham, south of Swayze, chiefly for base metals—copper, zinc, and lead. In the summer of 1931, a promising discovery of gold-bearing quartz was made by J. G. and J. L. Kenty, working for the Brett-Trethewey Mines, Limited, in association with Northern Canada Mining Corporation and Northland Prospectors, Limited. This property, now known as the Kenty Gold Mines, Limited, has been actively developed with encouraging results. Following this discovery, in 1931 and during the years 1932 and 1933, considerable prospecting took place in the area, as a result of which a number of other discoveries of gold were made, chiefly to the west of the original find. They are distributed over a wide area, which includes the townships of Rollo, Raney, Swayze, Denyes, Halcrow, and Greenlaw.

Means of Access

The Swayze area lies between the main lines of the Canadian National and Canadian Pacific railways, and it may be reached by good canoe routes from either line. For Halcrow township and the western part of the area, the Kinogama river from mile 107 on the Canadian Pacific railway is probably the best water route. From the railway to the centre of Halcrow township there are five portages, the longest of which is less than 30 chains in length. For the central and eastern parts, the two best routes make use of the Wakami river and its tributaries, and the Groundhog river. The former route starts from Ridout on the C.P.R., follows the Ridout and Wakami rivers to Ridout lake, from the east end of which a chain of lakes connected by portages leads to Brett lake in the northeast part of Swayze township.

From the Canadian National railway there are two routes. One from Groundhog crossing ascends the Groundhog river to Horwood lake. The other



Snowmobile used for transportation from Sultan to the Kenty mine.

route starts from Foleyet, by a 6-mile wagon road to Ivanhoe lake and continues up the Ivanhoe river to Raney township in the northwestern part of the area. The portages on all these routes are in fair condition, and the routes are best shown on map No. 1933*a*, issued by the Ontario Department of Mines.

A good wagon road, suitable for light freighting, has been completed from Sultan on the C.P.R. to the Kenty mine. During the past two years an almost daily airplane service to Swayze has been maintained from Chapleau and other points.

Topography and Drainage

The relief within the Swayze area is moderate and otherwise typical of the pre-Cambrian shield. Rocky hills and drift ridges, with elevations usually not exceeding 100 feet above the surrounding level, are characteristic throughout the area.

All of the Swayze area lies within the Hudson Bay watershed, the height of land being from 15 to 25 miles to the south. The rivers are all small with gentle gradients, lakes and stretches of river with sluggish current being interspersed with short stretches of rapids or waterfalls. The western part of the area is drained by the Ivanhoe river and its tributary, the Kinogama. The northeastern

part drains northeast by the Swayze river to Horwood lake and the Groundhog river. The southeastern part drains eastward by the Wakami river, which is also part of the Groundhog river system. Within the area none of the waterfalls on these streams have sufficient flow for the development of any considerable quantity of water power. A waterfall on the Kinogama river in Halcrow township has a drop of approximately 20 feet, and a dam has been put in by the Halcrow Swayze Mines, Limited, with the idea of utilizing this power for the development of their property.

Natural Resources

All of the Swayze area is covered with forest made up of spruce, balsam, jackpine, poplar, birch, and cedar. Most of the trees, however, are small, 12



Falls on the Kinogama river, Halcrow township.

inches at the base being the maximum diameter. Much of the timber is suitable for pulpwood, but there are only small areas sufficiently large or otherwise suitable for mining purposes.

For a more detailed account of the topography, natural resources, etc., reference may be made to an earlier report by G. D. Furse.[1]

Previous Geological Work

The earliest reference to the geology of this area is contained in a report by W. A. Parks,[2] who made a reconnaisance survey along the Woman, Groundhog,

[1]G. D. Furse, Ont. Dept. Mines, Vol. XLI, pt. 3, 1932.
[2]"Niven's Base Line," 1899, Ont. Bur. Mines, Vol. IX, 1900.

and Ivanhoe (Pishkanogama) rivers in 1899. The Geological Survey of Canada conducted a survey of the Woman River and Ridout areas[1] from 1923 to 1927 and of the Rush Lake area[2] from 1928 to 1930, inclusive. In 1931, G. D. Furse[3] made a geological survey of the Swayze area, including the townships of Raney, Rollo, Coppell, Newton, Denyes, Swayze, Dore, and Heenan.

Scope of the Present Report

In 1932, the writer was instructed to make an examination of the area to the west of the Swayze area, with a view to locating and mapping a possible westward extension of the Swayze belt of greenstones. The first part of the season was spent in making a reconnaisance survey of a group of nine townships, McGee, Chewett, Sandy, Borden, Gamey, Crockett, McNaught, Lackner, and Halcrow. With the exception of Halcrow township, no large area underlain by greenstones or sediments was indicated, and no detailed examination of the other townships was made. Most of them are covered by a heavy overburden of sand or drift, but sufficient outcrops were seen to indicate that they are largely underlain by gneisses and granite and are consequently, in general, unfavourable for gold deposits.

Township 26, lying to the west of Tooms township, immediately south of the Swayze area, was also examined, but the greenstones of Tooms township were found to be cut off to the west by granite and gneiss, as shown on the map of the Kamiskotia-Ridout area.[4]

The remainder of the season of 1932 and all of the season of 1933 were spent in making a detailed geological survey of the townships of Halcrow, Denyes, Swayze, Raney, Rollo, and parts of the townships of Dore, Cunningham, Greenlaw, and Tooms, with special reference to the possibilities of gold deposits.

Acknowledgments

During the two seasons spent in the area the writer and his party had the co-operation of the officials of the various mining companies and prospectors working in the area. It is a pleasure to acknowledge the many ways in which these gentlemen assisted in the work. Thanks are due to F. L. Trethewey, E. T. Corkill, and Massey Williams, of the Kenty Gold Mines, Limited, for their hospitality and for the information and plans supplied in connection with the Kenty mine, and for similar assistance rendered by the following gentlemen in connection with the properties under their direction: Horace Strong and the officials of the Halcrow Swayze Mines, Limited; R. E. Hore, Swayze Gold Belt Exploration Company; W. H. Graves, Agaura Exploration Company; P. J. Scott, McIntyre-Porcupine Mines, Limited; W. Cliff, Dome Mines, Limited; J. J. Byrne, Lee Gold Mines, Limited; S. S. Saxton, Waite Company; P. A. Dyment, Dyment Mining and Investments, Limited; and D. C. McKechnie, Consolidated Mining and Smelting Company of Canada, Limited. Space does not permit mention of the names of the many prospectors and others who afforded assistance and hospitality in the field.

During the summer of 1932, the late Dr. A. G. Burrows, Provincial Geologist, spent a week with the party in the area. The writer had the benefit of his wide experience and also that of C. W. Knight, who paid several visits to the area

[1]R. C. Emmons and Ellis Thomson, Geol. Surv. Can., Mem. 157, 1929.
[2]H. M. Bannerman, Geol. Surv. Can., map No. 290A (report covering this area not yet available).
[3]Op. cit.
[4]Ont. Dept. Mines, Map No. 1933*a*.

during the course of the work. G. D. Furse gave access to his field notes covering much the same area as this present report.

G. F. Summers and J. W. Tyrrell supplied advance plans of surveys made during the progress of the work. Thanks are also due to the officials of the Ontario Forestry Branch at Chapleau for information and assistance rendered by them.

During the season of 1932 the writer had as assistants H. C. Laird, C. H. Knight, W. S. Savage, and H. F. Zurbrigg. Messrs. Savage and Zurbrigg continued during 1933 along with B. C. Coles. All of these men rendered able assistance throughout the whole course of the work.

GENERAL GEOLOGY

The basement rocks of the Swayze area consist of volcanic flows and tuffs typical of the Keewatin greenstones of other areas, with which are enfolded bands of rocks essentially sedimentary, but including a considerable amount of volcanics in the form of rather acid flows and pyroclastics. There are two main bands of these sediments, known as the Ridout and Swayze series, and several smaller subsidiary bands. The basement rocks have been highly folded into a series of anticlinal and synclinal folds with a general east-west strike. The greenstones and sediments are intruded by basic eruptive rocks, followed by granites, porphyries, etc., of Algoman age, and lastly by diabase dikes of Keweenawan age.

The stratigraphic relationship of the greenstones and sediments is rather obscure owing to the intense folding, which has obliterated much of the original textures. Field evidence given later in the report indicates, however, that the main sedimentary bands lie stratigraphically at the top of the greenstone-sedimentary complex. The evidence on which this complex can be definitely separated into a Keewatin series and a Timiskaming series is somewhat contradictory. In fact serious objection might be made to a Timiskaming age being assigned to the rocks included under the Swayze-Ridout series.

The geological history of the area starts with a period of intense volcanic activity, followed by a period of alternating vulcanism and local sedimentation, and later by a period during which considerable thicknesses of conglomerates, greywackés, and other sediments were laid down. Volcanic activity persisted to some extent even into the last period, and much of the sedimentary material consists of reworked volcanic debris. At or near the bottom of both the Ridout and Swayze series there are local occurrences of conglomerate that show pebbles of granite and other characteristics of Timiskaming conglomerate, suggesting an erosional unconformity. The contacts between the sediments and greenstones, however, as shown on the map, do not always suggest an unconformity.

The first period of intense volcanic activity resulted in the laying down of flows of considerable thickness, essentially of basic to intermediate composition. Toward the end of the period the flows tended to become more acid; but the general term greenstone is particularly applicable to these rocks, and a Keewatin age has been assigned to them. The second period is more or less a transitional one. The volcanic activity continued but was largely explosive and resulted in the deposition of a thick series of rather acid pyroclastic rocks, including trachyte and rhyolite tuffs, agglomerates, and flow breccias. Rocks of this period are more local in their distribution than those of the other two periods. They are well represented, for instance, in the area north of Cree lake in Swayze township, but are almost entirely absent along the south contact of the Ridout series near

the boundary line between Tooms and Greenlaw townships, and along the south contact of the Swayze series in Halcrow township. The rocks of the third period consist essentially of water-sorted material forming conglomerates, quartzites, greywacké, slate, etc. The rocks of the last two periods, with the exception of some interbedded dark-coloured tuffs and slates, are prevailingly light-coloured, grey to greenish-grey rocks, as opposed to the dark-green colour of the Keewatin greenstones.

In most of the area it is possible to draw a line showing the contact between the rocks of the first and second, or first and third periods, but only in a very general way is it possible to map separately the rocks of the last two periods. There is no positive indication of a structural discordance separating any of the periods, but there is undoubted evidence of an erosional unconformity separating the greenstones and sediments. Moreover, the light-coloured rocks in general are somewhat less metamorphosed than the greenstones, and since they have much the same structural implications as the Timiskaming rocks of other areas they have been grouped with the Timiskaming series.

Table of Formations

QUATERNARY	
PLEISTOCENE:	Sand, gravel.
PRE-CAMBRIAN	
KEWEENAWAN:	Quartz diabase,[1] olivine diabase.
	Intrusive contact
ALGOMAN:	Quartz and feldspar porphyry, aplite, lamprophyre, granite, granodiorite, gneiss.
	Intrusive contact
PRE-ALGOMAN: (Haileyburian?)	Diorite, diabase, gabbro, peridotite, lamprophyre.
	Intrusive contact
TIMISKAMING(?): (Ridout-Swayze series)	Complex series consisting of sediments, including conglomerate, greywacké, quartzite, slate; trachytic to rhyolitic tuffs and agglomerates; hornblende and chlorite schists; iron formation.
KEEWATIN:	Acid to basic lavas, including basalt, andesite, gabbro, diabase; rhyolite, dacite; tuffs and agglomerates; hornblende and chlorite schists; iron formation.

Keewatin

The Keewatin rocks, as previously stated, are dark-greenish in colour and consist of basic to intermediate and acid volcanics, interbedded to a certain extent but with the more basic types at the bottom and becoming more acid toward the top. They show a wide variety of textures, including fine-grained and coarse-grained types. Pillow lavas are widespread throughout the area, though in many cases the rocks have been so much disturbed that original textures such as these have been partially or completely destroyed, and only rarely were the pillows suitable for the determination of the attitude of the flows. Where the flows are comparatively thick, the centres consist of diabase, gabbro, and diorite, in which cases it is difficult to distinguish them from later intrusive rocks. This condition is especially true in the Dore township section of the map area, south of Crossley lake. Around Cree lake the greenstones are almost entirely tuffaceous or agglomeratic.

The Keewatin rocks are highly altered, the chief secondary minerals being chlorite, uralite, sericite, and carbonates. This alteration is most intense along

[1]Possibly Matachewan series in part.

flow contacts and in the tuffaceous greenstones. Along the contact with the granites to the west the greenstones are represented chiefly by hornblende schist and gneiss.

Basic Volcanics

The basic volcanics consist essentially of basalts, with gabbroid and diabasic phases, and andesite. They are highly altered to secondary minerals, including chlorite, serpentine, uralite, carbonates, epidote, and leucoxene. The feldspars have been saussuritized. Very little original pyroxene remains except in the thicker flows which have resisted dynamic metamorphism.

Acid Volcanics

The acid volcanics consist largely of rhyolites, dacite, and their pyroclastic equivalents, tuff and agglomerate. Rhyolites are of rather local occurrence and were noted most frequently at the upper horizon of the Keewatin rocks. Along the north shore of Denyes lake in Raney township there is a band of rhyolite consisting of a fine-grained greenish-grey lava with phenocrysts of quartz. A dark-green rock showing much quartz is quite common among the more acid greenstones. In places it is coarse-grained, and might be called a quartz diorite or diabase, but in other places it has a flow structure and is thought to be a dacite.

The alteration of the acid volcanics consists in the development of such secondary minerals as sericite, chlorite, carbonates, and epidote, and results in the formation of sericite and chlorite schists.

Timiskaming(?)

Ridout Series

The Ridout series was originally described by R. C. Emmons and Ellis Thomson[1] in the Woman River and Ridout areas to the south and east of the Swayze area. This series forms an almost continuous band now known to extend from the northwestern part of Halcrow township in an easterly direction to the east side of Churchill township, in the West Shiningtree area, a total length of about 85 miles. The west end of the Ridout series lies along the southern part of the Swayze map area. Beginning in the northwestern part of Halcrow township, the band strikes southeast across Halcrow and the northeast corner of Tooms township into Greenlaw. It passes across the north end of Greenlaw to the east side, where it is faulted northward. From this fault it continues across the southern part of Swayze township to the east side, where it is again faulted north, crossing into Dore township and thence southeastward toward Opeepeesway lake. It ranges in width from a maximum of 2 miles in Halcrow township to less than half a mile at the east end of the area. It consists for the most part of greywacké and argillite with local occurrences of conglomerate, quartzite, slate, arkose, and tuffs.

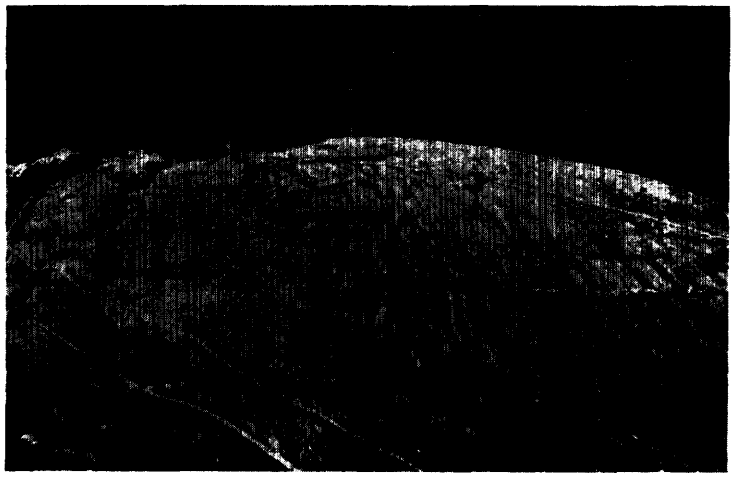
Conglomerate occurs at various horizons in the Ridout series of the Swayze area. The most important band lies along the south contact in the northeastern part of Tooms township. This band was traced for at least 2½ miles with an indicated maximum width of 600 feet. It is described by Emmons and Thomson[2] as follows:—

> North of Betty lake in Tooms township, the conglomerate consists of large boulders in an argillite matrix showing narrow, frequently crenulated bands. The boulders are exceptionally large and the bands remarkably distinct, especially on the weathered surface. The matrix is

[1]Op. cit.
[2]Op. cit., p. 10.

quite fine grained, but holds slightly larger, easily distinguishable grains of feldspar and quartz. The broader bands are only 2 or 3 inches wide, and many of these are finely sub-banded. Bands of one-quarter to one-half inch are very numerous; bands of smaller size are less noticeable. Each band varies considerably in width; the variation in part being related to the deformation. Deformation is intense in this locality, the matrix strongly chloritized, and the granite boulders and pebbles are markedly elongated. The planes of schistosity bend sharply about the boulders. Toward the southeast the banding of the matrix becomes progressively less prominent, is much narrower, but remains quite noticeable.

The fragments vary in size, the largest being 8 inches in diameter, and consist of greenstone, chert, quartz, and a porphyritic rock with quartz and feldspar, which appears to be a rhyolite. A few good granite pebbles were noted. With reference to the nature of the boulders and pebbles of the Ridout conglomerates, Emmons and Thomson[1] state that they are predominantly granite. Of the Tooms township conglomerate described above this would not appear to be true, unless the rhyolitic boulders may be included with the granites.



Bedded arkose on the south side of Kenty lake, Swayze township.

Another band of conglomerate not over 100 feet wide lies on the north side of the Ridout series almost opposite the conglomerate in Tooms. It appears to extend from the southwestern part of Denyes township southeastward across Lee lake in Greenlaw township. The boulders consist largely of trachyte, or rhyolite, with a few greenstone and chert pebbles much elongated by schisting. At the south end of the 16-chain portage on the Kinogama river above Halcrow lake there is an outcrop of conglomerate with large boulders of granite, etc., up to 2 feet in diameter. One mile northwest of this outcrop there is a highly schisted conglomerate in which the boulders have been squeezed out into ribbons but are still recognizable.

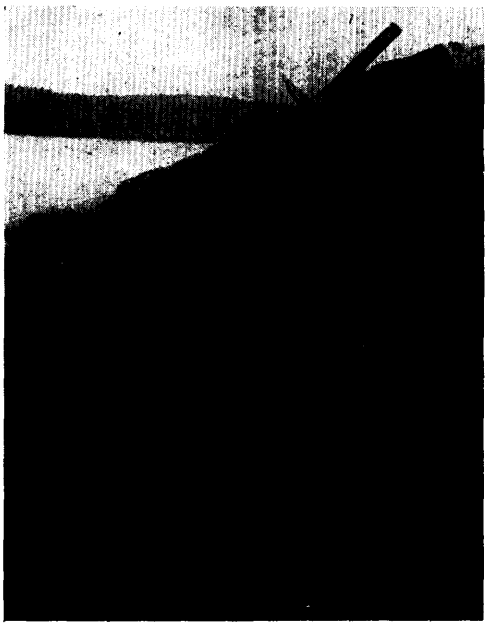
The remainder of the Ridout series consists of greywacké, quartzite, argillite, arkose, and tuffs. The margins of the Ridout sediments in Halcrow township are fairly sharp, but in the sections in Greenlaw, Cunningham, and Swayze townships the sediments and volcanics are intercalated and bands of dark slaty tuffs as well as thin flows alternate with the sediments near the margins. The tuffaceous bands persist right up through the Ridout series. In the section lying

[1]Op. cit., p. 9.

to the east of the fault in the eastern part of Swayze township there is a band of cherty rhyolitic rocks and acid pyroclastics separating the greenstones from the sediments, which here are narrow.

Swayze Series

Some narrow bands of sediments occurring near the north boundary of the townships of Denyes, Swayze, and Dore were provisionally designated the Swayze series by G. D. Furse. Adjacent to these sediments on the south side is a wide band of acid lavas and pyroclastic rocks, with which the sediments are closely associated and which, for reasons given previously, are included with the Swayze



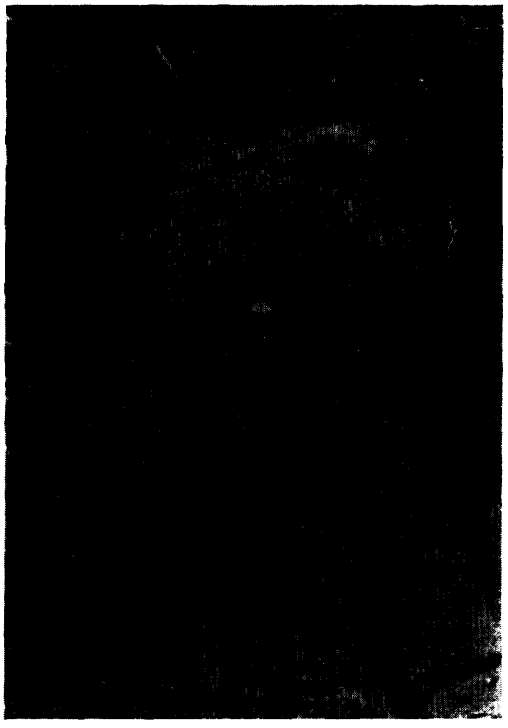
Agglomeratic rock of the Swayze series, south shore of Ackerman lake, Swayze township.

series. The main band of this series with an average width of 2 miles extends from the western part of Halcrow township eastward across the northern parts of the townships of Halcrow, Denyes, Swayze, and Dore. The sediments of the Swayze series consist of conglomerate, arkose, quartzite, greywacké, and slate.

The most important band of conglomerate lies along the southern part of the series in Halcrow township, extending westward from the Kinogama river almost to the Ivanhoe river. The outcrop is cut off at the east end by a prominent north-south fault; the band was not seen east of the fault, as there is very little rock outcrop for some distance along the contact. West of the fault it appears to have a thickness of almost 2,000 feet, but it is possible that its apparent thickness may be due to strike faults, of which, however, there is no definite evidence. The boulders, varying in size up to 15 inches in diameter, have been considerably elongated by schisting. They consist of greenstone, rhyolite, trachyte, chert, and granite in a greywacké or argillitic matrix. As with most of the conglomerates of the area, the largest proportion of the pebbles and boulders

are trachytic or rhyolitic in composition, but some of the larger ones are of grey and pink granite.

Narrow beds of conglomerate are of frequent occurrence throughout the Swayze series and occur at various horizons in it. These conglomerates grade from types having a greywacké or arkosic matrix with pebbles and boulders of various sorts to agglomeratic types in which the matrix and the included fragments or boulders consist of the same material, usually a porphyritic rock with the composition of a trachyte or rather basic rhyolite. Many of these agglomerates show bedding and have been subjected to some degree of sorting. The south shores of Dyment lake in Denyes township show good examples of this agglomeratic type.



Interbedded slate and greywacké, north shore of Raney lake, Raney township.

The other sedimentary rocks of the Swayze series consist of greywacké, quartzite, arkose, and slate, usually in narrow bands more or less interbedded. The best cross-section where these various types may be seen is along the Kinogama river below the falls in Halcrow township. The sediments here show good bedding, standing on edge or dipping at steep angles, usually to the north.

West of the south arm of Brett lake in Swayze township there is a large area of grey to greenish-grey moderately acid rocks, largely of pyroclastic origin, consisting of tuffs, agglomerates, and flow breccias. Many of these rocks are markedly porphyritic in appearance and are difficult to distinguish from later porphyry intrusives.

As with the Ridout series there is considerable interbedding of basic or acid flows with the Swayze series, particularly near the borders. This relationship is

seen north of Freymond lake in Swayze township. Again on claim S. 21,144 in Denyes township, approximately a mile east of the 4-mile post on the west boundary, an outcrop consists of an agglomeratic rock with fragments of porphyry and greenstone overlain by an andesite showing good pillows. A narrow band of pillow lavas was also noted in an outcrop on the trail connecting Dyment and Denyes lakes.

Besides the main band of the Swayze series there are three smaller bands, one in Denyes township east of Sylvanite lake, another in Raney township at the north end of Raney lake, and a third small one in Rollo township west of Rollo lake. The rocks of these bands consist of conglomerate, greywacké, and argillite, as in the main band. Their bedding relationships suggest that they are infolded with the greenstones as closely folded synclines.

On the Rush Lake sheet, H. M. Bannerman[1] shows lens-like bands of pyroclastic rocks, including some clastic sediments. This area is the eastward extension



Brecciated carbonate iron formation, south of Cree lake, Swayze township.

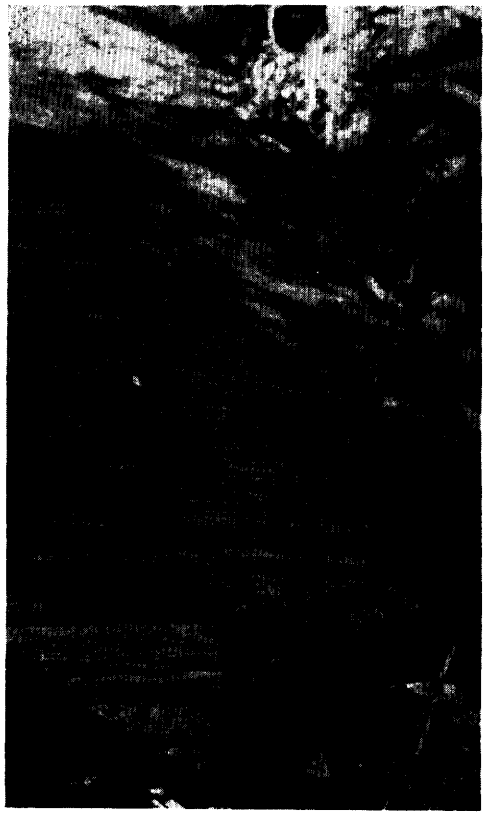
of the Swayze area, and it is probable, in view of the relationship of these bands to the underlying basic lavas, as indicated on this map, that some of them may be correlated with the Swayze series to the west.

Iron Formation

Typical banded iron formation occurs quite extensively in association with the Ridout series of the Swayze map area. Most of the occurrences are similar to those described by Emmons and Thomson,[2] who state that two iron formation horizons were recognized: one south of the Ridout series, i.e. in the greenstones, and the other at or close to the north edge of the sedimentary band. In the area covered by this report no typical banded iron formation was seen within the greenstones, and only one or two cases of conditions approaching iron formation within the band of rocks known as the Swayze series.

[1]Op. cit.
[2]Op. cit., pp. 20-28.

The occurrence of the iron formation at or near the north side of the Ridout series, however, is particularly marked. The most prominent band lies south of the east end of Cree lake in Swayze township and appears to be continuous for at least 1½ miles. Two good outcrops may be observed a few chains east and west of the Sultan-Kenty road. The occurrence consists of well-banded chert and jasper containing considerable amounts of quartz and sulphides. In places it is 300 feet wide and has been exposed by a series of old pits and trenches; further trenching has been done recently to search for gold in association with



Banded iron formation south of Halcrow lake, Halcrow township.

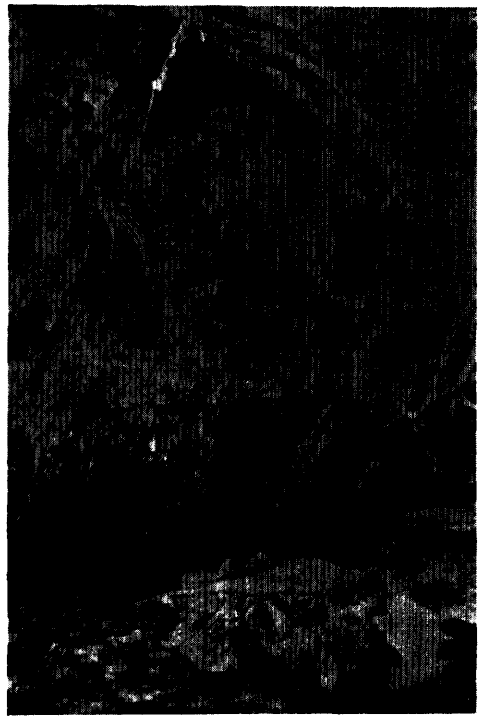
the sulphides. Parallelling the cherty banded material in a number of places is a prominent hogsback of breccia with a carbonate matrix.

Many other bands of iron formation were noted in the Ridout series from the east end of the map area right through to Halcrow township, and while they appear to be prominent along the north contact they are not by any means confined to it, but occur at various horizons within the series. Several bodies of iron formation occur in Greenlaw township, west of the portage connecting Hotstone (Edith) lake and Ridout lake. They are described by Emmons and Thomson[1] as follows:—

In Greenlaw township, at the west end of Ridout lake, iron formation occurs at the top of the sedimentary series. It strikes almost due east and dips 20 degrees to 70 degrees north, but in most

[1]Op. cit., p. 24.

places nearly 70 degrees. It forms a series of separate lenses, which occur at intervals for about one mile west of the portage from Edith lake to Ridout lake. Half a mile east of the portage, a rock, which becomes a small island at low water, is banded chert striking parallel to the rocks of the district and is a part of the same horizon. The lenses are 1,000 to 1,500 feet long in the case of the larger ones, and as much as 400 feet wide. Smaller lenses occur between and to one side or other of the larger ones. The grey and red chert of the more southerly bodies grades outwardly into dark, highly chloritized, finely banded argillite. The chert of the northern masses becomes dark-grey at the edges and is bounded by basaltic flows or by argillite or in places by diabase, which may be merely a diabasic flow. Sericite schists occur on the south sides of some of the lenses and in places in narrow zones within them. Near the portage where stripping has been done, bands rich in hematite and limonite, mostly less than one-half inch thick, are irregularly distributed through the chert and possibly compose a maximum of 15 to 20 per cent. of the rock. Locally the chert is brecciated, and in these brecciated zones there is considerable vein siderite.



Sericite schist with small drag fold,
Swayze township.

Structural Features of the Greenstones and Sediments

The conclusions as to the general structure of the Swayze area are based on the study of the attitude of the Ridout-Swayze series of sediments and the flows of the Keewatin greenstones. Careful attention was paid to the determination of dips and strikes or the attitude of any rocks showing bedding. Much of the evidence is somewhat contradictory, owing to the intensity of the folding, but enough information was obtained to afford reasonably safe conclusions on the broader structural features.

The main band of the Swayze series forms a syncline with its axial plane striking approximately east and west and dipping steeply to the north. Along the north contact of the sediments with the greenstones in Swayze township east of the northwest arm of Brett lake there is strong evidence that the tops of

the sedimentary beds face south. On a small lake north of Brett lake, half a mile west of the outlet, there are several good outcrops of well-bedded greywacké standing on edge, with the beds showing coarse-grained material on the north side grading to fine material on the south. Some minor drag folds on the Kenty property near the east boundary of Swayze indicate a similar relationship. G. D. Furse[1] observed similar evidence in a fine-grained arkose at the west end of Brett lake. The north contact of the Swayze series with the greenstones in Denyes and Halcrow townships to the west is mostly covered by drift, and very little satisfactory evidence, such as outlined above, was observed.

Along the south contact of the Swayze series the use of the same criteria indicate that the tops of the beds face north. On the north shore of Freymond lake there is a good outcrop of well-bedded argillite, with the bedding dipping at 50° N. and with a well-developed cleavage parallel to the strike of the bedding

Courtesy Massey Williams



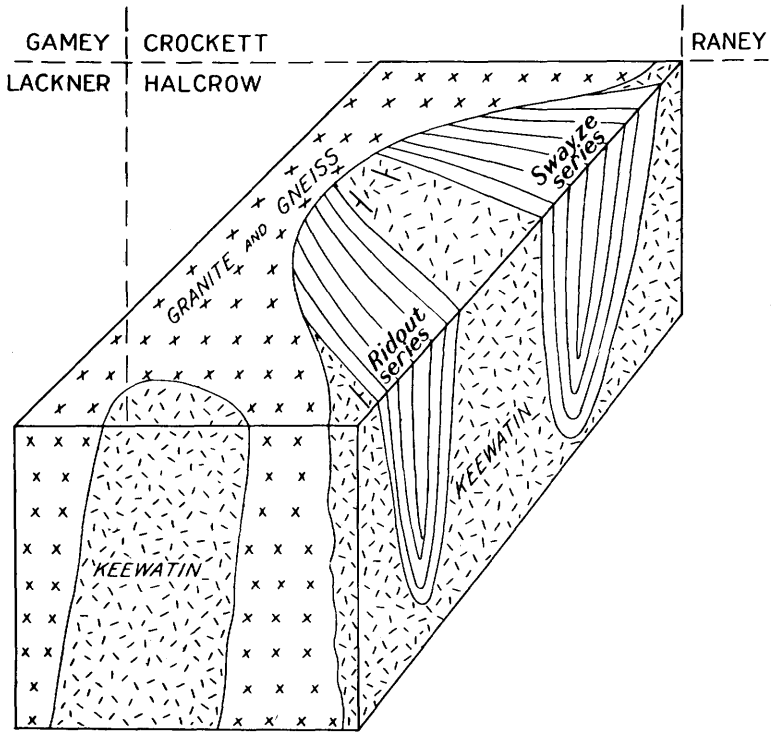
Drag fold in sediments of the Swayze series, Kenty mine.

but dipping at 75° N. In the southeast corner of claim S. 22,049, south of Dyment lake in Denyes township, H. F. Zurbrigg observed a basalt flow approximately 60 feet thick dipping steeply to the north. It shows a remarkable gradation in grains, with the coarse-grained material near the south side grading into fine-grained material to the north, clearly indicating that the tops face north.

In that part of the Ridout series included in the Swayze map area no conclusive evidence in the way of grain determinations of bedding, flow tops, etc., was obtained. Emmons and Thomson[2] concluded from their studies that the Ridout series was monoclinal in structure, i.e. that it was underlain by Keewatin volcanics on the south side and overlain by a similar series of volcanics on the north side. They based their conclusions on evidence obtained from grain determinations and cross-bedding relationships, largely in the vicinity of Opeepeesway lake. Farther east along the same belt H. C. Laird[3] concluded for various reasons that the Ridout series was synclinal in structure and overlay the greenstones to the north and south.

[1]Op. cit., p. 42.
[2]Op. cit., pp. 18, 19.
[3]"Geology of the Three Duck Lakes Area," Vol. XLI, pt. 3, 1932.

The only clues to the structure of the Ridout series observed in the Swayze map area lie in the apparent relationship of the Ridout and Swayze series at the extreme west limit of the greenstone sedimentary belt. In the northwestern part of Halcrow township there is a marked convergence of the two series, the north side of the former and the south side of the latter almost meeting, being cut off by the granite and gneiss. They are separated by greenstones, but the dips and strikes of the sediments along the contact strongly suggest that those parts of the two sedimentary series adjacent to the greenstone form the limbs of an anticline plunging steeply to the northwest. The determination of strikes and dips is



Idealized block diagram showing the relationship of the Ridout-Swayze series and the Keewatin series in Halcrow township.

complicated because of the fact that the rocks have been highly metamorphosed by the granite to the west, and it is difficult to be sure in places whether the foliation of the rocks is due to bedding or schisting. The latter possibility, however, seems hardly worthy of consideration, since the condition is apparently local. This major structural feature, combined with the fact that the main band of the Swayze series is synclinal and the dip of the sediments on the south side of the Ridout series is to the north, leads to the deduction that the two series are of the same age and are in the form of closely folded synclines converging to the west where they are cut off by the granite.

In the northern part of Swayze township there is a band of greenstones surrounded by sediments and acid volcanics of the Swayze series. This band is probably also in the form of a syncline plunging to the east in Dore township and to the west in Denyes township.

Pre-Algoman (Haileyburian?)

Among the rocks provisionally designated as Haileyburian in age are a number of varieties ranging in composition from ultrabasic to intermediate and including diorite, gabbro, diabase, peridotite, and lamprophyre. Their main distinguishing feature is their intrusive relationship to the sediments and greenstones. Where these intrusives occur within the Ridout or Swayze series the determination of their age relationship is reasonably certain, but there are many occurrences of similar rocks in the greenstones where it is difficult to classify them from an age standpoint.

A number of bosses and dike-like bodies of these intrusives occur in the vicinity of Lee lake in the northwestern part of Greenlaw township. They are usually massive green rocks with the textural appearance of diorite or diabase. In thin sections they are seen to consist essentially of fibrous hornblende, chlorite, and plagioclase, with a small amount of quartz. The plagioclase is usually saussuritized, and secondary minerals such as carbonates and leucoxene are present. An outcrop on the east shore of Lee lake is seen to consist chiefly of chlorite and serpentine with a little biotite. It is probably an altered peridotite or pyroxenite.

A number of small bosses or dikes of basic rock intrusive into the greenstones were noted, including peridotite, anorthosite, etc. About half a mile east of the south bay of Freymond lake an outcrop of coarse-grained rock consists essentially of a basic plagioclase, much altered to saussurite, with a little chlorite and epidote. It probably corresponds to anorthosite.

On the property of the Kenty Gold Mines there are a number of lens-like bodies or dikes of basic rocks, with lamprophyric, gabbroic, or dioritic phases, occurring in the sediments and in the greenstones. They have an east-west strike and are quite numerous in the vicinity of the two shafts. They vary considerably in appearance and composition in the same mass, owing probably in part to alterations caused by the porphyry intrusions and mineralizers associated with the formation of the veins. In many cases they contain a large number of inclusions of greenstone and sediments, giving them the appearance on a weathered surface of a conglomerate. One outcrop occurring southeast of No. 2 shaft has the appearance of diorite, varying from a dark-green to a lighter-coloured rock. In thin section the dark rock has a marked porphyritic texture with phenocrysts of augite and olivine in a fine-grained matrix of plagioclase partly altered to saussurite and carbonates. The olivine is almost entirely altered to serpentine containing nests of fine magnetite dust. The light-coloured rock contains much the same constituents with the addition of a little biotite. The augite has been partly altered to hornblende and chlorite, and the other constituents have been similarly altered with some carbonate replacement. These intrusives have been variously identified in hand specimens as gabbro, diorite, and lamprophyre, but they are probably phases of the same rock, which might be called a basic lamprophyre.

In Dore township south of Crossley lake there are a number of large bodies of basic rocks that look like diabase or gabbro. These rocks are massive and fresh-looking in contrast to the older appearance of most of the greenstones. In several instances, however, these coarse-grained rocks could be traced into fine-grained phases showing pillows with no sign of a contact. The coarse-grained phases form the centres of thick flows, and since the fresh appearances of these rocks is the only mark of distinction from the other greenstones they have not been included with the later intrusives. H. M. Bannerman[1] suggests the possi-

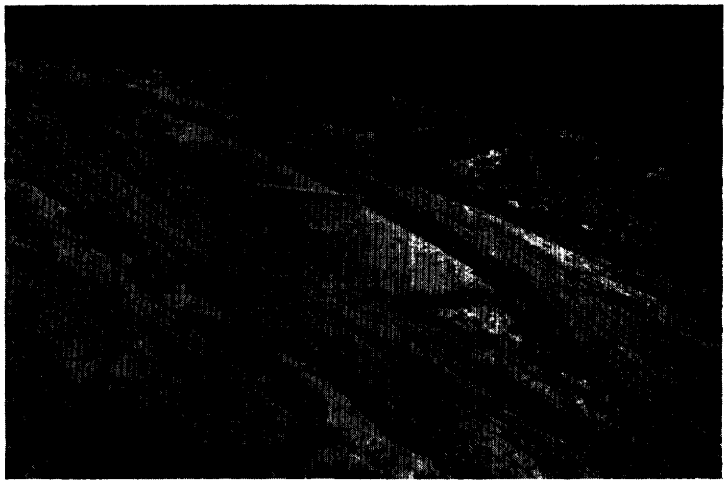
[1]Personal communication.

bility of a lava equivalent of some of the later intrusive rocks, and the suggestion seems worthy of consideration. The separation of such rocks from the other greenstones would, however, require considerable detailed study.

There are probably many other occurrences of rocks that are intrusive into the Keewatin, but from lack of definite evidence of their age relationship they have not been differentiated on the map. They are apparently all pre-Algoman and would not appear to have any economic significance as distinct from the older greenstones from the standpoint of gold deposition.

Algoman

The Algoman rocks consist essentially of granite, granodiorite, quartz porphyry, syenite porphyry, and lamprophyre. Along the west side of the Swayze area there are considerable areas of pink gneissoid rocks, many of which



Porphyry dikes cutting greenstones, Raney township.

are probably highly metamorphosed lavas or sediments. They have not been differentiated from the granites of Algoman age. It is also quite possible that there is more than one age of granites represented in the Swayze area.

Granite and Granodiorite

The granite along the western part of the map area varies in colour from pink to greyish and in texture from fine- to coarse-grained, and exhibits varying degrees of foliation. It is essentially a biotite-bearing type, occasionally showing some muscovite or hornblende. The granite bosses in Rollo and Raney townships are rather coarse grained with granodiorite phases. A prominent dike of granodiorite or quartz diorite occurs on the property of the Halcrow Swayze Mines, Limited, in Halcrow township, a few feet north of the shaft. The dike is from 100 to 200 feet wide and has been traced for over half a mile, striking S. 60° E. About 60 chains to the southeast near the Kinogama river the dike outcrops again with the same strike. In thin section it shows a medium coarse grained granitoid rock consisting of plagioclase, orthoclase, quartz, and biotite.

Porphyry

Small bosses and dikes of porphyry are of widespread occurrence in the greenstones and sediments throughout the area, but are most frequently found along the main band of the Swayze series from its western to its eastern limit. These porphyry bodies vary from narrow dikes a few inches wide to lens-shaped bosses as much as half a mile in width, usually with an east-west strike. The largest body of porphyry occurs at the east end of Brett lake, where it is three miles long with a maximum width of three-quarters of a mile. Included in this width, however, are a number of narrow parallel bands of sediments. In fact the south half of this porphyry appears to consist of sills or dikes of porphyry alternating with sediments. This condition is illustrated in cores from a series of diamond-drill holes put down by the Consolidated Mining and Smelting Company on the McNeely claims at the east end of Brett lake. One section near the north side of the porphyry showed a continuous width of over 1,000 feet of good porphyry. The porphyry is a typical pinkish quartz porphyry showing good phenocrysts of quartz, albite, and orthoclase in a groundmass of similar material. There is always some chlorite present; occasionally a little biotite or hornblende and apatite. The feldspars are much altered to kaolin and sericite, and carbonates are always prominent as secondary constituents.

The following is an analysis of a specimen of the quartz porphyry from the east end of Brett lake:—

	Per cent.
SiO_2	66.40
Al_2O_3	16.49
Fe_2O_3	1.05
FeO	1.56
CaO	2.97
MgO	1.28
Na_2O	4.82
K_2O	1.85
TiO_2	.37
P_2O_5	.28
H_2O	1.48
CO_2	1.44
S	trace
	99.99

Specific gravity, 2.69.

The porphyries throughout the area vary from reddish to grey in colour, and from types in which quartz is prominent to others in which it is practically absent. In the northwestern part of Halcrow township there are several bodies of typical syenite porphyry consisting essentially of orthoclase, albite, and biotite, without quartz.

Where these porphyries are intrusive into lavas they have sharp, well-defined boundaries, but where they intrude the sediments, coarse tuffs, or agglomerates, the contact is frequently indefinite. Apparently the porous fragmental rocks have been more or less soaked by solutions from the porphyry, giving them a marked porphyritic appearance and forming a hybrid type of rock. This condition is common along the main band of the Swayze series and makes it difficult to distinguish the true porphyries from the hybrid rocks. The process may be observed in the large bay at the west end of Brett lake, where coarse fragmental rocks can be seen grading into pinkish porphyritic rocks in which the outlines of the original fragments are only faintly visible.

Lamprophyre

Lamprophyre dikes of Algoman age are of frequent occurrence throughout the Swayze area. They are usually associated with the porphyry or other acid

dike rocks and are almost invariably to be found in the vicinity of the more promising-looking gold-bearing quartz veins. They are narrow, not usually over 5 or 6 feet in width. Where they were seen in contact with the porphyry they appear to be the later intrusive. The largest lamprophyre dike of this type occurs just west of the boundary line between Swayze and Denyes townships, 10 chains south of the 5-mile post. This dike is at least 75 feet wide and strikes approximately east and west. It is a dark-grey to black rock showing considerable biotite. In thin section it is porphyritic, consisting of orthoclase, plagioclase, biotite, and a little augite, with hornblende and chlorite as secondary minerals. It is a mica lamprophyre corresponding to minette.

Most of the lamprophyres of Algoman age are of this type, but other varieties were noted. In Halcrow township just west of Shunsby lake on the south side of a small creek flowing into the lake near the narrows, there is a dike of olivine-biotite lamprophyre in which the phenocrysts consist of olivine largely altered to serpentine and biotite in a groundmass of carbonates, probably replacing feldspar. A few lamprophyre dikes in which hornblende or augite and feldspar make up the phenocrysts were noted, and these rocks grade into the feldspar porphyries.

Keweenawan

Dikes of olivine diabase and quartz diabase are the latest intrusive rocks in the Swayze area. They vary in width, the maximum being 200 feet or more, and are otherwise similar to diabase dikes of other areas. They have been classed as Keweenawan in age, but it is quite possible that many of the quartz diabase dikes belong to the Matachewan series, as they have a strike within a few degrees of north and south, which is characteristic of that series.

Structure

Folding

Much of the information as to the nature of the folding in the Swayze area has been given previously in the report. The Keewatin-Timiskaming rocks have been closely folded along east-west axes. The strike of the axes varies from approximately E. 10° N. in the northwestern part of the area to E. 10° S. in the southern part. There are local indications of some cross-folding, i.e. in the vicinity of Denyes lake, where some of the sediments on the west side of the lake have a north-south strike and rather gentle dips to the west. The main bands of sediments represent synclines with intervening anticlines, from which the sediments have been eroded away. The main period of folding appears to have occurred during and subsequent to the deposition of the greenstones and sediments and prior to the intrusion of the Algoman rocks.

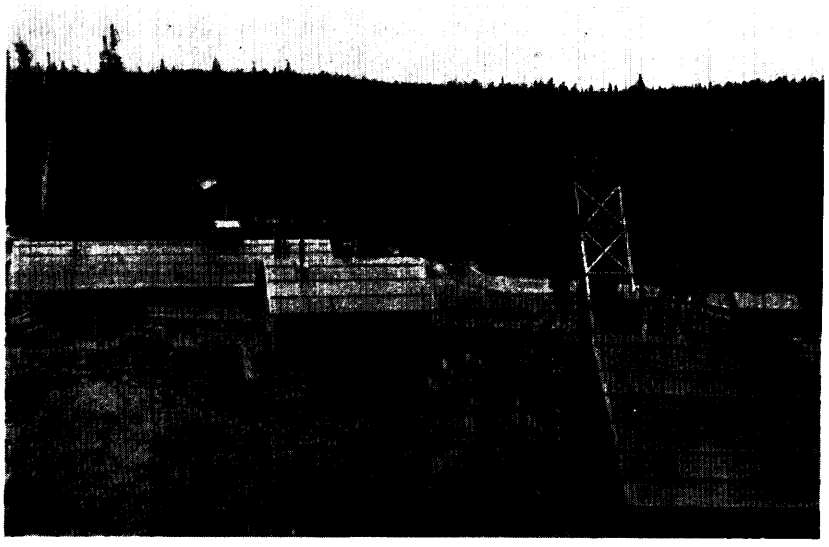
As a result of the high degree of folding, regional schistosity is marked in the area, but the shearing action is most pronounced along contacts of sediments and greenstones or in the tuffaceous bands. This shearing has resulted in a pronounced development of sericite, chlorite, and carbonate schists. The strike of the schistosity is almost always parallel to the strike of the bedding or flows. Fracturing and minor faulting have been for the most part confined to the vicinity of the Algoman intrusives.

Major Faulting

There are three major faults, all with a north-south strike, in the area. One fault crosses the townships of Swayze and Rollo in a direction slightly west of north. In the southern part of Swayze township a displacement of over a mile

in length is indicated, and it is well marked by valleys or escarpments. North of Brett lake it appears to be broken up: One part continues on to Ridley lake, where it is marked by a brecciated zone; the other may follow up the west side of Rollo lake. Another parallel fault crosses the central part of Denyes township; and a third one with a north-south strike lies in the eastern part of Halcrow township and is well marked where it crosses the Kinogama river. All of these faults affect all the rocks up to and probably including the Algoman, and they are, therefore, probably post-Algoman in age. It is difficult to establish the presence of faulting along an east-west direction owing to the prevailing strike of the formations. A fault with a northwest strike, however, is indicated in the west arm of Crossley lake.

Courtesy Massey Williams



No. 1 shaft, Kenty mine.

ECONOMIC GEOLOGY

Evidence of mineralization has been found in many parts of the Swayze area, but no evidence of any mineral, other than gold, of sufficient quantity to be of economic importance was noted. The various occurrences of iron formation described appear to have no economic significance under present conditions.

Gold Deposits

The gold-bearing veins of the Swayze area all occur within the greenstones or sediments in the vicinity of intrusive porphyries or small granite bodies. The intrusion of these Algoman rocks has resulted in considerable fracturing and shearing within the surrounding rocks, and within the openings thus formed the gold-bearing solutions have deposited their mineral content. Occurring as they do over a wide area, the deposits show considerable variation, including lode deposits, fissure veins, and shear-zones. In nearly all the veins the most prominent gangue minerals are quartz, ankerite, and pyrite. Other minerals occurring in varying amounts are chalcopyrite, galena, sphalerite, specularite, calcite, and

tourmaline. The gold is present for the most part in the free state. No tellurides have been identified as yet in any of the deposits. Although the work up to date has failed to prove up large deposits of commercial grade, yet conditions favourable for gold deposition exist over a wide area, all of which is well worthy of further prospecting effort.

Description of Properties

SWAYZE TOWNSHIP

Kenty Gold Mines, Limited

The discovery of the gold-bearing quartz veins on the Kenty property in 1931 drew attention to the Swayze area as a favourable field for prospecting.

Courtesy Massey Williams



No. 3 vein, Kenty mine.

Following the discovery, in 1931 and during the season of 1932, the management carried out a programme of surface prospecting, as a result of which a large number of veins were uncovered and considerable information as to the surface geology was obtained. Early in 1933 shaft-sinking operations were undertaken, two vertical shafts being put down to a depth of 500 feet, and lateral work on levels spaced at intervals of 125 feet has been carried on. The development work is under the direction of E. T. Corkill, assisted by Massey Williams, who is the resident engineer and geologist.

An east-west belt of Keewatin andesitic and basaltic lavas is bounded on the north and south by sediments consisting of quartzite, slate, and greywacké. The sediments immediately adjoining the lavas contain considerable volcanic debris and on the south side of the basalts form the north side of the main band of the Swayze series. The contact between the greenstones and sediments in the vicinity of No. 1 shaft is almost perpendicular. East of the property the greenstones pinch out and probably represent an anticlinal fold plunging to the east. The greenstones and sediments are intruded by basic rocks, probably lamprophyres with dioritic or gabbroic phases, previously described in the report under the heading of pre-Algoman. These lamprophyres, indicated on the accompanying geological sketch as wide lens-shaped masses, are shown by underground work

to be in the form of dikes or sill-like bodies, with an east-west strike, closely spaced over a width of 600 feet or more. Their actual attitude with respect to the enclosing rocks has not yet been determined. Along the south side of the property the sediments and greenstones are intruded by quartz-feldspar porphyry,

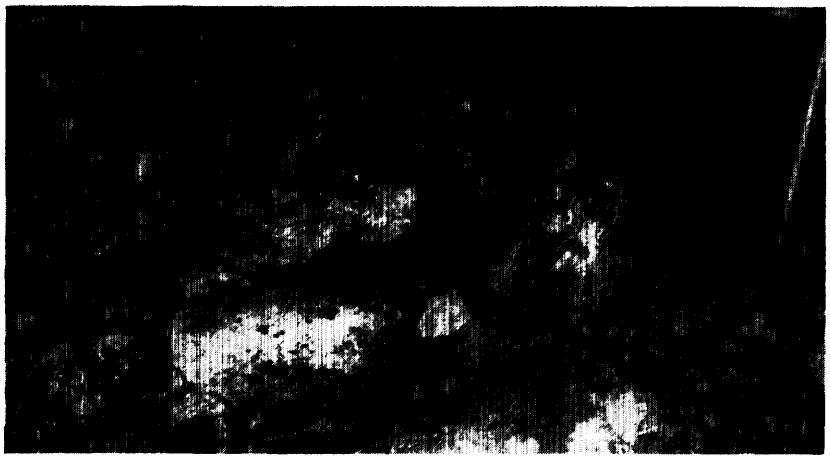
Courtesy Massey Williams



No. 5 vein, Kenty mine.

which here forms an eastern arm of the Brett lake porphyry body. Dikes of similar porphyry occurring to the north of the main body represent offshoots from the larger body. Small dikes of mica lamprophyre intrude all the above rocks.

Courtesy Massey Williams



No. 1 vein, Kenty mine, showing drag at the main fault.

Vein Characteristics.—The Kenty veins belong to the lode type of deposits, consisting of a series of parallel veins, each having a main quartz leader with subsidiary parallel veinlets and altered country rock intervening. They may occur in the lavas, sediments, or intrusive rocks. The average strike of the veins

is approximately N. 60° E., and they dip to the southeast at angles varying from 40 to 80 degrees. The veins occur in fractures in the country rock with practically no schisting. The average width of vein material is from 4 to 5 feet, with a maximum of 10 feet. The wall rocks show considerable replacement by carbonates, chiefly ankerite, and pyrite. The quartz contains some pyrite and tourmaline; other gangue minerals noted are calcite, galena, specularite, graphite, chalcopyrite, and a little feldspar. Coarse native gold is visible in fractures in the main quartz or in the narrow quartz veinlets. Almost every vein shows some visible gold, and in places on the surface it is present in spectacular amount, the most notable veins being Nos. 1, 3, 11, 16, and 21. Veins Nos. 9, 11, and 16 are probably

Courtesy Massey Williams



No. 3 vein, 290-foot level east, No. 2 shaft, Kenty mine.

faulted portions of the same vein; and in No. 16 over a length of 90 feet between two faults, coarse native gold is to be seen in fractures in the quartz for the full length.

Faulting.—A series of post-mineral faults intersect the veins, causing displacements from a few feet up to 350 feet or more. Vein No. 1, for example, in a length of 200 feet has three parallel faults striking N. 10° W., with a maximum displacement of 30 feet. At the east end of the surface showing it has been faulted to the northwest and has been recently picked up by crosscutting, proving a displacement of 360 feet. This condition of faulting adds somewhat to the problem of following the veins underground, but much information has already been obtained to assist in connecting various sections of the veins.

Underground Development.—Shafts Nos. 1 and 2 have been sunk to depths of 500 feet and 525 feet, respectively. Up to the end of April, 1934, approximately 5,000 feet of lateral work, including 3,000 feet of drifting, had been done.

Since the beginning of 1934 a campaign of diamond-drilling has been carried on to obtain further information on the geology, faulting, and vein structures. Up to the present the underground work has been concentrated on veins Nos. 1, 3, and 9, but there are many other veins indicated on the surface, in the drilling, and underground with possibilities worthy of investigation. In the vicinity of the two shafts and eastward the greenstones and sediments are intruded by the

Courtesy Massey Williams



No. 9 vein, Kenty mine, showing minor fault structures, 290-foot level east, No. 2 shaft.

lamprophyric rocks, and the veins lying to the north and dipping southward pass into these lamprophyres.

No. 1 Shaft.—Shaft No. 1, which was sunk on No. 1 vein, has been drifted on at three levels, 250, 375, and 500 feet. The vein, which is in basalt on the surface, dips about 58° S. and passes into the sediments above the 500-foot level. The vein is strong and has good widths with good mineralization down to and including the 375-foot level, but is narrow on the 500-foot level. On this level, however, another vein was encountered just north of the shaft and approximately 100 feet north of No. 1. One hundred and fifty feet east of the shaft both these veins are faulted to the north, and a crosscut run out to the north on the 375-foot level has picked up the eastward extension of No. 1 vein, showing a displacement

of 360 feet to the north. The fault strikes approximately N. 10° W., and it would appear that the vein encountered on the 500-foot level north of the shaft is the westward extension of what is known on the surface as No. 19 vein.

No. 2 Shaft.—At No. 2 shaft, which lies approximately 1,800 feet east of No. 1 and was put down to examine veins No. 9 and No. 3, drifting has been done at two levels, 290 and 525 feet. The veins have the usual complications due to minor faulting, but the fractures are strong and have good widths of quartz. Much of the wall rock of these two veins in this section of the underground work consists of the lamprophyric dikes, alternating with basalts, with the former type predominating. The west drift on the No. 9 vein at the 290-foot level and the intersection of this vein at the 525-foot level show considerable porphyry. A drill-hole to the south from the end of the south crosscut at the 525-foot level passed through more than 300 feet of basalt showing two strong-looking veins that are not represented on the surface. This band of basalt would appear from surface work to widen out toward the east.

Gold Values in the Veins.—Surface and underground work so far indicate that the best ore values are present where the veins occur in the greenstones as opposed to the lamprophyres or sediments. The only difference noted in the appearance of the veins in the different types of rocks lies in the amount of mineralization of the altered wall rock, particularly with regard to the amount of pyrite present. The fractures may be just as strong and the quartz may have just as good widths in the lamprophyres as in the greenstones, but the pyritization is more marked in the latter, and better values occur in general where the pyritization is strongest. The veins show low or erratic values in the lamprophyre, and, as a result, the development of ore shoots up to date has been only moderately encouraging, owing possibly to the extent of these lamprophyres in the vicinity of the underground work. Considerable further exploration is now being carried out, particularly in the area to the south of No. 2 shaft, where a large body of greenstone is indicated and into which the veins outcropping on the surface north of the shaft would appear to dip below the 500-foot level.

Equipment.—Two Diesel engines supplying 165 horse-power operate the two hoists, the drills, pumps, etc. A good camp has been built, and approximately 40 men are employed on the property. A fair wagon road has been constructed from Sultan on the Canadian Pacific railway, a distance of 21 miles from the mine, to bring in freight and supplies.[1]

McNeely-McCullough

A group of 14 claims staked by Geo. McNeely and John McCullough, of Sudbury, lies at the east end of Brett lake, adjoining the claims of the Kenty Gold Mines, Limited, to the east and northeast. Considerable trenching and stripping has been done on this group of claims in an effort to locate possible extensions of the Kenty vein systems. A number of showings have been uncovered, chiefly near the north edge of the main porphyry body. They consist mainly of narrow quartz veins or fractured zones with quartz stringers carrying considerable pyrite and carbonates. Some of these showings were reported to give moderately low values over narrow widths.

[1]Since this report was written operations at the Kenty mine have been suspended. An extensive campaign of underground work and diamond-drilling was completed in July, 1934. The results of the work appeared to indicate that values were too irregular to warrant the expectation of ore bodies of sufficient size or grade to justify the erection of a mill at present, and future plans of the company are indefinite.

During the summer of 1933 this property was under option to Consolidated Mining and Smelting Company, Limited, who completed 5,000 feet of drilling on the property. A series of holes dipping about 30° N. was put down, covering the ground from the south side of claim S. 20,813 to the north boundary of claim S. 20,812. The south half of claim S. 20,813 appeared to be largely altered sediments intruded by numerous dikes of quartz porphyry. On the north half of this claim and the south half of S. 20,812, a continuous body of quartz porphyry with a width of over 1,000 feet is followed by a narrow band approximately 100 feet wide of well-bedded slates, which is in turn followed by greywacké to the contact with the greenstone. A number of mineralized zones with pyrite and narrow quartz stringers was encountered, but gold values were low.

Miner Kenty

A group of 13 claims staked by Miner Kenty in the fall of 1931 adjoins the Kenty Gold Mines property to the south and west, 10 of the claims being in Dore township. In 1932, they were under option to the Cyril Knight Prospecting Company, Limited. Eight veins had been uncovered by trenching and stripping, mostly in the greenstone. The veins are all small, not over 100 feet long, with maximum widths of 2 feet. Approximately 1,000 feet of diamond-drilling was done on the property in the winter of 1931-32. Gold values in the veins were reported to be low.

Montgomery-Ackerman

A group of 17 claims was staked by Tom Montgomery in the fall of 1931. Five of the claims lie along the south boundary of the Kenty Gold Mines property, and the remainder extend eastward into Dore township along the south boundary of the Miner Kenty group. A considerable amount of surface trenching and stripping has been done, and a number of veins and mineralized shear-zones have been disclosed showing quartz, pyrite, carbonates, and other minerals, typical of the gold-bearing veins of the area. The veins discovered up to the end of 1933 were small, but some low values in gold were reported. A crew of men is at present engaged in further prospecting of the ground.

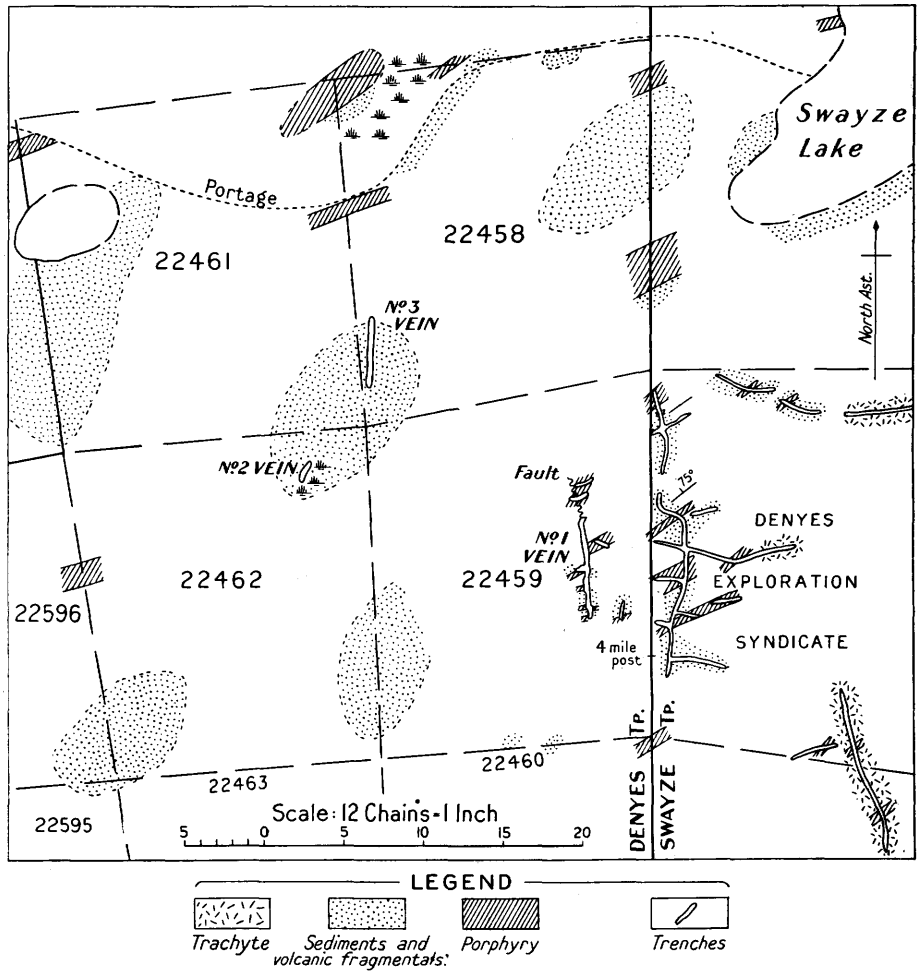
Buffalo-Canadian Gold Mines, Limited

The Buffalo-Canadian Gold Mines, Limited, controls a group of 12 claims in Swayze township lying north of the east end of Cree lake. The country rock consists essentially of greenstone intruded by porphyry dikes. In the vicinity of claim S. 21,389 a number of veins or mineralized zones have been uncovered. The property was visited during the winter of 1934, but only three of the showings were in condition to be examined. They appear to be in the nature of shear-zones, which have been silicified and carbonated and show considerable pyrite. Some visible gold was noted in what is known as No. 10 vein. No. 2 vein, which lies near the south boundary of claim S. 21,389, has been stripped for 500 feet. Two grab samples of the mineralized quartz from this vein gave 0.02 ounces per ton in gold. A grab sample from vein No. 2A, which is a branch from No. 2 vein, gave 0.08 ounces per ton in gold. The work consists of trenching and stripping and is under the supervision of A. C. Hahn, J. H. Collins is directing field operations. The officials in charge are reported to be contemplating some diamond-drilling of the showings in the near future.

DENYES TOWNSHIP

J. E. Derraugh

The property, staked by J. E. Derraugh, of Haileybury, in the fall of 1932, comprises a group of 8 claims adjoining the east boundary of Denyes township near the 4-mile post. The country rock consists of arkose, greywacké, trachyte tuffs and flows cut by dikes of quartz porphyry. The discovery vein, which lies



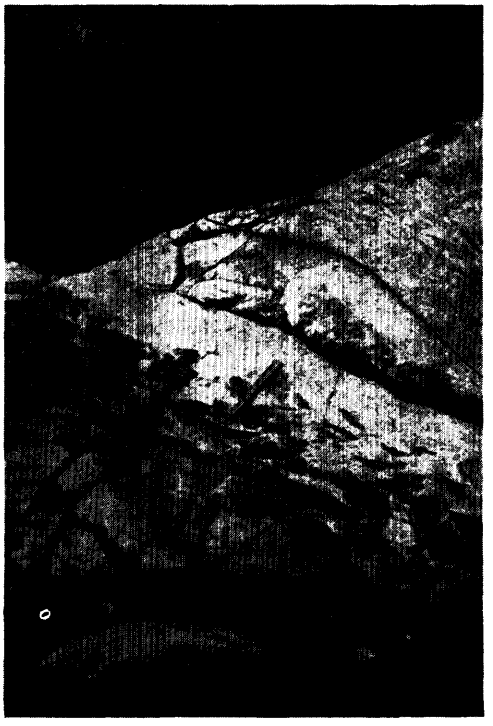
Geological sketch map of the Derraugh property.

in the eastern part of claim S. 22,459, has been trenched for 400 feet, of which 220 feet shows an almost continuous vein of quartz with small quartz veinlets in the footwall. The quartz is in the form of lenses with widths up to 6 feet. The main vein lies along a fault striking almost due north and south and dipping about 75° E. A much altered lamprophyre dike lies along the fault and has been brecciated by the movement.

Apparently the intrusion of the quartz porphyry dikes into the sediments was followed by a north-south fault accompanied by the intrusion of the lamprophyre dike. Further movement along the fault has brecciated the dike, and quartz

has come up along the fault, replacing the wall rocks. The fault can be seen distinctly along the main quartz vein, continuing north and south to the end of the stripping. The footwall rocks are much cut up by tension cracks, which contain small quartz stringers.

The quartz is mineralized with pyrite, chalcopyrite, a little galena, and carbonates. Lenses of vein material with considerable chalcopyrite carry high values in gold, though no native gold was seen. A chip sample taken continuously



No. 1 vein, Derraugh property, showing well-defined hanging wall and fault.

from west to east across a wide part of the best-looking section of the vein and assayed in sections showed the following values in gold:—

	Ounces per ton
(a) 8 inches, quartz with heavy sulphides	2.22
(b) 24 inches, chiefly quartz	.15
(c) 36 inches, altered wall rock	.03
(d) 56 inches, quartz	.24
(e) 24 inches, quartz	.32

No. 2 showing lies in the northwest corner of claim S. 22,462 and consists of a rusty silicified arkose containing stringers of quartz with pyrite. It is exposed in two strippings about 125 feet apart, with widths up to 20 feet, and strikes approximately N. 20° E. It is reported to show low values in gold.

No. 3 vein was discovered in the fall of 1933 and lies near the west boundary of claim S. 22,458. This vein, which strikes north and south and has a maximum width of 15 feet, has been stripped for over 400 feet. It is possibly the continua-

tion of No. 2 vein. Heavy mineralization in the form of pyrite, chalcopyrite, carbonates, and galena occurs in narrow streaks along the vein. Channel-sampling of this vein is reported to have shown low values in gold.

During the winter of 1932-33 this property was under option to the Kirkland Hudson Bay Gold Mines, Limited, who put down a series of short diamond-drill holes, with an aggregate of 2,000 feet of drilling. Eleven holes were put down on No. 1 vein, and 2 holes on No. 2. As a result of this drilling the option was dropped. The more recent work on No. 3 vein was done under the direction of J. E. Derraugh.

Denyes Exploration Company

The claims of the Denyes Exploration Company, staked by T. R. Buchanan, adjoin the Derraugh group on the west and north, and part of the ground lying



Main pit on the Dyment property, showing three quartz veins.

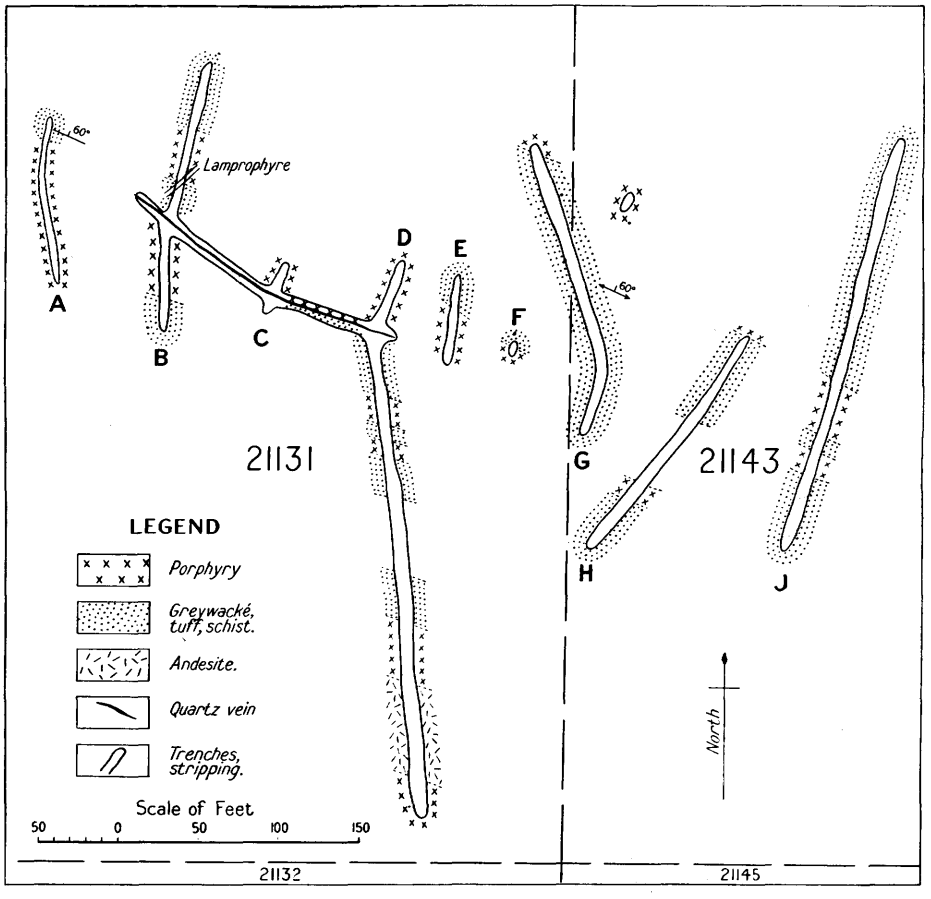
on the Swayze township side of the boundary is shown on the sketch of the Derraugh group. In 1932, the property was under option to the Dome Mines, Limited, who did considerable trenching and stripping, chiefly on claim S. 22,211 lying to the east of the discovery vein of the Derraugh. Some small quartz veins carrying values in gold were uncovered, but the option was dropped. The work was under the direction of W. Cliff.

Dyment Mining and Investments, Limited

In the summer of 1932 a group of 31 claims lying along the south side of Dyment lake in Denyes township was staked by Joseph Beaumont in the interests of the Dyment Mining and Investments, Limited. The claims cover an area about two and a quarter miles long in an east-west direction by three-quarters of a mile wide and lie along the contact between the Swayze series of sediments and volcanics to the north and the Keewatin greenstones to the south. A large number of dikes and small bosses of porphyry intrude the greenstones and sediments.

On the southwest shore of Dyment lake along the north end of claim S. 21,984 there is a band of schisted porphyry and tuff, with a maximum width

of 300 feet, striking S. 80° E. A series of quartz lenses occur in this schist forming an almost continuous vein for 150 feet and striking S. 60° E., i.e. cutting the schist at a small angle. The maximum width of the quartz is not over 2 feet, but one trench shows two parallel lenses of quartz, each about 2 feet wide, separated by 10 feet of schist heavily mineralized with pyrite and carbonates. The main pit shows three parallel quartz veins making up a total width of 5 feet of quartz over a width of 9 feet. The quartz is milky-white in colour and well fractured, showing fine native gold along the fractures. Galena, specularite, and a little



Geological sketch map of the Sylvanite vein.

chalcopyrite were also noted in the vein. Samples of the quartz from this pit carry high values in gold, but the work up to date seems to indicate that these values are confined to a short distance (not over 15 or 20 feet) to the east and west of the main pit. The rest of the quartz and the heavily mineralized schist alongside the quartz show erratic or very low values.

Seventy feet east of the main pit the vein appears to be faulted to the north approximately 90 feet, and the continuation was picked up in a trench to the east of the fault. To the west the main vein pinches out, but narrow lenses and stringers of quartz have been uncovered for 600 feet along the strike. A narrow dike of diabase parallels the vein and quartz lenses to the west, cutting across

it in places. Several large masses of porphyry intrude the tuffs immediately south of the vein.

During the winter of 1933-34 a small amount of diamond-drilling was done on this showing. The drilling consisted of a series of short holes with an aggregate of 1,000 feet, put down along the strike of the vein near the main showing. The results were not encouraging, and work was discontinued. Considerable surface trenching has been done on the property, the earlier work being done under the direction of C. H. E. Stewart and Joseph Beaumont, and the drilling under C. F. Cockshutt.

Sylvanite Claims

A group of 18 claims controlled by Sylvanite Gold Mines, Limited, lies in the western part of the township of Denyes, approximately one mile west of Dyment lake. During the summers of 1932 and 1933 a small crew of men were engaged in prospecting the claims under the direction of Duncan Campbell, of Haileybury.

In the southeastern part of claim S. 21,131 of the group, trenching has uncovered a series of parallel porphyry dikes striking S. 60° E. and intruding schistose greywacké and tuffs. The porphyry and schist have been fractured and the fractures filled with quartz heavily mineralized with pyrite and carbonates. The main features of the geology are indicated on the accompanying sketch showing the trenches. The quartz vein with an indicated length of 200 feet lies along the contact between bedded tuffs and porphyry extending from trench B to trench D. The vein dips about 60° N. and in trench C shows its maximum width of 4 feet. No native gold is visible, but channel-sampling over 3-foot widths over a length of 160 feet of this vein are reported to give values up to 0.40 ounces per ton in gold. Grab samples of the quartz carrying considerable pyrite gave values up to 0.36 ounces per ton in gold. A number of narrow zones with quartz stringers were noted in trenches to the east and west of the main vein. Quartz stringers occur in the fractured zones in the tuffs and porphyry, but the best gold values appear to be associated with the stringers in the tuff.

HALCROW TOWNSHIP

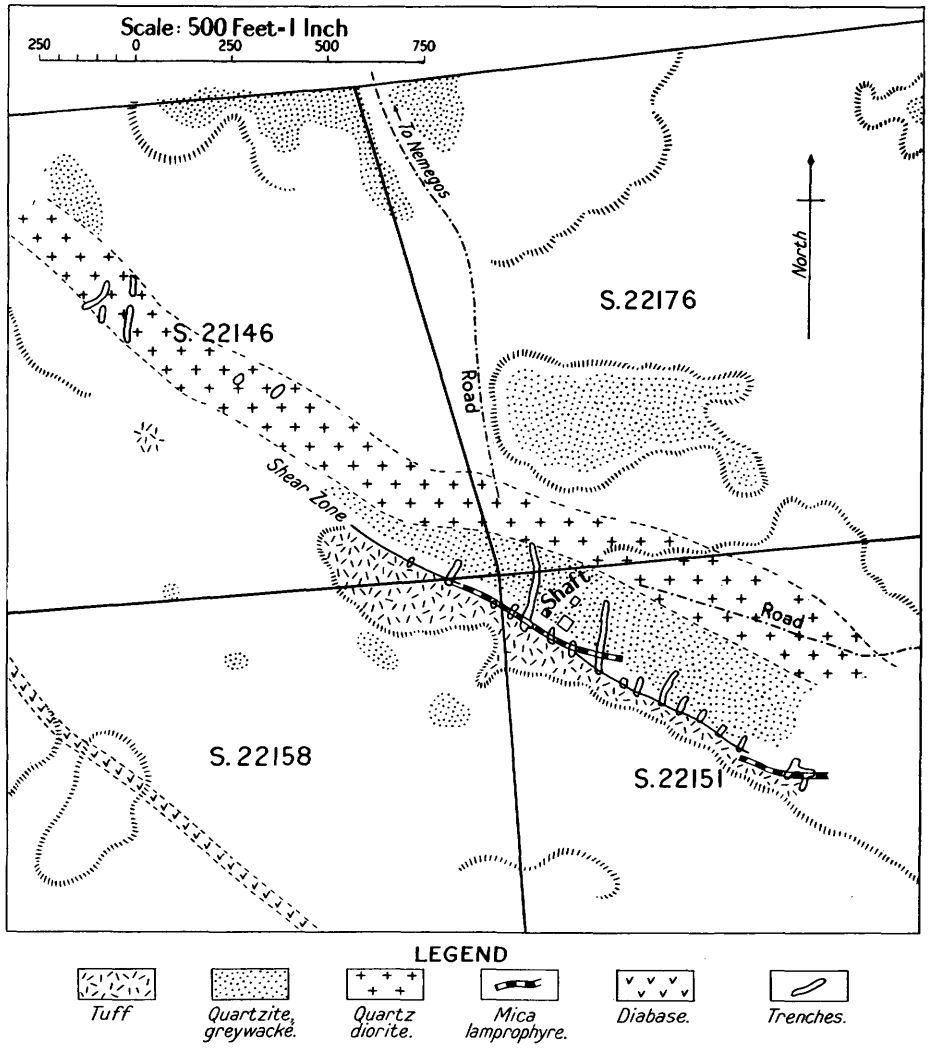
Halcrow Swayze Mines, Limited

The property of the Halcrow Swayze Mines, Limited, comprises a group of 35 claims lying in the central part of Halcrow township, staked by J. and D. Hughes and M. Shunsby in association with Horace Strong, of Haileybury. The claims lie along the contact between greenstones to the north and sediments of the Ridout series to the south. The principal showing occurs on claims S. 22,151, 22,158, and 22,146, and consists of a shear zone in an impure quartzite or greywacké, striking S. 60° E. and dipping 80° N.E. The south limit of the shearing is represented by a fault with greenstone tuffs on the footwall side. The north limit is represented by a dike of quartz diorite 100 feet or more in width, which parallels the shear zone and has been traced for half a mile. The width of the zone between the diorite dike and the fault varies, with a maximum of 200 feet, and the shearing varies in intensity across this width. In the zones of more pronounced shearing the quartzite and diorite have been mineralized, chiefly with pyrite and carbonates, and the gold values are associated with this mineralization. Definite quartz veins do not occur except in cross-fractures in the main zone.

The mineralization of this deposit seems to be genetically connected with the quartz diorite dike. Besides the main dike a number of small offshoots from

it may be seen in some of the pits. Several narrow mica lamprophyre dikes, usually not over a foot wide, occur along the shear zone. One of these dikes has been traced continuously for a distance of 500 feet, commencing east of the shaft and following westward along the footwall.

All the mineralized schist across the zone is reported to carry low values in gold, from 0.01 to 0.03 ounces per ton, and some zones show medium to moderately



Sketch map showing the surface geology of the property of the Halcrow Swayze Mines, Limited.

low values. One of these zones along the footwall side is reported from underground sampling to show over a width of 4 feet an average of 0.20 ounces of gold per ton for a length of 100 feet, or 0.15 ounces per ton for a length of 235 feet, and in addition at the west end of the drift an average of 0.20 ounces over 8 feet for a length of 50 feet. On the surface some quartz veins occurring in the cross-fractures with considerable pyrite and some chalcopyrite showed values con-

siderably higher than this. One of these, known as No. 1 vein, is reported to have shown 0.70 ounces per ton across a width of 44 inches. Surface trenching and test-pitting have indicated a zone with a length of approximately 1,500 feet containing low gold values over considerable widths with possibilities of finding enrichments that might afford ore bodies of medium to low grade.

During 1932 and 1933 a great deal of surface trenching and test-pitting was done, followed by 2,000 feet of diamond-drilling. Following this a shaft was sunk to a depth of 200 feet, and approximately 1,200 feet of lateral work has been completed. The main drifting was done along the zone at the south side of the shearing with a crosscut run out to the northwest toward the quartz diorite dike. The management proposes to continue the drifting to the west and at the same time to carry on drilling from the 200-foot level to encounter the mineralized zone at a depth of 500 feet. During the winter a small pilot mill of 25 tons capacity with crusher, ball mill, Diesel engine, and cyanide equipment was taken into the property to be used in sampling the ore. John Hughes, one of the stakers, is directing operations in the shaft; H. Bischoff is the engineer and geologist in charge for Horace Strong. A good winter road was cut from Nemegos on the Canadian Pacific railway, a distance of approximately 16 miles.

Lyall-Beidelman

A group of 15 claims has been staked in the northwest part of Halcrow township by Knut Hammerland in the interests of J. C. Beidelman and associates, of Montreal. The principal showings occur in the northern part of claim S. 22,487, about one mile north of the north end of Shunsby lake. The country rock consists of sediments, including conglomerate of the Swayze series, which have been intruded by large dikes or bosses of reddish syenite porphyry, and later by narrow dikes of mica lamprophyre. The porphyry body in which the showings occur has a width of at least 800 feet from north to south; its length cannot be determined owing to overburden. A series of trenches over a length of 200 feet shows a fracture zone in the porphyry striking approximately east and west. The fractures have been filled with quartz in the form of narrow veinlets, and the porphyry has been replaced by moderate amounts of pyrite and arsenopyrite.

One hundred feet north another fracture zone with a northeast strike shows a similar condition but with more quartz and heavier mineralization over widths up to 3 feet or more. The linear extent of this fracture has not been determined.

The oxidized material from these two zones pans gold very freely, and some fine native gold was noted in one place. Selected grab samples from these showings are reported to give high values in gold. Two chip samples taken across 18 inches and 24 inches in the north pit gave 0.03 ounces per ton in gold. The owners plan further extensive surface work on this property in the near future.

GREENLAW TOWNSHIP

Lee Gold Mines, Limited

A group of 17 claims staked by Martin Shunsby and controlled by the Lee Gold Mines, Limited, headed by J. J. Byrne, lies in the northwestern part of Greenlaw township. The principal showings occur on claim S. 23,938 on the west side of Lee lake. The country rock consists of diorite, which intrudes the Keewatin greenstones and sediments of the Ridout series approximately along the contact. The diorite is cut by a dike of quartz porphyry from 10 to 20 feet wide, striking S. 60° E., which has been traced by trenching for 800 feet. The porphyry and the diorite for a width of 5 to 10 feet on either side of the porphyry

have been sheared and replaced by quartz and carbonates heavily mineralized with pyrite and showing narrow streaks of chalcopyrite. This condition is seen in a series of seven deep trenches extending over a length of 300 feet. The mineralization is confined to the highly schisted rock, which dips about 80° N., and this mineralized schist is reported to show good values in gold. Four grab samples of this material gave a gold content up to 0.10 ounces per ton. A series of 11 shallow diamond-drill holes have been put down to intersect the mineralized zone over a length of 800 feet. Four of these holes are reported to have shown values in gold from 0.25 to 0.64 ounces per ton.

A shaft is being sunk for underground examination of the deposit. Good camps have been built, and an assay plant has been installed. The work is under the direction of Martin Shunsby.

Greenlaw Gold Mines, Limited

A group of 19 claims, controlled by J. J. Byrne, lies immediately southeast of the Lee Gold group. On claim S. 24,542 of the group a showing similar to



Camp of the Lee Gold Mines, Limited.

that of the Lee Gold Mines has been uncovered and consists of a porphyry dike cutting diorite with some pyrite and chalcopyrite mineralization. No definite information as to gold values is known.

Newbec Mines, Limited

A group of 10 claims was staked in 1932 by A. E. Dumond in the interest of the Newbec Mines, Limited, in Greenlaw township on the west side of Hotstone lake. The principal showings, which occur near the centre of claim S. 22,711, consist of a quartz vein with a maximum width of 2 feet, striking S. 80° E. and dipping 70° N. The vein, which has been stripped for 100 feet, occurs in a schistose greywacké of the Ridout series of sediments. The strike of the vein and smaller veins in the vicinity is the same as that of the schistosity. The quartz is glassy to whitish and contains a considerable amount of carbonates. Very little sulphide mineralization was noted and no native gold was seen, but three grab samples taken from different parts of the vein showed 0.29, 0.09, and 0.01 ounces per ton in gold. Smaller veins of similar quartz were noted 300 feet east and 60 feet west of this vein. The development work consists of trenching and stripping, and it is reported that further work has been planned by the controlling company.

ROLLO TOWNSHIP

Cyril Knight Prospecting Company, Limited

During the summer of 1932 a group of 15 claims was staked in Rollo township on the southeast side of Ridley lake by Miner Kenty working in the interest of the Cyril Knight Prospecting Company, Limited. In the northwest corner of claim S. 22,721 a gold-bearing quartz vein was discovered. The country rock consists of schisted andesitic lavas. The vein has an indicated length of approximately 800 feet, striking N. 65° E. and dipping 80° S.E. It is exposed in the main trench for 430 feet with a maximum width of 10 feet, pinching out sharply to the west and narrowing to a series of stringers to the east. The quartz, which is of the white glassy variety, is much fractured in a direction parallel to the strike of the vein. It carried a small amount of pyrite and a little native gold. Channel sampling of the vein is reported to have shown low values in gold.

Agaura Exploration Company, Limited

This group of 15 claims, staked by W. H. Graves on behalf of the Agaura Exploration Company, Limited, lies immediately south of the property of the Cyril Knight Prospecting Company and extends from the west boundary of Rollo township eastward to within a quarter of a mile of Rollo lake. The main showings occur on claim S. 22,632 and consist of two zones containing quartz veins mineralized with pyrite. The south zone has three short veins, striking N. 70° E., exposed in three trenches extending over a distance of 900 feet. The centre vein, which is the largest, has a maximum width of 13 inches and a length of approximately 70 feet. It is composed of quartz mineralized with pyrite, ankerite, and a little galena. Some native gold was noted, and a channel sample across 8 inches was reported to assay 0.70 ounces per ton in gold. The country rock of the veins in this zone is arkose.

Five hundred feet north in the greenstones is a strongly schisted zone with widths up to 12 feet. The schist is mineralized with coarse pyrite and lenses of quartz. This zone, which has been traced for 500 feet, strikes N. 80° E. Fifty feet south and parallel to the zone is a rusty carbonated quartz porphyry dike with a maximum width of 15 feet. Channel samples from this showing were reported to give low values in gold.

RANEY TOWNSHIP

Raney Lake Prospecting Syndicate

The Raney Lake Prospecting Syndicate controls a group of 35 claims in Raney township, extending northeast from the northeast bay of Raney lake. The claims were staked by G. A. Thorne and associates, of New York, in 1932. Two quartz veins have been discovered on claim S. 22,366. One vein with a width of 2 feet where exposed at the east end of the trenching has been traced for a distance of 100 feet, striking S. 80° E. and dipping steeply to the north. The country rock is arkose or impure quartzite. The quartz contains a little pyrite, some carbonates, and in one place a little native gold. Five hundred feet to the southwest another quartz vein, which has a maximum width of 6 inches and strikes N. 60° E., has been traced for a distance of 100 feet. It occurs in a feldspar porphyry and shows a little native gold in one place along with some pyrite, chalcopyrite, galena, and tourmaline.

DISCOVERIES OUTSIDE THE MAP AREA

Woman River Syndicate

The property of the Woman River Syndicate of New Liskeard lies in the northwestern part of Mallard township on the Woman river. The showing occurs on claim S. 20,506 at a falls on the river. It consists of narrow quartz veins and stringers in andesite, which is intruded by narrow dikes of porphyry. The largest of the quartz veins has a maximum width of 3 feet, and when the property was visited in May, 1933, this vein had been stripped for a length of 20 feet. The quartz is heavily mineralized with pyrite. No gold was visible. A channel sample across 3½ feet was reported to have assayed 0.25 ounces per ton in gold. A grab sample from this vein assayed 0.34 ounces per ton in gold. Across the river, approximately 400 feet west, a trench shows similar conditions, viz., a narrow porphyry dike cutting schisted greenstone with some quartz and pyrite. Since the property was visited, a considerable amount of work has been done, but the results are not known.

Mogridge Claims

This property, staked by Wm. Mogridge and associates, lies in the centre of Mallard township, on the Opeepeesway river. The showing, which lies near the northeast corner of claim S. 24,798, occurs in an area of schisted greenstone and tuffs. The strike of the schist is S. 45° E., and the dip vertical. The gold occurs in a silicified and carbonated zone in the schist, the zone being parallel to the strike of the schistosity. Very little vein quartz is present. The schist is heavily mineralized with pyrite and a little chalcopyrite. The mineralized zone has been traced for 500 feet and has widths as great as 30 feet. The showing has recently been diamond-drilled by N. A. Timmins Company. Five hundred feet of drilling in 4 short holes was done over a length of 520 feet. Grab samples of the pyritized schist from the surface gave values up to 0.45 ounces per ton in gold.

Hermiston Claims

Half a mile west of the Mogridge discovery a somewhat similar showing occurs on ground staked by P. A. Hermiston and Wm. Hammerstrom, working in the interests of Horace Strong, of Haileybury. Near the east side of claim S. 24,851 a mineralized zone is exposed in two trenches 80 feet apart. The strike of the schist is S. 45° E. The mineralization occurs over a width of 15 feet, with lenses of quartz and a considerable amount of pyrite. In the southeast trench a dike of felsite 10 feet wide cuts the greenstone parallel to the schistosity. Two grab samples of the pyritized schist from this find assayed 0.21 and 0.28 ounces per ton in gold.

Horwood Lake

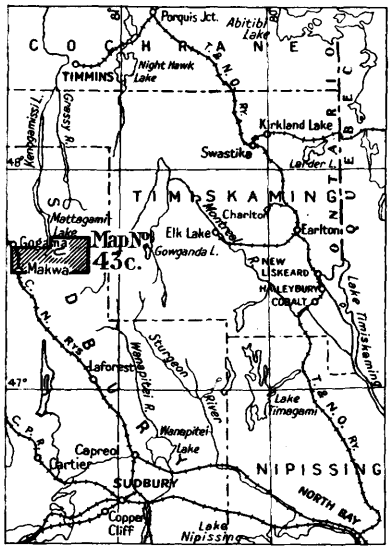
Several new finds have recently been reported from the area north of the townships of Newton and Dale and west of Horwood lake. A visit was paid to the claims of the Eclipse Airways at the end of the season. The group of claims lies on the Swayze river immediately north of the north boundary of Newton township. The country rock consists of greenstone with some coarse dioritic phases cut by porphyry dikes. A number of fractured zones containing narrow quartz veins and stringers have been exposed by trenching on these adjoining claims. The veins are mostly either flat-lying or dip at low angles and are mineralized with pyrite and a little chalcopyrite. One vein from 6 to 8 inches wide and exposed for 30 feet showed some native gold, and a number of these small veins are reported to show gold in panning.

Geology of the Makwa-Churchill Area

By H. C. Laird

INTRODUCTION

During the summer of 1933 a geological investigation was carried on in a section lying between Gogama on the Canadian National railway and the West Shiningtree gold camp. This section includes parts of the townships of Champagne, Groves, Brunswick, Connaught, Cabot, and Churchill, in the district of Sudbury, and is contiguous to the Three Duck Lakes area to the west. Previous work by the writer in 1931,[1] together with information supplied by reports of the Geological



Key map showing the location of the Makwa-Churchill area. Scale, 60 miles to the inch.

Survey of Canada, indicated the strong probability that a belt of sedimentary rocks known as the Ridout series traverses the townships discussed in this report. This feature has now been established, and it is known that the Ridout series extends in an almost unbroken belt from Halcrow township in the Swayze gold area to Churchill township in the Makwa-Churchill gold area, a distance of nearly 90 miles.

Generally speaking, a belt of sedimentary rocks of the magnitude of the Ridout series is of great significance to the prospector, who has learned to regard the sections in or near these belts as commonly being the loci of important gold deposits. The Makwa-Churchill area has been prospected with this point in mind. Several gold prospects have been located, but as yet none of them have received more than preliminary surface development.

[1]H. C. Laird, "Geology of the Three Duck Lakes Area," Ont. Dept. Mines, Vol. XLI, pt. 3, 1932.

The area is readily accessible from either Gogama or Westree, both of which are on the main line of the Canadian National railway less than 100 miles north of Sudbury. There is no accommodation at Makwa, but trains will stop on flag. Every part of the area is served by excellent canoe routes and good portages. Many old lumber roads in Groves and Champagne greatly facilitated the traversing of these townships. An excellent gravel road connects Shiningtree with Westree, a distance of 20 miles. Motor cars use this road in reaching the Churchill, Ribble, and Burvan properties in the Wasapika section of the West Shiningtree camp. In the fall of 1933 this road was being extended in a northeast direction toward Tyrrell township. Eventually it is planned to extend it to Gowganda.

During the latter part of the season the more important properties in the West Shiningtree and Three Duck Lakes camps were visited. The progress of development in these camps is discussed later in this report.

Acknowledgments

The writer wishes to tender sincere thanks to the citizens of Gogama and Shiningtree for their courtesies and general expressions of goodwill. Special thanks are due to Chief Rangers Wm. Piggott, of Gogama, and James Burns, of Mattagami Post, and to Deputy Chief A. C. Mitchell, of Shiningtree, for their cordial hospitality and sustained interest in the work and welfare of the party; also to Thos. Saville and Lloyd Foster, of Shiningtree, for maps and plans of Cabot and Connaught townships.

The writer was assisted until the middle of September by C. H. Knight, who performed his duties in a highly capable and satisfactory manner. D. A. Marshall took Mr. Knight's place for the remainder of the field season.

Previous Work

In 1880, when a location for the Canadian Pacific railway was being sought, a trial line surveyed by W. A. Austin traversed the area lying between Nabakwasi[1] lake and Mattagami[2] lake. In 1875, Robert Bell in the course of an extensive reconnaissance survey between Lake Huron and James bay, described the sediments at the south end of Mattagami lake, and crossed the portage to Wanatangua lake. In 1899, W. A. Parks traversed Mattagami lake to its southern extremity. His report is accompanied by a coloured geological map. In 1900, J. R. L. Parsons traversed parts of the area described in this report, which had been visited earlier by Bell and Parks. In 1900, A. P. Coleman reached Mattagami lake via Nabakwasi lake. In 1916, the Geological Survey of Canada published a preliminary map-sheet[3] to accompany a report by T. L. Tanton on reconnaissance traverses along the Canadian Northern Ontario railway (now the Canadian National railway) between Gogama and Oba. This map indicates a narrow belt of Keewatin schists extending from the southern extremity of Mattagami lake to Minisinakwa lake and beyond. These rocks are now mainly regarded as being sedimentary in origin and belonging to the Ridout series. In 1917, the Geological Survey of Canada published a memoir entitled "Onaping Map-Area," by W. H. Collins. This report gives a very detailed and admirable description of the general geology and petrographic nature of the rocks in the

[1]Originally Napawquazi.

[2]A contraction for Mattawagami or Mattawagamanque, meaning branch or fork lake.

[3]"Explored Routes in a Belt Traversed by the Canadian Northern Ontario Railway between Gogama and Missonga," Pub. No. 1697.

eastern part of the area. References to other geological work, no less important than that above, are included in a selected bibliography listed below.

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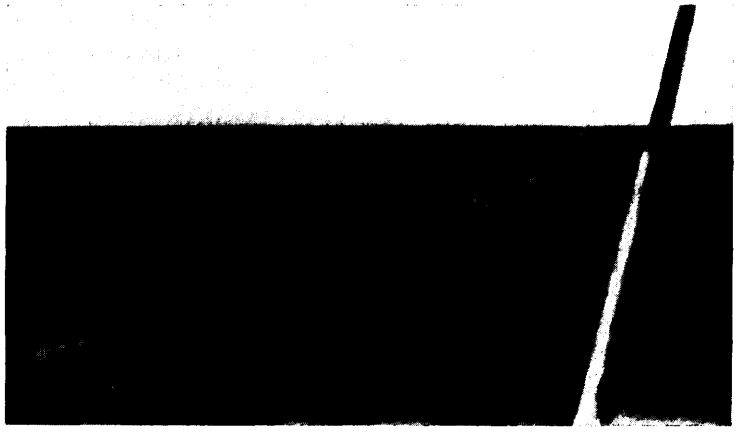
Topography and Drainage System

The Makwa-Churchill area displays a monotonous repetition of topographical features characteristic of the central part of Northern Ontario. In general, it is a region of moderately low relief and consists largely of low hills interspersed with wet muskeg areas. Any trace of pre-glacial ruggedness has no doubt been further obliterated by the infilling or dumping of subsequent glacial deposits in the hollows, a process that gives the present surface a gently undulating appearance. Dome-shaped hills with gentle slopes occur in the central part of Brunswick township, where, in some cases, they attain an elevation of 200 feet or more above the level of the main watercourses. Relatively high hills of a more rugged nature occur in the southeastern part of Connaught township near Elephanthead lake. In other parts of the area hills seldom rise more than 100 feet above the general level of the surrounding country.

It may be observed from the accompanying map that the main watercourses occur along well-defined north-south fault lines, among the more conspicuous of which are the Minisinakwa lake fault, the Groves-Hanover lakes fault, the Nabakwasi river fault, and the Mattagami-Nabakwasi lakes fault. These "breaks" show up particularly well from the air, where they are seen to extend

across the country in parallel lines for many miles beyond the limits of the area under discussion. Fault escarpments are not commonly observed, but one striking instance is that on the east side of the Nabakwasi river just south of the 15-chain portage. At this point a cliff of granite a quarter of a mile long rises almost vertically out of the water to a height of about 250 feet.

A gently undulating sand plain occupies much of the country between the Nabakwasi river and Elephanthead creek. It extends south toward Nabakwasi lake and north for several miles on either side of Mattagami lake. Within this area are many topographical features indicative of glacial phenomena, such as esker ridges and kettle lakes. A fine example of the latter is Wanatangua lake on the portage route between Mattagami lake and Waonga lake. This lake contains beautiful clear cold water and has no outlet. It lies in a steep-walled depression 150 feet or more below the level of the surrounding sand plain, and 100 feet below Waonga lake, which is located a few chains to the south.



Aerial view of Mattagami lake looking south. The outlet of Claw creek is seen in the left foreground. Waonga and Nabakwasi lakes are in the background.

The height-of-land between the St. Lawrence and Hudson bay watersheds passes through Connaught township. The main rivers to the west of this line are the Mollie, Noble, and Nabakwasi, which form a part of the Mattagami river system. These streams carry a considerable volume of water, since their drainage basins extend as far west as Yeo township and south to a point a few miles south of Ruel station on the C.N.R. Except for short stretches of rapids and waterfalls, the rivers mentioned above are readily navigable by canoe. A notable exception, however, is that part of the Mollie river between Makwa and the railway bridge at the south end of Minisinakwa lake, where rapids and waterfalls occur over practically the whole distance. Over most of its course the Nabakwasi river is a fairly wide stream, especially in its lower reaches; but in places it flows through narrow rock gorges, where, in the spring, the swirling waters, using boulders as tools, have cut deep pot-holes in the solid rock. At the 15-chain portage pot-holes 3 feet deep and 2 feet in diameter were observed.

In connection with the power development at Wawaitin Falls, Mattagami lake was converted into a supply reservoir, as a result of which the water level was raised about 12 feet. The lower part of the Nabakwasi river was flooded back to the 13-chain portage where the depth of the waterfall decreased accord-

ingly. Below this point a waterfall completely disappeared. At the same time a lagoon at the south extremity of Mattagami lake was flooded and made navigable for another half mile or more.

Elephanthead creek flows north through the central part of Connaught township close to the height-of-land and empties into Claw creek[1] in the south central part of Cabot township. For the most part, it meanders through sandy country and low alder swale. It carries a considerable volume of water at all times and has a current estimated at about 1 mile per hour. This stream, which at present is not navigable on account of numerous log-jams, fallen trees, and brush, could readily be made a good canoe route through the centre of a township that otherwise is not easily accessible by canoe.

The waters in Churchill township flow into the west branch of the Montreal river, and belong to the St. Lawrence watershed. West Shiningtree[2] lake is characterized by a very irregular, rocky shoreline. It empties into Okawakenda[3] lake by way of West Shiningtree creek, a wide shallow stream broken only at its



Rapids at the 13-chain portage, Nabakwasi river, Brunswick township.

inception by a half mile of rapids and near its outlet by one short stretch of rapids, in which a channel has been cleared so as to make a portage unnecessary. Okawakenda lake empties into Michiwakenda[4] lake, the waters of which in turn reach the Montreal river by way of Wasapika lake.

Natural Resources

Timber

The eastern part of the Makwa-Churchill area lies within the Timagami Forest Reserve, the west boundary of which follows the portage route between Mattagami lake and Nabakwasi lake, as shown on the map accompanying this report.

Lumbering operations have been confined to Groves and Champagne townships, where numerous abandoned camps and logging roads attest the

[1]Called "Wabasistagenda" on old maps.

[2]Derived originally from the Ojibwayan name of a small lake on the route to the west branch of the Montreal river, meaning "bare white tree."

[3]A contraction of an Ojibwayan word meaning "big pickerel."

[4]A contraction of an Ojibwayan word, "Michigowganda," meaning "on the way to Gowganda."

magnitude of activity in previous years. These operations were carried on largely by jobbers, who delivered their product to the mills in Gogama. White pine appears to have been the principal type harvested. Other coniferous types, such as red or Norway pine, jackpine, and spruce, are still plentiful, particularly fine stands of red pine having been observed in the vicinity of Shuller lake. No lumbering has been carried on in Brunswick township, where fine stands of white pine, red pine, and jackpine remain to be harvested, if they are not already over-mature. In the central part of Brunswick township, just west of the Nabakwasi river, giant white pines belonging to the old forest tower majestically above the forest of more recent growth. Farther east, in the vicinity of Mattagami and Waonga lakes, approximately 75 per cent. of the coniferous trees are red pine. Officials of the Ontario Forestry Branch rate the standing timber in this area as largely mature coniferous and mixed, and, in part, semi-commercial.

As a result of the lumberman's axe many parts of Groves and Champagne townships are covered with heavy brush and slash, making a traverse difficult and creating a most dangerous fire hazard during the summer season. In recent years, however, the area has been fortunate in escaping any serious conflagration. Small brulé areas were encountered at Makwa (burned in 1921), at Hanover lake, at Okawakenda lake, at Mataris lake in the central part of Connaught township, and on the southwest side of Nabakwasi lake. The West Shiningtree fire in 1911 swept the country lying between West Shiningtree lake and the Montreal river. The old brulé is now being replaced by young poplar, birch, and jackpine, which, in places, form very dense thickets.

Nature itself has been a potent agent in the general destruction of the forest. This is particularly true in Brunswick township, where hurricanes of recent years have swept wide swaths through the bush laying low everything in their paths for many miles. Even more noticeable is the almost total annihilation of the Canada balsam as the result of the ravages of a larva said to be allied to the spruce budworm. Scarcely a living tree of this species was seen anywhere in the area.

Fish and Game

The lakes and rivers of this area abound in types of fish common to northern waters, namely pike, pickerel, sucker, whitefish, perch, and ling. Commercial fishing is done on a small scale in Mattagami lake. Okawakenda lake is noted for the large size of its pike and pickerel. In 1929, the Fish Culture Branch, Ontario Department of Game and Fisheries, planted 2,000 small-mouthed black bass fingerlings in Minisinakwa lake.[1] If this stock has not been entirely destroyed by other rapacious types, enthusiastic anglers may expect to hook them at least by next season.

Big game is rather scarce, only one moose and two red deer being seen by the party during the entire season. The black bear is very common. Although most of the common fur-bearing animals were observed, trappers state that they are really scarce and that trapping is an unprofitable venture.

Water Power

Possible sites for the development of small quantities of water power occur on the Mollie river, a quarter of a mile east of Makwa, and at the 15-, 18-, and 13-chain portages on the Nabakwasi river. It seems improbable, however, that it would ever be necessary to harness these sites for other than very local needs, since the Ontario Hydro-Electric Power Commission, whose transmission line

[1]Ont. Dept. Game and Fisheries, 23rd Ann. Rept., 1929, p. 34.

traverses the area, could supply cheaply almost any quantity of power required for mining purposes.

Agriculture

As yet the area is not adapted to broad agricultural pursuits. It should be stated, however, that when the necessity arises much of Brunswick and Connaught townships will be cleared and made to yield profitable crops. For the most part, the soil is a sandy loam well adapted to the growth of vegetables, particularly potatoes.

Mapping Methods

In the compilation of the accompanying map, township plans provided by the Ontario Department of Surveys were used as a base. The lakes in the south half of Groves township were surveyed by means of a Lugeol split-lens micrometer with prismatic compass control, the traverse being tied to known points on township lines. When time did not permit mapping by this method, rough sketches of the lakes and streams were made, these being indicated on the map by broken lines. In the eastern part of Connaught township a rough survey of the lakes was made a few years ago by Lloyd Foster of Shiningtree. This information, in part, was used in the compilation of this part of the sheet. Bush traverses, controlled by standard pace-and-compass methods, were made at suitable intervals, depending on the locality and the nature of the information desired. For 1933, the magnetic declination in this area was 9° 10′ west of true north.

GENERAL GEOLOGY

The consolidated rocks in this area are pre-Cambrian in age. The assemblage consists of a wide variety of extrusive, intrusive, and sedimentary rocks, the age relationships of which have been fairly well established.

Champagne township is underlain largely by granitic rocks. A few scattered outcrops in the southern part indicate that granite gneiss underlies this heavily drift-covered section. At Makwa, granodiorite containing many recrystallized basic inclusions is the common type. This granodiorite is a part of the Three Duck lakes batholith lying to the west. North of Makwa, as far as mileage 80 on the C.N.R., there is a rather striking assemblage of transition rocks consisting of granite, granodiorite, diorite, greenstone, and acid porphyry dikes. These types alternate in a most bewildering manner and must be regarded as a fine example of a broad contact zone between the Keewatin and Algoman rocks.

The townships of Groves and Brunswick are traversed by a belt of sediments known as the Ridout series, the average width of which is approximately 1¼ miles. These rocks are well exposed on the east shore of Minisinakwa lake toward the south end, along the railway between mileage 80 and 81, at the north end of Hanover lake, along the Nabakwasi river in the central part of Brunswick township, and on the east side of Mattagami lake near the extreme south end. For the most part the series is strongly sheared parallel to the bedding, and consists of boulder conglomerate, greywacké, sericite schist, arkose, quartzite, and iron formation. The strike varies between N. 80° E. and S. 60° E.; and although the dip is likewise variable, for the most part it is close to the vertical. The south boundary of the sediments is everywhere in contact with granite, whereas the north boundary is separated from the granite by narrow belts of either hornblende schist or tuffaceous greenstone.

In the eastern part of the area, i.e. Cabot, Connaught, and Churchill townships, sediments, pyroclastics, and greenstones have a wide distribution. Intrusive

rocks, such as porphyry, lamprophyre, and diabase, likewise occur, but in less volume than the extrusive types.

The Ridout sedimentary series may be readily traced from the south end of Mattagami lake eastward to Elephanthead creek. Between this point and the east boundary of Connaught township the sediments are extremely altered and schisted, so much so, in fact, that their original nature and origin is in many cases very obscure. Moreover, if the general field relationships were not known, these rocks might readily be considered as highly altered and schisted acid lavas or even porphyries. The sediments cross the east boundary of Connaught township 26 chains south of the 5-mile post; at this point the belt is probably not more than 10 chains in width. They continue eastward across the north half of Churchill township as far as Michiwakenda lake, where they terminate abruptly owing to a well-defined fault.

In Connaught and Churchill townships the sediments are closely associated with a thick series of acid to intermediate flow rocks and pyroclastics, with which they are thought to be infolded in a syncline. The latter rocks occur in wide belts on either side of the sediments, structurally underlying them. Farther out, and structurally beneath the acid volcanics, are basic volcanics consisting largely of an undifferentiated complex of pillow lavas, andesite, and basic tuffs, all of which are typically Keewatin in age. Unfortunately there are few places where the actual contact between the sediments and volcanics may be observed. However, one exposure on the north shore of Okawakenda lake near the middle shows that there is no apparent structural unconformity, but rather that the contact is marked only by a gradual passing from volcanic to sedimentary types. More will be said, in another section of this report, of this relationship between what are here designated as Keewatin and Timiskaming rocks.

Lying within the area of volcanics and sediments and intrusive into them are dikes and stocks of late Algoman rocks, the distribution of which is more widespread in the eastern part of the area than in the western part. Porphyry dikes and lamprophyre dikes are commonly observed, but, as a rule, they are narrow and probably not important with regard to mineralization. More significant in this respect, however, are stocks of diorite, quartz-feldspar porphyry, and granite porphyry. The Saville gold quartz showing in the Claw lake section of Cabot township would appear to be associated genetically with a stock of diorite 1½ miles long and half a mile wide. Gold-bearing quartz veins in the West Shiningtree camp are thought to be related to small irregular intrusions of granite porphyry, quartz porphyry, and feldspar porphyry. About half a mile south of the 4-mile post on the north boundary of Connaught township there is a small stock of reddish quartz-feldspar porphyry, in the environs of which one might expect to encounter gold-bearing quartz veins; as yet none have been disclosed.

Toward the centre of Connaught township, just east of Elephanthead creek, there are isolated areas of a fresh-looking, flat-lying, reddish boulder conglomerate closely associated with beds of impure arkose or greywacké. The general appearance, attitude, and unmetamorphosed condition of these rocks suggest that they are outliers of the Cobalt series, the parent mass of which occurs in Natal township, 10 miles to the northeast.

Diabase dikes are very common. Both quartz and olivine varieties occur, the former being by far the most abundant. On the accompanying map no distinction is made between them, both types being considered as Matachewan in age. Certain olivine varieties, however, are definitely later than the quartz diabases, and may be of Keweenawan age.

Table of Formations

QUATERNARY	
RECENT:	Sand beaches, peat, diatomaceous marl.
PLEISTOCENE:	Glacio-fluvial deposits.
	Unconformity
PRE-CAMBRIAN	
KEWEENAWAN:	Diabase sills and sill remnants.
ANIMIKEAN: (Cobalt series)	Conglomerate, greywacké.
	Unconformity
MATACHEWAN:	Diabase dikes and sills.
	Intrusive contact
ALGOMAN:	Hornblende and mica lamprophyre. Quartz-feldspar porphyry, diorite. Porphyritic granite, pink and grey granite, gneiss, granodiorite, diorite.
	Intrusive contact
PRE-ALGOMAN: (Haileyburian?)	Diorite, serpentine-carbonate rock.
	Intrusive contact
TIMISKAMING: (Ridout series)	Schistose conglomerate, greywacké, arkose, quartzite, slate, sericite schist, banded iron formation.
	Unconformity
KEEWATIN:	Iron formation. Upper Group: Hornblende andesite and trachyte flows, tuff, and agglomerate. Lower Group: Andesite, pillow lava, hornblende schist, basic tuff.

Keewatin

Except for a narrow strip in Brunswick and Groves townships the Keewatin rocks are confined to that part of the area lying east of Mattagami and Waonga lakes. They form the south border of a broad area of Keewatin rocks extending north toward Porcupine and Abitibi lake. They consist mainly of volcanic types, including varieties of andesite, trachyte, rhyolite, and their associated tuffs and agglomerates. On the basis of wide differences in lithological character as well as stratigraphical arrangement, these rocks have been divided into what will hereafter be known as the Upper group and the Lower group, the stratigraphical succession of which is as follows: The infolded Ridout series of sediments is underlain on either side by broad subparallel belts of acid volcanic types, which are included in the Upper group. These, in turn, are underlain by another subparallel series of highly folded and strongly metamorphosed rocks, to which, in many cases, the term "greenstone" is especially applicable; this is the Lower group. Whether or not these groups are separated by an unconformity has not been established here, but it is noteworthy that evidence of such a relationship has been recorded by others who have studied a similar succession of rocks a few miles to the east in the Shiningtree Lake area[1] and in Tyrrell township.[2]

More information than is available at present would be necessary before the boundary between the Upper and Lower groups of volcanics could be mapped with any degree of accuracy. For this reason a notation rather than a colour is used on the map to mark the approximate location of these rocks.

[1]Geo. B. Langford, "Shiningtree Silver Area," Ont. Dept. Mines, Vol. XXXVI, pt. 2, 1927, pp. 88, 89.

[2]A. R. Graham, "Tyrrell-Knight Area," Ont. Dept. Mines, Vol. XLI, pt. 2, 1932, pp. 33, 36.

Lower Group

The rocks in this group occur widely in Connaught township, in the south half of Churchill township, and in the north half of Asquith township. They constitute a schist complex varying somewhat in general appearance and degree of metamorphism, but they are predominantly dark-green, highly altered basic lavas, close to andesite in composition. In places the lavas are massive, coarse-textured types having the appearance of diabase or diorite. In other places narrow east-west belts of chlorite schist are metamorphic expressions of the strong shearing movements to which these basic rocks have been subjected. In Cabot township, the flows have a general east-west strike and vertical dip, but eastward in Churchill township, where the rocks have been much disturbed by folding and faulting, they have a northwest-southeast strike, but still maintain their vertical attitude, or nearly so. Throughout the area it was observed that the strike of the schistosity in the volcanics was parallel to that of the flows, and that this in turn was approximately parallel not only to the Ridout series contact but to the bedding of the sediments themselves.

In the Mattagami-Claw lakes section there are many narrow bands of rather basic tuffs, agglomerates, and flow breccias interbedded with lava flows. No doubt this is true of other parts of the area, but it is less noticeable. As a rule, a flow grades upward into pyroclastic types with little or no line of demarcation between them. The contact with the overlying flow, however, is rather sharp. One of the few places where the latter feature was observed was on the south side of the narrows at Claw lake. Nowhere was there sufficient exposure to measure the actual thickness of any individual flow, but they are probably seldom more than 300 to 400 feet thick, the majority being much less.

Pillow or ellipsoidal lavas were encountered in various places throughout the Keewatin area. The area of greatest distribution is that in the environs of West Shiningtree lake, Churchill township. Smaller areas of the same rock were observed at Cryderman lake and on the east shore of Michiwakenda lake, 1½ miles from the south end. The rock is a rather basic type of andesite, varying in colour from greyish-green to dark-green, usually with a fine-grained texture. For the most part it has a somewhat fresh appearance, but thin sections under the microscope show that it is composed largely of highly altered feldspar and secondary hornblende. The outstanding feature, of course, is the development of excellent subellipsoidal structures ranging from a few inches to several feet in diameter. Adjacent ellipsoids are separated by a narrow zone half an inch to two inches wide of rusty-weathering epidotic interstitial material. These structures are particularly conspicuous along the rocky shores of West Shiningtree lake toward the north end. Commonly the ellipsoids are seen only in cross-section, but in several instances close to the water's edge wave action has exposed them almost in their entirety. As a rule, Keewatin lavas of this type are characterized by the presence of small amygdules or gas cavities near the periphery of an ellipsoid. Although they were eagerly looked for, since their distribution often gives a clue to structural relationships, none were observed here.

A more acid type of ellipsoidal andesite occurs along the north shore of Wire lake, Connaught township. The freshly broken rock is fine-grained and greyish-green in colour, whereas the weathered surface is characterized by a distinct reddish-brown colour.

In many places the greenstones of the Lower group are in contact with broad areas of granite intrusives, the contact metamorphic effects of which are very marked. Along the north contact, between Minisinakwa lake and the Nabakwasi river, a strip of greenstone ranging from 4 to 40 chains in width has been converted

into hornblende-chlorite schist. This contact action has been particularly intense in the vicinity of Vendette lake. Along the south contact the occurrence of a broad zone of transition rocks is further evidence of the strong contact metamorphic action to which these rocks have been subjected. The general character of this zone will be described under the heading of granite.

In the vicinity of Speed and Gosselin lakes, in the south central part of Churchill township, and extending for three miles southeast toward Stewart lake, there are localized bands of rusty-weathering carbonate rock, unweathered portions of which are a pleasing malachite green. A chemical analysis[1] shows that this rock is an impure magnesium-iron-lime-carbonate type. It is closely associated with small intrusive masses of porphyry and is intersected by intricate stockworks of auriferous quartz veins. This relationship leads to the supposition that this carbonate rock is the result of strong hydrothermal alteration of the greenstone. The alteration was caused by the invasion of hot carbonated waters exuded from the intrusives. Carbonate rocks of this type are common in the Keewatin areas of Northern Ontario, notably at Porcupine, Night Hawk lake, Larder lake, and Abitibi lake.

As far as is known, no iron formation occurs within the volcanics of the Lower group, but in the east central part of Churchill township a band of this rock lies between the Lower and Upper groups. It has been traced from Perkins lake southeast across the Cochrane and Gold Corona properties, a distance of two miles. On the latter property it consists mainly of black aphanitic material strongly impregnated with pyrite and quartz, which occur in stringers. On weathering the pyrite gives rise to a dark-brown limonitic substance.

Upper Group

The rocks of the Upper group are confined largely to that part of the area lying between Elephanthead creek and Michiwakenda lake. Excellent exposures occur on Okawakenda lake and toward the north end of Michiwakenda lake. The rocks consist of hornblende andesite and trachyte flows, and their associated breccias, tuffs, and agglomerates. As compared with the rocks of the Lower group they have a distinct fresh appearance and are quite massive, being free from intense folding or shearing movements. Flow structures are not common, but in places rudely developed pillow structures were observed, viz. certain tuffaceous flows at the extreme north end of Michiwakenda lake.

The hornblende andesite is a fine-grained, dull greyish-green rock with varying amounts of black hornblende occurring as slender glistening prisms up to one-half inch in length. It is a more acid type of andesite than that in the Lower group. Other varieties, more acid in composition, are greyish in colour, contain fewer hornblende prisms, and show a marked development of light-coloured phenocrysts of feldspar. A thin section under the microscope shows phenocrysts of hornblende, plagioclase, and orthoclase set in a dense felsitic matrix of the same materials and their alteration products. The feldspars are quite turbid on account of alteration products, and much of the hornblende is altered to chlorite. The rock may be properly called a trachyte. Toward the west end of Okawakenda lake, the trachyte is pale-reddish in colour, and locally shows the development of porphyritic texture with phenocrysts of hornblende and feldspar. In hand specimens this rock bears a strong resemblance to certain reddish hornblende lamprophyre, with which it might readily be confused, but the latter may be distinguished by the fact that it always occurs in the form of

[1]P. E. Hopkins, "West Shiningtree Gold Area," Ont. Dept. Mines, Vol. XXIX, pt. 3, 1920, p. 33.

dikes. The reddish porphyritic variety, moreover, has frequently been mistaken for intrusive porphyry of the syenite type. As a rule, however, close examination will reveal delicate reddish to greenish mottled effects and a felsitic texture. In general, all gradations between hornblende andesite and hornblende trachyte occur, giving rise to a wide variety of rocks. So close indeed is their association that, in spite of their variable nature, they are believed to be phases of one and the same extruded magma.

Interbedded with the andesite and trachyte flows, but of more widespread distribution, are volcanic *ejectamenta* types, such as tuffs and agglomerates, the latter being merely a coarse phase of the former. The fragments vary in size from microscopic grains to boulders 8 inches in diameter. The larger ones are oval to subangular in shape and tend to become more angular with decrease in size. They are composed mainly of trachyte and andesite, materials similar in every respect to the flow rocks with which they are associated; the matrix is



Volcanic agglomerate, Okawakenda lake, Churchill township.

composed of the same materials. Black, cherty, vitreous fragments are not uncommon. Weathering tends to accentuate the fragmental character of these rocks, which on freshly broken surfaces is scarcely noticeable. The bedded character of the tuffs is not always clearly discernible, but a good example was observed on the most northerly point of the large island in Okawakenda lake near the west boundary of Churchill township. Here the beds strike at S. 65° E and have a vertical dip. The agglomerate has a marked tendency to occur in well-defined bands, which in many cases are so persistent as to constitute good horizon markers. A notable instance is the agglomerate band striking in an east-west direction across the islands and mainland at the west end of Okawakenda lake and outcropping again at the narrows toward the north end of Michiwakenda lake. This band is at least 4 miles long and a quarter of a mile in width.

Timiskaming

Ridout Series

Although the occurrence of sedimentary rocks had been noted in the early explorations of parts of this area, the first detailed description was that given by

W. H. Collins[1] in his study of the Onaping map area. In this connection, however, his work was limited to those sediments in the region about Okawakenda lake, Churchill township. At a later date T. L. Tanton[2] traced these rocks from the south end of Mattagami lake westward to Schist lake, in the Three Duck Lakes area, but in his report and map he did not discriminate between the greenstone and the clastic sediments, apparently regarding them as a part of the pre-Huronian schist complex. Farther west, and at a still later date, R. C. Emmons and Ellis Thomson[3] mapped the sediments separately from the greenstones, and called them the Ridout series. As a result of subsequent mapping this series has been traced from the Swayze area to the West Shiningtree area, a distance of nearly 90 miles.

Although the belt would seem to terminate abruptly in Churchill township, it occurs again and has been mapped in the Tyrrell-Leonard area, 8 miles to the east. In this connection it should be noted that Duncan McDonnell, who has made a study of the geology in the northern half of Macmurchy township, states



Sheared conglomerate of the Ridout series, mileage 80½, Canadian National railway, Groves township. Note the narrow diabase dike.

that the Ridout series may be traced across the northern half of this township, and that there is no gap in the sedimentary belt between Churchill and Tyrrell townships. On one occasion Mr. McDonnell accompanied the writer to a point near the outlet of Big Four lake, Macmurchy township, where there is an outcrop of conglomerate undoubtedly belonging to the Ridout series.

For the most part the Ridout series in this area possesses certain characteristic features that are common to the belt as a whole. So excellent and detailed has been the description of these features by officers of the Geological Survey, named above, that a further extended account would seem unnecessary. For the sake of completeness, however, a general description will be given.

The Ridout series is dominantly composed of greywacké, impure arkose and quartzite, conglomerate, and sericite schist, but slate and banded iron formation are prominent locally. Normally these rocks are strongly sheared in a general east-west direction, as is the case from Groves township to Connaught township;

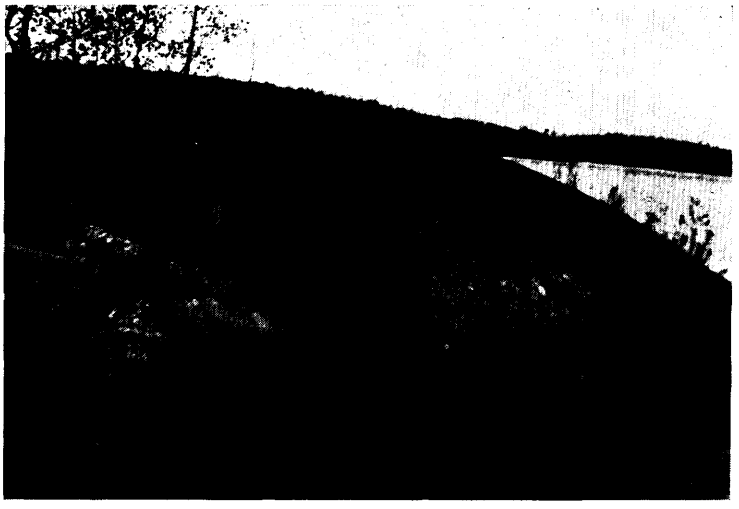
[1]W. H. Collins, "Onaping Map-Area," Geol. Surv. Can., Mem. 95, 1917.

[2]T. L. Tanton, "Reconnaissance along Canadian Northern Railway between Gogama and Oba," Geol. Surv. Can., Sum. Rept., 1916, pp. 179-181.

[3]R. C. Emmons and Ellis Thomson, "Preliminary Report on Woman River and Ridout Map-Areas," Geol. Surv. Can., Mem. 157, 1929.

but toward the east end of Okawakenda lake, they are more massive in appearance, the shearing movements apparently having petered out. The dip of the beds, except in the Okawakenda lake section, is never far from the vertical, and in most cases the beds stand on edge. The more easily altered types, such as greywacké, conglomerate, and arkose, have undergone intense alteration to chloritic, sericitic, and carbonated materials.

Conglomerate occurs in the position of a basal conglomerate, i.e. at both margins of the sedimentary belt, as well as at various horizons within the belt. This recurrence of conglomerate bands may be ascribed to the complex folding to which the whole series has been subjected. As a rule, the narrow bands are elongated lens-shaped structures traceable for only short distances. The wider bands, however, are more persistent as to length; for example, the band extending



Narrow lenses of coarse conglomerate in massive greywacké of the Ridout series, small island at the east end of Okawakenda lake, Churchill township. Note the *roche moutonné* shape of the outcrop caused by glacial ice movement.

eastward from the south end of Mattagami lake to the central part of Connaught township has been traced for nearly two miles. An excellent vertical exposure on the east shore of the lake indicates that the conglomerate band is at least 1,500 feet wide, a figure singularly great if it represents the true thickness of the deposit. Since folding and faulting commonly cause the duplication of beds, a feature not always clearly discernible in outcrops of limited extent, the danger of assuming a thickness of this magnitude is readily apparent.

The conglomerate contains a wide variety of pebbles and boulders. In the western part of the area they are mainly granite, gneiss, red jasper, black chert, and greenstone, whereas in the eastern part of Churchill township they are largely volcanic types apparently derived from the underlying andesite, trachyte, and tuffs; granite, porphyry, and black chert are less common here than is usually the case elsewhere along the belt. Normally the pebbles and boulders have been greatly stretched in the direction of the schistosity, but in the region about Okawakenda and Michiwakenda lakes, where the beds have not been sheared, they are well rounded to subangular, and closely crowded together. The matrix is predominantly greywacké, but arkose and feldspathic quartzite types were also

observed. In general, the conglomerate grades into other types, such as greywacké, arkose, or slate, the gradation being marked only by the disappearance of pebbles.

Greywacké and arkose have a wide distribution in this area, particularly in the western part. In the field, the distinction between these rocks is more or less an arbitrary one based largely on colour, the light-coloured varieties being referred to arkose. All gradations between greywacké and arkose were observed. Under the microscope the so-called arkose shows an abundance of impurities, so much so in some cases that the term "greywacké" might be more appropriate in order to be strictly within the limits of the definition as proposed by certain authorities in these matters. Where these rocks have not been strongly sheared they frequently display a distinct banded appearance, owing to the alternate arrangement of light- and dark-coloured materials, as in varved clays, which they strongly



Vertical section of banded greywacké of the Ridout series, rock cut on the Canadian National railway, 10 chains north of the 80-mile post, Groves township.

resemble. A particularly fine illustration of this feature occurs in a rock cut on the C.N.R., 10 chains north of the 80-mile post.

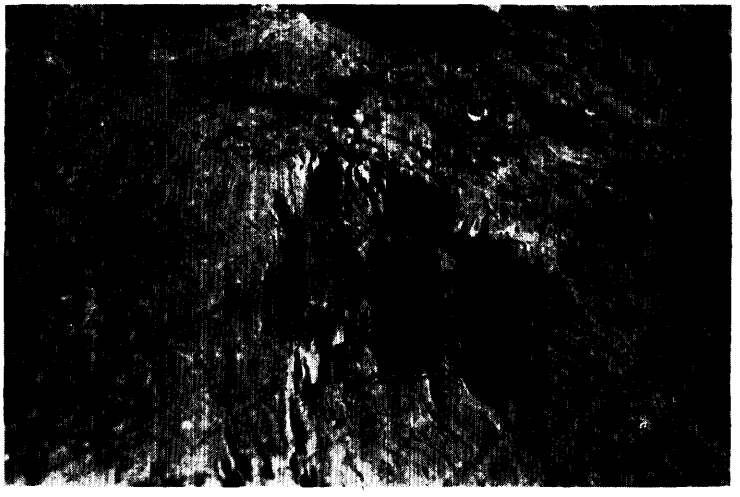
Light-coloured bands of feldspathic quartzite occur locally. Thin sections under the microscope show a predominance of clastic quartz grains, and minor amounts of feldspar and ferromagnesian minerals.

Slate is not of widespread distribution in this area, being confined almost entirely to the eastern part of Churchill township. Fine exposures occur along the east shore of Michiwakenda lake; on the large islands and mainland in the east half of Okawakenda lake; and in the deep bay of Okawakenda lake into which West Shiningtree creek flows. It is a fine-grained, dark-grey to muddy-green rock showing excellent bedding. In places the *laminae* display variegated colours to such an extent that the beds have a distinctly banded appearance. In every instance, the beds are strongly contorted and show excellent drag folds and fracture cleavage. In places, thin bands of slate up to 5 inches in width are intercalated with beds of greywacké.

On the large islands at the east end of Okawakenda lake, and on the east side of Michiwakenda lake just opposite the bay leading to Okawakenda lake, are exposures of well-banded iron formation, the thickness of which probably does not exceed 100 feet. It is distinctly a phase of the slaty formation, since the

laminae consist of alternating layers of reddish iron oxide and greenish slate. The iron-rich layers are never more than half an inch in thickness and diminish almost to paper thinness in some cases. The iron occurs mainly in the form of hematite, but locally magnetite is present in quantities sufficient to seriously deflect a compass. The total iron content is small.

Iron formation, more typical than that noted above, occurs in a band close to the south shore of Pensyl lake, Groves township. This band has been traced for three-quarters of a mile and is probably not more than 50 feet in width. At one point near the east end of the lake the band consists of alternating layers of dark chert and magnetite, in the vicinity of which there is strong magnetic attraction. On the east shore of the lake, magnetite is absent and the band consists of light-coloured cherty quartz having a rudely laminated appearance. The strike of the iron formation conforms to that of the accompanying greywacké, with which it is interbedded.



Contorted beds of slate of the Ridout series, north shore of Okawakenda lake, Churchill township. Note the glacial striae.

Age and Relationships of the Ridout Series

Previous geological work[1] by officers of the Geological Survey of Canada led to the conclusion that the Ridout series is Keewatin in age. The writer, up to the present, has not been able to subscribe to this view, but rather holds that the Ridout series belongs to the Timiskaming period of sedimentation. In a report on the Three Duck Lakes area[2] evidence in support of this conclusion was presented, and evidence of a similar nature was observed in the area under consideration.

The Ridout series possesses certain lithological features that have long been regarded as typical of the Timiskaming series in other areas of Northern Ontario and Quebec; in other words, they look like the Timiskaming rocks. The materials composing the rock, the well-banded appearance, and the vertical attitude of the beds are all characteristic of the Timiskaming series.

[1]W. H. Collins, op. cit., p. 41.
R. C. Emmons and Ellis Thomson, op. cit., pp. 4, 18.
[2]H. C. Laird, Ont. Dept. Mines, Vol. XLI, pt. 3, 1932, p. 18.

In other parts of Ontario and Quebec, where Timiskaming rocks have been mapped, an unconformable relationship with the Keewatin rocks has, in every case, been recognized, whether it be an erosional one, structural, or both. That an erosional unconformity exists between the Keewatin volcanics of the Upper group and the Ridout series is reasonably certain from the fact that conglomerate bands lying in the position of a basal conglomerate, i.e. at or close to the bottom of the sedimentary series, are composed largely of the debris of the subjacent volcanics. The north shore of Okawakenda lake affords one of the few places in this area where this relationship may be observed. Here, the volcanic tuffs grade upward into a well-bedded slate horizon, 100 feet or more in thickness, with no evidence of a structural unconformity; the slate in turn grades upward into a thick conglomerate band. The pebbles in the conglomerate are predominantly trachyte and andesite tuff and flow materials precisely like that of the underlying volcanics; pebbles of granite, diorite, chert, and slate occur less abundantly.



Reddish banded iron formation of the Ridout series, east side of the large island at the east end of Okawakenda lake, Churchill township.

The occurrence of an erosional unconformity signifies a time interval between the periods of deposition of the fragmental volcanics and the Ridout series. That this interval was of relatively short duration is suggested by two observations noted above: First, the volcanics and sediments are structurally conformable and grade into one another; second, the conglomerate shows a notable homogeneity of pebbles, on account of their having been derived from a rather localized area. Had the time interval been great, one might expect to find a wider variety of pebbles than is the case.

Farther west in Connaught township the Upper group of volcanics is absent, the Ridout series being in contact with the greenstones of the Lower group. Evidence of a discordant relationship was observed at Wire lake, where the contact is marked by a well-defined fault that strikes across the lake and follows the creek bed east from the Hydro camp. Within a few feet massive pillow lavas give place to highly contorted argillaceous schist of the Ridout series type. This schist grades upward into coarse arkose, which in turn grades into boulder conglomerate containing a wide variety of granite, chert, schist, and quartz pebbles. That the conglomerate in this instance is not a basal conglomerate does not militate strongly against the evidence of an unconformity, since there are

many instances in the study of sedimentation where sediments have been deposited unconformably on older rocks without an intermediary conglomerate. This unconformity is believed to represent a reasonably long period of time, in which there was erosion rather than deposition.

So widely divergent are the relationships between the volcanic series and the sedimentary series in different parts of the area, that widely varying geological processes must have taken place. The chronology of events as based on observations noted in the preceding paragraphs is believed to have been as follows:—

In the eastern part of the area a brief interval of time followed the extrusion of the basic volcanics of the Lower group. This was followed by vulcanism of a more explosive type, with the result that great thicknesses of acid flows and tuffs were deposited. As this period came to a close there were weak intermittent explosions between brief periods of erosion and reworking of the volcanic materials under water. This would account for the gradational nature of the contact on Okawakenda lake. Farther west the tuffs appear to pinch out laterally on account of the increased distance from the volcanic vent or vents. In the western part of Connaught township, where they seem to fail entirely, their period of deposition is represented by a great hiatus or gap in the record, as expressed by a marked unconformity.

In connection with discordant relationships it should be stated that conditions similar to those noted above are known to obtain at the Keewatin-Timiskaming boundary in Porcupine, Kirkland Lake, and Quebec. In parts of these areas tuffs and agglomerates fill the gap between the Keewatin basic volcanics and the Timiskaming sediments, a feature that has frequently given rise to some apprehension as to where these rocks should be placed in the stratigraphical column. On lithological grounds the writer, in the area under consideration, has included them with the Keewatin, but there would seem to be no very serious objection to their being regarded as Timiskaming in age if the chronology of geological events as stated above be correct.

Pre-Algoman (Haileyburian?)

Among the basic plutonic rocks provisionally regarded as Haileyburian in age are two small masses of serpentine-carbonate rock close to the Churchill-Asquith boundary line, and a small mass of diorite on the portage route between Chris lake and Mataris lake, Connaught township. The outcrops of serpentine are found on the east side of Gosselin lake and on the south side of Chlorus lake. Hopkins[1] states that they are "probably altered peridotites which immediately preceded the acid rocks of the Algoman epoch." On Gosselin lake weathered surfaces show characteristic columnar structures hexagonal in outline and in juxtaposition. The diorite is a dark, coarse-textured, fresh-looking rock intruding the Ridout series.

Algoman

Various types of intrusive rocks believed to be of Algoman age occur in this area.

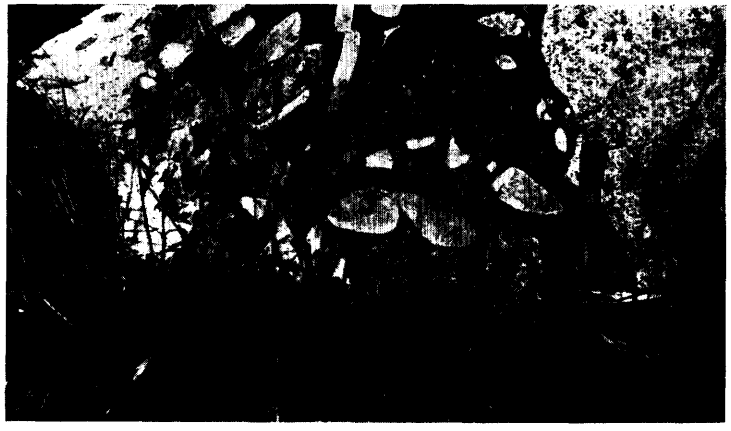
Granite, Gneiss, Granodiorite, Diorite

Granite, gneiss, granodiorite, and diorite have a widespread distribution on either side of the narrow belt of sediments and volcanics, but this report concerns only those in the immediate vicinity of the belt. The wide variation in their lithological character and composition suggests the intrusion of more than one magma, but this would be difficult to establish, since one type apparently grades

[1]Op. cit., p. 35.

into another. This observation is particularly well illustrated along the C.N.R. between mileages 74½ and 82. In one place greyish hornblende-biotite granite passes gradually into hornblende-biotite gneiss with no line of demarcation between them. South of Makwa grey biotite granite passes into granodiorite in a similar manner. Granodiorite, in turn, passes into diorite, the change being marked only by a gradual increase in the amount of dark mineral. Much of the rock that would ordinarily be called granite in the field is really a granodiorite, since plagioclase is the predominating feldspar. The granodiorite and diorite, moreover, are everywhere characterized by scattered eyes of blue quartz, the occurrence of which has not been observed in the typical granites. At the east end of the small lake on the portage route between Piggott lake and Shuller lake, there is an outcrop of reddish alkali granite consisting of little other than quartz and pink orthoclase.

Porphyritic varieties of all the above-mentioned rocks are commonly observed. Bordering the north boundary of the sedimentary belt between the



Algoman granite with a large inclusion of conglomerate of the Ridout series, Nabakwasi river, a quarter of a mile north of the 13-chain portage, Brunswick township.

Nabakwasi river and Mattagami lake there is an extensive area of coarse-grained, massive, red porphyritic granite of striking appearance and notably different from other porphyritic granites observed elsewhere in the area on account of the development of large phenocrysts of orthoclase feldspar and quartz. The feldspars are salmon-coloured and commonly attain a length of 4 inches and a diameter of 2 inches. On weathered surfaces quartz grains as much as half an inch in diameter stand out like grains of tapioca. In many respects this granite bears a strong resemblance to the Killarney granite along the north shore of Lake Huron, but of course the writer does not mean to imply contemporaneity.

The invasion of granite or granodiorite into the older belt of volcanics and sediments has produced noteworthy contact metamorphic effects resulting in broad zones of transition rocks. This condition obtains everywhere along the south margin of the belt and to a lesser extent along the north margin. Along the C.N.R. between mileages 78 and 79½ there is a bewildering alternation of greenstone and granodiorite bands, many of which are only a few feet in width. The disposition of these bands is such as to suggest that a rather flat-topped batholith invaded the overlying greenstone, roof pendants of which have been

exposed by subsequent erosion. Farther out in the massive granodiorite, as in the vicinity of Makwa, there are great numbers of basic inclusions consisting largely of recrystallized greenstone. These inclusions vary widely in shape and size and show all stages of digestion from those retaining their original angular character, through those more or less rounded by assimilating processes, to those occurring only as dark vestiges of the original material. In Brunswick and Groves townships the granite is in contact with the Ridout series. The nature of this contact is well illustrated on the shores of a small lake 16 chains east of the north end of Piggott lake. The granite invaded the sediments parallel to the bedding, as a result of which there is a contact zone several hundred feet in width consisting of alternating bands of granite and schist, the latter being a metamorphic derivative of the sediments. Farther from the contact the granite contains fragments of the sediments in all stages of assimilation. In the vicinity of Elephanthead lake, Connaught township, the contact is in the nature of a brecciated zone. Apophyses of the granite penetrate the greenstone schist, and closely crowded angular blocks of the schist apparently floated out into the granite magma for short distances.

Porphyry and Lamprophyre

Quartz-feldspar porphyry is not common in the western part of this area. A few east-west trending dikes ranging from 1 to 15 feet in width were observed along the C.N.R. between mileages 79½ and 80½, and on the east and west shores of Minisinakwa lake. They are definitely younger than the granodiorite, since they intrude it. Other narrow porphyry dikes were observed at the north end of Piggott lake and at the north end of Hanover lake. Farther east, in Connaught township, porphyry intrusions would appear to be more common. Between Wire lake and Okawakenda lake there are two small stocks of reddish feldspar porphyry and numerous narrow dikes of the same rock. A thin section of the porphyry just west of Elephanthead creek shows phenocrysts of quartz, orthoclase, and plagioclase set in a dense fine-grained matrix of the same materials. The feldspars are turbid on account of strong alteration.

Acid intrusives in the form of dikes and stocks occur widely in the south half of Churchill township. The following description by P. E. Hopkins[1] can scarcely be improved upon.

> The light-coloured rocks in southeast Churchill township included with this group comprise quartz porphyry or rhyolite, granitic rocks, feldspar and granite porphyry, which grade at times into each other, thus making it difficult to separate them in mapping. They are quite massive and fresh-looking, and crosscut at times the green schist; nevertheless, some of the quartz porphyries may be connected with the rhyolites. . . . Certain gold-bearing deposits lie in the green schist not far from the north and east contacts of this group of rocks in southeast Churchill. The quartz porphyries are light-grey or pink. The numerous quartz and occasional feldspar phenocrysts stand out prominently in the dense fine-grained groundmass. The granitic rocks, which are at times in sharp contact with the quartz porphyries, are mauve in colour and have a fine and even grain. The microscope shows quartz, acid feldspars, biotite, apatite, chlorite, and magnetite. In places the granite becomes lamprophyric and porphyritic.

In the Claw lake section, Cabot township, a stock of granitic rock 1½ miles long and half a mile wide intrudes Keewatin tuffs. The mass shows all stages of differentiation from diorite along the south contact through granodiorite to typical red granite and acid porphyry along the north contact. The rock has a remarkably fresh appearance in hand specimens, but thin sections under the microscope show that it is strongly altered. The basic phase is a highly altered quartz diorite, thin sections of which show plagioclase, hornblende, and quartz. The feldspars have been altered to carbonate and sericite, and the hornblende to chlorite.

[1]Op. cit., p. 36.

On the shores of Claw lake, light-coloured dikes of quartz-feldspar porphyry are seen cutting the Keewatin volcanics. They range in width from a few feet up to 20 feet. Thin sections show large phenocrysts of plagioclase and quartz set in a fine-grained mosaic of quartz, sericite, epidote, and hornblende. These dikes are doubtless acid differentiates of the large granitic stock noted above. In this section the mineralization seems to be associated with dikes of this nature.

A few scattered dikes or sills of lamprophyre were observed, mainly in the eastern part of the area. The most notable example is the lamprophyre sill(?) on the Herrick property toward the south end of Michiwakenda lake. It is a dull reddish rock containing large phenocrysts of chloritized mica in book form, as well as large rounded fragments of what is apparently foreign material up to several inches in diameter. Its composition is such that it may be properly called a minette. A fine-grained dike rock, similar in outward appearance to that just mentioned, occurs on the east shore of Burns lake, Connaught township. A close examination of a thin section under the microscope shows that it is close to hornblende lamprophyre (camptonite) in composition. It is composed of phenocrysts of oligoclase feldspar slightly sericitized, chlorite pseudomorphs after hornblende, and apatite, set in a matrix of carbonated and sericitized feldspars, chlorite, magnetite, and a little quartz. The age of these lamprophyres has not been definitely established, but they are believed to be either very early or very late differentiates of the granite magma.

Matachewan

Diabase dikes cutting all the above-mentioned rock formations occur widely throughout this area, being particularly abundant in the eastern section. In Groves and Brunswick townships the strike of the dikes varies from east-west to north-south, but farther east they assume a very definite north-south alignment. They range in width from a few inches to 200 feet or more. Certain irregularly shaped masses of diabase in the eastern part of Churchill township are probably sill remnants. Both olivine and quartz varieties occur; the latter in many cases is porphyritic, having phenocrysts of highly altered yellowish-green feldspars (huronite) up to several inches in diameter. Magnetite is a common constituent of the olivine diabase, and in many instances occurs in such quantities as to cause strong magnetic attraction.

Since many of the dikes in this area exhibit lithological characteristics peculiar to diabase of Matachewan age, as established by intrusive relationships with the Cobalt series in the neighbouring areas of Gowganda and Matachewan, most of them have been assigned to the Matachewan period of diabase intrusion. To this group belong the quartz diabases, in particular those carrying phenocrysts of huronite. It should be added, however, that dikes and sills of the comparatively rare olivine-bearing diabase may be of Keweenawan age, and some of them have been so designated on the accompanying map. On the trail leading south from Burns lake, the Cobalt conglomerate has been intruded by a flat-lying sill of fine-grained diabase, which, on account of its intrusive relationship, may with certainty be assigned to the Keweenawan period of intrusion.

Animikean

Cobalt Series

Toward the centre of Connaught township, just east of Elephanthead creek, there are at least two isolated areas of a fresh-looking, flat-lying, reddish boulder conglomerate closely associated with arkose and greywacké. The general

appearance, attitude, and unmetamorphosed condition of these rocks suggest that they are outliers of the Cobalt series (Gowganda formation), the parent mass of which occurs in Natal township, 10 miles to the northeast. In general, little difficulty would be experienced in distinguishing between this series and the older Ridout series.



Conglomerate of the Cobalt series, Connaught township.

The conglomerate is a very massive rock consisting of pebbles and boulders of widely varying shape, size, and composition, derived entirely from the pre-Cobalt basement. It grades imperceptibly into greywacké and arkose, which,



Cobalt conglomerate resting uncomformably on Keewatin hornblende andesite, Connaught lake.

in some cases, have such a fresh appearance that the term "sandstone" would seem more applicable.

In a rocky cliff, near the narrows at the west end of Connaught lake, massive conglomerate beds may be seen resting discordantly on the older Keewatin hornblende andesite. The beds contain reddish granite boulders up to 4 feet in

diameter and dip 30° S.W. The surface of the andesite is rough, and jagged pieces project up among the pebbles and boulders of the overlying conglomerate.

Pleistocene and Recent

Lying on the consolidated pre-Cambrian rocks, and separated from them by an unconformity representing a vast time interval, is a relatively thin mantle of unconsolidated materials consisting of sand, gravel, and clay. In Pleistocene time the advancing ice-sheet gouged and polished the underlying rock leaving characteristic features, such as glacial striae, flutings, *roches moutonnées*, and chatter marks. The direction of these surface markings indicate that the ice moved almost due south. The dumping of vast quantities of glacio-fluvial debris by succeeding recessions and advances of the ice-front greatly modified the earlier topography and resulted in characteristic glacial land forms, such as ground moraines, eskers, and pitted outwash plains.

Among the materials of glacial origin, unsorted sand and gravel predominate. Makwa marks the east limit of a gently rolling outwash sand plain extending far



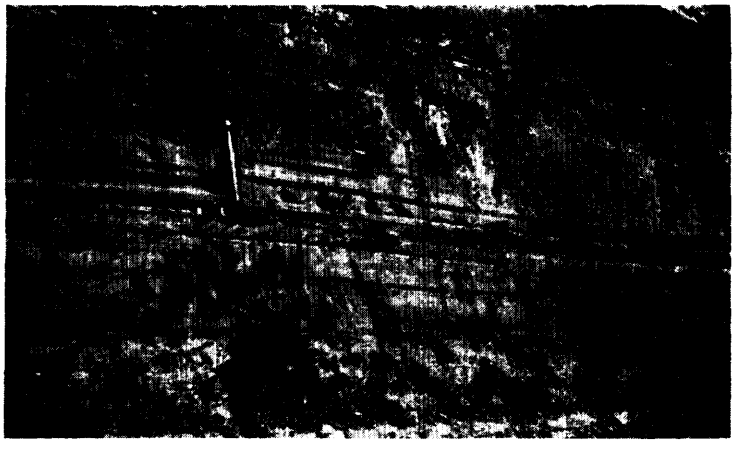
Typical Pleistocene sand and clay deposits, west shore of Mattagami lake, Togo township.

to the south and west. Coarse gravel ridges of the esker type, having a north-south trend, occur in the vicinity of Shuller, Mattagami, and Nabakwasi lakes. A large part of Brunswick township is occupied by a gently undulating ground moraine, thick enough to conceal most of the underlying rock. Kettle lakes are common in the Mattagami-Nabakwasi section, Wanatangua lake being a notable example. In places, e.g. at Wanatangua lake, the drift attains a thickness close to 150 feet, but over the whole area the average thickness is probably not more than 20 feet. The north part of Miramichi township and most of Londonderry township are heavily drift-covered and display all the features of glacial topography mentioned above.

Since this area lies outside the clay belt regions of Northern Ontario, clay deposits are scarce and somewhat local in their distribution. Much of the ground moraine material contains boulder clay mixed with sand in such proportions as to constitute a loam.

Freshly exposed sections of stratified sand and clay may be observed at various points along the shores of Mattagami lake, where wave action has resulted in the caving of the steep-walled banks, which locally rise 25 feet or

more above the new lake level. Cross-bedding is a feature commonly observed in both the coarse and fine sand deposits. On the west side of Mattagami lake, two chains south of the boundary line between Togo and Brunswick townships, there is an excellent exposure of interbedded sand and clay. Near the top of the section are three distinct dark-grey clay seams up to 2 inches in thickness alternating with light-coloured silty sand members up to one foot in thickness. Stratification planes within the individual members are clearly discernible. On the same side of the lake, and 16 chains farther north, a 12-foot section of varved clay is exposed at the water's edge. The varves are uniform neither in thickness nor composition. Dark-grey clay members up to 2 inches in thickness alternate with light-coloured silty clay members up to 16 inches in thickness. Toward the top of the section, the clay grades imperceptibly into well-stratified, fine, yellowish sand, a fact that indicates a change from quiescent to freshet conditions of deposition. Limonitic clay concretions occur abundantly in the lower part of the section. Most of them are rudely cigar-shaped structures up to 4 inches in



Varved clay and sand deposits, west shore of Mattagami lake, Brunswick township.

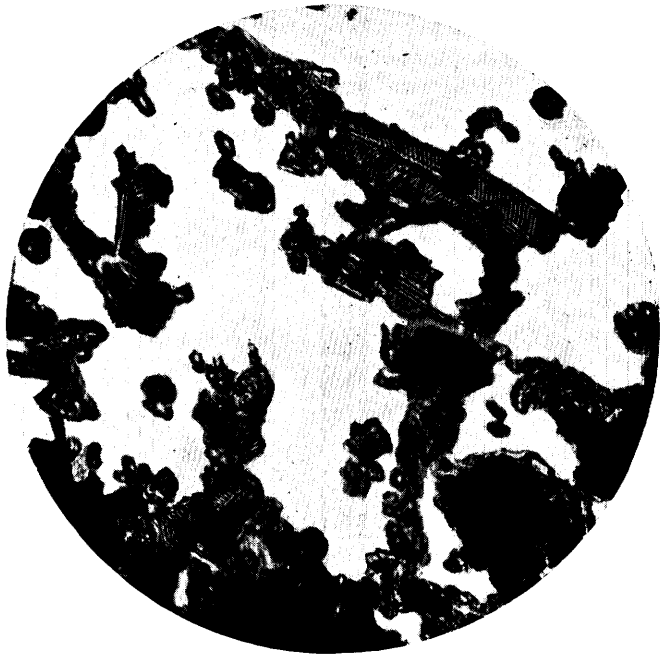
length and standing in a vertical position with respect to the enclosing beds; hollow, suboval forms were also observed.

Terraces of stratified sand, silt, and clay, many feet above the present water-levels in the Mattagami and Nabakwasi lake sections, would indicate deposition under fluvio-lacustrine conditions in a broad river valley with occasional lake-like expanses. That the waters of this supposed Pleistocene river flowed south rather than north, as at present, is indicated by the structure of the cross-bedding in the sand and gravel deposits. If this be true it may be inferred that late in the Pleistocene, the waters of this area drained toward Lake Algonquin (the present Lake Huron basin) by way of the Opikinimika-Vermilion river valley. Furthermore, there is reason to suppose that this river provided the main avenue of escape for the waters of Lake Ojibway, a glacial lake lying in front of the ice-sheet to the northeast.

Deposits of the Recent consist of sand beaches, ice ramparts, peaty swamp deposits, and lake deposits. Of extraordinary interest among the latter is a deposit of diatomite or diatomaceous marl reported by Thomas Saville, of Shiningtree, as underlying the whole of the west and north arms of Claw lake, Cabot township. This part of the lake is extremely shallow, being filled to the

surface level by a black slimy ooze with an average depth of 4 to 5 feet; there is little or no open water except for narrow channels close to the shore. With the assistance of Mr. Saville, the writer obtained several representative samples of the diatomite from depths of 4 to 12 feet; the samples were taken by means of a long-handled auger operated over the gunwale of a canoe.

The diatomite is a siliceous deposit essentially composed of the siliceous skeletons of tiny aquatic plants called diatoms. When dry it is a dull, whitish, earthy material of very small density. Impurities in the form of grit, calcareous shells, and iron occur in such abundance as to seriously impair the economic value of the deposit. Examination of the calcined material under the microscope shows a wide variety of diatoms, the specific identification of which is not



Photomicrograph of calcined diatomite (×1,100), Claw lake, Cabot township. The feathered and seed-shaped structures are diatoms, the others being detrital material.

important in a report of this nature. It should be stated, however, that seed-like types are much more abundant than rod-shaped types, a feature that limits in no small degree the economic uses to which this material might be put, even though there were no impurities present. For a complete and exhaustive account of diatomite, its occurrence, preparation, and uses, the reader is referred to a report[1] by V. L. Eardley-Wilmot.

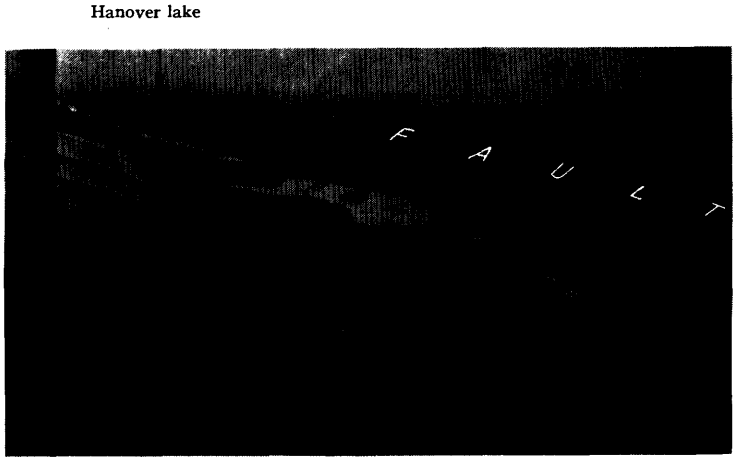
It is of scientific interest to note that the back slimy material overlying the diatomite is really a living diatomaceous ooze, since the microscopic examination of a calcined sample showed diatoms like those in the underlying deposit. It follows, therefore, that diatomite is being slowly deposited in Claw lake at the present time.

[1]V. L. Eardley-Wilmot, "Diatomite," Mines Branch, Dept. of Mines, Ottawa, Pub. No. 691, 1928.

Structural Features

The absence of a structural discordance between the Ridout series and the Keewatin series shows that little or no deformation of the volcanics took place prior to the deposition of the sediments. In post-Timiskaming time, however, both series were closely folded into a major syncline or synclinorium, whose axis follows the sedimentary belt across the area in an east-west direction. This folding is especially complex in the sediments, as a result of their being less resistant to strong compressional forces than the more massive lavas and tuffs. Subsequent to folding, the sediments were subjected to strong east-west shearing movements parallel to the strike of the beds. This latter deformation is definitely pre-Algoman in age and was caused by forces other than those attending the batholithic intrusions of granite.

Fragmentary evidence from various sources argue in favour of the supposition that the sediments have been folded into a major syncline. The best evidence was obtained from a study of the differential movements in the beds as expressed



Aerial view of the Groves-Hanover lakes fault, looking southwest. Note the Geoffrion-Shuller lakes fault showing dimly in the distance.

by the disposition of drag folds and fracture cleavage. Locally, even this evidence was of a contradictory nature, but this might be expected on account of the fact that small synclines and anticlines doubtless occur on the flanks of the major fold. In many instances, a right-hand drag fold has been directly superimposed on a left-hand drag fold, leaving considerable doubt as to which belongs to the major structure. Further evidence was obtained on Okawakenda lake, Churchill township, where the sediments are definitely younger than the volcanic tuffs since, in part at least, they are derived from the latter. It follows that the fold must necessarily be a synclinal one.

Strong regional faulting has divided this area into distinct segments, as is the case in the adjacent Three Duck Lakes area. No less than seven major fault lines cross the country in a direction a little east of south. They are represented by the linear basins of Minisinakwa lake, Shuller lake, Hanover lake, Nabakwasi river, Mattagami lake, Elephanthead creek, and Michiwakenda lake. These faults show up particularly well from the air, where they can be seen extending to the north and south far beyond the limits of the accompanying map-sheet. The displacement attending this faulting has been both horizontal and vertical.

as shown where fault lines intersect the east-west trending Ridout series. The greatest horizontal displacement is that on the Nabakwasi river, where the sediments have been shifted nearly 1¼ miles. In every case, the east segment has moved north with respect to the west segment. Strike faults occur along or close to the boundary between the Keewatin rocks and the Ridout series, a notable example of which is that just east of Wire lake, Connaught township. Other minor adjustment faults of local importance occur throughout the area.

The age of the major faulting is definitely post-Algoman, as shown by the fact that the "breaks" intersect the Keewatin-Timiskaming belt of rocks and extend far out into the Algoman granite areas. This point is particularly well illustrated in the case of the Nabakwasi river fault, a well-defined scarp of which may be observed in the granite just south of the 15-chain portage.

ECONOMIC GEOLOGY

Gold-bearing quartz veins were found near West Shiningtree lake in the summer of 1911. Subsequent discoveries in the Wasapika section of that camp led to a heavy influx of prospectors, who, finding no unstaked ground, soon spread westward along the favourable belt of rocks. Many old abandoned test pits and trenches in the central part of Groves township and in the northern half of Connaught attest the magnitude of development in those days. Not until 1930 were these efforts rewarded by notable discoveries of gold farther afield in the Three Duck Lakes area and in the Tyrrell-Knight area. As a result of the impetus given to prospecting effort by the present world-wide depression, this area, for reasons both economic and geologic, has been singled out as worthy of a more intensive search for gold, either in the form of new mines or in the rehabilitation of old ones. In 1933, gold was found at several places in this area, but at present development work has not yet reached the stage where a deposit of commercial ore is indicated on any of the showings. On three of the properties, however, results obtained by preliminary stripping, trenching, and test-pitting have been so encouraging that intensive development campaigns have been planned.

Apart from gold, there are no other minerals in this area occurring in possible economic quantities. An extensive deposit of diatomite in the Claw lake section has economic possibilities in the future if the demand for this material continues to increase.

Description of Prospects

CHAMPAGNE TOWNSHIP

North Bay Group

In the summer of 1922, gold was discovered half a mile east of the railway bridge at Makwa on what is known as the North Bay group, which consists of 7 unsurveyed claims. A little work, done some years ago, is indicated near the main showing on claim S. 5,385. As far as the writer is aware, no one was on the property during the past season. A sparsely mineralized quartz vein, ranging from 2 to 4 feet in width, has been traced for 300 feet; it strikes N. 81° E. and dips steeply to the south. The country rock is granite or granodiorite. A 5-foot test pit a few feet to the east on the strike of the vein shows a heavy gossan in a strongly jointed and fractured zone having a width of from 6 to 10 feet. The zone is heavily mineralized with fine sulphides, consisting of pyrrhotite, chalcopyrite, and pyrite. Samples of the auriferous gossan from this showing are reported to have yielded high values in gold, and particles of native gold as large as wheat

grains were obtained. Since the quartz itself contains only minute quantities of gold, the spectacular amounts in the gossan can only be attributed to weathering and concentration processes.

T. L. Tanton,[1] who examined this property shortly after the original discovery was made, describes other showings as follows:—

> On the next claim north [S. 5,382] . . . an irregular quartz vein with maximum width of 10 inches trends south 30 degrees west up the side of a low cliff which lies at the margin of the sand-covered lowland through which Mollie river flows. The country rock is an inclusion of calc-chlorite schist in the granodiorite. The vein pinches and swells for its exposed length of 15 feet. It consists of white quartz mineralized with chalcopyrite, which is so abundant in some places as to make up 5 per cent. of the vein by volume. There are a number of small chlorite schist inclusions in the vein. Gold can be panned from the roasted and pulverized vein material.
>
> Fifteen chains northeast from the above occurrence several large lenticular quartz veins occur as a stockwork permeating an inclusion of chlorite schist in the granodiorite. The vein material is restricted to the inclusion, which is 20 feet wide. The trend of the veins and the schist is north 40 degrees east. There are no metallic minerals to be seen in the veins, though a rusty stain occurs in the quartz locally. . . .
>
> All the above quartz veins . . . trend in various directions, but they are all of the same age and origin. A consideration of the field evidence collected at the time of the visit leads to the conclusion that the quartz veins are genetically related to the granite intrusion. . . . The surface examination indicates that no commercial deposit of gold ore has yet been encountered on the claims.

Makwa-Champagne Gold Mines, Limited

In May, 1933, Wesley Claus found visible gold about 10 claims north of the dam on the Mollie river, near the northwest corner of what is now claim S. 24,527. This discovery led to a small rush, in which nearly 100 claims were staked and recorded across the north half of the township. In October of the same year, Makwa-Champagne Gold Mines, Limited, took over 9 unsurveyed claims previously known as the Butterfield-Devanney-Rivers group, consisting of claims S. 24,523 to 24,531, inclusive. At the time of the writer's visit early in July, the main showing was the discovery vein near the northwest corner of claim S. 24,567. It consists of two parallel quartz lenses separated by a horse of granodiorite, the strike being about N. 35° E., and the dip slightly west. The east lens is 2 feet wide, and the west one 3 feet wide; the total exposed length is about 30 feet. At the west end of the exposure the lenses meet and pinch out, and at the east end they are apparently terminated by a fault. The quartz is a rather white glassy variety containing pyrite, chalcopyrite, and visible specks of very pale yellow gold.

Near the southwest corner of claim S. 24,527, a flat-lying quartz vein was stripped for a few feet. It strikes N. 70° E. and dips north at approximately 30 degrees. The quartz is only sparsely mineralized, and no gold was observed. Other slightly mineralized gash veins had been uncovered at the time of the writer's visit, but none of them seemed promising.

The company is reported to be actively engaged in surface exploration, the results of which are said to have been encouraging.

Champagne Mining Syndicate, Limited

Champagne Mining Syndicate, Limited, has title to 12 mining claims located immediately southwest of Makwa siding. No special examination of this section was made, as the claims were not staked until after the writer's visit to this part of the township. Officials state that several auriferous quartz veins have been uncovered. Plans are being made to continue surface exploration and to institute a programme of diamond-drilling.

[1]T. L. Tanton, "Gold Occurrence at Makwa," Geol. Surv. Can., Sum. Rept., 1922, pt. D, pp. 11, 12.

John C. Dunn

The John C. Dunn group consists of 7 claims (S. 24,576-78, 24,621, 24,622, 24,579, and 24,580) lying immediately to the east of the property of the Makwa Champagne Gold Mines. Early in July, John C. Dunn uncovered a large irregular lens of quartz in the northwest corner of claim S. 24,580. Stripping exposed it for a length of 45 feet and a width of 10 feet. The lens, which strikes N. 61° E. and has a vertical dip, occurs at the contact of a large inclusion of Keewatin schist on the north and granite or granodiorite on the south. The quartz is sparsely mineralized, but is said to yield fine gold when panned.

Three narrow quartz stringers were uncovered on the south side of a high hill, 5 chains east of the northwest corner of claim S. 24,622. The veins, which strike N. 66° E. and dip steeply north, were exposed for a length of 25 feet. They occur in an inclusion of Keewatin schist at the contact between granodiorite to the north and a diabase dike to the south. Except for a small amount of specular hematite, very little mineralization was observed.

Tyrrell McMurchy Syndicate

The Tyrrell McMurchy Syndicate, under the management of George Bruce, holds 6 claims lying immediately east of the Dunn group. No discoveries have been reported.

GROVES TOWNSHIP

A total of 50 claims were staked and recorded in Groves township, but many of these were allowed to lapse. As yet no discoveries of economic importance have been made.

Tasmijopen Syndicate

The Tasmijopen syndicate, representing Pennsylvania interests, holds a group of 12 claims centred about Pensyl lake. During the past summer an energetic programme of surface exploration was carried on under the direction of J. Earl Jones, H. S. Pensyl, and O. H. Smith. Certain showings were probed to shallow depths by a light diamond-drill of the type assembled by Boyles Brothers; this drill was owned by the syndicate. The main showings occur at the east end of Pensyl lake in the northwest corner of claim S. 24,319. On the lake shore stripping has exposed a rudely banded sugary or cherty quartz vein for a length of 25 feet and a width of 9 feet. It strikes N. 86° E. and is in contact with greywacké on the north. Locally the quartz is strongly impregnated with very fine sulphides. A picked sample of the drill-core material from a depth of 20 feet is reported to have assayed 0.15 ounces gold and 0.15 ounces silver per ton.

Eight chains east of the above showing, a 6-foot test pit has been sunk in a band of cherty iron formation associated with highly contorted beds of greywacké. The iron formation strikes N. 85° E. and dips steeply to the north. The band has been exposed for a length of 30 feet, and heavy gossan occurs over a width of 25 feet or more. The mineralized portion of the band is about 5 feet in width and consists of narrow layers of dark cherty material alternating with layers of sulphides. The sulphides consist of pyrite, pyrrhotite, chalcopyrite, mispickel, and sphalerite in about the same order of decreasing abundance. Some of the magnetite present has been replaced by pyrrhotite, and this in turn has been partly replaced by chalcopyrite. Grab samples of the mispickel, which occurs rather sparingly in the bottom of the test pit, are reported by O. H. Smith to have yielded from 0.25 to 0.50 ounces gold per ton and notable quantities of silver. About 100 feet north of this point is a mineralized quartz vein in greywacké. It is one foot wide, strikes S. 81° E. and dips 80° N. It has been opened up for

a length of 40 feet, along parts of which there is a heavy ankerite and pyrite gossan. A grab sample taken by O. H. Smith is reported to have yielded 0.50 ounces gold and 2.5 ounces silver per ton.

The band of iron formation has been picked up at two points on the south side of Pensyl lake. Although it carries notable quantities of sulphides, there are no gold values.

Flintoba Mines, Limited

Early in 1934, Flintoba Mines, Limited, took over a group of 12 claims lying south and west of the narrows on Shuller lake. This group was staked late in 1931 by W. J. McMurchy in the interests of the Empire Holding Syndicate, Toronto. Very little work has been done on this property beyond the sinking of a few shallow test pits in rusty shear zones in the sediments along the tote road west of the lake. An official of the company states that preparations are being made to carry on a campaign of surface exploration.

Arthur La Rose

The Arthur La Rose group consists of 6 claims located between Groves and Duckbreast lakes. No less than 12 showings were visited, on which considerable assessment work has been performed in the last few years. The country rock consists of a wide variety of granitic types, such as porphyritic gneiss, porphyritic diorite, granite porphyry, massive red granite, and feldspar porphyry dikes. The quartz veins, which occur both in the granitic types and in inclusions of chlorite schist, show little or no mineralization. One vein, 15 claims west of the north end of Groves lake, consists almost entirely of granular epidote and pyrite, but contains no gold values. Veinlets of specular hematite up to a quarter of an inch in width are common in the granitic types. On the small lake just north of Groves lake, what appears to be a large inclusion of greenstone or sediments in the granite carries an abundance of large reddish-brown garnets.

W. Claus

The W. Claus group consists of 12 claims lying between the south end of Shuller lake and Piggott lake. On the portage 10 chains west of Shuller lake shallow test pits have been sunk on a narrow, irregular, east-west fractured zone in light-coloured granite. The zone appears to be silicified and sericitized, and is strongly impregnated with very fine iron pyrites. Grab samples showed no values in gold.

At the east end of the small lake on the same portage, considerable work was done on a stockwork of narrow quartz stringers in a salmon-pink granite. The zone is 7 feet in width, strikes S. 35° E., and dips steeply southwest. Over this width it is moderately mineralized with pyrite and specular hematite. No gold values were obtained.

J. W. Young

The J. W. Young group consists of 8 claims, S. 24,461-68, inclusive, in the southwest corner of the township. In addition, there are 6 claims in St. Louis township, S. 24,469-74, inclusive, and 4 claims in Benneweiss township, S. 24,475-78, inclusive. During the past summer the group was thoroughly prospected by Charles Young, who reports that results were disappointing. In general, the claims are located along the south contact of the granite and the Ridout series.

BRUNSWICK TOWNSHIP

Brunswick township has not been prospected to any great extent. At present there are no mining claims in good standing.

CONNAUGHT TOWNSHIP

No recent discoveries have been made in Connaught township. However, as a result of the Mataris discovery several years ago, 115 mining claims were staked across the northern half of the township, but they have all long since been allowed to lapse.

John Mataris

Twenty years ago, John Mataris discovered copper mineralization about three-quarters of a mile southwest of the extreme west end of Okawakenda lake, on what is now mining claim T.R.S. 3,556. In 1916, several deep test pits were sunk, and some of the mineralized material was sent to Sudbury. In 1927, Noah Timmins took an option on the property and drilled one 200-foot hole. The property, which has since reverted to the original owners, consists of 6 claims held under lease from the Crown. There is no evidence of any recent development work having been done.

The deposit occurs in a rather unusual type of dark-coloured, aphanitic, brecciated or fragmental type of rock, exposures of which are confined almost entirely to the immediate vicinity of the showings. In places, vesicular structures have been developed, which in many cases have been filled with quartz or pyrite. A thin section of this rock under the microscope shows that it consists mainly of quartz, a pale-greenish chloritic material, and glass; tiny flow structures are very much in evidence. It is probably a flow breccia of pyroclastic origin and closely related to the volcanic tuffs that occur near by. The mineralized zone attains a width of 100 feet and has been traced for several hundred feet. Among the minerals observed on the rock dump were pyrite, chalcopyrite, azurite, malachite, bornite, and covellite. Generally speaking, the mineralization is rather disseminated and has a strong tendency to occur in tiny fractures and little pockets in the otherwise massive rock. Interesting gold values are said to have been obtained from this deposit, but grab samples of the best-looking material taken by the writer failed to show even traces of gold.

Lloyd Foster

In 1927, Lloyd Foster did considerable surface work on two parallel bands of iron formation occurring on a trail leading northwest from the north end of Burns lake. The bands are highly disturbed, strike approximately east-west, and consist of sugary quartz, limonitic material, and massive pyrite. The claims have been allowed to lapse.

J. C. Mahon

In November, 1933, J. C. Mahon staked a group of 12 claims lying between Wire lake and Elephanthead creek. The group is centred about a small boss of feldspar porphyry. Although no discovery has been reported as yet, it should be stated that the geological conditions here are such as to warrant an intensive search for gold-bearing veins.

CABOT TOWNSHIP

Interest in Cabot township is largely confined to the region about Claw lake, where gold was discovered a few years ago. The north half of the township is covered by an extensive sand plain.

Thomas Saville

Thomas Saville, of Shiningtree, holds a group of 9 claims, T.R.S. 5,550-54, 5,607, 6,253-55, on which several promising discoveries have been made. During the past season these showings commanded considerable attention on the part of various mining scouts.

Considerable surface development has been carried on at the main showing, known as No. 1, in the southeast corner of claim T.R.S. 6,255, 10 chains from the east arm of Claw lake. It occurs close to the north margin of a stock of diorite, to which reference has already been made in a previous section. At this point the diorite has been differentiated into a reddish porphyry. The showing itself consists of an intricate stockwork of quartz stringers ranging in width from a fraction of an inch to several inches and cutting what appears to be a strongly granitized and sheared Keewatin tuff. A series of 4 north-south trenches, located at suitable intervals across the strike, has exposed the showing for a length of nearly 500 feet, and for widths as great as 250 feet. The country rock has a reddish to greenish mottled or bleached appearance, such as is commonly observed in wall rock immediately adjacent to quartz veins. This appearance may be attributed to the effects of a hydrothermal alteration process involving carbonatization, sericitization, silicification, and pyritization. The larger quartz veins commonly exhibit vein breccia structure due to wall-rock fragmentation. A series of three parallel quartz-feldspar porphyry dikes ranging from 2 to 15 feet in width cut across the showing in an east-west direction. The close association of the quartz stockwork with these dikes strongly suggests that there is a genetic relationship between them. The altered tuff is strongly impregnated with very fine iron pyrites, and locally the quartz carries notable quantities of molybdenite, specular hematite, and galena. The gold values over suitable mining widths are reported to be low, but the possibility of developing a large low-grade deposit should not be overlooked.

No. 2 showing, which occurs on claim T.R.S. 6,254, on an east-west picket line, 1,900 feet west of No. 1, is exposed in a north-south cribbed trench 30 feet in length. It consists of two parallel quartz veins striking east-west and dipping steeply south. The north vein is 16 inches wide, and the south one 10 inches wide. They occur in a fresh-looking reddish granite, which is probably an acid differentiate of the diorite stock mentioned in the preceding paragraph. The quartz is fairly well mineralized with pyrite, galena, molybdenite, and chalcopyrite, in about the same order of decreasing abundance. Fair gold values are reported, but a grab sample of the well-mineralized material yielded low values.

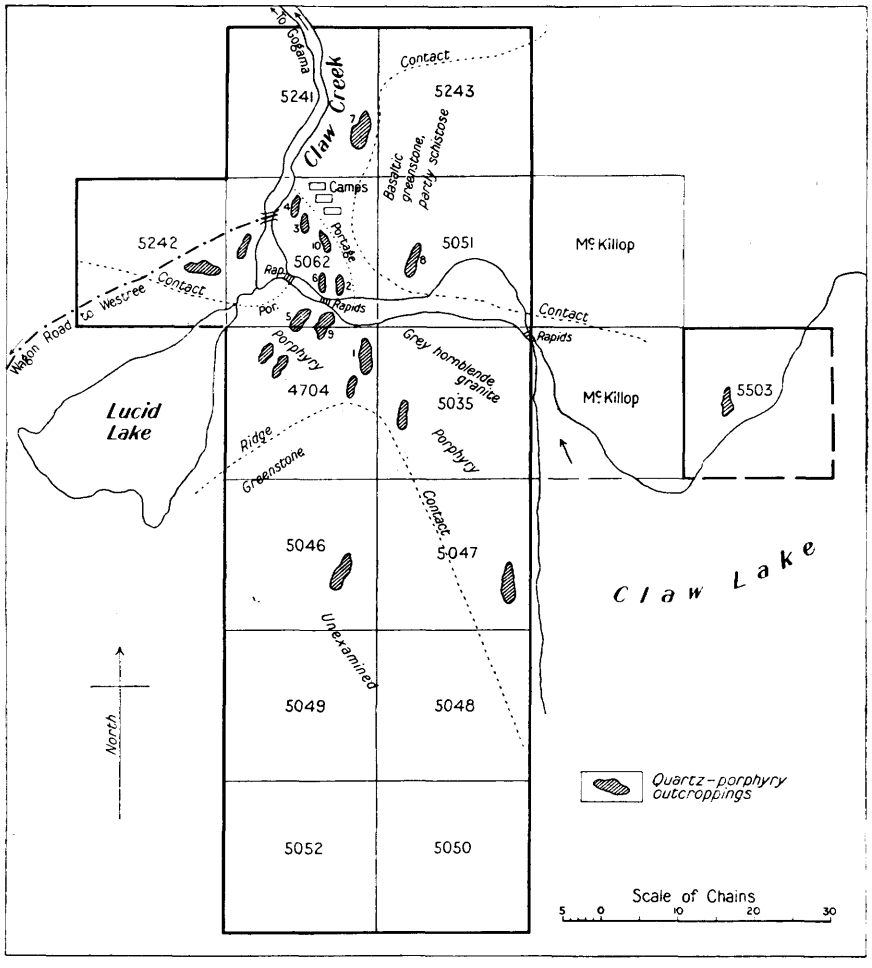
No. 3 showing is located a few chains northeast of No. 1. A 10-foot test pit has been sunk on two parallel vertical quartz veins, each about 20 inches in width, which strike N. 70° E. They occur in a highly schisted quartz-feldspar porphyry. The south vein contains an unusually heavy concentration of molybdenite and its yellow oxide, molybdite. The former occurs both in the massive state and as thin films in tiny fractures in the quartz. An analysis[1] of this material gave 0.74 per cent. molybdenum. Coarse pyrite occurs rather sparingly, and there is only a trace of gold.

A narrow quartz vein associated with a heavy rusty gossan has been uncovered near the north line of claim T.R.S. 6,255 on the shore of the north arm of Claw lake. The vein strikes east-west and occurs in a quartz-feldspar porphyry dike. A sample of the quartz yielded no gold values.

[1]By W. K. McNeill, Provincial Assayer.

Porcupine-Kirkland Gold Mines, Limited

Porcupine-Kirkland Gold Mines, Limited, has 13 claims in the vicinity of Lucid lake, one of which, T.R.S. 4,704, is now held under lease. A few years ago considerable surface work was done on a spectacular showing of quartz veins located on the north slope of a hill immediately opposite the south end of the 16-chain portage on Claw creek. This work included some diamond-drilling. On the whole, the results are said to have been rather disappointing, but scattered



Geological plan of the claims of the Porcupine-Kirkland Gold Mines, Limited, Cabot township. (Information from a plan furnished by company officials in 1926.)

gold values were obtained. For the most part the quartz is a glassy, barren variety, but in places it contains small quantities of sulphides. The property has been idle for some time.

Tasmijopen Syndicate

During the summer of 1933, the Tasmijopen syndicate uncovered a quartz vein near the southwest corner of claim T.R.S. 6,727. A good trail leads west from the north arm of Claw lake to the showing, a distance of 35 chains. The vein is 4 feet wide, strikes N. 10° W., and stands vertically. It occurs in a whitish-

weathering, highly altered porphyry phase of the granite, with which is associated a stockwork of narrow quartz veinlets. The quartz contains an abundance of carbonate material and sparse quantities of pyrite. No gold values were obtained here.

Alexander Irving

Alexander Irving holds under lease a group of 4 claims, T.R.S. 3,207, 3,208, 3,210, 3,211. These claims are located on either side of the Hydro-Electric Power Commission transmission line, midway between Claw creek and the south boundary of the township. No showings are known to the writer, nor is there any record of development work having been done on this group.

Progress Report on Gold Camps

The latter part of the season was spent in making a cursory examination of the various gold properties in the Three Duck Lakes area and the West Shiningtree camp. This was done not with the idea of making a re-examination, but rather with the idea of recording the progress of development in these camps since they were last reported on.

WEST SHININGTREE CAMP

The first serious effort to develop the West Shiningtree area began in 1912. Since that time its career has been a hectic one from the point of view of mining development. In the early days of the camp the discovery of much spectacular high-grade gold ore, particularly in the Wasapika section, led to a period of extravagant financing and fanciful development. The inevitable result of this over-expansion was chaos, litigation, and a general loss of public confidence, a blow from which this camp has not yet fully recovered. At present attempts are being made to correct this condition by what is believed to be a sincere mining effort on the part of certain interests, particularly those holding properties in the Wasapika section.

For a more detailed description of the various properties in this area, reference should be made to previous reports[1] of the Department of Mines.

Churchill Mining and Milling Company, Limited

Churchill Mining and Milling Company, Limited, owns 4 claims, T.R.S. 3,741, 3,773, 3,774, and 4,044, located at the southern extremity of Michiwakenda lake, Churchill township. The main showings, which occur close to the road in the north half of claim T.R.S. 3,774, have been described by P. E. Hopkins[2] as follows:—

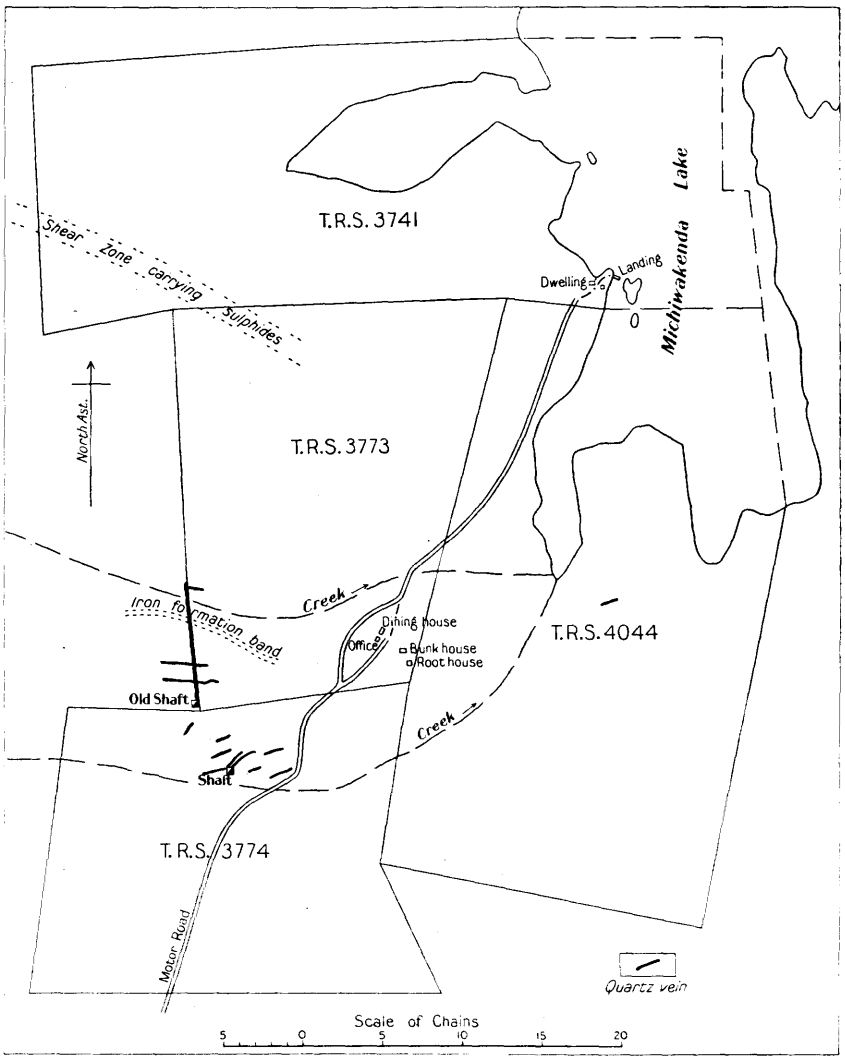
> Two veins from 2 to 3 feet wide occur in the rusty pillow lava schist. They have been traced for 200 feet or more in a direction slightly north of east, the dip being 75° to the south. Towards the west the veins come together and pass into a porphyritic rock. Towards the east they have been faulted, the easterly portions being thrown 20 feet to the south. A 40-foot shaft has been sunk on the north vein which was reported by Mr. Knox to average in the shaft 38 inches in width. Gold could be seen in various parts of the veins, usually occurring in fractures, with pyrite and other dark minerals.

The south vein, known as No. 1, and that part of No. 3 vein east of the fault occur in a light-coloured rhyolite or quartz porphyry, which is somewhat sheared at S. 80° E. This porphyry, which is probably a differentiated portion of the large granitic mass lying to the south, occurs as a narrow tongue pinching out a few hundred feet to the north of the showing. Locally it is intersected by irregular

[1]P. E. Hopkins, "West Shiningtree Gold Area," Ont. Dept. Mines, Vol. XXIX, pt. 3, 1920, pp. 37-52; "Ontario Gold Deposits," Ont. Dept. Mines, Vol. XXX, pt. 2, 1921, pp. 36-38.
F. L. Finley, "Wasapika Section, West Shiningtree Gold Area," Ont. Dept. Mines, Vol. XXXV, pt. 6, 1926, pp. 92-96.

[2]P. E. Hopkins, Ont. Dept. Mines, Vol. XXIX, pt. 3, 1920, p. 41.

stockworks of narrow quartz stringers, which are reported to carry low values in gold. The veins are of the fissure type and are definitely later than the porphyry, since they cut it. The north-south faults displacing the veins belong to a late system of north-south fracturing characteristic of the whole region. In the case of the adjoining properties, Gold Corona, Herrick, and Wasapika, the north-



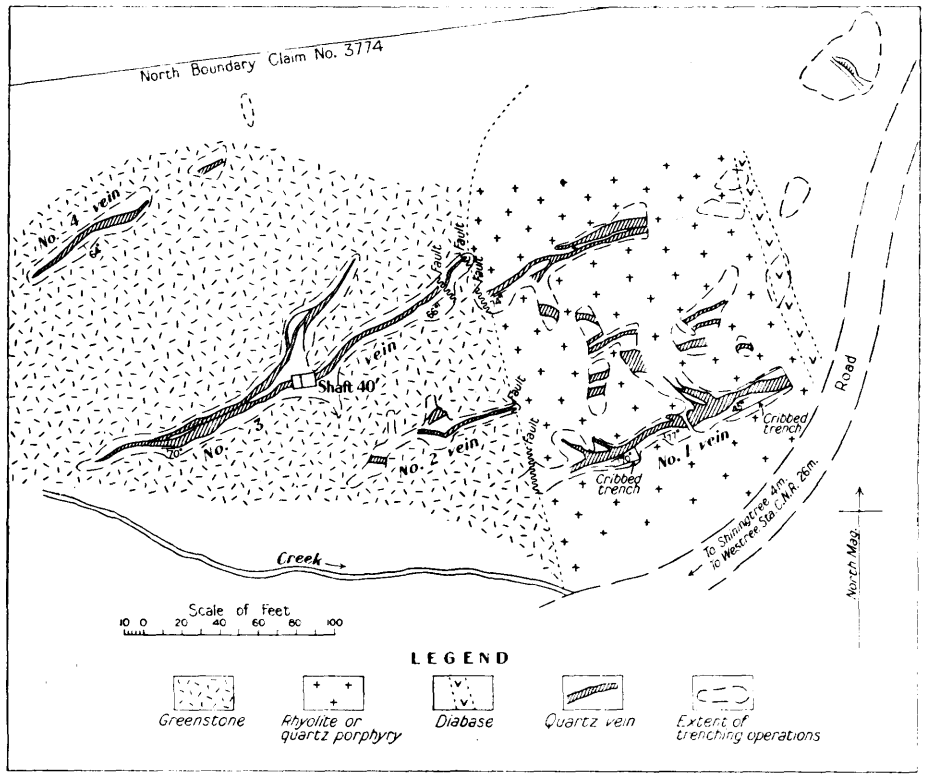
Plan showing the location of quartz veins on the claims of the Churchill Mining and Milling Company, Limited, Churchill township.

south fractures carry the gold-bearing quartz veins, but on the Churchill property the east-west fractures are in this respect the important ones.

In February, 1933, a small crew of men was engaged to open up further the main showing and prepare it for systematic sampling. When the writer visited the property in October, 1933, No. 1 vein had been exposed for a length of over 100 feet, with native gold showing at many places. No. 3 vein had been exposed for a length of 300 feet, with native gold showing toward the west end. As a rule the quartz carries a little pyrite and carbonate, but no other minerals were

observed. The following table is a compilation of assay results taken from the company's assay plan, which was provided through the courtesy of John A. Knox, resident manager.

Vein	No. of channel samples	Average width of sample	Average gold value
		feet	ounces per ton
No. 1.....	5	4	0.858
No. 3.....	18	4	.801



Detailed surface plan of the geology and vein system on claim T.R.S. 3,774, Churchill Mining and Milling Company, Limited, Churchill township.

Late in the season a new vein was discovered near the middle of claim T.R.S. 4,044, 14 chains east of the camp. It is 4 to 6 inches wide, strikes N. 80° E., and dips 75° N. It lies directly on the strike of the veins at the main showing and, although of no importance itself, shows the possibility of a strong vein system being picked up in the intervening low ground.

The results of surface development to date have so encouraged the management that a 10-ton test mill is being installed. The property is equipped with an excellent set of camps and may now be reached by motor car.

Consolidated Ontario Gold Mines, Limited

Consolidated Ontario Gold Mines, Limited, was incorporated in January, 1933, for the purpose of merging certain of the larger properties in this area

and consolidating a number of scattered mining claims. The properties reported to be involved in this merger are Herrick Gold Mines, Limited; Miller-Adair Mines, Limited; Algonquin Mines, Limited; and Shining Tree Consolidated Mines, Limited. The mining claims included in the consolidation are 2 held by Orion Gold Mines (formerly owned by Gosselin Gold Mines, Limited); 4 claims formerly held by Wakenda Mines, Limited, Nos. 6,369, 6,370, 6,371, and 6,372; claim W.D. 1,408, now No. 2,796; and other scattered groups, making a total of 32 claims.

The immediate plans are to carry on further underground development at the Herrick property, where a two-compartment shaft is already at a depth of 308 feet and where several hundred feet of lateral work and diamond-drilling has been done. It is the intention to sink the shaft to a depth of 770 feet and start drifting toward a point where a diamond-drill is reported to have cut 22 feet of vein matter.

White Rock Mining Company, Limited

White Rock Mining Company, Limited, hold 2 claims, Nos. 2,535 and 2,536 (formerly known as the Saville-McVittie group), in Macmurchy township, Wasapika section. Two shafts have been sunk, one 375 feet and the other 210 feet, and several hundred feet of drifting has been done. In September, 1932, the company resumed underground operations, being equipped with a new mining plant. On surface, further trenching was done along the vein just east of the shaft. Development continued until May, 1933, when the plant was closed down, dismantled, and sold. It is reported that the rich ore that warranted this development has now been exhausted and that the future of the property depends on further underground exploration.

Other Properties

In the summer of 1933, 12 tons of gold ore were shipped from the *Atlas* property. This ore came from the vein several feet above the tunnel entrance and is said to have yielded 0.70 ounces gold per ton. Late in the season, the *Bennett* vein was sampled for Toronto interests. The *Burvan Gold Mines, Limited*, was incorporated in December, 1932, to acquire the assets of the Canadian Champion Reef Mining Company, Limited, originally known as the Westree Mines, Limited. The underground development consists of a 500-foot shaft, with levels established at 90, 240, and 500 feet, and 200 feet of drifting. The property is equipped with a mining plant and good camp buildings, but it has been idle for some time.

Watchmen are being maintained at the *Kingston*, *White Rock*, *Burvan*, *Ribble* (formerly Wasapika), *Gold Corona*, and *Wood* properties.

The southern part of the camp, known as the West Shiningtree section, is not being developed to any extent at this time. This section includes such properties as the *Gosselin*, *Holding*, and *Buckingham*. Lying half a mile south of the Buckingham shaft is the *Kubeik* group, on which an active programme of surface development is being pursued by the joint owners, M. Graiboski and N. Kubeik. Visible gold has been found in several of the test pits.

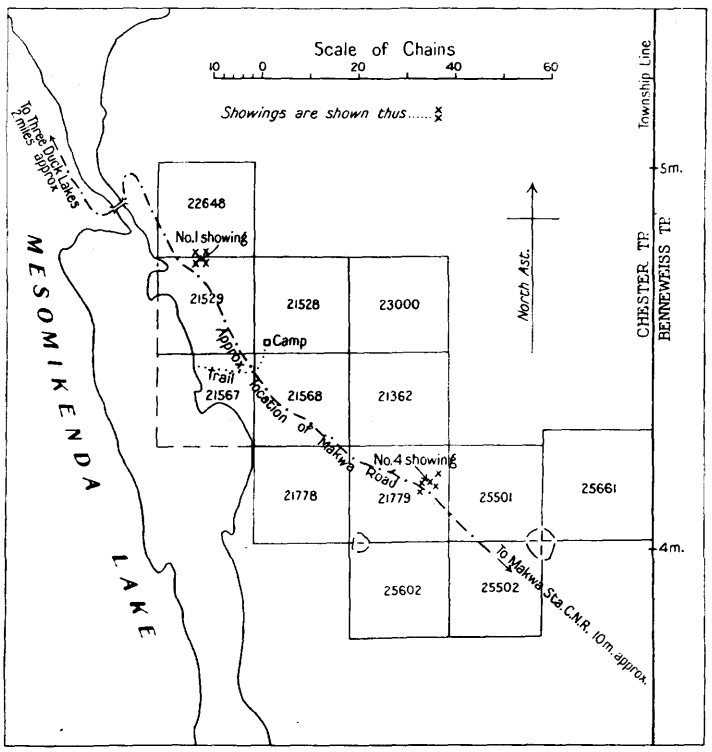
THREE DUCK LAKES AREA

Considerable interest is attached to development work in the Three Duck Lakes area on account of the fact that several discoveries have been made since the area was examined and mapped by the writer in 1931.[1] The following is a brief description of the more important of these new finds.

[1]H. C. Laird, "Geology of the Three Duck Lakes Area," Ont. Dept. Mines, Vol. XLI, pt. 3, 1932.

Beaver-Bethnal Gold Mines, Limited

In August, 1933, Beaver-Bethnal Gold Mines, Limited, resumed active surface exploration on their group of 34 claims lying between Mesomikenda lake and Three Duck lakes. Much of the recent work has been done on a showing just south of the small lake on the winter road between Mesomikenda lake and Bagsverd lake. The showing, which consists of a strongly schisted zone in highly carbonated and sericitized greywacké, strikes S. 65° E. and has been traced eastward by means of a picket line for several hundred feet. Test pits have been sunk at suitable intervals. The zone is strongly impregnated with fine iron



Key map showing the position of the claims of the Eccles-Holmes group, Chester township.

pyrites and silicified over a total width of 6½ feet. The results of channel assays are not known to the writer, but grab samples of the well-mineralized material yielded gold up to 0.40 ounces per ton.

The property is now equipped with an excellent set of camps, and it is planned to continue surface exploration.

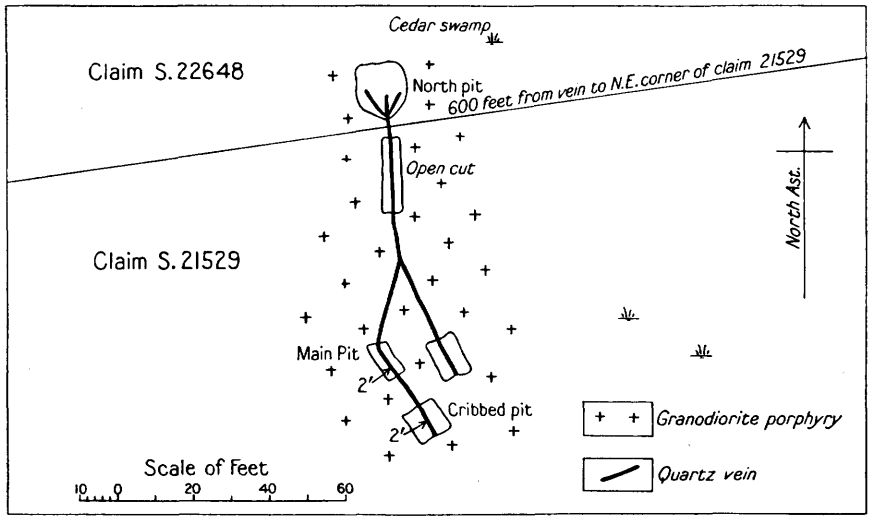
Chester Gold Mines, Limited

Chester Gold Mines, Limited, which is controlled by Porcupine Crown Mines, Limited, holds 14 claims, S. 21,575-80, 21,587-99, 23,640-42, lying between Chester lake and Clam lake. A new discovery was being opened at the southwest corner of S. 21,576 at the time of the writer's visit late in October, 1933. Quartz veinlets impregnate a well-fractured zone in a strongly epidotized rock, which is probably a porphyry phase of the granite. The zone has a width of 5 feet or

more, strikes N. 73° E., and dips 30° S. A shaft has been sunk to a depth of 35 feet. Massive pyrite is common, and native gold is occasionally observed. A grab sample yielded 0.10 ounces gold per ton, but higher values are reported by officials. To date, 9 men have been engaged in stripping, trenching, and deep test-pitting, with the result that 4 mineralized quartz veins have been discovered. Further surface exploration may be expected to disclose other gold-bearing quartz veins.

J. F. Eccles-Holmes

The Eccles-Holmes group consists of 13 claims, S. 21,362, 21,528, 21,529, 21,567, 21,568, 21,778-79, 22,648, 23,000, 25,501, 25,502, 25,602, 25,661, located on the east side of Mesomikenda lake just south of the road bridge. A narrow quartz vein, known as No. 1, has been uncovered at the north boundary of S. 21,529 in a coarse phase of the granodiorite porphyry. It strikes north-south,



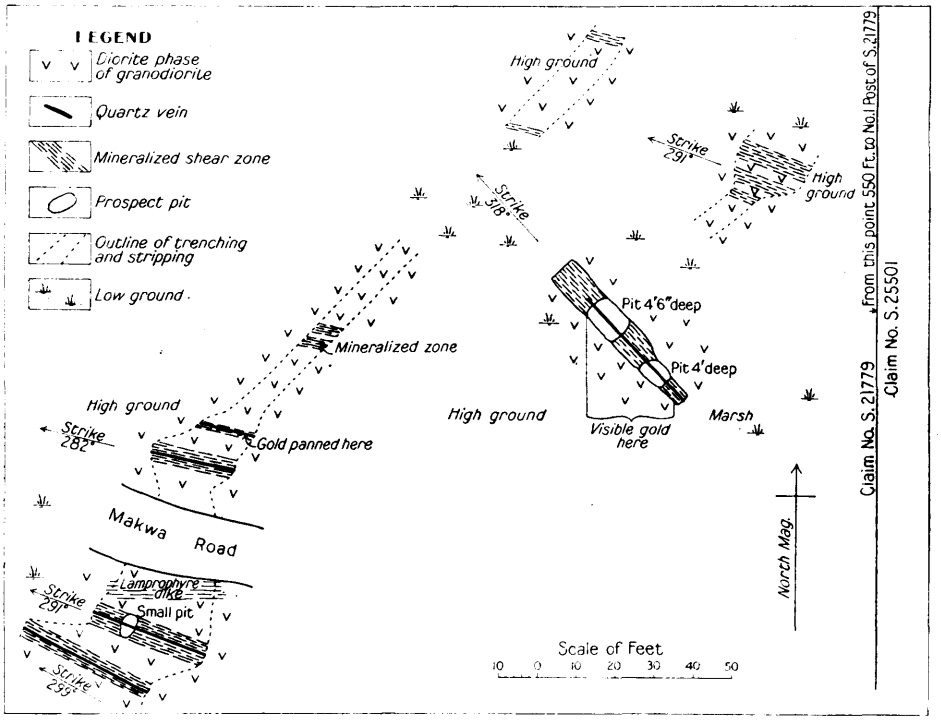
Surface plan of No. 1 showing, Eccles-Holmes property, Chester township.

has an average width of 1 foot, and has been traced for 100 feet. The wall rock is silicified and fairly well mineralized with pyrite for several inches on either side of the vein. The common minerals are pyrite, chalcopyrite, and molybdenite in minute quantities. Midway toward the south of the exposure, the vein splits into two parts. Two test pits have been sunk, disclosing heavy mineralization over a width of 3 feet. From the bottom of the main pit, which is cribbed and has a depth of 14 feet, a channel sample taken by J. F. Eccles-Holmes over a width of 3 feet 3 inches is reported to have yielded 0.50 ounces of gold per ton, and a grab sample of the quartz yielded 1.00 ounces of gold per ton. A grab sample of only moderately mineralized quartz taken by the writer from the same pit yielded 0.70 ounces gold per ton and 1.70 ounces silver. Another grab sample of fresh or silicified vein matter taken by the writer from an open cut at the north end of the vein yielded 0.31 ounces gold per ton.

About 200 feet southwest of No. 1 vein there is a strongly fractured zone, which in places shows 6 inches of quartz carrying an abundance of pyrite and chalcopyrite. The total width of the "break" is about 3 feet. The wall rock immediately adjacent is silicified and epidotized and is essentially the granodiorite

type. A grab sample of the mineralized vein matter from the bottom of a shallow test pit yielded negligible gold values.

Another vein, known as No. 4, has been uncovered on claim S. 21,779, a few feet northeast of the Makwa road. It occurs in a sheared zone in a rather basic or dioritic phase of the granodiorite. The zone itself varies from 3 to 5 feet in width, strikes northwest, and apparently widens in the same direction. The main quartz leader is 6 inches wide and is accompanied by narrow quartz stringers on either side. The mineralization consists of pyrite, chalcopyrite, and a little visible gold; actinolite is abundantly developed at one point. The quartz is characterized by the presence of minute quantities of a silvery-grey metallic



Surface plan of No. 4 showing, Eccles-Holmes property, Chester township.

mineral occurring in nest-like forms. Microchemical tests on this material indicate that there are probably two minerals, bismuthinite (bismuth sulphide, Bi_2S_3) and tetradymite (bismuth telluride, Bi_2Te_3). Two 4-foot test pits have been sunk on the vein. A 27-inch channel sample taken by Captain Eccles-Holmes from the south pit yielded 1.39 ounces gold per ton. A grab sample taken by the writer from the same pit yielded 2.58 ounces gold per ton. Thirty feet north of the road, stripping has disclosed another quartz vein, one foot in width, from which gold may be panned freely.

A. Labbé

In 1931, a well-mineralized break was uncovered in the northwest corner of S. 19,991, Chester township. Further surface exploration during the past season has resulted in the tracing of this break several hundred feet to the east, as well as the picking up of a parallel break 40 feet to the north of it. The new showings,

which occur in the northwest corner of S. 20,011, consist of sheared zones, 2 to 9 feet wide, in a silicified granite porphyry. Small quartz lenses, up to 4 inches in width, occur at intervals along these zones. The mineralization consists of pyrite, chalcopyrite, and a little visible gold.

A new showing near the north boundary of the group on claim S. 19,992 was being stripped when the writer visited the property. The vein appears to trend N. 80° E., and consists of a sort of stockwork of quartz veins in a dark-coloured quartz porphyry, the total width being about 25 feet. Both the porphyry and quartz are strongly impregnated with very fine pyrite and chalcopyrite as well as coarse light-coloured pyrite. The type of mineralization in this vein suggested that fair gold values might be expected, but the results of assays of three representative grab samples were disappointing.



Prospect pits along a strongly fractured zone containing gold-bearing quartz lenses, Chester Shannon claims, west shore of Clam lake, Chester township.

It is reported that this group, consisting of 9 claims, has been optioned by Porcupine Crown Mines, Limited. Camps have been erected, and a small crew of men have been maintained to complete the necessary assessment work.

Chester Shannon Syndicate

Late in 1931, the main showing on the claims of Chester Shannon Syndicate, on the point at the northeast corner of Clam lake, was diamond-drilled, holes being put down to intersect the vein at various horizons down to 500 feet. The deepest hole showed continuity of vein width and gold values, but on the whole the results are said to have been inconclusive.

In 1933, work on the property was resumed, and a programme of surface exploration was energetically carried on under the direction of J. A. Shannon and M. S. Beal. A most unusual occurrence of gold was discovered on the west shore of Clam lake, almost directly opposite the showing on the east shore that created so much interest in 1931. The showing consists of irregular quartz lenses in a strongly sheared zone ranging in width from 6 to 10 feet, striking S. 78° E., and dipping 54° N. It occurs at the contact of quartz porphyry and a fine-grained

micaceous schist or lamprophyre. The break has been exposed for a length of 440 feet, and 5 deep test pits have been sunk at intervals along the strike. The mineralization is heavy and consists of an intimate intergrowth of siderite or ankerite, quartz, books of biotite, pyrite, chalcopyrite, and visible gold. In places the siderite is very massive, and books of biotite an inch in diameter are commonly observed. In some instances the gold is intimately associated with the biotite. The biotite, which occurs in rather unusually large volume, is a product of wall-rock alteration and owes its presence to the reaction of mineralizing solutions on a type of country rock high in ferromagnesian minerals, which in this case is lamprophyre or hornblende-mica schist.

Another new showing has been uncovered in the southwest corner of claim S. 9,289, Yeo township. It consists of a series of irregular quartz lenses up to 16 inches in width in a strongly fractured zone in porphyritic granodiorite. The "break" has been exposed by stripping for a length of over 100 feet; it strikes in an east-west direction. The wall rock on either side is strongly mineralized with pyrite, chalcopyrite, bornite, and covellite, and a heavy gossan occurs over a total width of about 25 feet. The centre of the showing is traversed by two narrow lamprophyre dikes only a few feet apart, which strike S. 42° E.

The syndicate now holds 14 claims which have been brought to patent.

R. S. Sheppard

During the past summer the West McWatters Syndicate had an option on the R. S. Sheppard group of claims, in the central part of Chester township. They carried on a programme of surface development, mainly on showings in the north half of claim S. 20,655. Two parallel veins, about 50 feet apart, have been opened for about 200 feet along the east-west strike. Channel assays over a width of 90 inches are reported to have yielded values up to 0.84 ounces gold per ton.

A newly discovered vein, known as No. 5, occurs near the east boundary of claim S. 20,657. It consists of a sheared zone in quartz diorite porphyry exposed for a length of 125 feet and, in places, attaining a width of 3 feet. The quartz occurs as small lenses up to 8 inches in width. It is heavily mineralized with pyrite, chalcopyrite, and visible gold.

Other narrow quartz veins have been uncovered on claims S. 20,661 and 20,662, but they appear to be of little importance at the present stage of development.

The property is equipped with an excellent camp, and further surface exploration is contemplated.

Martin Syndicate

Robert Martin, of Sudbury, maintains a majority interest in the Gosselin group of claims formerly held by the Three Ducks Syndicate. In 1932, a diamond-drilling campaign was carried on in what is known as the Coté lake section of the property. The results of this work are not known to the writer, but an engineer's report is said to have been highly favourable. Since that time the claims have been further prospected without important results. A caretaker is being kept at the property to look after an excellent set of camp buildings.

Ironstone Syndicate

P. S. Ironstone and associates, of Gogama, hold a group of 21 claims, lying east of the Sheppard and Labbé groups, on which considerable surface exploration was carried on during the summer of 1933. A quartz vein was uncovered near the northwest corner of claim S. 21,616. A grab sample of the quartz is reported to have yielded 1.25 ounces gold per ton, and a channel assay over a width of 4½ feet yielded 0.19 ounces gold per ton.

M. S. Beal

The M. S. Beal group of claims, formerly known as the Coté property, consists of 6 claims lying between Clam lake and Coté lake. A small quartz lens, striking at S. 80° W. and dipping 40° W., has been uncovered near the west line of S. 14,598, a few chains north of Clam creek. The lens, which occurs in a well-defined fracture in the granodiorite, ranges from 6 to 12 inches in width and has been traced for 25 feet. The quartz is heavily mineralized with pyrite and chalcopyrite and contains visible gold.

Corbett-McCambly

The Corbett-McCambly group consists of 11 claims in Chester township, located just south of Schist creek. Leslie Corbett reports an 8-foot quartz vein at the contact of a feldspar porphyry dike and arkose on claim S. 24,803. It strikes east-west and dips slightly south. A channel assay from a prospect pit over a width of 8 feet yielded 0.09 ounces gold per ton. A 6-foot quartz vein in sheared arkose is exposed in another prospect pit on claim S. 24,936. It strikes east-west and dips steeply south. A channel assay over a width of 7 feet yielded 0.05 ounces gold per ton; a grab sample of the same material gave 0.32 ounces gold per ton.

Young-Shannon Gold Mines, Limited

Young-Shannon Gold Mines, Limited, was incorporated in 1932 to take a working option on a group of 14 claims, held by the Chester Shannon Syndicate, in the vicinity of Clam lake. Sufficient work was completed to bring this group to patent, and the company now holds a 15 per cent. interest in the Chester Shannon Syndicate. In addition, the company holds a group of 8 claims, S. 20,641-47, 20,653, lying between Owl (Chester) creek and Clam lake.

In October, 1933, a small gang of men, under the direction of C. T. Young, were engaged in completing the necessary assessment work on the company's claims, named above. During the progress of this work a quartz vein was discovered on a small island toward the south end of Clam lake, only a few feet north of the south boundary of claim S. 16,304. This claim, which at that time was held by the Chester Shannon Syndicate, has since been purchased outright by the Young-Shannon company. The vein, the discovery of which was made while the writer was visiting the Clam lake section, is exposed only at the water's edge and consists of about 3 feet of dark smoky quartz, which is heavily mineralized with mispickel, pyrite, and chalcopyrite. Assays of two grab samples yielded 0.49 and 0.02 ounces of gold per ton. Mr. Young reports that this vein, or possibly another one that is parallel to it, has been picked up on the mainland a few hundred feet to the west and that interesting mineralization is being encountered, as well as consistently high gold values.

A 26-foot test pit has already been sunk near the original discovery. The results obtained have been so encouraging to the management that plans are being made to establish a level at a depth of 125 feet, at which point the vein will be drifted on for 600 feet. If the results are still encouraging a more extensive programme of underground development will be initiated by sinking a vertical shaft on the mainland. For this purpose the property is being equipped with a complete mining plant and excellent camps. In this connection it is interesting to note that this company is the first in the Three Duck Lakes area to undertake a programme of underground development.

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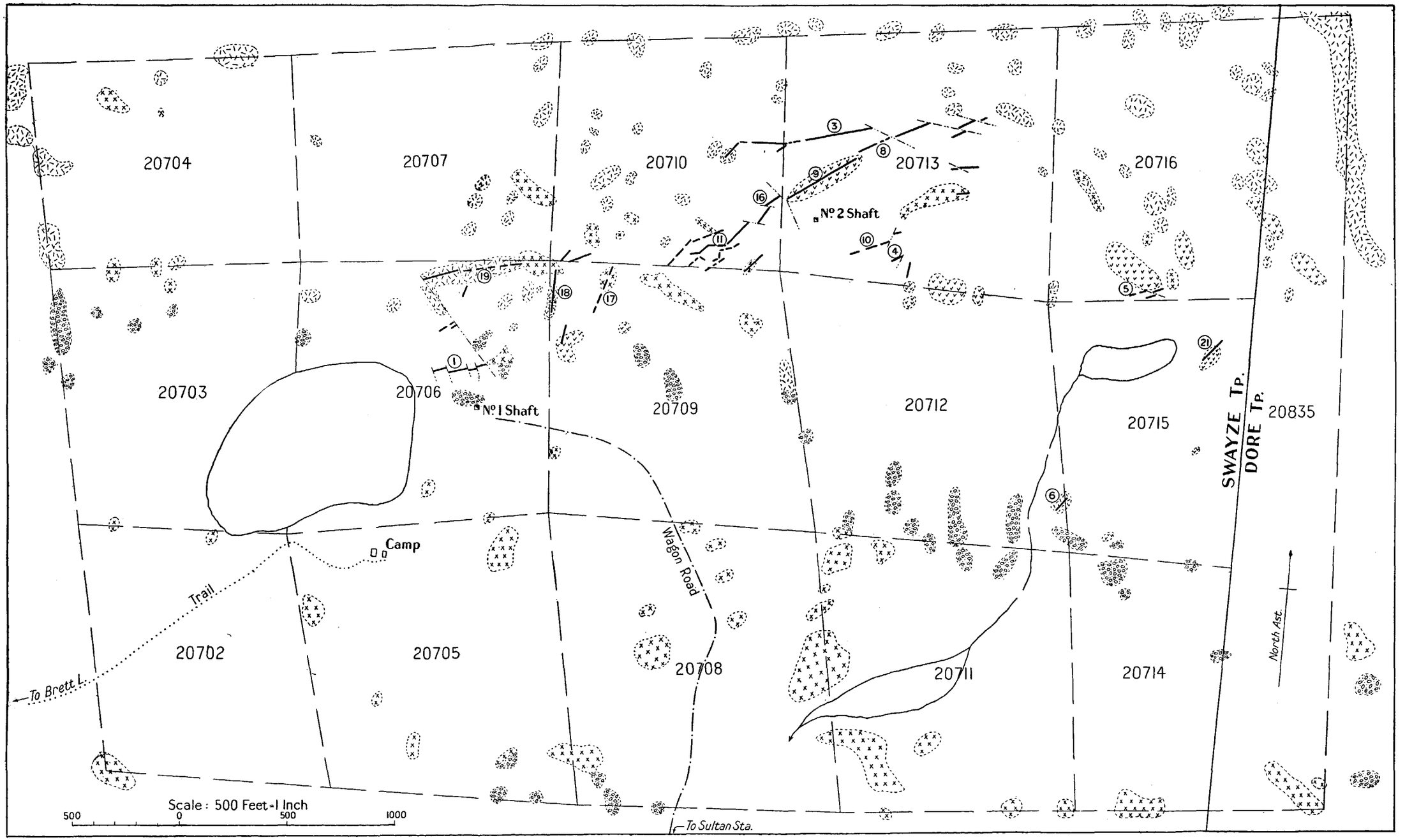
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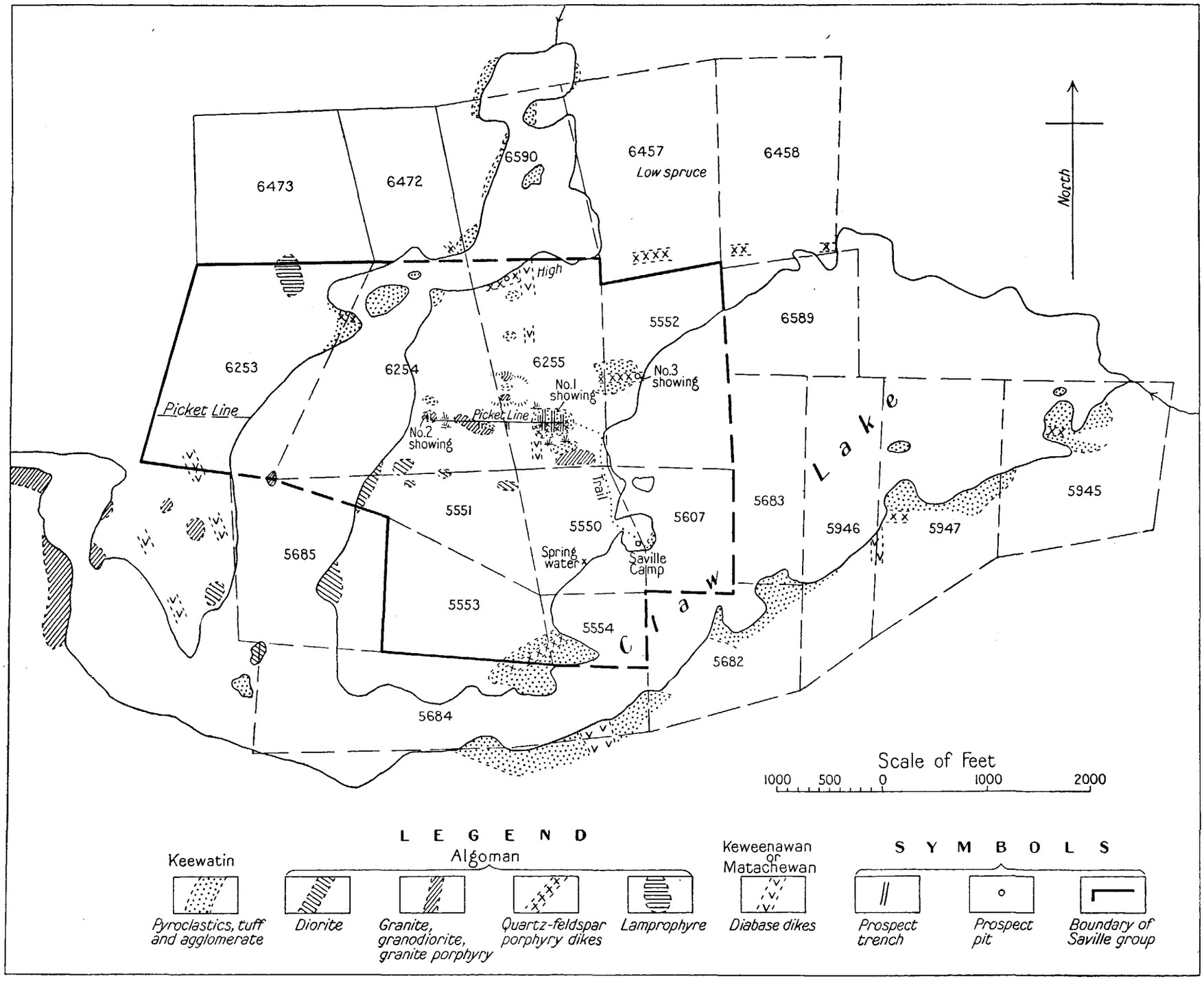
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GEOLOGICAL SKETCH MAP OF THE PROPERTY OF THE KENTY GOLD MINES, LIMITED

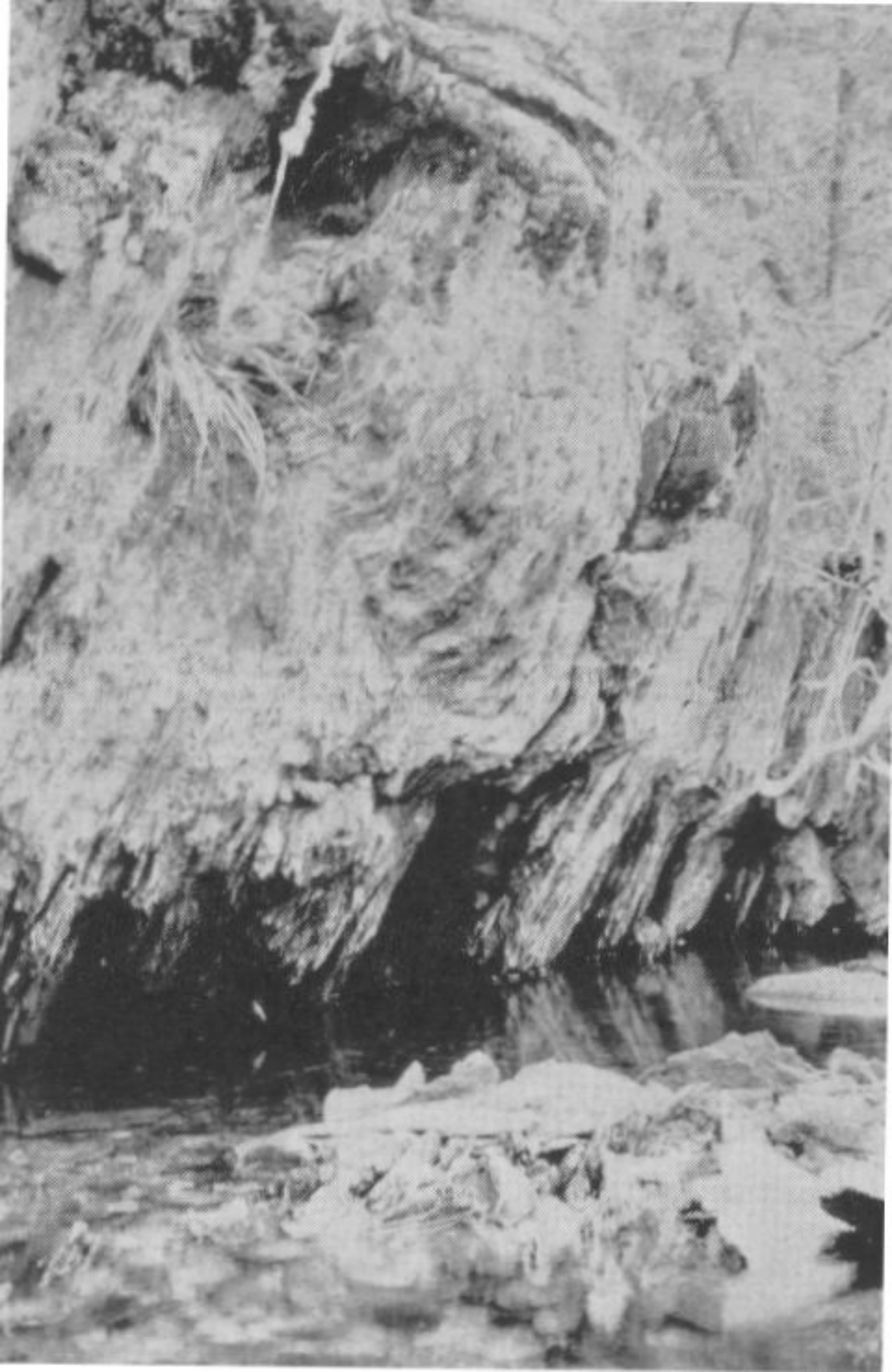
The map is based on a preliminary sketch of the claims before they were surveyed, and additional information was obtained largely from the officials of the company.



SKETCH MAP SHOWING THE GENERAL GEOLOGY IN THE VICINITY OF THE SAVILLE GROUP, CLAW LAKE, CABOT TOWNSHIP.































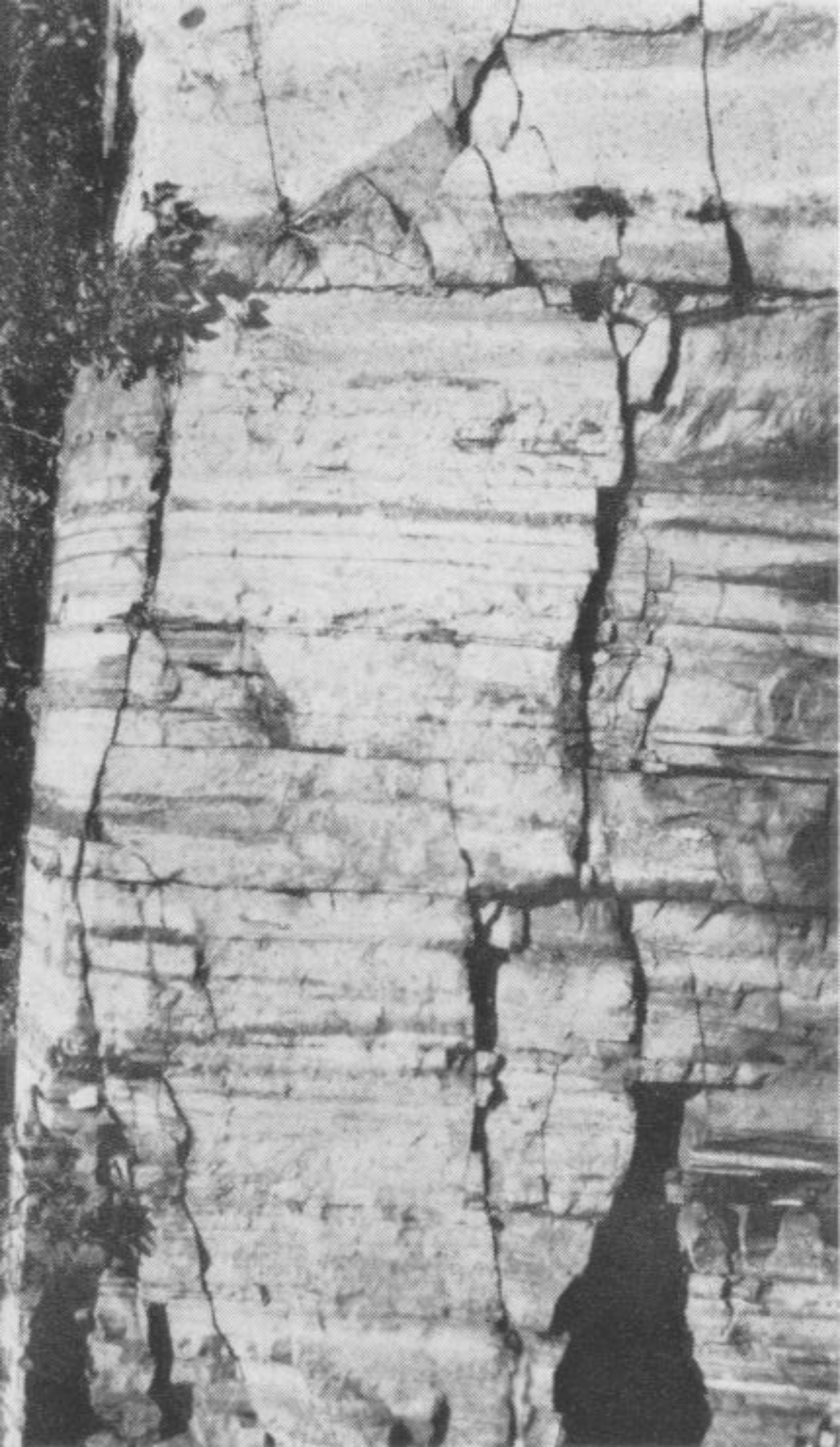














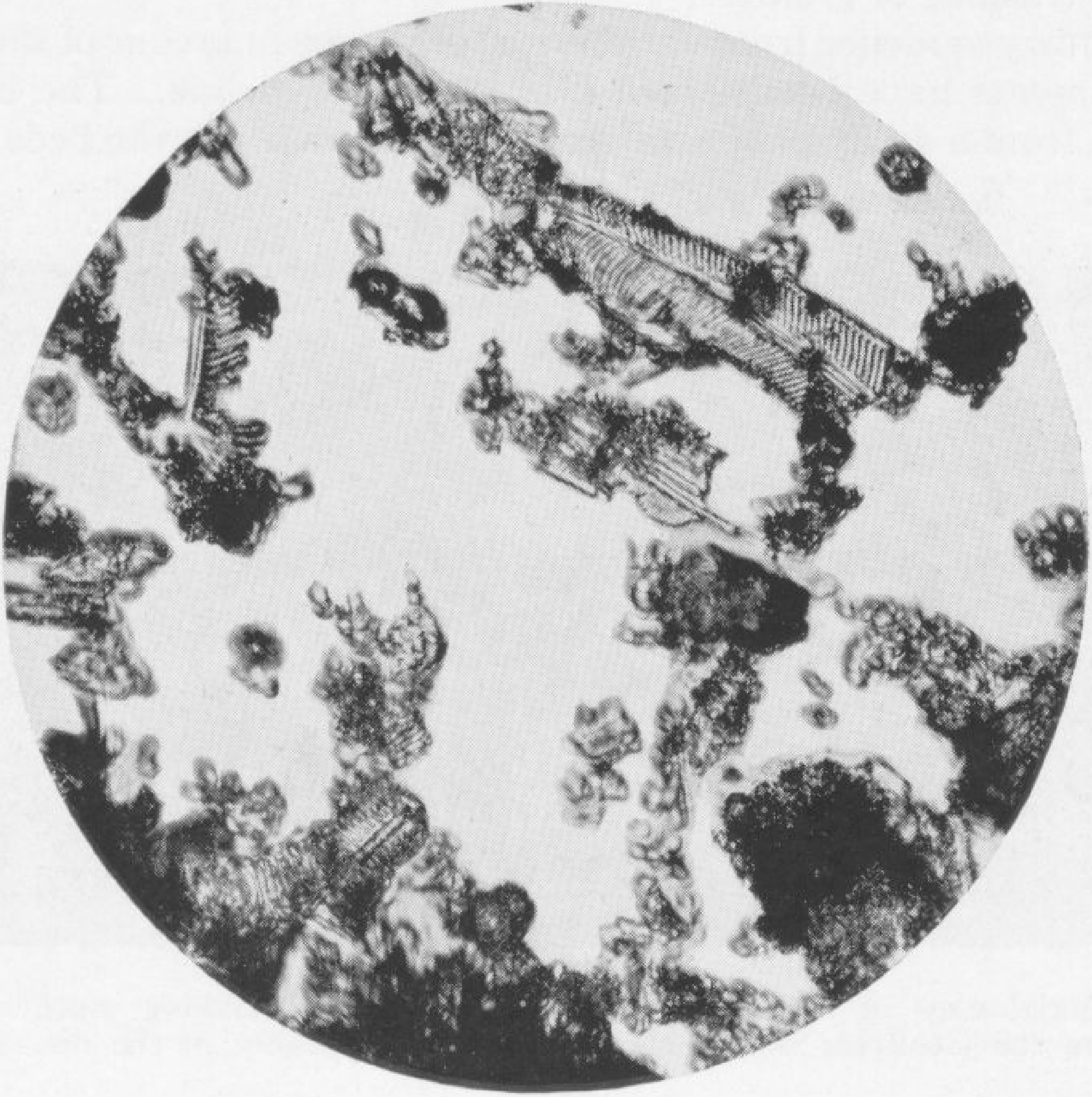












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PROVINCE OF ONTARIO
DEPARTMENT OF MINES

HON. PAUL LEDUC, *Minister of Mines* THOS. W. GIBSON, *Deputy Minister*

FORTY-THIRD ANNUAL REPORT

OF THE

ONTARIO DEPARTMENT OF MINES

BEING

VOL. XLIII, PART IV, 1934

Geology of the Straw–Manitou Lakes Area

By

JAS. E. THOMSON

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COLOURED GEOLOGICAL MAP

(In pocket at back of report)

Map No. 43*a*—Straw–Manitou Lakes Area, Districts of Kenora and Rainy River, Ontario. Scale, 1 mile to the inch.

Royal Canadian Air Force Photograph



Aerial view eastward along the Kenora–Rainy River boundary line from a point near Manitou stretch. Dogfly lake is in the centre foreground, and Vista lake is the elongated body of water beyond it.

Geology of the Straw-Manitou Lakes Area

By Jas. E. Thomson

INTRODUCTION

In 1932, a geological survey was made of an area between Upper Manitou and Stormy lakes in the district of Kenora.[1] During the field season of 1933 this investigation was continued southward through Lower Manitou lake and westward to the eastern extremity of Pipestone lake. This map area, called the Straw-Manitou Lakes area, is located largely in the district of Kenora but extends southward into the district of Rainy River to within a few miles of Rainy lake. It is approximately 35 miles north of the town of Fort Frances.

About thirty-five to forty years ago, there was a considerable gold mining boom around the Manitou lakes in conjunction with similar gold "rushes" into the Lake of the Woods and the Rainy Lake areas. Several gold mines were

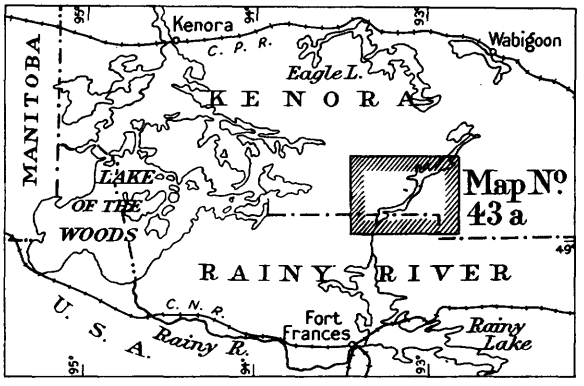


Fig. 1—Key map showing the location of the Straw-Manitou Lakes area. Scale, 60 miles to the inch.

opened up, and most of the territory adjoining Upper and Lower Manitou lakes was staked by prospectors at that time. The area proved to be disappointing, and only a small amount of gold was obtained. Practically all of this came from the Laurentian mine, which has a recorded production of approximately $141,000. Around 1912, almost all mining and prospecting development in the Manitou area was discontinued. Since that time sporadic attempts have been made to rework a few of the old properties, but so far without success. Practically all the properties that were worked in the early days lie within the Manitou-Stormy Lakes area and were discussed in a previous report.[2] Many mining locations, however, were staked at that time in the area described in this report. Some development work was done on a few of these old properties, but no gold was produced.

The year 1933 witnessed a considerable revival of prospecting interest in this section of the country. During the summer months new gold discoveries

[1]Jas. E. Thomson, Ont. Dept. Mines, Vol. XLII, pt. 4, 1933.
[2]Ibid.

were made on Straw (Strawberry) lake. Mining claims were staked along a belt extending from Mister lake to the east end of Pipestone lake. This is a part of the country that appears to have been largely overlooked by prospectors in the early days of mining activity in the Manitou and Lake of the Woods areas. In the latter part of the year two properties in the Manitou lakes section were secured by mining interests, and active development by diamond-drilling was commenced on one of them.

The Dryden sheet (No. 52F), issued by the Topographic Survey of Canada, provides an excellent aerial map of the region. This was used as a base map in the preparation of the accompanying geological map (No. 43*b*). A few minor alterations and additions have been made to this topographical map, chiefly in the drainage of small lakes and the location of portages. The geological map adjoins that of the Manitou-Stormy Lakes area (map No. 42*c*) on the north and comes within about 6 miles of the Kakagi Lake area (map No. 42*b*)[1] on the west.

Acknowledgments

The writer wishes to express his appreciation to the various individuals who provided assistance and information throughout the summer. Special acknowledgment for many courtesies is due to Mr. and Mrs. Geo. B. Scattergood and Charles W. Merrill, of Goldrock; S. H. Baldwin of Devils Cascade, Rainy lake; and Geo. L. Sullivan, of Emo. Neil D. Runnalls rendered able assistance in the field and did a considerable part of the geological mapping. Paul Aronson, of Goldrock, served as a capable assistant during the last month of the field season.

J. Ellis Thomson prepared polished sections of ore for the writer in the Mineralogical Laboratories of the University of Toronto, and identified the telluride in the gold ore from Straw lake. The photomicrographs of these polished sections that appear in this report were prepared by Professor Thomson.

Assays and chemical analyses were made by the staff of the Provincial Assay Office.

Access

The Manitou lakes may be easily reached from either Wabigoon or Dinorwic on the Canadian Pacific railway, or from Fort Frances on the Canadian National. During the tourist season a boat makes regular trips between Fort Frances and the Devils Cascade at the north end of Rainy lake. From the Cascade there are five short portages on the Manitou river to Esox lake. From this point it is possible to proceed 35 miles up the Manitou lakes without a portage. From the C.P.R. the Manitou lakes may be reached from Dinorwic lake and a chain of lakes east of Goldrock. A 7-mile government road extends from Minnehaha lake to Goldrock. In the summer Charles Merrill, of Goldrock, operates a truck on this road and makes regular trips with a large motor boat from Minnehaha lake to Wabigoon.

Two canoe routes extend eastward from Lower Manitou lake. The northern route passes through Aronson, Vickers, Mang, and Kawawia lakes. The southern route goes from the southern arm of Lower Manitou lake through Manitou stretch, Dogfly, Vista, Twist, and Pickwick lakes. It is possible to continue south along this latter route to the Northeast bay of Rainy lake. An alternative route southward is by way of Bat and Respite lakes and Little Canoe creek to Manitou sound on Rainy lake.

[1]E. M. Burwash, Ont. Dept. Mines, Vol. XLII, pt. 4, 1933.

A canoe route extends westward from Lower Manitou through Grant, Harris, Missus, Straw, and Yoke lakes to Pipestone lake. During the high-water season there are no portages of any length along this route, but in the summer the creek between Floyd and Straw lakes dries up, necessitating the use of a mile portage. The Straw lake section is more easily reached from Emo on the Canadian National railway. A motor road leads from Emo to tourist camps near the south end of Burditt lake. It is possible to travel by canoe from this point to the north end of Pipestone lake without a portage.

Previous Geological Work

The southern part of the map area is discussed by A. C. Lawson in his first report on the Rainy lake region, published in 1887.[1] This report was accompanied by a geological map known as the Rainy Lake sheet. The northern part is included in the Manitou Lake sheet, prepared by McInnes and published in 1902.[2] The Kenora sheet (map No. 266A) of the Geological Survey of Canada shows the general relationship of the geology in the area to other parts of northwestern Ontario.

In 1894, A. P. Coleman[3] made a reconnaissance trip through the area. Between 1900 and 1904, Jas. A. Bow[4] and W. E. H. Carter[5] examined some of the properties near Lower Manitou lake, where mining was being attempted.

Topography and Drainage

The area presents the typical topographic features of the pre-Cambrian shield. From any of the hilltops a monotonous continuity of rounded hills with almost equal elevation may be observed in every direction. An occasional monadnock stands out 50 feet or so above the general level of the peneplain. Locally, some ridges give a rather rugged aspect to the topography, although the relief is probably not more than 200 feet at any point. The area is largely covered by rock outcrops, but a thin veneer of glacial deposits is everywhere in evidence in the depressions. The shore line of most of the lakes is rocky, and the water is beautifully clear. These conditions add greatly to the natural beauty of the country. Raised beaches observed on Kaiarskons and Furlonge lakes were caused by artificial lowering of the outlet. The level of Kaiarskons lake has been lowered 14 feet.

One of the outstanding topographic features is the abundance of lakes. The shape and pattern of these lakes has been controlled in some parts of the area by the nature and structure of the bed rock. The general northeast-southwest trend of Lower Manitou lake is parallel to the axis of the folds in the greenstone belts. Near the south end of Manitou stretch there is an abrupt change to an east-west course. Here the lake follows the contact of a steeply folded belt of sedimentary rocks. Faulting has undoubtedly affected the topography to a certain extent, as this section of the lake follows a faulted contact between the sedimentary and greenstone formations. The channel of Manitou river at Cedar narrows is also located along a fault.

All the lakes within the area drain southward into Rainy lake. The outlet of the greater volume of water is through the Manitou river. Vista, Twist, and

[1]A. C. Lawson, Geol. Surv. Can., Vol. III, pt. F, 1887.
[2]Wm. McInnes, Geol. Surv. Can., map No. 720.
[3]Ont. Bur. Mines, Vol. IV, 1894, pp. 60-64.
[4]Ibid, Vol. IX, 1900, p. 63.
[5]Ibid, Vol. X, 1901, p. 100; Vol. XIII, pt. 1, 1904, p. 68.

Pickwick lakes drain into Northeast bay of Rainy lake, and the lakes in the western section flow into Northwest bay.

Natural Resources

Timber

The principal forest trees in the area are red and white pine, jackpine, spruce, balsam, poplar, birch, and cedar. A great deal of excellent timber has been taken out of the country, most of which was red and white pine. There are still a few rather small areas of valuable pine timber. Large sections, however, have been burnt over and contain only small second-growth material.

Brulé of different ages is found throughout the country. A fire in 1932 passed through a section on the southeast side of the large expanse of Lower Manitou lake. The southern part of the area was burnt over several years ago and is now covered with scrubby second growth. This burn extended from Alonghill lake to the western limits of the map area and northward to the south shores of Straw and Missus lakes. There is also an area of brulé around the north end of Vista lake.

The Ontario Forestry Branch has a fire rangers' station at Goldrock on Upper Manitou lake.

Game and Fish

Game is plentiful throughout the area. Deer, moose, bears, porcupines, weasels, skunks, and rabbits are often seen. In the fall partridges are abundant, and ducks are commonly found in marshy lakes and bays. Many new beaver-houses were noticed in some parts of the area.

All the larger lakes contain lake trout, whitefish, and pike. Black bass, maskinonge, and pickerel are caught in some of the lakes. Commercial fishing has been carried on in Lower Manitou lake in recent years.

Tourist Attractions

A large number of tourists visit the area each summer. Canoe trips can be made through all parts of the country with considerable ease. There are tourist camps at Devils Cascade, Rainy lake, and on Lower Manitou, Yoke, and Pipestone lakes. A boys' camp is located on Sphene lake, which is an expanse of the Manitou river immediately south of the map area. The great natural beauty and easy accessibility of this country, combined with an abundance of game and fish, makes it particularly attractive to summer visitors. The majority of the tourists motor northward from the midwestern States and secure their camping equipment at Fort Frances or Emo. Hunting parties visit the more accessible parts of the area every fall.

GENERAL GEOLOGY

The consolidated rocks are almost entirely of early pre-Cambrian (Archean) age. Keewatin lavas and pyroclastics cover the greater part of the map area. A belt of sedimentary rocks lies stratigraphically above the Keewatin series and is of Timiskaming age. Both lavas and sediments are intruded by Algoman granite and porphyries.

The various formations may be classified as follows, the oldest rocks being placed at the bottom:—

QUARTERNARY	
PLEISTOCENE and RECENT:	Boulder clay, sand, gravel, peat.
	Great unconformity
PRE-CAMBRIAN	
KEWEENAWAN(?):	Diorite.
	Intrusive contact
ALGOMAN:	Quartz, feldspar, and granite porphyry; aplite. Hornblende and biotite granite and gneiss.
	Intrusive contact
PRE-ALGOMAN:	Gabbro, diorite, quartz diorite, lamprophyre.
	Intrusive contact
TIMISKAMING:	Conglomerate, arkose, quartzite, slate.
	Unconformity
KEEWATIN:	Acid volcanics: rhyolite, trachyte, felsite; acid agglomerate and tuff; sericite schist. Basic volcanics: massive andesite, basalt, pillow lava; basic agglomerate and tuff; chlorite and hornblende schist.

Keewatin Series

Basic Volcanics

Lavas.—The greater part of the Keewatin series consists of lavas ranging from andesite to basalt in composition. They are typically fine-grained, dark-green rocks, which have been considerably metamorphosed and are generally termed "greenstones" in the field. They are often quite massive, but in many places have been sheared to chlorite and hornblende schists. Pillow lavas are sometimes found; occasionally these have well-developed spherules near the margin of the pillows.

Coarse-grained gabbroic rocks are found within the greenstone areas. These may grade laterally into fine-grained basic lavas which show flow structure. In this case the gabbroic phases undoubtedly represent the central parts of rather thick lava flows where cooling of the magma proceeded slowly, resulting in coarser crystallization of the constituent minerals near the centre than at the margin of the flows. There are also basic intrusives within the area. These intersect agglomerates and also the sedimentary series, which has been assigned to the Timiskaming period. These intrusive gabbroic rocks are identical in appearance with coarse-grained phases of lava flows. Thus, it is generally impossible to determine whether a coarse-grained basic rock when found in an isolated outcrop is an intrusive or extrusive. On the accompanying map most of these gabbroic rocks have been included with the basic lavas for the reason that no intrusive contact could be found.

On rare occasions, a porphyritic lava containing large phenocrysts of feldspar in a finer-grained matrix may be seen. This is similar to the rock described as "feldspar basalt porphyry" in the adjoining area to the north, where it was thought to represent porphyritic horizons in lava flows.[1] The only place where it occurs in any amount in the area under discussion is along the north shore of Grave lake and the east shore of Fahey lake. The feldspar phenocrysts occur in a gabbroic matrix.

[1]Jas. E. Thomson, op. cit., p. 9.

Fragmental Rocks.—Large areas of agglomerate and volcanic tuff are closely associated with the basic lavas. Within the Manitou-Stormy Lakes area it was possible to roughly differentiate between the lavas and pyroclastics on the geological map. In the area under discussion, however, there is such a heterogeneous assemblage of lavas and pyroclastics that it is very difficult to map them separately. The larger areas of agglomerate and tuff are roughly indicated on the map by the lettering "1b."

Typical agglomerate consists of fragments of light-coloured material, sometimes porphyritic, in a dark-green matrix. The fragments are usually elongated parallel to the schistosity but are occasionally angular or subangular. The matrix is largely altered to chlorite, but there is evidence that it was once of a tuffaceous nature. Narrow bands of well-bedded tuffs are sometimes found. These gradually pass above and below into either agglomerate or coarse-grained tuff. These tuffs and agglomerates are interbedded with basic lava flows. The contact between individual flows and the pyroclastics in places is well defined. It is apparent that at certain intervals during Keewatin vulcanism rock fragments and volcanic ash were also ejected, thus producing an alternation of the two rock types. Locally, the finer ashy material was sorted under water and deposited in beds.

Some of the fragmental material associated with the basic lavas is a flow breccia. This was probably formed by the shattering of a crust that was consolidated on the outer surface of a flow and then engulfed in the still molten material. This flow breccia is generally difficult to distinguish in the field from the tuff breccia or agglomerate, and for this reason all the fragmental rock types associated with the lavas have been grouped as a unit on the accompanying map.

Contact Gneisses and Schists.—Bordering the northwest side of Lower Manitou lake there is a band of gneisses and schists adjacent to the granite. Hornblende syenite and other phases of the granite have been injected into these rocks, making a sort of transition complex. On the northeast side of Olsen bay there are places where the gneisses have a laminated character which somewhat resembles bedding.

These gneisses were encountered at the end of the field season of 1932,[1] and their lithology and structure suggested the possibility that they might be equivalent to the Coutchiching sedimentary rocks that Lawson[2] has described on Rainy lake. Further study in this vicinity has shown that this is not the case. It is the writer's opinion that these gneissic rocks are highly metamorphosed lavas in the granite contact zone.

Fine-grained grey gneisses and chlorite schist occur in the vicinity of the granite contact in Barker and Olsen bays, but there is no satisfactory evidence that any of this complex is of a sedimentary origin. A typical section across this contact complex would reveal a rough transition from massive andesitic or basaltic lava to chlorite schist, followed by a mixture of chlorite schist and fine-grained gneiss with *lit par lit* injections of granitic material, and then the main granite mass. The strike of the foliation in these gneisses and schists is approximately parallel to the granite contact, and the dip varies from 30° to 50° S.E., i.e. away from the granite. This complex is intersected by increasingly larger amounts of pink porphyritic granite and granite gneiss, until finally only xenoliths of the older rock are found in the intrusive. These contact phenomena may be observed over a distance of approximately half a mile across the strike.

[1]Jas. E. Thomson, op. cit., p. 8.
[2]A. C. Lawson, Geol. Surv. Can., Mem. 40, 1913.

Thin sections of typical gneisses from Olsen bay show a mosaic of quartz, biotite, and epidote, with lesser amounts of hornblende, garnet, zoisite, magnetite, orthoclase, and plagioclase. The feldspar is generally decomposed. The lamination of the rock is largely due to the arrangement of quartz, biotite, and epidote in bands. A chemical analysis of the gneiss[1] shows the ratio of magnesia to lime and of potash to soda to be in accordance with the general characteristics of igneous rather than sedimentary gneisses.

McInnes[2] considered the band of gneisses along the granite contact on the northwest side of Lower Manitou lake to be extremely altered phases of the adjacent lavas. This seems to be a satisfactory explanation of their origin.

Acid Volcanics

The largest belt of acid lavas and associated pyroclastics is found between Mister and Straw lakes. These rocks are characteristically lighter-coloured than the basic lavas. They vary from pinkish to creamy-white or grey in colour. Some of the rocks are massive and of a fine-grained cherty appearance. Most of these have the composition of rhyolite; less commonly they are trachytes. Occasionally the rhyolite flows show small quartz "eyes." Acid agglomerates and tuffs are occasionally associated with the flows. The fragments in these rocks are quite numerous at certain locations. They are composed of light-coloured felsitic or rhyolitic materials, which are always elongated parallel to the schistosity. Well-developed pillows were observed in acid flows on Straw lake and in isolated lava flows on Sucan lake. In the latter case numerous spherules occur near the periphery of the pillows.

A large proportion of the acid lava flows between Mister and Straw lakes have been highly sheared and are now largely altered to sericite schist. The contact between acid lavas and the granite east of Straw lake is not sharply defined. There is a transition from a dense, light-coloured, felsitic phase of the lavas to aplite and white quartz porphyry. The porphyry merges into granite without any visible contact.

Towards the boundaries of the large areas of acid lavas there is considerable interbedding of basic flows with the acid variety. The contact between the two lava types has been arbitrarily defined on the accompanying map, but in reality it is a rather gradual transition from one type to another.

When examined microscopically these acid lavas exhibit distinct felsitic texture. The trachytes contain phenocrysts of orthoclase and plagioclase, usually acid andesine, in a fine-grained groundmass. Quartz phenocrysts are present in the rhyolites in addition to the above-mentioned minerals. Quartz, magnetite, sericite, and carbonate constitute the groundmass. Under the microscope most of the acid lavas reveal sufficient quartz to be classed as rhyolites.

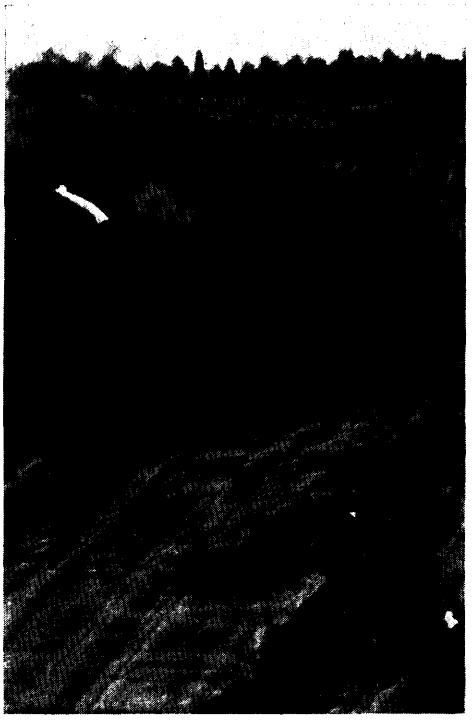
Structure of the Keewatin Series

The structure of the Keewatin rocks may be rather vaguely inferred from fragmentary information. Pillow structures are seen in the lavas, but no reliable data concerning the attitude of the flows could be gleaned from them. This was in part due to their rather poor preservation and in part to the fact that they are apparently rather thick. At no place was it possible to study a section across an entire flow and determine with absolute certainty which side was the top.

[1]Jas. E. Thomson, op. cit., p. 8.
[2]Wm. McInnes, Geol. Surv. Can., map No. 720, 1902, marginal note.

The attitude of narrow bands of bedded tuffs in the complex of lavas and pyroclastics shows that the formation is steeply folded; the beds seldom vary over 20 degrees from a vertical position. Along the northern side of the greenstone belt the beds almost invariably dip to the south or southeast at rather steep angles, suggesting that this is the north limb of a closely folded syncline. No sediments are intercalated with the lavas on the south side.

The strike of the schistosity or foliation of the greenstones is approximately parallel to the boundaries of the formation. On the northwest side of Lower



Bedded Timiskaming sediments on the island opposite the logging camp in Manitou stretch. This location is near the nose of a syncline, and the schistosity (indicated by the smooth vertical face) is almost at right angles to the strike of the beds.

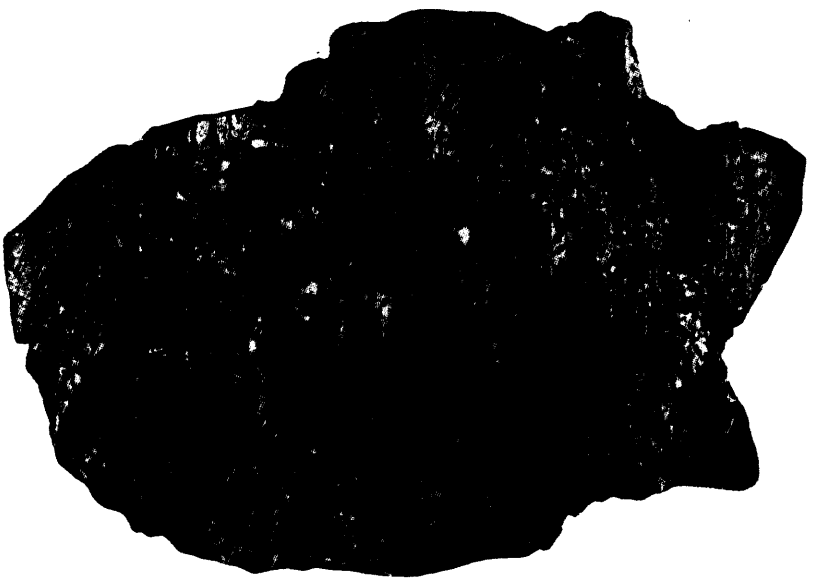
Manitou lake the dip is generally from 30 to 50 degrees away from the adjacent granite, but over the greater part of the area it varies only a few degrees from vertical. At Cedar narrows on the Manitou river there is a fault with a horizontal displacement of about 1,100 feet.

Timiskaming Series

Three separate areas of sedimentary rocks appear within the map area. A small belt of arkose and slate occurs west of Kahabeness lake. The largest body of sediments is found south of the lower part of Manitou stretch and on Esox and Lou lakes. Similar sediments may be seen westward along the strike on Sucan and Pipestone lakes.

The sedimentary series is composed of arkose, quartzite, slate, and a small amount of conglomerate. Bedding is well preserved in many places, especially in the finer-grained clastics. The beds may vary from a fraction of an inch to a couple of feet in thickness. They sometimes show a gradation from relatively coarse-grained sandy arkose or quartzite at the base of the bed to fine-grained slaty material at the top. Such a change in grain size may be observed across several successive beds.

Boulder conglomerate occurs only at or near the base of the sedimentary series, but narrow bands of pebble conglomerate are found occasionally with the arkosic sediments between Pipestone and Sucan lakes. A splendid exposure of conglomerate occurs on a small island on the south side of Canoe bay in Esox



Specimen (one-half natural size) of black graphitic quartzite (?), containing spherical cavities, obtained on the portage from Manitou stretch to Alonghill lake.

lake. At this point the conglomerate contains boulders and pebbles of greenstone, granite, porphyry, vein quartz, and chert. Approximately 40 per cent. of the pebbles are greenstone similar in composition to the underlying basic lavas of the Keewatin series. The sorting is poor. Boulders of granite up to 18 inches in diameter occur in the conglomerate. The smaller pebbles are often well-rounded, while the larger are generally subangular or angular in shape. The matrix of the conglomerate is a coarse-grained arkose.

Graphitic Quartzite (?)

In a few places throughout the area the contact between the sedimentary series and the lavas is marked by the occurrence of a most peculiar, black, graphitic rock, which contains numerous spherical cavities (vesicles). It carries a sufficient amount of native graphite to soil the fingers on handling. Owing to the fact that it is a rather soft rock and weathers rapidly, no outcrops were observed, and its relationship to either sediments or lavas could not be exactly determined. It may be seen in place in old test pits on the portage from Manitou

stretch to Alonghill lake and also on the south and east sides of Sucan lake. Weathered boulders and fragments of this rock lying along the lake shore appear somewhat like ordinary dark-coloured coal "clinkers."

Freshly broken rock specimens show a dense, black, slatelike groundmass. At irregularly located zones in the rock spherical cavities occur. Some have very minute dimensions, and others are half an inch in diameter. The greater number of these are empty, but some are filled with a framework of delicate graphite flakes. In the Sucan lake material an occasional vesicle is filled with pyrite or marcasite. The spherical cavities are often enclosed by a narrow rim of quartz.

Thin sections show the rock to be composed entirely of quartz, graphite, and a few tiny flakes of sericite. The groundmass consists of small quartz grains, which, in some sections, are surrounded by a rim of graphite. Some



Photomicrograph of graphitic quartzite (?) showing vesicles (grey) surrounded by a rim of quartz (white). The dark groundmass consists of graphite and fine-grained quartz. (Partially crossed nicols, ×10.)

pieces of graphite are interstitial between quartz grains. Sometimes alternate bands of quartz and graphite may be observed. It is very probable that the quartz and graphite in the groundmass were deposited simultaneously. Around the periphery of the vesicles small columnar quartz crystals are radially arranged (see photomicrograph above). These form a part of the quartz veinlets that run throughout the groundmass in an irregular fashion. All of this later generation of quartz was introduced after the consolidation of the rock. Sometimes graphite is seen in a vesicle within the enclosing rim of quartz crystals.

A chemical analysis was obtained of a typical specimen of the fresh rock from an old test pit on the portage from Manitou stretch to Alonghill lake. The analysis is given in the first column, and shows the rock to have a composition similar to that of quartzite, if the carbon is disregarded. For purposes of comparison two other analyses, one of quartzite and the other of quartz schist, from other localities are included in the second and third columns.

	No. 1	No. 2	No. 3
	per cent.	per cent.	per cent.
SiO_2	92.14	92.00	91.65
Al_2O_3	2.61	4.21	1.59
Fe_2O_3	.13	1.80	3.57
FeO	1.58	.....	.21
MgO	.30	.....	.17
CaO	.33	.04	none
Na_2O	.14	.16	.07
K_2O	.25	1.16	1.93
H_2O	.29	.96	.60
TiO_2	.05	.14	.13
P_2O_5	trace	.21	none
MnO	.02	.....	trace
CO_2	.30	.....	.....
C	1.98	.....	.....
S	.35	.....	.....
Total	100.47	100.68	99.92

Sample No. 1—Graphitic quartzite (?), Manitou stretch. Analysis by Provincial Assay Office, 1934.

Sample No. 2—Quartzite, South Mountain, Pennsylvania; F. Bascom, U.S. Geol. Surv., Bull. No. 136, 1896, p. 34.

Sample No. 3—Quartz schist, Stevenson station, Maryland; U.S. Geol. Surv., Bull No. 150, 1898, p. 302.

It is difficult to find a satisfactory explanation of the origin of this rock. Its composition indicates that it might be a carbonaceous sediment or even vein material. Lawson[1] and Parsons[2] have described a rock of exactly similar appearance that occurs on Corkscrew island and southwest of Zig-zag point on the Lake of the Woods. Lawson named this rock "carbonaceous schist" and states that a specimen was analysed and found to contain 5.77 per cent. of carbonaceous matter.[3] He suggests that the confining of gas may have been responsible for the formation of the spherical cavities. Parsons has suggested that, "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."[4]

Structure of the Timiskaming Series

Folding.—The Timiskaming series consists of three isolated belts of sedimentary rocks, all of which have been closely folded. These belts are roughly on the same strike, and it is possible that they are remnants of a once continuous body of sedimentary rocks. If this surmise is correct, cross-folds in the formation have elevated those portions now missing to a point where they were subsequently removed in the general peneplanation of the country. The area of granite around Bretz lake suggests a doming of the greenstones and any possible sediments in this vicinity, thus separating the bodies of sediments now found on either flank. The nose of granite on the north side of Straw lake suggests a cross-fold in the formation between the sediments on Lou and Sucan lakes.

These isolated belts of sediments are interpreted as canoe-shaped synclinal remnants lying stratigraphically above the lavas and pyroclastics of the Keewatin. The synclines are so closely folded that the dip of the beds generally varies only

[1] A. C. Lawson, Geol. Surv. Can., Vol. I, pt. CC, 1885, pp. 58, 59, 124.
[2] A. L. Parsons, Ont. Bur. Mines, Vol. XXII, pt. 1, 1913, p. 221.
[3] A. C. Lawson, op. cit., pp. 58, 59.
[4] A. L. Parsons, op. cit., p. 222.

a few degrees from vertical, and often they are slightly overturned. Such intense folding was naturally accompanied by other disturbances, and locally the beds are drag-folded, fractured, and faulted. In places differential movement between the softer slaty portions and the more competent arkosic phases of beds has resulted in fracture cleavage being developed in the slates (see photograph below). The relation of this secondary cleavage to the bedding is a useful criterion for determining the tops and bottoms of beds. Gradation in grain size, from relatively coarse-grained arkose at the bottom of a bed to very fine grained slate at the top, is occasionally seen.



Specimen of Timiskaming sediments (natural size) from Manitou stretch, showing the relation of fracture cleavage (oblique) to bedding (vertical). This structure was developed by differential movement between beds during the folding of the sediments.

A rather detailed study was made of the structure of the sediments in the vicinity of Esox lake (see Fig. 2). These are considered to form the southern limb of a syncline, the northern part of which has been removed by a fault along Manitou stretch. At both the east and southwest ends, the sediments nose out sharply, and bedding may be traced at intervals around the nose of the fold. A section across the sedimentary series from Canoe bay to Manitou stretch shows a basal conglomerate, which lies adjacent to massive lavas and contains a large number of water-worn pebbles of the older greenstone. North of the conglomerate the cleavage and bedding relationships in the slate, arkose, and quartzite indicate that the tops of the beds always face north.

The belt of sedimentary rocks that has been traced from Sucan to Pipestone lakes has not been completely mapped, so that it is impossible to make any conclusive statements concerning its structure. The structural data available,

however, suggest that this is the eastern extremity of a syncline area of sediments, the axis of which plunges westward from Sucan lake, where the sediments nose out rather abruptly.

Faulting.—As already indicated, the sedimentary rocks on Esox lake represent the south limb of a syncline. This implies that the northern portion must have been removed by faulting. Concrete evidence of faulting is found on the small islands opposite the logging camp in Manitou stretch. Here, well-stratified sediments strike N. 40° W., yet directly along the strike on the adjoining mainland

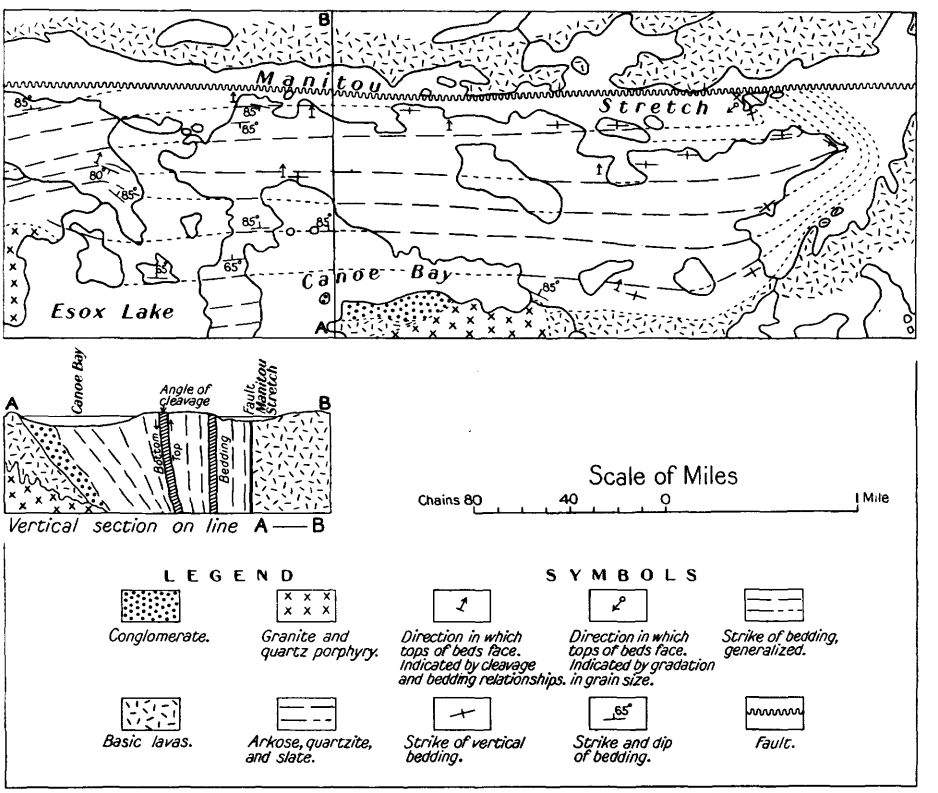


Fig. 2—Diagram showing structure of sediments in the vicinity of Esox lake.

massive basic lavas are found. This situation can only be explained by a fault. The fault truncates the strike of the sediments at an angle of 50 degrees at this point. The fault is expressed topographically by the straight and narrow east-west-trending valley occupied by Manitou stretch.

Correlation

The sedimentary series lies stratigraphically above the Keewatin rocks and corresponds with rocks of Timiskaming age found elsewhere in Northern Ontario. The structure and lithology of these sediments is similar to that of the Seine series which Lawson[1] has described in the Rainy lake country to the south. The presence of a basal conglomerate containing boulders of the underlying

[1]A. C. Lawson, op. cit.

greenstones indicates a period of erosion and is evidence of an unconformity between the Keewatin and Timiskaming rocks.

A similar belt of sediments of Timiskaming age was found in the Manitou-Stormy Lakes area to the north and was given the specific name of Manitou series.[1] It is possible that the Manitou series and the Timiskaming rocks discussed in this report may have once formed a continuous belt. However, the specific name of Manitou series has not been used for the assemblage of sedimentary rocks in the Straw-Manitou Lakes area. It seems expedient to discontinue this name, since the sediments have been traced beyond the confines of the Manitou country and, in addition, the term Timiskaming is sufficient to locate their position in the stratigraphic column.

The sedimentary series described in this report differs lithologically from the Timiskaming sediments in the adjoining Manitou-Stormy Lakes area in two respects: (1) There is a marked paucity of conglomerate in the sedimentary belts to the south in sharp contrast to the abundance of this rock in the vicinity of Upper Manitou and Stormy lakes. (2) No volcanic tuffs and agglomerates are found with the sediments in the southern area. In the Manitou-Stormy Lakes area a certain amount of these pyroclastics are intimately associated with the sedimentary rocks.

Pre-Algoman Intrusives

A few small areas of basic intrusives intersect the Keewatin greenstones and Timiskaming sediments. The rocks consist of gabbro, diorite, and quartz diorite, all of which are somewhat altered. Often it is almost impossible to distinguish these from coarse-grained phases of basic lava flows. This is especially true in isolated outcrops where relationships cannot be observed. In certain places, however, a definite intrusive contact may be seen. Dikes and irregular masses of diorite cut the sediments east of Canoe bay in Esox lake.

These intrusives are grey to greenish-grey in colour and of medium- to fine-grained texture. Under the microscope they exhibit a granitic texture. The feldspars are generally so decomposed that they cannot be accurately determined. The constituent minerals are chiefly altered orthoclase and plagioclase, and carbonate, sericite, and leucoxene. The original ferromagnesian minerals are largely altered to chlorite.

An occasional lamprophyre dike occurs in the area. These are generally too small to be shown on any geological map. They intersect the Keewatin greenstones and Timiskaming sediments, but their relationship to the Algoman granite and porphyries could not be determined. The lamprophyres are dark-coloured, rather fine-grained rocks containing much mica, usually biotite.

Algoman

Granites and Gneisses

So far as could be ascertained, all the acid plutonic rocks within the map area are part of the same batholithic intrusion, although there is often a considerable variation in composition and a gradation from one type to another. On Esox lake granite is intrusive into the Timiskaming sediments and is thus Algoman in age. The age of the remainder of the granite in the area cannot be so definitely stated, but in all probability it is also part of the same Algoman batholith.

[1]Jas. E. Thomson, op. cit., p. 13.

The rock may be generally described as a medium- to coarse-grained granite, generally massive but occasionally gneissoid. It ranges from grey to pink in colour. The proportion of hornblende to biotite varies with the locality, the hornblende variety being more abundant near the greenstone contacts.

Near the borders of the granite areas there is often a gradation to other rock types. In the stock on Esox lake the granite grades into a quartz porphyry. On the northeast side of Straw lake and eastward along the contact a grey quartz prophyry containing a large amount of free quartz occurs across a width of from 200 to 300 feet. To the north this grades into massive red granite.

In several places the contact between granite and the older greenstone is not well defined, but rather a contact complex is developed over a considerable area. For example, on Bluffpoint lake a contact zone containing granite, granodiorite, gabbro, and greenstone, sometimes recrystallized to amphibolite, occurs across a width of approximately one mile. The transition is roughly from granite to granodiorite and from granodiorite to gabbro near the greenstone body. A large number of inclusions of greenstone are found in the basic marginal phase of the batholith. It seems quite possible that assimilation of large amounts of the older lavas is responsible for the increasing basicity of the intrusive at the contact. On Konigson lake similar difficulty is encountered in any attempt to delineate the contact. The Keewatin rocks near the contact are agglomerate and tuff, which in places are altered to a fine-grained biotite gneiss and injected with granitic dikes. The contact phase of the granite is a dark-grey granodiorite containing inclusions of the gneissic greenstone. This contact phase is cut by pegmatitic dikes, which are probably later injections from the same magma that produced the granite.

On the original geological map of the area, McInnes[1] has differentiated the various phases of the batholithic intrusives on the basis of relative predominance of biotite or hornblende. The areas of "hornblende granite gneiss" occur near the older greenstone belts, while the biotite variety is found in the central part of the batholith. In a marginal note it is stated that there is a gradual transition from one type to another. In the adjoining Kakagi Lake area, Burwash[2] has found that at Atikwa lake the border phase of the granite, named "hornblende-biotite gneiss or granodiorite" on the geological map, is an older rock and is intruded by a younger "red biotite gneiss." At Bluffpoint and Konigson lakes the contact relationships of this same area of granite, as described above, suggested to the writer that the more basic marginal phase of the granite batholith is due either to differentiation within the granitic magma or to assimilation of large amounts of basic lavas near the contact. The latter theory is the more tenable, owing to the large number of xenoliths in the contact complex and the variety of rock types developed in this zone.

Under the microscope granites from several different points in the area show the characteristic mineral assemblage of such rocks. A thin section of granodiorite from the central part of Bluffpoint lake contains quartz, orthoclase, oligoclase, hornblende, biotite, epidote, magnetite, and apatite. The proportion of orthoclase to plagioclase is within the limits set for granodiorite.[3] A thin section of a more basic phase of the batholith near the greenstone contact on Bluffpoint lake shows the rock to be a normal gabbro. The feldspar is predominantly labradorite with a little orthoclase. Augite, hornblende, and biotite are the femic minerals, and magnetite and apatite are accessory constituents.

[1]Wm. McInnes, Manitou Lake sheet, Geol. Surv. Can., map No. 720, 1902.
[2]E. M. Burwash, Ont. Dept. Mines, Vol. XLII, pt. 4, 1933.
[3]W. Lindgren, Amer. Jour. Sci., Vol. IX, 1900, p. 269.

Acid Porphyries and Aplite

As already stated, the granite in places grades laterally into quartz porphyry. This is identical with the quartz porphyry that occurs in the form of dikes and irregular masses in the older greenstones and sediments. It is thus quite evident that the various porphyries and the granite are closely related and that all were produced from the same parent magma.

Quartz porphyry is by far the commonest type of these intrusives. It occurs largely as dikes, which were injected parallel or nearly parallel to the strike of the foliation in the adjoining rocks. Most of the dikes are less than 50 feet in width. The quartz porphyry is typically a greyish or cream-coloured rock, generally rather massive but sometimes schistose, and almost always distinguished from the other porphyries by the presence of distinct "eyes" of quartz. Feldspar porphyry differs from the quartzose variety only by the occurrence of feldspar phenocrysts instead of quartz.



Photomicrograph of typical quartz porphyry showing phenocrysts of quartz (Q), orthoclase (O), and oligoclase (P) in a fine-grained groundmass. (Crossed nicols, × 10.)

Granite porphyry differs from those already mentioned in that the phenocrysts occur in a rather coarsely crystalline or granitic groundmass. A dike of typical granite porphyry is found on Fahey lake. Quartz eyes up to a quarter of an inch in diameter occur in a pinkish-coloured groundmass with granitic texture. A stock of granite porphyry on Furlonge lake exhibits perfect crystals of pink orthoclase up to an inch in length in a granitic groundmass.

In the vicinity of Straw lake it is sometimes difficult to distinguish between intrusive porphyries and extrusive rhyolites and trachytes. They both have a grey or cream colour. In general, the acid lavas are much schisted, whereas the porphyries are fairly massive. Rhyolites with eyes of quartz are seldom seen, so that the presence of distinct quartz phenocrysts is always suggestive of the intrusive rock. The fact that there are two distinct ages of acid rocks in this vicinity is proved at several places south of Straw lake. The relationship is well shown a short distance west of the portage to Sucan lake. Here, a fine-grained, greyish-coloured acid lava with flow structure is intersected at about

right angles to the schistosity by a massive quartz porphyry dike containing distinct quartz phenocrysts. Study of a thin section of the acid lava showed it to be a rhyolite.

Some porphyry dikes contain a large amount of quartz. This is generally present as a network of small veins and stringers. The pattern formed by these veinlets suggests that they occupy tension cracks which were developed by shrinkage of the dike on cooling. Tourmaline and carbonate is sometimes associated with this quartz, and gold has been found in it.

On Esox lake the quartz porphyry is brecciated in places. This is especially noticeable south of the entrance to Canoe bay. The brecciation is quite pronounced near the sediments and gradually diminishes in amount away from the contact, until finally this rock type passes into ordinary massive quartz porphyry. The fragmental appearance is very noticeable owing to the presence of dark-coloured material in the matrix between the fragments of light-coloured porphyry. At the east end of Canoe bay the fragments in the porphyry are sometimes fairly well rounded, and the rock has the appearance of a pseudo-conglomerate. The origin of this brecciated porphyry was not exactly determined. However, the fact that it occurs at the periphery of the intrusive and gradually diminishes at increasing distance from the contact suggests that the breccia is related to shrinkage adjustments during the original consolidation of the magma rather than to later disturbances produced by diastrophic movements.

Aplite occurs in the form of dikes and irregular masses, but is not often found. It is generally a dense, reddish, fine-grained intrusive and is a finely crystalline equivalent of the granite. For this reason it is largely confined to the contact zone and is injected as a series of dikes which run parallel to the foliation of the intruded rock. Such aplitic dikes are commonly found in the belt of schisted lavas adjoining Reefer lake.

On a point on the southwestern side of Lower Manitou lake there is a small area of fine-grained greyish aplite, which grades southward into a rock with a more granitic texture. Microscopic examination shows the latter rock to be a quartz monzonite containing orthoclase, andesine, quartz, and ferromagnesian minerals, which are almost completely altered to chlorite. No well-defined intrusive contact could be found. As only a small amount of this rock was found it is included with the Algoman intrusives, but it resembles the older Laurentian intrusives found in the adjacent Manitou-Stormy Lakes area.[1]

Under the microscope the porphyries show distinct phenocrysts of quartz, orthoclase, and plagioclase (basic oligoclase to acid andesine) in a groundmass of quartz, feldspar, sericite, magnetite, chlorite, and carbonate. The quartz porphyry from Esox lake exhibits considerable granulation of phenocrysts due to shearing of the rock. Porphyries from other localities are not altered to any extent.

Keweenawan(?)

On the east side of Esox lake a dark-coloured diorite dike intersects the stock of granite and quartz porphyry. It is probably a part of the Keweenawan basic intrusives. The rock contains orthoclase, microcline, andesine, biotite, hornblende, and muscovite, and shows little alteration.

Pleistocene and Recent

There are no very extensive drift-covered sections in the area, but small patches of sand and clay soil occur everywhere in the depressions. Occasional

[1]Jas. E. Thomson, op. cit., p. 11.

areas of boulder clay, ground moraine, and low drumoidal hills of drift material were produced by the continental glaciation. The effects of glacial carving are everywhere in evidence. Glacial striae and grooves show the direction of ice movement to have been S. 20° W. to S. 50° W.

ECONOMIC GEOLOGY

Nature of the Gold Deposits

Gold is the only metal that has been found to date in commercially valuable deposits within the Straw-Manitou Lakes area. It occurs chiefly in quartz veins located in Keewatin lavas and fragmentals, but has also been found in porphyry masses. Pyrite, chalcopyrite, molybdenite, sphalerite, and galena are sulphides associated with the quartz veins. In places, they also contain carbonate and small amounts of tourmaline. Native gold occurs in the vein quartz and in the schistose wall rock. A small amount of the gold is carried in the sulphides associated with the deposits, but the larger part is lodged in the quartz between the sulphide crystals. The bismuth telluride, tetradymite, occurs on the Mosher-Grozelle discovery at Straw lake.

The gold deposits that have been uncovered to date are usually found in close proximity to bodies of Algoman porphyries, and there is every reason to believe that they are genetically related to these intrusives.

Prospecting Conditions

From a standpoint of working conditions, prospectors will find the area probably better than the average for Northern Ontario. All parts of the country are readily accessible by convenient canoe routes, rock outcrops are plentiful, and bush travelling is not especially difficult.

As previously mentioned, the gold deposits are genetically related to Algoman porphyritic intrusives. It thus seems only logical to assume that those areas containing schistose or fractured Keewatin lavas or Timiskaming sediments that are intruded by porphyries or related rocks should be of most promise to prospectors. The Straw lake section displays these theoretically ideal geological conditions. In the vicinity of Straw, Floyd, and Mister lakes the acid lavas are highly schistose, and in the greenstones and sediments between Straw and Kaiarskons lakes porphyry intrusives are quite numerous. Previous to the summer of 1933 this area does not seem to have received much attention from prospectors.

In the vicinity of Grave lake porphyry dikes intersect the massive greenstones and quartz veins occur. Some claims were staked in this neighbourhood many years ago. Most of the veins are of white vitreous quartz; some of them contain pyrite, chalcopyrite, and molybdenite in small amounts. Three grab samples were taken from the most promising-looking material in three different veins on the shore of Grave lake. None of these gave any gold values when assayed.

A number of porphyry dikes are found around the southern part of the large expanse of Lower Manitou lake. The greenstones are sometimes well sheared in this section, and some quartz veins may be seen. Most of those observed were small and practically unmineralized. It is known that gold was found in small amounts at the Barker mine (H.W. 339), located west of Barker bay, and at the Petrie mine (H.W. 515), situated west of Reefer lake. These were prospected around 1900, but no bodies of gold ore were ever found.

In the vicinity of Esox lake a stock of quartz porphyry and granite intrudes the sediments and greenstones, but very little mineralization was observed.

Massive sulphide bodies occur in a few places throughout the area. They are chiefly pyritic replacement masses in the greenstones, but sometimes pyrrhotite and a trace of chalcopyrite are found with the pyrite. Several lenticular masses of almost solid sulphides are found on Furlonge lake near a stock of granite porphyry. A little sulphide mineralization was also noticed in the porphyry near its southeastern margin. A considerable amount of surface trenching was done on these sulphide bodies several years ago. It is said that the investigators were endeavouring to develop a pyrite deposit. The largest exposure of sulphide mineralization occurs on the southwestern shore of the lake. It occupies an irregular area about 60 feet in length and 25 feet wide. A grab sample of this material contained no gold values. Magnetic disturbance in the greenstone area near the granite contact north of Kaiarskons lake suggests the possible occurrence of covered bodies of similar sulphides. Southwest of Sucan lake on the shores of a small lake near the Kenora–Rainy River boundary a zone of sulphides was found near a porphyry dike. Prospectors have reported that when this sulphide material was thoroughly roasted and carefully panned one or two gold colours were seen, but a grab sample taken by the writer from this location gave no gold value when assayed.

A few siliceous carbonate zones occur in the basic lavas throughout the area. These outcrop as rusty bands, owing to surface oxidation of the ankerite. They sometimes contain veinlets of quartz and traces of pyrite and chalcopyrite. A band of siliceous carbonate rock, 8 to 10 feet wide, runs across some of the islands in the northern part of Dogfly lake. A grab sample of this material was assayed but contained no gold.

In the vicinity of Harris, Dogfly, and Vista lakes, and Manitou stretch the lavas are generally massive, and granite and porphyries do not intrude the greenstones to any extent. Little evidence of mineralization was observed in these localities.

Description of Properties

OLD MINING LOCATIONS

Barker Mine

The Barker mine was located on claim H.W. 339 about a mile west of Barker bay on Lower Manitou lake. In 1899 a shaft was sunk 62 feet, and some surface trenching was done.[1] There is little evidence of any vein or mineralization. Some white quartz stringers may be seen in the old trenches.

Petrie Mine

In 1899 a shaft was sunk 60 feet on a quartz vein on claim H.W. 515 by D. C. Petrie and associates.[2] This property is located about half a mile west of Reefer lake. At the shaft a vein of white vitreous quartz may be traced 250 feet. The vein occurs in fine-grained gneiss and chlorite schist, both of which are cut by an occasional aplite or granite dike. South of the shaft the vein is 4 or 5 feet wide. No mineralization was noted in the vein or in the broken quartz on the dump. An assay sheet of 13 samples, taken from the shaft in 1900, was submitted to the writer by D. C. Petrie. This shows gold values ranging between 0.096 and 0.330 ounces per ton.

[1]Jas. A. Bow, Ont. Bur. Mines, Vol. IX, 1900, p. 63.
[2]Ibid, p. 63.

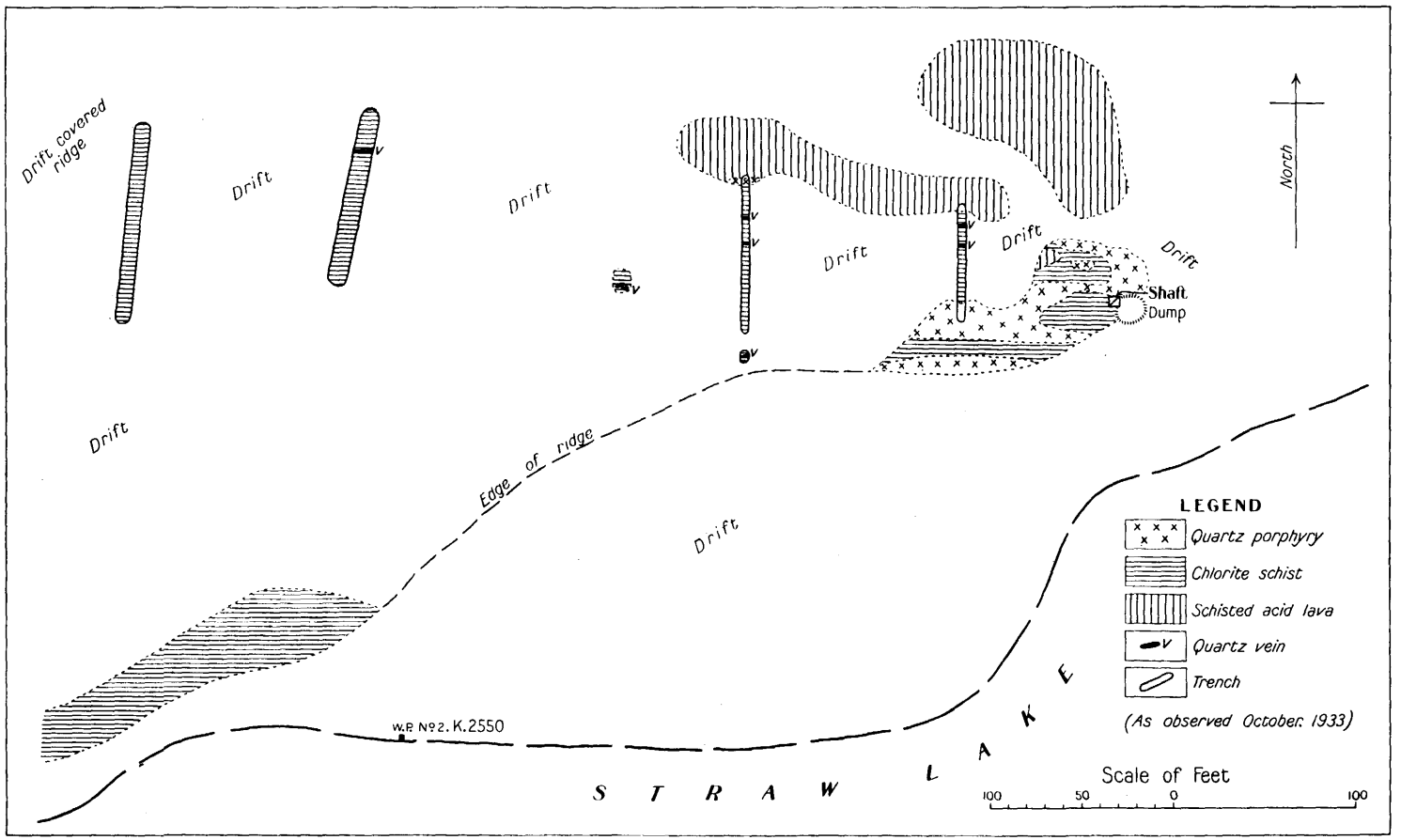


Fig. 3—Geological sketch map of the showings on the Konigson claims, Straw lake.

Gold Standard Mine

The Gold Standard mine is located on a small peninsula on the northwest side of Nelson lake (claim H.W. 271). During 1902 and 1903 a shaft was sunk 95 feet and some crosscutting was done.[1] The only surface exposure of the vein is in a shallow test pit near the water's edge, about 25 feet from the shaft. The vein strikes north and south and is about 6 feet wide. The vein material is white vitreous quartz containing a little black tourmaline and some carbonate. On the dump near the shaft an occasional piece of quartz can be found which contains pyrite and chalcopyrite in fracture zones. A picked sample of the best mineralized quartz on the dump assayed 1.80 ounces per ton in gold. There is no sign of the vein at the collar of the shaft, and Carter states that it was not picked up underground in the shaft or crosscut.

The rock in the vicinity of the vein is massive gabbroic greenstone interbanded with agglomerate and is intersected by two narrow quartz porphyry dikes near the shaft.

STRAW LAKE SECTION[2]

Konigson Claims

Edward Konigson owns two mining claims, K. 2,549 and 2,550, on the north shore of Straw lake. A short distance from the water's edge Mr. Konigson was able to pan gold from a narrow rusty sheared zone at the contact of chlorite schist and an irregularly shaped mass of intrusive quartz porphyry. A shaft was sunk to a depth of about 40 feet at this location. At about 10 feet from the surface a quartz vein and mineralized schist were intersected. The vein material, which widens rapidly and at a depth of 30 feet is 9 feet wide, consists of quartz, carbonate, and schist, all rather heavily impregnated with pyrite, and a trace of chalcopyrite, and carries co mercial values in gold.

This showing was examined in the spring of 1933 by Wm. ("Hardrock Bill") Smith and optioned by him for T. H. Rea, of Toronto. Surface trenching was carried on west of the shaft, revealing a sheared zone striking E. 10° S. in chlorite schist. It contains small irregular masses and stringers of quartz and carbonate with a trace of sulphides. A little gold is reported to have been panned from some of this, but it is quite different from the vein material encountered in the shaft. A grab sample of heavily mineralized sulphide ore taken from the shaft by the writer assayed 2.65 ounces of gold per ton.

Microscopic examination of polished samples of typical ore, consisting of chlorite schist and quartz both heavily mineralized with pyrite, shows a considerable amount of fine-grained, pale-coloured gold. By far the greater proportion of the gold is lodged in the quartz between crystals of pyrite. Small blebs of gold are also observed within the sulphide. Some of the pyrite crystals are fractured.

The option of T. H. Rea on this property was dropped during the early months of 1934.

The rocks on the Konigson claims are chiefly interbedded acid and basic lava flows, which are generally sheared and are intersected by a few masses of quartz porphyry. The gold ore in the shaft is undoubtedly genetically related to the nearby irregular mass of quartz porphyry.

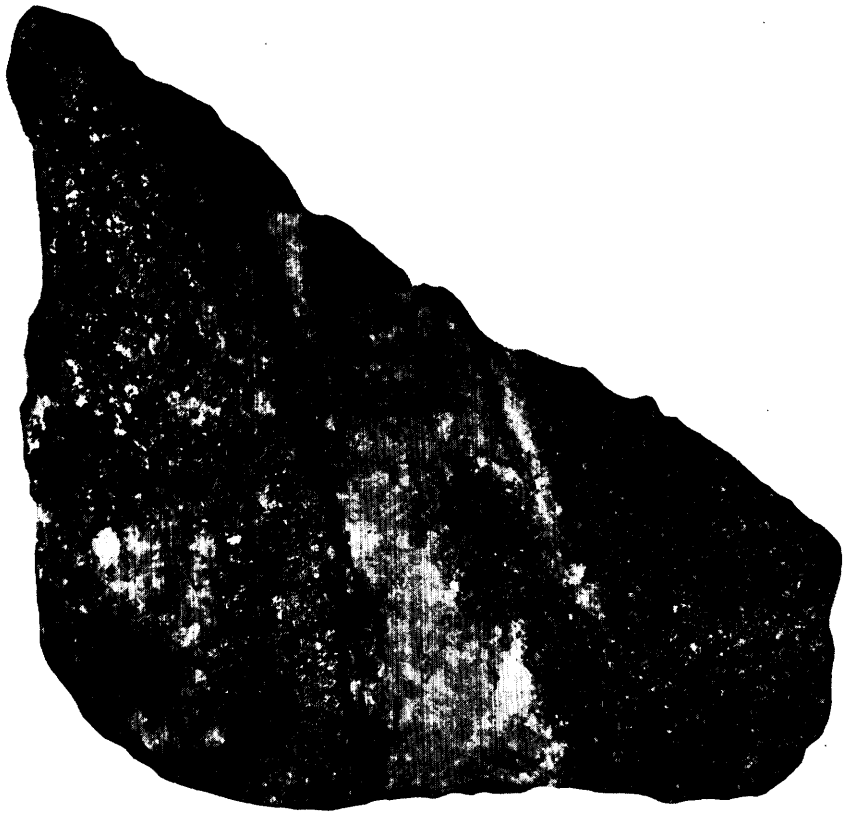
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[1] W. E. H. Carter, Ont. Bur. Mines, Vol. XIII, pt. 1, 1904, p. 68.

[2] A more detailed description of some of these properties will appear in a later report covering field work in 1934.

Mosher-Grozelle Claims (Straw Lake Beach)

A gold discovery was made on the south side of Straw lake in July, 1933, by Murdock Mosher and Fred Grozelle. On a ridge about 10 chains south of the lake shore (claim K. 3,944), they located a quartz vein in a sheared zone in acid lava and agglomerate. This sheared zone strikes N. 80° E. and dips about vertically. Surface development on the vein was carried out during the summer and autumn. By the time of the fall freeze-up, gold had been found by stripping and trenching at intervals for a distance of 675 feet along the main sheared zone.



Specimen of typical gold-bearing vein material (one-half natural size) from the Konigson shaft, Straw lake. The quartz (white) is heavily mineralized with pyrite. This particular sample assayed 2.65 ounces of gold per ton.

Between the trenches on the east and west end, any vein material that may be present was covered by several feet of overburden for a distance of 338 feet. On the east end, a section of the vein is close to, but not directly on, the strike of the western portion of it. The vein material in the showing consists of mineralized quartz and schist containing pyrite, chalcopyrite, galena, a bismuth telluride, and native gold. Traces of magnetite and sphalerite are found by microscopic examination of the ore. In several places along the exposed part of the vein visible gold has been found, closely associated with the telluride. Some samples show rather spectacular amounts of native gold, which occasionally occurs in coarse fragments.

The vein quartz is generally a white or creamy-white colour but on the weathered surface is reddish, due to the oxidation of sulphides. It is somewhat fractured and contains variable amounts of sulphides. At the extreme western end the quartz is only 2 to 4 inches in width. The wall rock is chlorite and



Polished section of ore from the Mosher-Grozelle vein, showing the association of pyrite (P), tetradymite (T), galena (Ga), and gold (G). The black portions are gangue. Narrow bands of galena may be seen within the tetradymite. (× 160.)

sericite schist containing pyrite. This section does not carry commercial values in gold.

Farther east a section of the vein has been exposed continuously for about 75 feet, and a pit 6 feet in depth has been sunk at the spot where the vein disappears under drift. In this section, the vein is in the form of a lode. The main quartz leader has a maximum width of 25 inches, but it branches into a

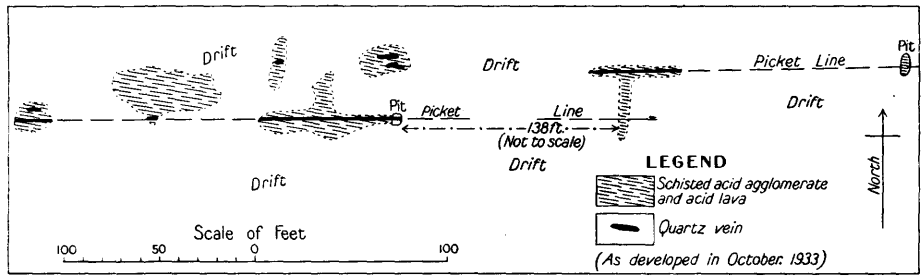
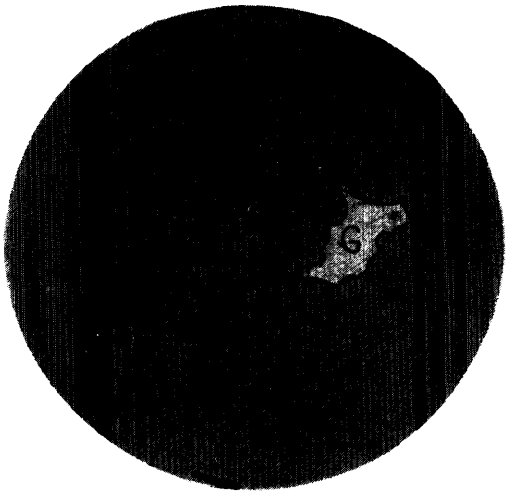


Fig. 4—Geological sketch map of the showing on the Mosher-Grozelle claims, Straw lake.

number of irregularly connected masses of quartz 3 to 6 inches in width. Silicified sericite and talcose schists occur with the quartz. The quartz contains some pyrite and a trace of chalcopyrite. Native gold may be seen in the fractured quartz along with the soft greyish-white telluride. The silicified schist is impregnated with fine sulphides.

The widths of this vein material that may make ore will necessarily be determined by sampling rather than limited by any geological boundaries. Sampling in this section indicates that the quartz carries much better values than the schist. Channel samples taken by Mr. Mosher revealed values all the way from 0.02 to 0.1 ounces per ton in gold for varying widths of mineralized schist, and the best section of the quartz assayed 1.52 ounces across 25 inches.[1] A channel sample across 43 inches of vein material averaged 0.96 ounces per ton in gold. Other samples show values of 0.34 ounces across 21 inches; 0.14 ounces across 54 inches; and 0.20 ounces across 46 inches.

About 300 feet east of the above location vein material has again been picked up. The main quartz vein is 18 to 21 inches in width and contains sulphides, native gold, and telluride. A channel sample across 21 inches of quartz assayed 2.37 ounces per ton in gold, and in a pit 5 feet deep a similar



Polished section of ore from the Mosher-Grozelle vein, showing the association of pyrite (P), chalcopyrite (Ch), and gold (G). The dark lines are fractures in the pyrite. (× 160.)

sample ran 0.58 ounces across 3 feet 4 inches. The walls of the vein are silicified sericite schist well mineralized with pyrite. A channel sample across 4 feet 10 inches of this schist assayed 0.07 ounces per ton in gold. A seam 1½ inches wide in this material carries a large amount of native gold and telluride.

The telluride in the ore has been identified by J. Ellis Thomson as tetradymite. In hand specimens it is a very soft mineral with a steel-grey colour. It has a metallic lustre and one well-defined cleavage. The tetradymite is almost always closely associated with native gold. Professor Thomson made an examination of the gold ore from this property for the writer and reported as follows:[2]—

Four specimens of the ore from the Mosher-Grozelle vein at Straw lake were examined in polished section under the microscope. In two of these tetradymite and galena were the main metallic minerals, with pyrite, chalcopyrite, and native gold present in minor quantities. In the other two, pyrite is the chief metallic mineral; smaller quantities of galena, sphalerite, tetra-

[1]All visible gold was removed from the samples. The values are published by kind permission of W. E. Segsworth.

[2]Written communication.

dymite, magnetite, chalcopyrite, and native gold are also present. These metallic minerals are associated with a mixed quartz, sericite, and carbonate gangue.

The modes of occurrence of the metallic minerals are as follows: Pyrite occurs as rounded crystals or crystal fragments of cubic habit, sometimes showing a rough cubic cleavage, and is disseminated through the quartz gangue; magnetite, as ragged remnants of small granular areas scattered through the quartz gangue; sphalerite and chalcopyrite, as small blebs or short stringers, the former in the quartz gangue and the latter in the quartz or carbonate gangues and in a few of the larger pyrite crystals; tetradymite, galena, and native gold, along with carbonate, form the filling of small fractures in the quartz gangue. They also occupy fractures in the larger pyrite crystals, but to a much lesser extent. The galena, which was not observed with the pyrite crystals, occurs as replacement remnants associated directly with the replacing mineral, tetradymite.

So far as can be judged from the examination of these four specimens, the order of mineral depositions seems to have been as follows:—

1. Pyrite and magnetite.
2. Quartz.
3. Carbonate and sphalerite.
4. Galena.
5. Tetradymite and chalcopyrite.
6. Native gold.

There must, however, have been some overlapping of the first two of these stages, while the last three were undoubtedly nearly contemporaneous.

A chemical analysis of the purest sample of tetradymite that was obtained from the showing was made at the Provincial Assay Office. Owing to the intimate association of gold and telluride, it was impossible to remove all the native gold from the sample, but as much as possible was picked out. The chemical composition of the material analysed is indicated below:—

	Per cent.	Molecular proportions	Tetradymite $Bi_2(TeS)_3$	Pyrite	Gold	Iron oxide
Bismuth	26.66	0.128	0.128	.....	.....	.....
Tellurium	18.42	.144	.144	.....	.....	.....
Sulphur	1.92	.060	.048	0.612	.....	.....
Gold	.52	.003	.....	.....	0.003	.....
Iron[1]	4.21	.073	.....	.006	.....	0.067
Lead	trace	.....	.....	.....	.....	.....
Silver	trace	.....	.....	.....	.....	.....
Mercury	none	.....	.....	.....	.....	.....
Antimony	none	.....	.....	.....	.....	.....
Copper	none	.....	.....	.....	.....	.....
Total	51.73[2]	.....	.....	.....	.....	.....

[1]Iron is mostly in the oxide form; very little sulphide.
[2]The remainder of the sample is gangue.

Assuming that all the tellurium is combined with the bismuth, the composition of the tetradymite is calculated to be: 57.2 per cent. bismuth, 39.5 per cent. tellurium, and 3.3 per cent. sulphur.

The rocks on the Mosher-Grozelle group of claims, K. 3,943-3,946, on the south side of Straw lake are largely schistose acid lavas and fragmentals. These are intruded by quartz porphyry dikes. Microscopic examination of a thin section of the lava from a point about 400 feet south of the vein revealed it to be a rhyolite. In hand samples it is a very fine-grained, light-grey rock. Under the microscope it exhibits a felsitic texture and contains small phenocrysts of orthoclase and a little plagioclase. These are embedded in a fine-grained groundmass of quartz, feldspar, and some carbonate. Near the southwest corner of claim K. 3,943, the acid lavas are interbedded with the basic variety.

The rock in the vicinity of the vein and to the west is distinctly fragmental, and is very probably a brecciated acid flow. The fragments, which are small

and considerably elongated due to schisting, are of light-coloured material similar to the acid lavas.

Lucy Claims (Straw Lake Syndicate)

In the fall of 1933, Wm. Lucy discovered gold on the south side of Straw lake on claims K. 4,016 and K. 4,017, in a feldspar porphyry dike, which contains a network of quartz veins and stringers. No test pits had been sunk on the showing at the time of the writer's visit. The dike, which intrudes schistose basaltic lava, had been traced a considerable distance by stripping the thin veneer of soil and moss from the surface. It is reported that gold may be panned at several places along the exposed section of the dike.

The eastern exposure of the dike has been traced 150 feet across a ridge. Here it strikes E. 10° S., dips vertically, and is about 7 feet wide. The schist near the contact is mineralized with small cubes of pyrite. The porphyry contains crystals of feldspar up to a third of an inch in length. It is somewhat carbonated and carries some very fine grained sulphides. The quartz is white and contains some carbonate but no sulphides. The quartz veinlets are from 1 to 4 inches in width. A representative grab sample of the quartz from several of these veinlets assayed 0.14 ounces per ton in gold. A similar sample of the mineralized porphyry showed only a trace of gold.

Five hundred and sixty feet across a swamp to the northwest a similar dike, which may be a continuation of the one mentioned above, but which strikes E. 35° S., has been traced 400 feet across a hill. It is about 12 feet wide and is intersected by a number of quartz veinlets. A grab sample of the quartz assayed 0.01 ounces per ton in gold, and a chip sample across 8 feet of porphyry and quartz also carried 0.01 ounces.

MANITOU LAKES SECTION

The properties in this group have been described in a previous report.[1] As development work has been done on a few of these since that time, they were revisited in 1933.

Merrill Claims

During the summer of 1933 Charles Merrill and associates did a considerable amount of development work on claims located about a mile southwest of Upper Manitou lake. In the group there are 9 claims, including the old Swede Boy location, which was worked in 1895. A new vein was uncovered in 1932 about 300 feet east of the Swede Boy vein.

The newly located vein follows a well-defined sheared zone in massive gabbroic greenstone. The sheared zone strikes N. 30°-35° E. and dips at an angle of 65° to the southeast. At the time of the writer's visit (September), vein material had been picked up at intervals in trenches for a distance of 1,065 feet along the strike.

At the northeast end of the original discovery the main vein is 18 inches wide, but there are quartz stringers in the highly sheared chlorite schist on either wall. The quartz is white and sugary with seams of chlorite running through it. Native gold is found in considerable amount in the quartz, especially in the vicinity of fractures containing chlorite. To the southwest the vein runs into a swamp but is picked up about 600 feet along the strike. A trench 90 feet in

[1]Jas. E. Thomson, op. cit.

length at this point reveals quartz and silicified schist across a width of about 10 feet in the sheared zone. This material is impregnated with fine-grained sulphides, principally pyrite with traces of chalcopyrite. Gold can be panned from all parts of the vein at this place, and native gold has been observed. A chip sample taken by the writer across 3 feet of vein material assayed 0.16 ounces per ton in gold.

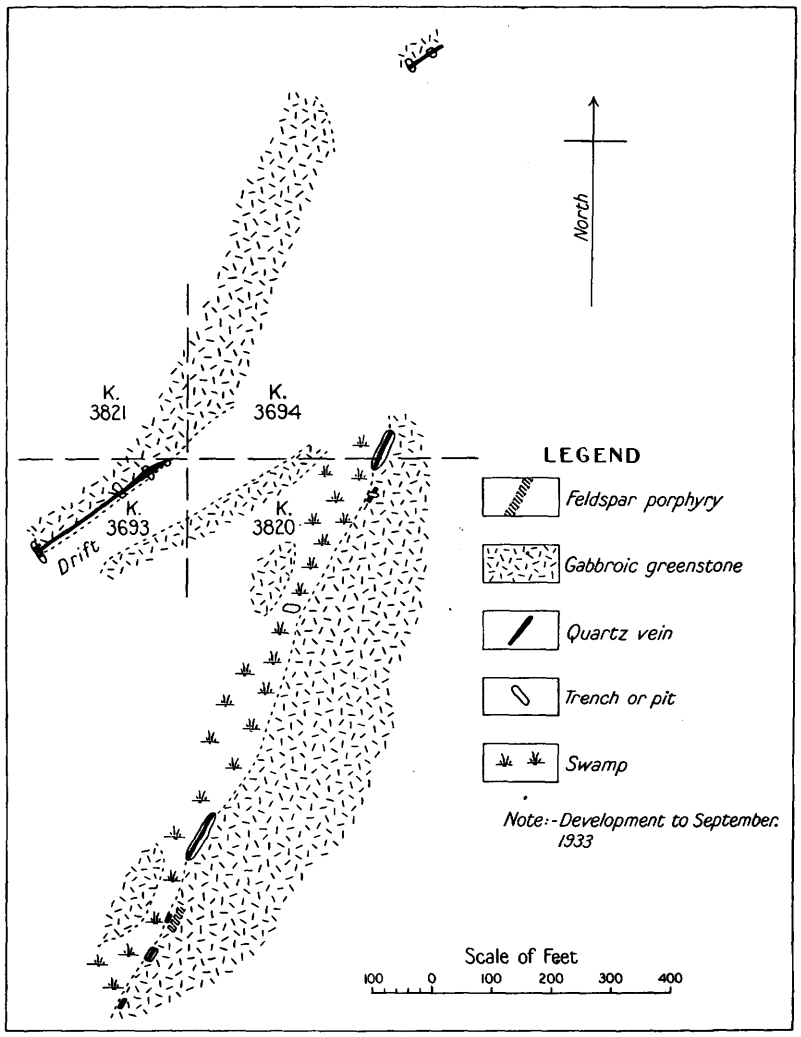


Fig. 5—Geological sketch map of the showing on the Merrill claims, Upper Manitou lake.

About 150 feet farther along the strike, quartz was uncovered across a width of 6 to 18 inches at the time of the writer's visit. A considerable amount of chalcopyrite is present at this place. A grab sample of this vein material assayed 4.64 ounces per ton in gold.

In December, 1933, the Merrill claims were optioned by Arnold Hughes and associates. Surface trenching and test-pitting was carried on during the summer of 1934.

Gaffney Claims

The claims of Frank Gaffney and associates on Manitou island in Lower Manitou lake were optioned by David Angus, of Haileybury, in the fall of 1933. A diamond-drilling programme was carried out on the showing in the early months of 1934, but the property was subsequently dropped.

Manigoon Syndicate

In the winter of 1933, the Manigoon syndicate acquired claim H.W. 66 on the north shore of Mosher bay in Upper Manitou lake. A 2-stamp test mill was erected on the property.

The showing consists of a network of small quartz veins in the marginal phase of a quartz porphyry dike and in the adjoining chlorite schist. The vein system has been stripped for 21 feet along the strike and has a maximum width of 12 feet. Part of the vein contains a considerable amount of fine-grained pyrite. Gold can be panned from the rusty gossan overlying the vein. Three chip samples taken by the writer across the vein at different places gave the following assays: 0.01 ounces, 0.01 ounces, and a trace of gold. Work was discontinued on the property in the spring of 1933.

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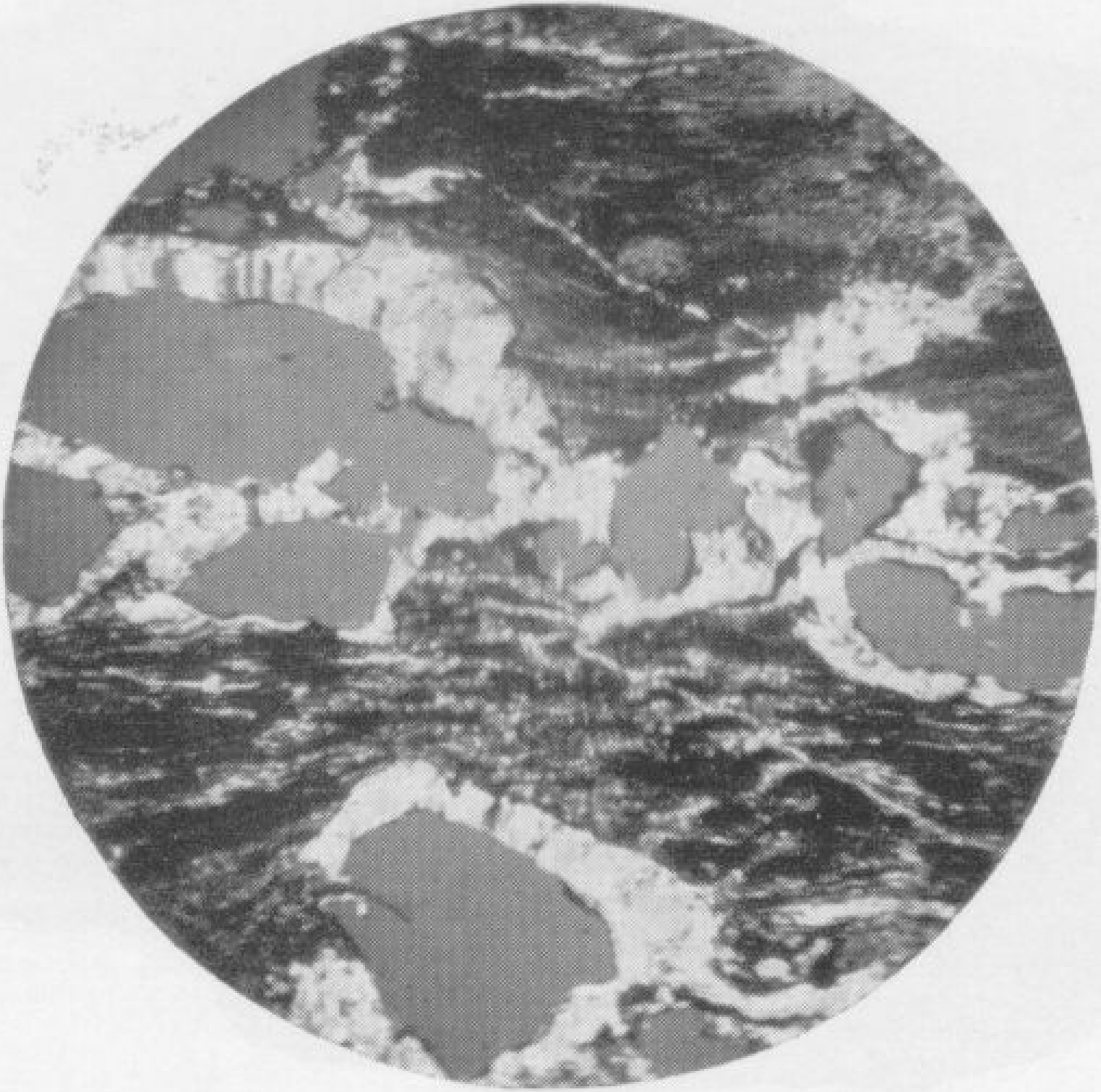
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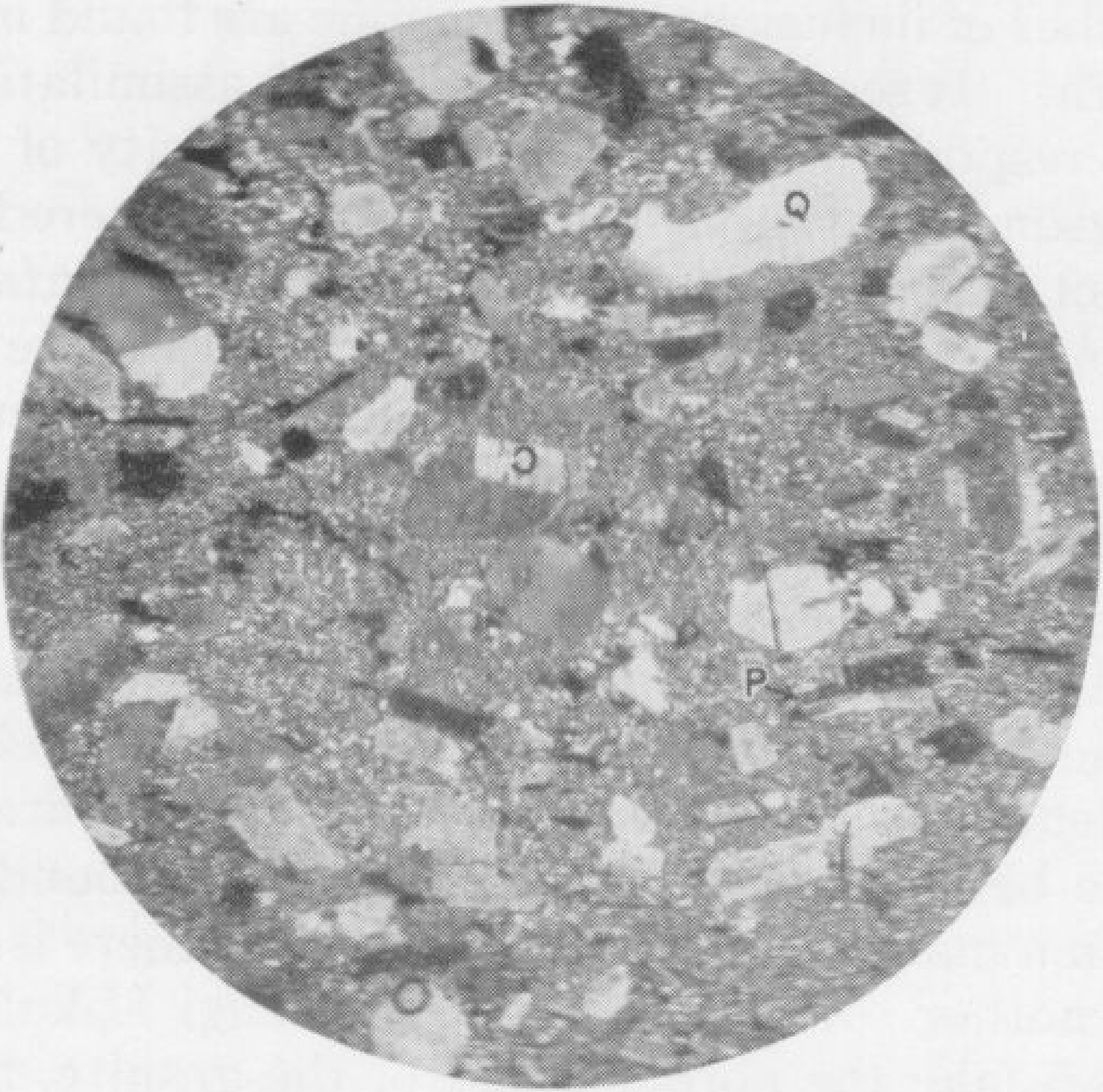
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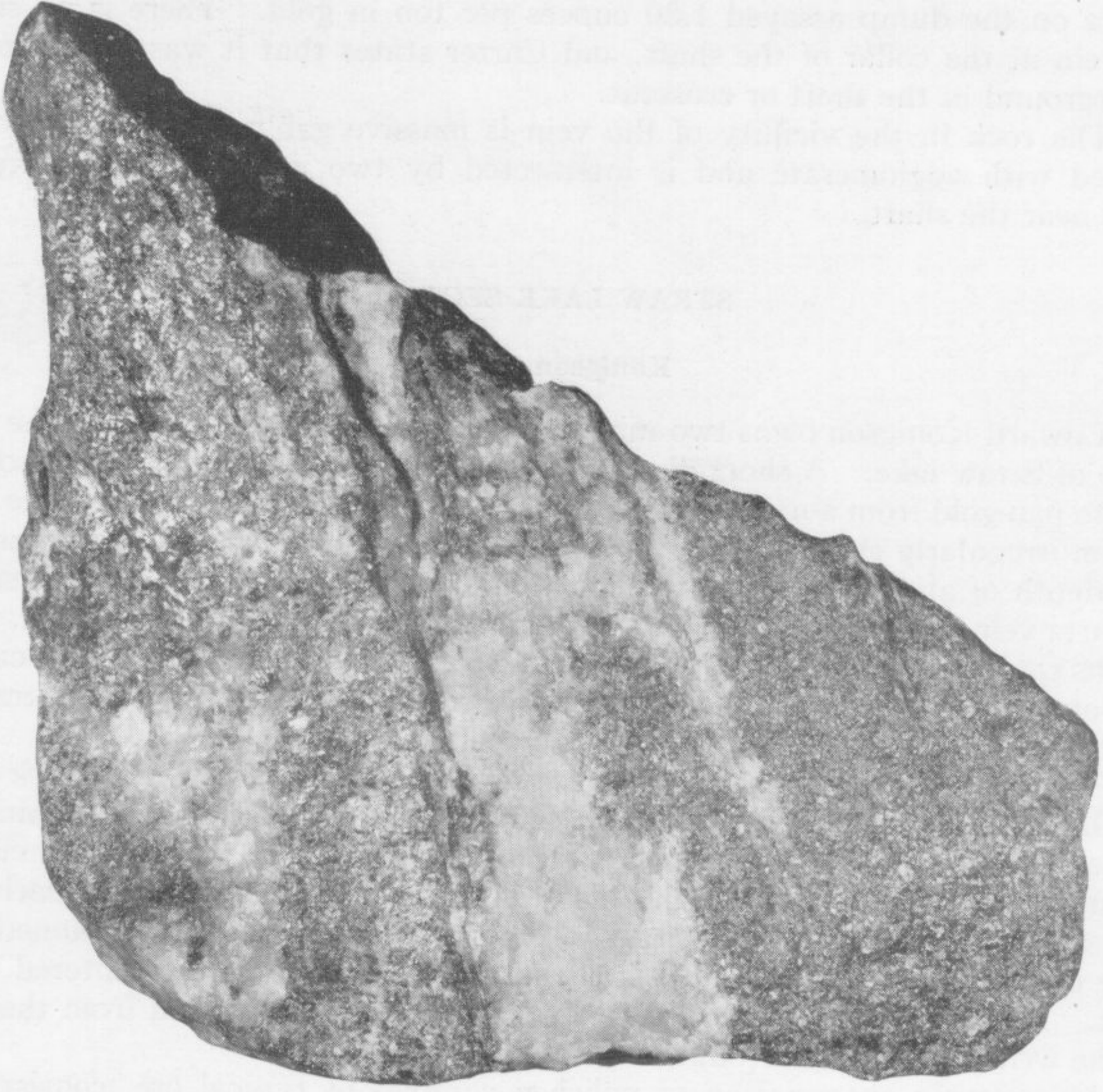
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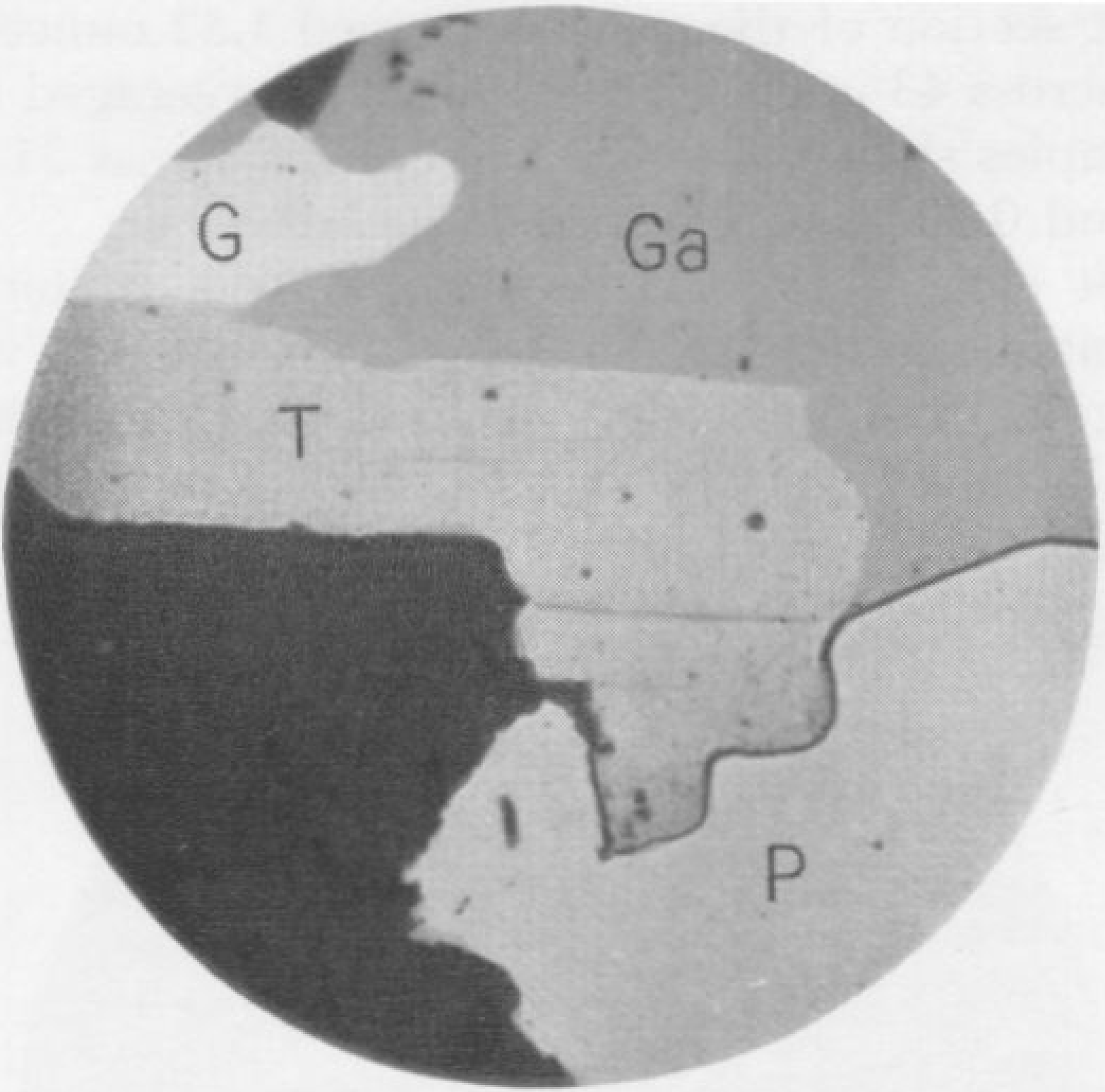
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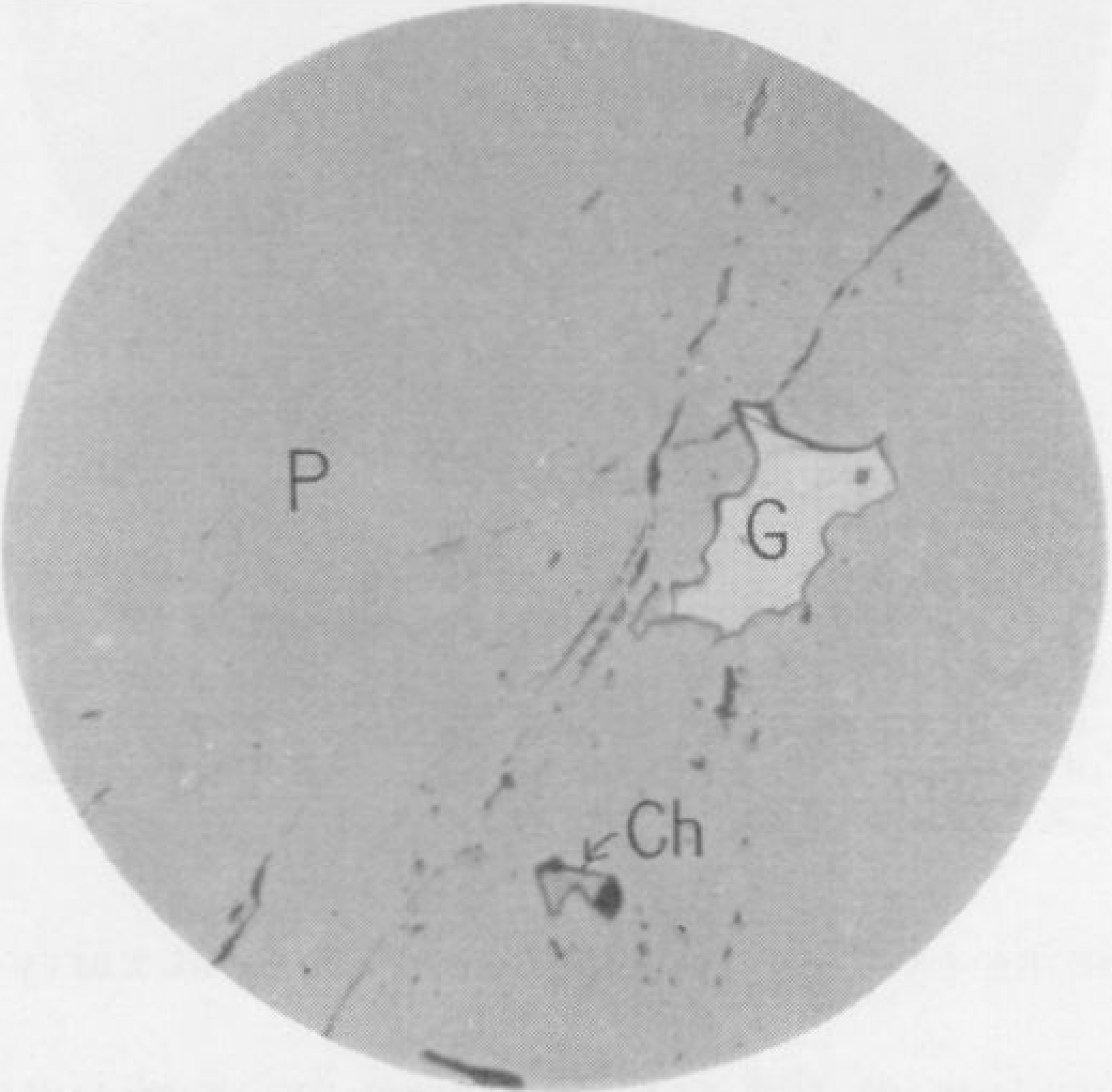




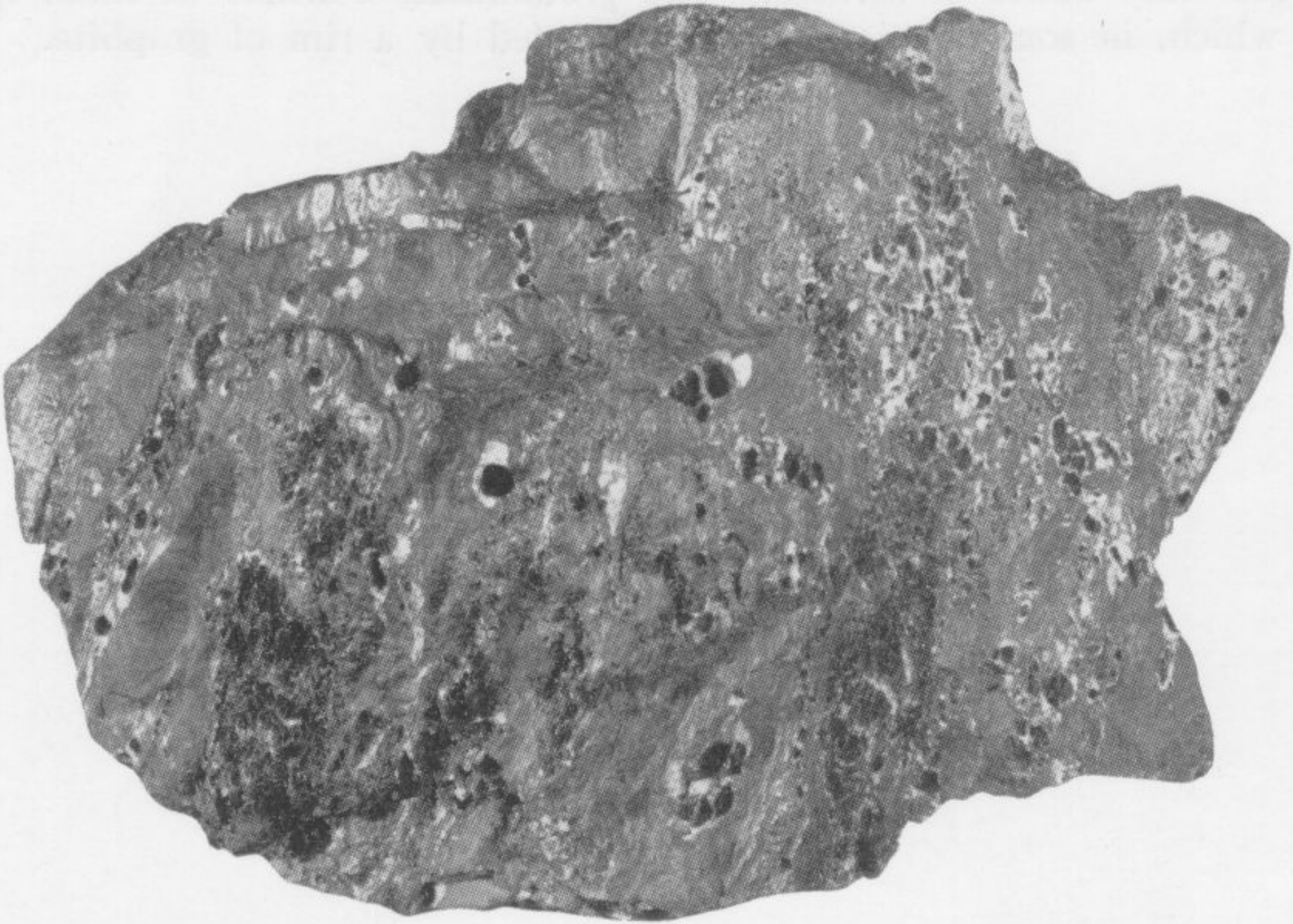

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RAINY RIVER
KENORA

PROVINCE OF ONTARIO

DEPARTMENT OF MINES

HON. PAUL LEDUC, *Minister of Mines* THOS. W. GIBSON, *Deputy Minister*

FORTY-THIRD ANNUAL REPORT

OF THE

ONTARIO DEPARTMENT OF MINES

BEING

VOL. XLIII, PART V, 1934

Natural Gas in 1933, by R. B. Harkness - - - 1-51

Petroleum in 1933, by R. B. Harkness - - - 52-56

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NATURAL GAS IN 1933

By R. B. Harkness

General

The production of natural gas in 1933 was 7,166,659 M cubic feet, valued at $4,523,084, which makes natural gas fourth in value of mineral production in Ontario.

The year 1933 was, on the whole, very mild in temperature; the months of January to April were the mildest for many years, which compensated for the colder autumn months. This, with the economies practised by consumers in general and the reduction in the total number of consumers, is the reason for a loss in production in 1933 of 219,595 M cubic feet. The greatest reduction was in the Tilbury field, where the production was 200,000 M cubic feet less than in the previous year. An increase in production was noted in the Haldimand field of 70,000 M cubic feet, and in the Dawn field of 100,000 M cubic feet.

Table I shows a comparison by fields of the production of natural gas for the past four years.

TABLE I—NATURAL GAS PRODUCTION BY FIELDS, 1930-1933

County	Field	1930	1931	1932	1933
		M cu. ft.	M cu. ft.	M cu. ft.	M cu. ft.
Essex	Kingsville	4,999,278	4,376,184	4,506,072	4,201,704
Kent	Tilbury				
	Dover	459,112	338,422	275,958	252,694
Lambton	Dawn	131,647	130,198	170,671	265,061
	Oil Springs				
Middlesex	Crumlin	300	300	.....	.....
Elgin	Bayham	48,018	43,536	45,708	45,968
Norfolk	Norfolk	277,971	312,535	365,638	346,621
Lincoln	Lincoln				
Haldimand	Haldimand	1,479,032	1,590,452	1,453,864	1,524,251
Wentworth	Wentworth				
Brant	Onondaga	58,637	170,521	140,612	121,578
Bruce	Amabel	858	516	500	500
Welland	Welland	408,475	377,566	351,616	333,619
Wells in surface drift	Howard and Sarnia	20,088	19,304	15,515	14,663
Private wells	.....	60,000	60,000	60,000	60,000
Total produced		7,943,416	7,419,534	7,386,154	7,166,659
Value		$5,061,588	$4,635,497	$4,719,297	$4,523,084
		M cu. ft.	M cu. ft.	M cu. ft.	M cu. ft.
Imported mixed gas		144,577	102,141	111,727	97,075
Manufactured gas		3,248	.....	.....	.....
Total distributed		8,091,241	7,521,675	7,497,881	7,263,734

The number of consumers in the province, for the first time on record, has shown a loss, viz., 1,698 less than in 1932. This loss in consumers is mainly in Hamilton and the Border Cities, which may be attributed to a loss of popula-

tion. In Hamilton, many consumers of previous years only used gas when electricity failed, or to supplement electricity as fuel. The quantity used per consumer shows a loss over the previous year, the figures for which were considered to be a minimum consumption. This may be attributed to the use of cheaper fuels, which entail more time and labour, as well as the keener competition of electricity for heating water.

TABLE II—DOMESTIC CONSUMPTION OF NATURAL GAS, CAPITAL INVESTED, AND WAGES PAID, 1921–1933

Year	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	58,609	5,937,316	101.3	$17,328,757	632	$592,606
1922	63,229	6,028,947	95.3	17,769,664	692	539,072
1923	62,352	6,210,459	99.6	25,570,972	603	633,365
1924	61,100	5,933,595	97.1	24,781,723	727	639,167
1925	62,338	5,300,424	85.6	26,111,387	692	625,826
1926	63,695	5,595,521	87.8	30,500,874	860	842,305
1927	66,818	5,210,315	78	31,987,879	1,123	1,148,339
1928	70,259	5,699,553	71.2	36,601,828	1,209	1,497,999
1929	80,991	6,336,873	78.2	35,162,736	1,323	1,529,367
1930	84,135	6,332,519	75.2	36,162,268	1,328	1,545,648
1931	86,050	5,607,744	65.1	42,921,142	1,241	1,383,286
1932	86,631	5,409,154	62.2	45,982,719	893	1,059,643
1933	84,933	5,102,340	60	51,766,592	958	958,336

[1]This includes capital invested in drilling, producing, and distributing.

The price of natural gas will show a slight decrease, owing to rate reductions and discount in certain areas.

Following the investigation into gas reserves in 1921, it was considered advisable to discourage the use of gas in large volumes. The retail rates were, in consequence, made to penalize the large consumer, by an increase with every ten thousand cubic feet used. Twelve additional years' experience and a study of gas reserves has shown that the reserves are much greater than anticipated, and the main distributing companies have prepared to serve their customers indefinitely. It has now been considered advisable to bring gas rates more in line with rates charged for other commodities by charging either a flat rate or, preferably, encouraging its use by giving a lower rate for larger consumption. Rates are gradually being brought in line with this principle.

Gas Wells Drilled in 1933

There was little exploratory drilling in 1933. One well was drilled in Maidstone township, Essex county; one in Orford township, Kent county; one in Chatham Gore, Kent county; one in Ekfrid township, Middlesex county; and one in Puslinch township, Wellington county. One well was begun in Sarnia township, Lambton county, to test deep horizons.

Further drilling was carried out in an endeavour to enlarge the fields in Raleigh township, Kent county; Dawn township, Lambton county; Middleton township, Norfolk county; and in Tuscarora, Indian reserve, Brant county.

The remainder of the drilling was within the limits of the Haldimand, Norfolk, and Welland fields, with the greatest activity in Walpole township following the success of 1932.

Over 90 per cent. of the wells drilled are owned by small independent producing companies, who drill under contract to sell their output to a distributing company.

The open flow of new wells was 15,826 M cubic feet, as compared with 8,870 M cubic feet in 1932. Fifty-one drilling rigs were in operation in 1933, and a total of 234,869 feet was drilled, an increase over 1932 of 58,372 feet. The number of wells abandoned increased by 13, and the number of dry wells drilled showed the greatest percentage of increase, being 67 in 1933 as compared to 32 in 1932. The acres under lease decreased over 200,000, but the rentals paid increased $11,500. Drillers had an investment of $251,303.61 in drilling rigs and equipment, and they employed 129 men. Wages paid amounted to $100,486.02. These figures are included in Table II, which shows the capital invested, number of men employed, and wages paid in all branches of the natural gas industry.

As well as the investment shown in Table II, the people of Ontario have, at a low valuation, $7,000,000 invested in service lines, house-piping, ranges, furnace equipment, burners, space heaters, hot plates, and hot water heaters.

Analysis of Gas Consumption

Tables III and IV give the statistics of gas consumed in homes and industries in all gas-using municipalities during 1933. By comparing these tables with those published annually since 1921, the quantity used at various rates can be ascertained for each locality. It will be noted that there is a marked difference in the quantity used at equal prices between urban and rural municipalities, and that municipalities where gas has been used for many years use more gas at the same rates than do municipalities where gas has been in use for a shorter period.

It should be remembered that the years 1931 to 1933 are scarcely normal years, and it is probable that more than ordinary economy in the use of gas was practised by the average consumer. A return to prosperity should increase the average consumption per consumer.

It should be noted that the rates have been slightly reduced in the Border Cities, and changes have been made elsewhere. Lack of space does not permit the publication of the intermediate rates.

TABLE III—GAS CONSUMPTION IN TOWNS AND CITIES, 1933

Town or city	Population	No. of consumers		Quantity consumed, M cu. ft.			Distance from gas field	Net rate per M cu. ft.
		Pay	Free	Pay	Free	Industrial		
							miles	
Alvinston	648	181	....	10,898	.....	.....	20	$0.55-.80
Aylmer	1,987	650	....	23,522	.....	.....	16	.90
Bartonville	602	119	....	4,150	.....	.....	19	.60
Belle River	719	146	....	10,252	.....	539	29	.55-.80
Belmont	317	77	....	3,419	.....	.....	9	1.00
Binbrook	100	18	1	1,056	189	.....	1	.40
Blenheim	1,702	573	1	51,275	160	880	20	.50-.75
Bothwell	685	130	1	8,132	21	468	14	.55-.80
Brantford	30,611	4,263	5	169,153	973	7,832	140	.80
Brigden	433	165	....	9,934	.....	1,848	30	.55-.80
Burlington	3,562	230	....	21,686	.....	.....	48	.60-1.90
Cainsville	324	101	....	4,067	.....	.....	4	.80
Caledonia	1,475	499	....	37,882	.....	11,497	7	.60
Canfield	166	60	....	4,496	.....	.....	1	.60
Cayuga	693	203	1	18,147	49	361	6	.60
Chatham	16,140	4,024	3	369,416	4,265	4,793	22	.50-.75
Chippawa	1,051	11	1	310	90	.....	5	.40
Coatsworth	101	23	1	1,418	26	264	4	.40-.65
Comber	506	142	....	13,922	.....	2,421	19	.50-.75
Cottam	425	84	2	6,790	167	593	35	.55
Courtland	348	49	....	2,943	.....	121	3	.60
Courtright	338	120	4	7,043	158	881	53	.50-.75
Crystal Beach	529	197	....	10,732	.....	.....	1	1.00-1.50
Delhi	1,269	366	....	27,747	.....	244	4	.60
Dorchester	403	113	....	6,790	.....	.....	95	.60-.85
Dresden and Tupperville	1,469	508	2	42,975	149	766	38	.50-.75
Dundas	5,032	1,122	1	55,350	4	2,194	172	.70
Dunnville	3,632	1,059	2	91,126	401	10,526	7	.50-.60
Dutton	798	241	3	20,090	151	880	52	.55-.80
Echo Place	732	76	....	2,705	.....	.....	5	.80
Eden	76	29	....	1,344	.....	.....	11	.60
Essex	1,786	459	2	40,390	110	1,381	33	.55-.80
Fairground	75	13	....	659	.....	.....	1	.60
Fenwick	328	98	....	5,622	.....	.....	18	.75
Fingal	169	34	....	2,351	.....	.....	71	.55-.80
Fisherville	162	51	....	3,553	.....	57	2	.50
Florence	184	63	....	3,231	.....	.....	5	.55-.80
Fonthill	872	210	....	5,750	.....	.....	25	.75-.85
Fort Erie	5,366	1,376	3	60,031	1,364	.....	8	1.00-1.50
Galt	14,057	1,890	1	68,505	263	3,784	147	.80
Grimsby	1,952	219	....	7,026	.....	.....	10	.85
Grimsby Beach		45	....	1,407	.....	.....	11	.85
Hagersville	1,355	407	....	29,165	.....	.....	14	.60
Hamilton	153,504	8,246	3	318,856	546	577,335	47	.75
Hepworth	380	5	2	100	400	.....	1	.75
Hespeler	2,798	91	....	4,137	.....	.....	155	.80
Highgate	343	104	2	8,917	409	.....	32	.50-.75
Ingersoll	5,104	1,032	2	38,543	246	810	100	.80
Inwood	250	84	....	3,927	.....	.....	14	.55-.80
Jarvis	531	203	....	16,904	.....	.....	9	.60
Kingsville	2,354	666	1	70,749	164	87	30	.50-.55
Lake Shore	.....	323	....	4,854	.....	.....	16	1.00-1.50
Lambeth	172	108	....	7,049	.....	.....	85	.60-.85
Leamington	5,004	1,396	....	154,715	.....	2,359	20	.55
Lynedoch	175	41	....	2,979	.....	.....	2	.60
Merlin	189	140	3	12,699	2,070	612	2	.50-.75
Merritton	2,487	417	....	14,189	.....	270	35	.75
Nelles Corners	86	7	....	878	.....	.....	1	.60
Niagara Falls	18,193	3,048	....	93,815	.....	14,347	11	1.00-1.50
Oil Springs	462	125	....	6,459	.....	.....	2	.60-.75

TABLE III—GAS CONSUMPTION IN TOWNS AND CITIES, 1933—*Continued*

Town or city	Population	No. of consumers		Quantity consumed, M cu. ft.			Distance from gas field	Net rate per M cu. ft.
		Pay	Free	Pay	Free	Industrial		
							miles	
Paris	4,297	840	1	36,685	150	4,231	129	.80
Petrolia	2,715	770	1	67,736	380	1,112	60	.55–.80
Port Burwell	423	207	....	11,324	.....	.....	3	.60
Port Colborne and Humberstone	7,859	1,735	4	72,188	273	325	5	.60–1.00
Port Dover	1,692	561	....	43,797	.....	324	1	.60
Port Rowan	692	232	....	12,287	.....	.....	1	.60
Preston	6,189	497	1	21,107	61	1,475	151	.80
Ridgetown	1,914	640	4	53,966	1,861	621	28	.50–.75
Ridgeway	1,096	230	....	12,648	.....	.....	1	1.00–1.50
Rodney	748	231	1	17,598	68	483	40	.55–.80
St. Anns	120	21	....	796	.....	.....	7	.85
St. Catharines	26,161	4,929	1	211,333	457	11,691	35	.75
St. George	507	113	....	3,886	.....	.....	148	.80
St. Williams	270	107	....	5,056	.....	382	1	.60
Sarnia and Pt. Edward	18,956	4,919	1	299,251	1,560	7,065	55	.55–.80
Selkirk	196	140	1	10,424	78	315	1	.60
Shedden	233	92	....	6,378	.....	351	63	.55–.80
Simcoe	5,174	1,751	2	165,437	906	9,329	20	.60
Smithville	570	182	....	7,480	.....	.....	6	.75
Sombra and Port Lambton	419	157	....	10,589	.....	124	45	.50–.75
Stevensville	418	32	....	1,807	.....	.....	1	1.00–1.50
Straffordville	253	83	....	5,803	.....	543	6	.60
Thamesville	763	227	4	13,122	71	896	13	.55–.80
Thorold	4,945	1,031	....	36,166	.....	400	35	.75
Tilbury	1,897	522	2	42,442	503	1,775	14	.50–.75
Tillsonburg	3,380	1,046	1	74,695	429	1,615	16	.63
Vienna	222	79	1	3,730	97	.....	1	.60–.80
Vittoria	205	86	....	3,879	.....	.....	3	.60
Wallaceburg	4,457	1,163	1	97,625	247	478,346	19	.50–.75
Wallacetown	143	46	1	3,499	42	552	60	.55–.80
Waterdown	919	24	....	1,198	.....	.....	45	.60–.90
Waterford	1,213	122	....	7,613	.....	139	30	.60–1.48
Welland	10,655	2,682	4	76,441	820	.....	3	1.00–1.50
West Lorne	776	166	3	12,036	210	282	49	.55–.80
Wheatley	754	223	....	18,249	.....	531	12	.50–.75
Windsor (Border Cities)	93,739	12,397	....	992,995	.....	136,021	45	.55–.80
Woodstock	11,007	2,105	3	83,828	215	1,982	110	.80
Wyoming	505	138	....	7,650	.....	603	65	.55–.80
Total	.....	77,011	84	4,578,974	20,803	1,309,663	.....	.....

TABLE IV—GAS CONSUMPTION IN TOWNSHIPS, 1933

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	98	2	7,482	233	181	$0.50–.55
Gosfield South	2,311	460	.....	33,792	.....	26,470	.50–.55
Maidstone	2,976	66	7	4,456	1,761	428	.55–.80
Mersea	4,929	363	5	34,068	587	11,064	.50–.55
Rochester	2,260	171	6	11,059	1,184	551	.55–.80
Sandwich East	5,376	9	.....	691	.....	.....	.55–.80
Sandwich South	2,066	110	.....	8,565	.....	796	.55–.80
Tilbury North	1,920	22	.....	1,074	.....	127	.50–.75
Tilbury West	1,554	16	1	1,195	172	.....	.50–.75
LAMBTON:							
Brooke	2,217	15	.....	563	.....	.....	.55–.80
Dawn	2,160	70	5	4,577	1,381	1,055	.40–.65
Enniskillen	2,725	105	.....	6,243	.....	317	.55–.80
Moore	2,873	290	.....	17,484	.....	863	.50–.75
Plympton	2,681	6	.....	483	.....	.....	.55–.80
Sarnia	3,156	.....	10	.....	2,117	.....	.40
Sombra	2,746	53	.....	2,260	.....	1,067	.50–.75
KENT:							
Camden	2,152	12	.....	632	.....	.....	.50–.75
Chatham	5,832	73	.....	6,115	.....	.....	.50–.75
Dover	3,906	400	1	35,311	159	14,130	.45–.70
Harwich	5,010	401	11	32,311	3,777	.....	.50–.75
Howard	2,813	142	3	11,661	789	.....	.50–.75
Orford	1,718	17	2	1,664	188	.....	.50–.75
Raleigh	4,230	574	23	46,574	6,719	716	.40–.75
Romney	1,456	68	40	5,033	11,143	.....	.40–.65
Tilbury East	3,406	224	75	18,021	22,374	3,797	.40–.65
Zone	859	14	.....	627	.....	.....	.55–.80
ELGIN:							
Aldborough	2,708	19	1	930	367	.....	.55–.80
Bayham	3,265	77	20	3,139	4,082	444	.60–.80
Dunwich	2,357	53	2	3,140	100	.....	.55–.80
Malahide	2,714	50	2	1,302	488	.....	.60–.80
Southwold	2,397	101	.....	6,549	.....	.....	.55–.80
MIDDLESEX:							
North Dorchester	2,932	16	1	906	94	.....	.60–.85
Westminster	6,730	167	.....	19,468	.....	.....	.60–.85
NORFOLK:							
Charlotteville	2,978	15	5	927	985	.....	.60
Middleton	2,493	48	2	3,011	198	.....	.60
North Walsingham	2,118	7	2	602	420	.....	.60
South Walsingham	1,711	20	5	1,664	700	.....	.60
Townsend	2,968	29	.....	2,550	.....	.....	.60
Windham	3,618	2	3	191	601	.....	.60
Woodhouse	2,308	175	9	15,587	1,403	.....	.60
BRANT:							
Brantford	7,336	46	.....	1,927	.....	.....	.80
Burford	3,697	3	.....	145	.....	.....	.80
Onondaga	964	52	12	2,535	1,491	.....	.60–.70
South Dumfries	2,523	13	.....	333	.....	.....	.80
Tuscarora	2,654	6	.....	710	.....	.....	.30–.70
OXFORD:							
East Oxford	1,957	8	.....	386	.....	.....	.80
West Oxford	1,796	56	.....	2,502	.....	.....	.80

TABLE IV—GAS CONSUMPTION IN TOWNSHIPS, 1933—*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	98	46	5,944	8,300	196	.60
Dunn	805	152	10	6,318	2,048	.....	.60
Moulton	1,590	155	19	7,087	2,551	.....	.60
North Cayuga	1,282	51	10	3,277	2,142	.....	.60
Oneida	1,301	68	12	5,867	1,807	.....	.50–.60
Rainham	1,608	152	26	9,077	4,586	400	.50–.60
Seneca	1,589	148	29	9,128	5,222	.....	.60
Sherbrooke	346	55	9	2,343	1,122	.....	.60
South Cayuga	580	55	15	2,232	2,539	.....	.60
Walpole	3,145	315	57	19,352	8,571	270	.60
LINCOLN:							
Caistor	1,260	115	1	3,448	132	148	.50–.60
Gainsborough	2,091	29	.....	466	.....	.....	.75–.85
Grantham	5,010	9	.....	513	.....	.....	.75
Louth	2,903	11	.....	627	.....	.....	.75
WELLAND:							
Bertie	4,174	180	64	9,955	11,089	.....	.50–1.50
Crowland	5,082	88	18	2,210	2,109	.....	.75–1.50
Humberstone	2,368	244	33	7,242	5,158	.....	.70–1.50
Pelham	2,690	62	1	3,575	103	.....	.75
Stamford	8,020	87	4	4,839	739	.....	1.00–1.50
Wainfleet	2,718	183	22	3,952	3,675	.....	.60–1.00
Willoughby	905	31	26	786	4,396	.....	1.00–1.50
WENTWORTH:							
Ancaster	3,606	96	.....	7,538	.....	.....	.70
Barton	1,840	258	.....	17,805	.....	.....	.60–.75
Binbrook	1,080	81	21	5,801	3,496	330	.60
East Flamborough	3,705	50	.....	2,650	.....	.....	.60
Glanford	1,265	125	4	10,244	1,024	468	.60–.75
Saltfleet	4,837	260	.....	10,096	.....	.....	.75
WATERLOO:							
Waterloo	7,591	22	.....	549	.....	.....	.80
Total	.....	7,922	682	523,366	134,322	63,818	.....

SUMMARY

	M cu. ft.
Total distribution to customers	6,630,946
Used by companies for all purposes	45,552
Used by private well-owners	74,000
Leakage in transmission lines	274,367
Leakage in distribution plants	228,045
Leakage in rural lines	10,824
Total amount of gas distributed	7,263,734

Gas Wells and Their Production

Table V gives the details by townships and fields of the natural gas wells drilled in 1933. There was an increase over 1932 of 114 in the number of producing wells in the province. The number of producing wells drilled was 22 more than in 1932, and the open flow of the 173 wells drilled was 6,956 M cubic feet more than that of the 151 wells drilled in 1932.

TABLE V—GAS WELLS AND THEIR PRODUCTION, 1933

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	22			1	50		150	719	$381
	Maidstone			1						
	Mersea	3						265		
Kent	Harwich						4,201,704			
	Orford			2						
	Raleigh	36		4	1	12		521	55,547	145,414
	Romney	144	1					195		
	Tilbury East	150	1	1	7	540		214		
	Chatham Gore			1						
	Dover	9			1	535	252,694	350	5,351	
Lambton	Dawn	22		1	3	2,740	256,802	651	41,666	
	Euphemia	3						265		
	Enniskillen	4					6,459	231	1,000	
	Moore								4,000	
	Sarnia	13					1,800	70	6,573	
Middlesex	Caradoc and others									
	Ekfrid			1					11,271	88
	Metcalfe									
	Mosa	3						743		
	North Dorchester	3						50	10,000	90
Elgin	Aldborough									
	Bayham	35					45,968	156		
	Dunwich									
	Malahide	1						180		
Norfolk	Charlotteville	13						225		
	Houghton	7						342		
	Middleton	39	2	4	4	397		279		
	North Walsingham	10			1	45		312		
	South Walsingham	14			1	280	346,621	382		
	Townsend	1						330		
	Windham	8						233		
	Woodhouse	55	1	1				242		

Haldimand	Canborough	173	4	2	9	255			94		
	Dunn	50		7	21	1,627			201		
	Moulton	122	6	3	14	488			129		
	North Cayuga	160	3	2	12	839			216	338,902	104,489
	Oneida	54	2	2	4	80			155		
	Rainham	272		10	22	1,206			243		
	Seneca	173	11	6	5	1,090			94		
	Sherbrooke	18					1,524,251		238		
	South Cayuga	53	2						155		
	Walpole	274	2	14	50	5,026			257		
Wentworth	Binbrook	53	1						75		
	Glanford	11							59		
Lincoln	Caistor	61	1						110		
	Gainsborough	5							119		
Welland	Bertie	96			5	228			130		
	Crowland	36	12						116		
	Humberstone	62	4				333,619		54		
	Wainfleet	27	2		1	8			63		
	Willoughby	43		2	4	240			246		
Wellington	Puslinch			1							
Brant	Onondaga	40					121,578		87	43,900	1,050
	Tuscarora	66		2	7	140			113		
Bruce	Amabel	2					500		100	50	
Peel	Caledon	6									
Surface wells	Harwich	69					14,000[1]				
	Howard						663[2]				
Private wells[3]		300					60,000[4]				
Total		2,821	55	67	173	15,826	7,166,659		518,979	251,512	

[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]This gas is sold to the Union Gas Company, and was used in Ridgetown.
[3]Principally in Haldimand, Norfolk, and Welland counties.
[4]Estimated.

Leakage

There is a slight increase in the leakage of natural gas in 1933 over 1932. This is mostly in the high-pressure transmission lines. Distribution plants show a reduction in leakage, which compensates for the increase in other places.

This increase is attributed to enforced economies through reduced revenues. It is certain that there has been a decrease in the sales of gas, as noted on page 2 of this report.

All gas companies have been urged to keep a strict watch on leaks on high-pressure lines and to keep this work up to a high standard.

Tables VI, VII, and VIII give details of the leakage for the year 1933. Leakage is measured by deducting the gas measured into distributing plants from the quantity measured into the transmission lines at the point where the gas in the field is collected. It is not possible to do this in the Haldimand-Norfolk field nor in the Welland field. The fields cover such an area that it is impractical to collect gas at a central point. The short transmission lines to Hamilton and Niagara Falls are such a small percentage of the total pipe lines that the result to be obtained does not merit the entailed expenditure.

The unmeasured leakage on these several hundred miles of collecting lines would probably increase the total by 25 per cent.

The actual miles of pipe lines of all sizes, gathering, transmission, and distribution, is 3,235 miles. To form a basis for comparison, all sizes of pipe are figured at their equivalent length in 3-inch pipe, which gives a total mileage of 54,890.

TABLE VI—LEAKAGE IN DISTRIBUTION PLANTS, 1933

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	4.34	11,107	10,792	315	868	148	2,128	6
Belmont	Ontario Salt Co	1.67	4,330	3,419	911	334	77	11,831	6
Blenheim	Union Gas Co	12.78	53,339	52,560	779	2,556	574	1,357	5
Bothwell	Union Gas Co	5.34	8,668	8,601	67	1,068	131	511	5
Brantford	Brantford Gas Co	93.44	191,261	177,957	13,304	18,688	4,268	3,117	4
Brigden	Union Gas Co	3.88	12,235	11,782	453	776	165	2,745	5
Cainsville	Dominion Natural Gas Co	5.45	8,192	6,765	1,427	1,090	176	8,108	4
Chatham	Union Gas Co	80.28	378,597	377,762	835	16,056	4,027	207	6
Comber	Union Gas Co	3.47	16,541	16,342	199	694	142	1,401	5
Corunna	Union Gas Co	5.28	9,201	8,792	409	1,056	249	1,642	6
Courtright	Union Gas Co	3.83	8,511	7,991	520	766	124	4,193	5
Dorchester	Southern Ontario Gas Co	2.86	8,454	7,732	722	572	113	6,389	4
Dresden	Union Gas Co	8.88	45,044	43,891	1,153	1,776	510	2,261	5
Dundas	Dominion Natural Gas Co	12.75	60,817	57,548	3,269	2,550	1,123	2,911	4
Dunnville	Dominion Natural Gas Co	14.21	100,179	92,260	7,919	2,842	1,053	7,520	4
Fenwick	Dominion Natural Gas Co	1.37	6,745	6,027	718	274	98	7,326	4
Florence	Union Gas Co	1.80	3,229	3,229	0	360	63	0	5
Fonthill	Fonthill Gas Co	5.33	7,101	5,750	1,351	1,066	210	6,433	5
Galt	Dominion Natural Gas Co	32.15	77,767	72,597	5,170	6,430	1,891	2,734	4
Hagersville	Dominion Natural Gas Co	7.33	36,183	29,165	7,018	1,466	407	17,243	4
Ingersoll	Dominion Natural Gas Co	22.53	43,232	39,699	3,533	4,506	1,034	3,416	4
Inwood	Union Gas Co	2.09	3,994	3,927	67	418	84	797	5
Kingsville	Southern Ontario Gas Co	13.18	80,614	74,015	6,599	2,636	666	9,908	4
Leamington	Leamington Corporation	25.47	177,641	157,074	20,567	5,094	1,396	14,733	8
Merlin	Union Gas Co	2.77	15,501	15,380	121	554	143	983	5
Mount Hamilton	Dominion Natural Gas Co	23.59	57,811	47,591	10,220	4,718	2,500	4,088	4
Paris	Dominion Natural Gas Co	14.72	43,441	38,771	4,670	2,944	841	5,552	4
Petrolia	Union Gas Co	15.80	73,476	69,176	4,300	3,160	771	5,577	6
Port Burwell	Dominion Natural Gas Co	3.84	8,128	6,837	1,291	768	130	9,930	4
Port Lambton	Union Gas Co	2.02	5,075	4,562	513	404	70	7,328	5
Ridgetown	Union Gas Co	18.02	60,796	56,907	3,889	3,604	644	6,038	5
St. Catharines	Dominion Natural Gas Co	55.33	303,269	283,088	20,181	11,066	4,930	4,093	4
St. George	Dominion Natural Gas Co	2.11	3,940	3,557	383	422	113	3,389	4
Sarnia	Union Gas Co	89.16	337,367	307,642	29,725	17,832	4,920	6,041	5
Shedden-Fingal	Southern Ontario Gas Co	6.11	11,116	9,080	2,036	1,222	130	15,661	4
Simcoe	Dominion Natural Gas Co	29.46	178,677	176,755	1,922	5,892	1,753	1,096	4

TABLE VI—LEAKAGE IN DISTRIBUTION PLANTS, 1933—*Continued*

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.	
South London	Southern Ontario Gas Co	8.87	20,352	15,971	4,381	1,774	167	26,233	4
Straffordville	Dominion Natural Gas Co	1.34	6,803	6,486	317	268	83	3,819	4
Thorold	Dominion Natural Gas Co	13.31	46,156	39,246	6,910	2,662	1,031	6,702	4
Tilbury	Union Gas Co	9.20	45,428	44,719	709	1,840	524	1,353	5
Tillsonburg	Dominion Natural Gas Co	23.48	83,274	76,949	6,325	4,696	1,047	6,041	4
Vienna	Dominion Natural Gas Co	1.04	1,597	1,443	154	208	20	7,700	4
Wallaceburg	Union Gas Co	21.05	106,244	102,751	3,493	4,210	1,166	2,995	6
West Hamilton	Southern Ontario Gas Co	3.81	8,401	7,816	585	762	252	2,321	4
Wheatley	Southern Ontario Gas Co	3.46	20,921	18,807	2,114	692	223	9,479	4
Windsor (Border Cities)	Union Gas Co	477.36	1,164,930	1,125,897	39,033	95,472	12,397	3,148	4
Woodstock	Dominion Natural Gas Co	48.35	93,434	86,054	7,380	9,670	2,108	3,501	4
Wyoming	Union Gas Co	4.93	8,344	8,256	88	986	138	637	5
Total		1,248.84	4,057,463	3,829,418	228,045	249,768			

TABLE VII—LEAKAGE IN TRANSMISSION LINES, 1933

Transmission line	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	8.8	121,661	114,587	7,074	20
Gas field to Sarnia and Petrolia	6-, 8-, 10-, 12-inch	380.91	1,653,803	1,618,334	35,469	40–80
Leamington to Hamilton	8-, 10-, 12-inch	710.5	1,354,219	1,206,498	147,721	75
Gas field to Windsor	8-, 10-, 12-, 18-inch	423.08	1,345,682	1,310,283	35,399	30–80
Gas field to Ridgetown	6-, 8-inch	81.42	210,973	186,868	24,105	25–80
Gas field to Bothwell	4-, 6-inch	32	28,531	27,101	1,430	30–50
Gas field to Hamilton	8-inch	58.24	86,315	79,383	6,932	30–50
Dunnville to St. Catharines	8-inch	57.1	338,442	322,205	16,237	50
Total		1,752.05	5,139,626	4,865,259	274,367	

TABLE VIII—LEAKAGE ON RURAL LINES, 1933

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	3,193	3,170	23	175	43	535	6	.....
Dawn	13,400	2,898	2,842	56	508	29	1,931	6	.....
Dover	102,835	30,956	29,483	1,473	3,895	369	3,992	5	9
Enniskillen	10,156	2,618	2,520	98	385	35	2,800	6	.....
Harwich	101,994	26,544	24,835	1,709	3,863	430	3,974	5	5
Howard	17,681	7,117	6,504	613	670	97	6,319	6	4
Moore	11,195	2,288	2,174	114	424	51	2,235	6	.....
Raleigh	140,774	37,173	34,534	2,639	5,332	405	6,516	6	6
Raleigh (Blake system)	32,314	5,671	3,160	2,511	1,224	78	32,192	4	.....
Rochester	34,400	14,698	14,574	124	1,303	173	717	6	12
Sandwich, East	1,432	807	712	95	54	10	9,500	6	5
Sandwich, South	18,192	7,122	6,766	356	689	77	4,623	5	5
Sombra	1,929	555	497	58	73	12	4,833	6	.....
Tilbury, East	62,978	22,833	21,878	955	2,386	207	4,614	6	6
Total	553,936	164,473	153,649	10,824	20,981	2,016	.....	.....	.....

Licenses Issued in 1933

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 IX to XIII show a list of those to whom licenses were issued during 1933. There was an increase of 7 in the number of licenses issued to lease and prospect for natural gas, a decrease of 4 in the licenses to drill, and an increase of 7 in licenses to produce.

The licenses required under the above Acts 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 IX—OPERATORS LICENSED TO LEASE AND PROSPECT FOR NATURAL GAS, 1933

License No.	Name	Address
615	Acme Gas and Oil Co., Ltd.	Toronto, Ont.
614	Adams, L. W.	Toronto, Ont.
610	Ajax Oil and Gas Co., Ltd.	Toronto, Ont.
661	Blain, Dr. E. B.	Hamilton, Ont.
588	Bradley, J. E.	London, Ont.
658	British Petroleum Co., Ltd.	Hamilton, Ont.
627	Culver, W. H., Jr.	Dunnville, Ont.
603	Cyclops Gas Syndicate.	Toronto, Ont.
630	Daly, C. A.	Tupperville, Ont.
620	Dawson, Ralph.	Merlin, Ont.
618	Dickenson, Charles E.	Toronto, Ont.
596	Dominion Natural Gas Co., Ltd.	Buffalo, N.Y.
642	Dominion Petroleum Co., Ltd.	Glencoe, Ont.
602	Emerald Gas Syndicate.	Toronto, Ont.
616	Erie Gas, Limited.	Toronto, Ont.
635	Ferris, T. Gordon.	Toronto, Ont.
592	Geddes, E. W.	Chatham, Ont.
655	Glenney, Daniel.	Dunnville, Ont.
584	Gray, Ira.	Merlin, Ont.
606	Haldimand Natural Gas Syndicate.	Stevensville, Ont.
609	Harris, J. E.	Stevensville, Ont.
591	Harrison, George Edward.	Toronto, Ont.
639	Heitbohmer, Frederick.	Guelph, Ont.
595	Henderson, J. E.	Chatham, Ont.
625	High Grade Natural Gas Co., Ltd.	Chatham, Ont.
624	Highbank Oil, Limited.	Chatham, Ont.
631	Holmes, A. B.	Toronto, Ont.
641	Hoon, W. C.	Glencoe, Ont.
683	Hoover, May, Limited.	Selkirk, Ont.
608	House, Chas. C.	Stevensville, Ont.
585	Howard, W. C.	Leamington, Ont.
704	Hussey, W. J.	Petrolia, Ont.
633	Jackson, Percy L.	Dunnville, Ont.
634	James, F. L.	Tillsonburg, Ont.
599	Jasperson, Bon.	Kingsville, Ont.
654	Lake of the Woods Oil Co., Ltd.	Rainy River, Ont.
626	Lymburner, M. G.	Dunnville, Ont.
636	McDougall, A. S.	Melbourne, Ont.
619	McGill, Joseph.	Petrolia, Ont.
657	McNinch, S. E.	Canboro, Ont.
623	Medina Natural Gas Co., Ltd.	Chatham, Ont.
652	Morrish, Albert Ross.	Wallacetown, Ont.
659	Parks, A. W.	Oil Springs, Ont.
651	Parsons, L. S.	Hamilton, Ont.
605	Patterson, W. C.	Jamestown, N.Y.

TABLE IX—OPERATORS LICENSED TO LEASE AND PROSPECT FOR NATURAL GAS, 1933—*Continued*

License No.	Name	Address
722	Port Colborne-Welland Gas and Oil Co., Ltd	Port Colborne, Ont.
593	Reaume, Earl	Chatham, Ont.
617	Reichheld, O. E	Fisherville, Ont.
660	Roberts, James R	Windsor, Ont.
656	Romney Gas and Oil Co., Ltd	London, Ont.
601	Rowe, E. P., Jr	Toronto, Ont.
604	Ryan, John J	Toronto, Ont.
589	Ryan, W. T	Toronto, Ont.
613	Ryder, John W	Toronto, Ont.
650	Schafer, Roy	Delhi, Ont.
653	Schollenberger, Christian	Wallacetown, Ont.
594	Scullard, Fred B	Chatham, Ont.
612	Sheffield, Reginald C	Toronto, Ont.
632	Smith, Ernest G	Windsor, Ont.
628	Smith, H. B	Windsor, Ont.
629	Smith, Dr. Luke	Chatham, Ont.
600	Smith, Robt. H	Lowbanks, Ont.
597	Southern Ontario Gas Co., Ltd	Buffalo, N.Y.
665	Stover, F. H	Chatham, Ont.
638	Sullivan, Geo. F	Sarnia, Ont.
586	Topp, Nathan	Cayuga, Ont.
607	Welland County Gas Syndicate	Stevensville, Ont.
644	White, Roy	Tillsonburg, Ont.
611	White Oil and Gas Co., Ltd	Sarnia, Ont.
640	Williams, Maxwell M	Toronto, Ont.
621	Willits, D. E	Bothwell, Ont.
622	Willits, G. E	Bothwell, Ont.
643	Wilson, Leo. A	Sarnia, Ont.
598	Woodhouse, Henry	Toronto, Ont.

TABLE X—OPERATORS LICENSED TO DRILL OR BORE FOR NATURAL GAS, 1933

License No.	Name	Address
494	Beecher, L. W.	Jarvis, Ont.
493	Cherry, Robert	Collingwood, Ont.
488	Culver, W. H., Jr	Dunnville ,Ont.
489	Culver, W. H., Jr	Dunnville, Ont.
520	Culver, W. H., Jr	Dunnville, Ont.
511	Dawson, Ralph	Merlin, Ont.
491	Demaray and Carrothers	Kerwood, Ont.
490	Goit, Lorne R	Dunnville, Ont.
529	Gregory, Geo. F., and Son	Petrolia, Ont.
530	Gregory, Geo. F., and Son	Petrolia, Ont.
532	Hockley Valley Oil Co., Ltd	Toronto, Ont.
524	Holmes, A. B	Toronto, Ont.
549	Hoover, May, Limited	Selkirk, Ont.
550	Hoover, May, Limited	Selkirk, Ont.
551	Hoover, May, Limited	Selkirk, Ont.
503	House and Harris	Stevensville, Ont.
509	Hussey, W. J	Petrolia, Ont.
504	Jackson, Percy L	Dunnville, Ont.
505	Jackson, Percy L	Dunnville, Ont.
506	Jackson, Percy L	Dunnville, Ont.
495	Jasperson, Bon	Kingsville, Ont.
496	Kiser Bros	Chatham, Ont.
497	Kiser Bros	Chatham, Ont.
508	Lymburner Bros. and Webber	Dunnville, Ont.
528	MacCorkindale, J. H	Manitowaning, Ont.
499	McCutcheon, Thos. J	Dunnville, Ont.
500	McCutcheon, Thos. J	Dunnville, Ont.
501	McCutcheon, Thos. J	Dunnville, Ont.
502	McCutcheon, Thos. J	Dunnville, Ont.
516	McGaffey, Roy	Bothwell, Ont.
517	McKechnie, Sam	Dunnville, Ont.
518	McKechnie, Sam	Dunnville, Ont.
519	McKechnie, Sam	Dunnville, Ont.
512	McLister, J. J	Dunnville, Ont.
507	Perkins, J. E	Dunnville, Ont.
575	Port Colborne–Welland Gas and Oil Co., Ltd	Port Colborne, Ont.
533	Prairie Gas and Oil Co., Ltd	Toronto, Ont.
527	Romney Gas and Oil Co., Ltd	London, Ont.
492	Seynuck Valley Oil Co., Ltd	Acton, Ont.
523	Smith, Dr. Luke	Chatham, Ont.
498	Smith, Robt. H	Lowbanks, Ont.
526	Smith's Drilling Company	Windsor, Ont.
521	Stover, F. H., and Son	Chatham, Ont.
522	Stover, F. H., and Son	Chatham, Ont.
592	Sundy, Basil K	Tillsonburg, Ont.
510	Walter Gas Syndicate	Orchard Park, N.Y.
513	Willits, D. E	Bothwell, Ont.
514	Willits, D. E	Bothwell, Ont.
515	Willits, D. E	Bothwell, Ont.
525	Wilson, Bert	Sarnia, Ont.
531	Wright, David	Sarnia, Ont.

TABLE XI—OPERATORS LICENSED TO PRODUCE NATURAL GAS, 1933

License No.	Name	Address
617	Acme Gas and Oil Co., Ltd.	Toronto, Ont.
612	Aikens Gas Syndicate	Vineland, Ont.
610	Ajax Oil and Gas Co., Ltd.	Toronto, Ont.
627	Amity Gas and Oil Co., Ltd.	Lowbanks, Ont.
637	Aragain Gold and Natural Gas Syndicate	Toronto, Ont.
732	Bertie Township Gas and Oil Syndicate.	Selkirk, Ont.
728	Broadway Gas Syndicate	Cayuga, Ont.
656	Canadian Natural Gas Syndicate	Simcoe, Ont.
690	Canfield Natural Gas Co., Ltd.	Canfield, Ont.
628	Central Pipe Line Co., Ltd.	Chatham, Ont.
692	Colonial Natural Gas and Oil Co., Ltd.	Hamilton, Ont.
603	Continental Gas Corporation, Ltd.	Toronto, Ont.
598	Cyclops Gas Syndicate	Toronto, Ont.
626	Dawson, Ralph	Merlin, Ont.
593	Dominion Natural Gas Co., Ltd.	Buffalo, N.Y.
726	Dunn Natural Gas Co., Ltd.	Dunnville, Ont.
597	Emerald Gas Syndicate	Toronto, Ont.
720	Emerson, Harry L.	R.R. No. 1, Dunnville, Ont.
702	Empire Natural Gas, Limited	Toronto, Ont.
618	Erie Gas, Limited	Toronto, Ont.
631	Fisherville Gas Company	Fisherville, Ont.
698	Gifford, Arthur, and Son	R.R. No. 2, Cayuga, Ont.
707	Glenney, Daniel	R.R. No. 5, Dunnville, Ont.
709	Grand River Gas and Oil Syndicate	Canfield, Ont.
715	Grand River Natural Gas Co., Ltd.	Welland, Ont.
729	Grimsby Natural Gas Co., Ltd.	Grimsby, Ont.
623	Haldimand Gas Syndicate	Cayuga, Ont.
605	Haldimand Natural Gas Syndicate	Stevensville, Ont.
629	Highbank Oil, Limited	Chatham, Ont.
704	Hill, A. W.	Coatsworth, Ont.
609	Hope Gas Syndicate	St. Catharines, Ont.
607	House and Harris	Stevensville, Ont.
632	Ideal Gas Syndicate	Fisherville, Ont.
592	Industrial Natural Gas Co., Ltd.	Chatham, Ont.
596	Jasperson, Bon	Kingsville, Ont.
719	Kelly Gas and Oil Syndicate	Toronto, Ont.
613	Lincoln Gas Co., Ltd.	Toronto, Ont.
616	Lymburner Bros. and Webber	Dunnville, Ont.
633	McKechnie and Hussey	Dunnville, Ont.
590	McKinney, John F.	Niagara Falls, N.Y.
708	Melrose Gas and Oil Syndicate	Toronto, Ont.
678	Midwal Oil and Gas Co., Ltd.	Toronto, Ont.
717	Mohawk Gas and Oil Syndicate, Ltd.	Hamilton, Ont.
644	Niagara Natural Gas Co., Ltd.	Buffalo, N.Y.
601	Niece, Hosea, and Son	Lowbanks, Ont.
646	North Cayuga Gas Syndicate, Ltd.	Cayuga, Ont.
712	Olga Gas and Oil Co., Ltd.	Toronto, Ont.
700	Otterville Natural Gas Co.	Otterville, Ont.
604	Patterson, W. C.	Jamestown, N.Y.
667	Petrol Oil and Gas Co., Ltd.	Toronto, Ont.
705	Port Colborne–Welland Gas and Oil Co., Ltd.	Port Colborne, Ont.
621	Provincial Natural Gas and Fuel Co., Ltd.	Fort Erie, Ont.
624	Rainham Gas Syndicate	Cayuga, Ont.
661	Regal Gas Syndicate	Toronto, Ont.
713	Rich Gas Company	Toronto, Ont.
721	Riley, James V.	Simcoe, Ont.
645	Romney Gas and Oil Co., Ltd.	London, Ont.
639	Salina Gas Co., Ltd.	Chatham, Ont.
723	Sarnia Oil and Gas Co., Ltd.	Sarnia, Ont.
615	Selected Natural Gas and Oil Syndicate.	Toronto, Ont.
600	Sherbrooke Gas Syndicate	Lowbanks, Ont.
599	Smith, Robt. H.	Lowbanks, Ont.
594	Southern Ontario Gas Co., Ltd.	Buffalo, N.Y.
622	Springvale Gas and Oil Co., Ltd.	Hagersville, Ont.
619	Standard Gas and Oil Syndicate	Fisherville, Ont.

TABLE XI—OPERATORS LICENSED TO PRODUCE NATURAL GAS, 1933—*Continued*

License No.	Name	Address
636	Sterling Gas Syndicate	Toronto, Ont.
595	Stevensville Natural Gas and Fuel Co.	Stevensville, Ont.
614	Superior Gas Syndicate	Fisherville, Ont.
620	Sweets Corners Gas and Oil Syndicate	Fisherville, Ont.
724	Tillsonburg Oil and Gas Co., Ltd	Tillsonburg, Ont.
591	Union Gas Co. of Canada, Ltd	Chatham, Ont.
630	Vacuum Gas and Oil Co., Ltd	Toronto, Ont.
625	Walpole Natural Gas Syndicate	Cayuga, Ont.
722	Walter Gas Syndicate	Buffalo, N.Y.
606	Welland County Gas Syndicate	Stevensville, Ont.
611	White Oil and Gas Co., Ltd	Sarnia, Ont.
608	Yager, J. J	Selkirk, Ont.

TABLE XII—OPERATORS LICENSED TO DISTRIBUTE NATURAL GAS, 1933

License No.	Name	Address
428	Brantford Gas Company	Buffalo, N.Y.
452	Canfield Natural Gas Co., Ltd	Canfield, Ont.
435	Central Pipe Line Co., Ltd	Chatham, Ont.
429	Dominion Natural Gas Co., Ltd	Buffalo, N.Y.
436	Fisherville Gas Company	Fisherville, Ont.
459	Fonthill-Ridgeville Gas Co	Portland, Indiana.
437	Grimsby Natural Gas Co., Ltd	Grimsby, Ont.
426	Industrial Natural Gas Co., Ltd	Chatham, Ont.
457	Leamington, Town of	Leamington, Ont.
460	Lincoln Gas Co., Ltd	Toronto, Ont.
430	Manufacturers Natural Gas Co., Ltd	Buffalo, N.Y.
432	Oil Springs Oil and Gas Co., Ltd	Oil Springs, Ont.
449	Ontario Salt Co., Ltd	Hamilton, Ont.
455	Port Colborne-Welland Gas and Oil Co., Ltd	Port Colborne, Ont.
433	Provincial Natural Gas and Fuel Co., Ltd.	Fort Erie, Ont.
431	Southern Ontario Gas Co., Ltd	Buffalo, N.Y.
434	Springvale Gas and Oil Co., Ltd	Hagersville, Ont.
424	Union Gas Co. of Canada, Ltd	Chatham, Ont.
427	United Gas and Fuel Company of Hamilton, Ltd	Hamilton, Ont.
425	Windsor Gas Co., Ltd	Windsor, Ont.

TABLE XIII—OPERATORS LICENSED TO OPERATE PIPE LINES, 1933

License No.	Name	Address
94	Central Pipe Line Co., Ltd	Chatham, Ont.
92	Dominion Natural Gas Co., Ltd	Buffalo, N.Y.
93	Southern Ontario Gas Co., Ltd	Buffalo, N.Y.
91	Union Gas Co. of Canada, Ltd	Chatham, Ont.

Logs of Wells

The logs of oil and gas wells drilled in Ontario in 1933 are given on the pages following. They show the formation, total depth, and occurrences of gas, oil, and water as reported by the drillers.

These logs are on file in the office of the Natural Gas Commissioner, and they give the length of casing used, as well as other information regarding the texture of formations. In many cases samples of drill-cuttings are available to the

public. The source of the information for the logs that follow is the company or person whose name appears at the top of each log.

ABBREVIATIONS

B.F	Broken front.
C	From Canborough.
Con	Concession.
E	East.
E. ½	East half.
E.C	East centre.
F.C	Front concession.
L.F	Lake front.
N	North.
N. ½	North half.
N.E	Northeast.
N.E. ¼	Northeast quarter.
N.D.R	North of Dover Road.
N.F.R	North of Forks Road.
N.L.R	North of Longwoods 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.
Rd	Road.
S	South.
S. ½	South half.
S.D.R	South of Dover Road.
S.E. ½	Southeast half.
S.L.R	South of Longwoods Road.
S.T.R	South of Talbot Road.
S.W. ¼	Southwest quarter.
Tp	Township.
W	West.
W. ½	West half.

Brant County

PETROL OIL AND GAS CO., TORONTO
Lot 3, B.F., Tuscarora tp.

Completed July 28, 1933.
Open flow: 68,344 cu. ft.
Rock pressure: 240 lbs.

Formation	Thickness, ft.
Surface	67
Salina	67
Guelph and Niagara	263
Rochester	51
Clinton	27
Red Medina	20
Cabot Head	57
White Medina	25
Queenston	53
Total depth	630

Gas at 448 and 557 feet.
Fresh water at 76 feet; sulphur water at 255 feet.

PETROL OIL AND GAS CO., TORONTO
Lot 5, B.F., Tuscarora tp.

Completed August 23, 1933.
Open flow: 72,706 cu. ft.
Rock pressure: 240 lbs.

Formation	Thickness. ft.
Surface	53
Salina	80
Guelph and Niagara	267
Rochester	50
Clinton	26
Red Medina	20
Cabot Head	58
White Medina	29
Queenston	52
Total depth	635

Gas at 450 and 559 feet.
Fresh water at 63 feet.

PETROL OIL AND GAS CO., TORONTO
Lot 8, B.F., Tuscarora tp.

Completed September 15, 1933.
Open flow: 27,047 cu. ft.
Rock pressure: 235 lbs.

Formation	Thickness, ft.
Surface	37
Salina	88
Guelph and Niagara	278
Rochester	41
Clinton	30
Red Medina	14
Cabot Head	58
White Medina	29
Queenston	50
Total depth	625

Gas at 444 and 551 feet.
Fresh water at 55 feet.

PETROL OIL AND GAS CO., TORONTO
Lot 38, R.R., Tuscarora tp.

Completed May 11, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	86
Salina	57
Guelph and Niagara	262
Rochester	40
Clinton	20
Red Medina	20
Cabot Head	65
White Medina	16
Queenston	
Total depth	566

Fresh water at 88 feet.

AJAX OIL AND GAS CO., TORONTO
Lot 14, con. V, Tuscarora tp.

Completed July 26, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	50
Salina	69
Niagara and Guelph	281
Rochester	49
Clinton	29
Red Medina	15
Cabot Head	69
White Medina	8
Total depth	570

Show of gas at 459 and 566 feet.
Fresh water at 64 feet.

AJAX OIL AND GAS CO., TORONTO
Lot 32, con. VI, Tuscarora tp.

Completed August 18, 1933.
Open flow: 35,000 cu. ft.
Rock pressure: 150 lbs.

Formation	Thickness, ft.
Surface	91
Salina	30
Niagara and Guelph	257
Rochester	38
Clinton	30
Red Medina	24
Cabot Head	59
White Medina	10
Red shale	50
Total depth	589

Gas at 418, 429, and 533 feet.
Fresh water at 92 feet.

AJAX OIL AND GAS CO., TORONTO
Lot 30, con. VI, Tuscarora tp.

Completed September 12, 1933.
Open flow: 17,000 cu. ft.
Rock pressure: 150 lbs.

Formation	Thickness, ft.
Surface	88
Salina	34
Niagara and Guelph	243
Rochester	50
Clinton	31
Red Medina	14
Cabot Head	68
White Medina	8
Red shale	50
Total depth	586

Gas at 417, 425, and 530 feet.
Fresh water at 60 feet.

AJAX OIL AND GAS CO., TORONTO
Lot 29, con. VI, Tuscarora tp.

Completed October 5, 1933.
Open flow: 6,000 cu. ft.
Rock pressure: 150 lbs.

Formation	Thickness, ft.
Surface	112
Salina	45
Niagara and Guelph	243
Rochester	49
Clinton	31
Red Medina	16
Cabot Head	63
White Medina	9
Red shale	20
Total depth	588

Gas at 454, 460, and 563 feet.
Fresh water at 115 feet.

AJAX OIL AND GAS CO., TORONTO
Lot 32, con. VI, Tuscarora tp.

Completed October 28, 1933.
Open flow: 12,000 cu. ft.
Rock pressure: 150 lbs.

Formation	Thickness ft.
Surface	97
Salina	31
Niagara and Guelph	239
Rochester	51
Clinton	30
Red Medina	12
Cabot Head	67
White Medina	9
Red shale	50
Total depth	586

Gas at 430, 444, and 532 feet.
Fresh water at 98 feet.

Dufferin County

HOCKLEY VALLEY OIL CO., TORONTO
Lot 12, con. VII, Mono tp.

To December, 1932.
Dry hole.

Formation	Thickness, ft.
Sandy loam	22
Gravel	21
Coarse gravel	18
Quicksand and gravel	114
Clay shale	2
Gravel and sand	26
Hudson River shale	352
Utica brown shale	86
Trenton	659
Sandstone	3
Granite	332
Total depth, December, 1932	1,635

Show of gas at 1,300 feet.
Fresh water at 175 feet; brackish water at 197 feet.
Drilling is being continued.

Essex County

BON JASPERSON, KINGSVILLE
Lot 7, E. ½, con. I, Gosfield South tp.

Completed May 6, 1933.
Open flow: 50,000 cu. ft.
Rock pressure: 275 lbs.

Formation	Thickness, ft.
Quicksand	42
Clay	42
Shell rock and quicksand	3
Lime	357
Lime and gypsum	6
Lime	478
Total depth	928

Gas at 650, 847, and 920 to 923 feet.
Fresh water at 86 feet; mineral water at 98, 375, and 455 feet.

Haldimand County

ARAGAIN GOLD AND NATURAL GAS SYNDICATE, TORONTO
Lot 13, con. I, Canborough tp.

Completed July 28, 1933.
Open flow: 62,000 cu. ft.
Rock pressure: 125 lbs.

Formation	Thickness, ft.
Surface	59
Shale and lime	66
Niagara	225
Shale	54
Clinton	30
Red Medina	40
Shale	54
White Medina	10
Red shale	35
Total depth	573

Gas at 452 and 533 feet.
Fresh water at 80 feet; sulphur water at 200 feet.

DANIEL GLENNEY, DUNNVILLE
Lot 6, N.W. pt., con. III, Canborough tp.
Completed September 1, 1933.
Open flow: 25,000 cu. ft.
Rock pressure: 132 lbs.

Formation	Thickness, ft.
Surface	83
Blue shale	90
Brown lime	52
Niagara	200
Grey lime	53
Shale	40
Clinton	28
Red Medina	38
Grey shale	56
White Medina	15
Red shale	60
Total depth	715

Gas at 547 and 646 feet.
Sulphur water at 84 feet.

DANIEL GLENNEY, DUNNVILLE
Lots 5 and 6, E.C. pt., con. III, Canborough tp.
Completed September 26, 1933.
Open flow: 9,000 cu. ft.
Rock pressure: 138 lbs.

Formation	Thickness, ft.
Surface	58
Blue shale	85
Brown lime	65
Niagara	205
Grey lime	70
Shale	35
Clinton	28
Red Medina	38
Grey shale	56
White Medina	15
Red shale	26
Total depth	681

Gas at 560 and 645 feet.
Sulphur water at 60 feet.

ASSOCIATED OIL AND GAS SYNDICATE, TORONTO
Lot 5, con. III, Canborough tp.
Completed June 21, 1933.
Open flow: 45,000 cu. ft.
Rock pressure: 175 lbs.

Formation	Thickness, ft.
Surface	49
Lime and shale	186
Niagara	225
Shale	58
Clinton	31
Red Medina	38
Shale	60
White Medina	13
Red shale	50
Total depth	710

Gas at 521, 569, and 655 feet.

ASSOCIATED OIL AND GAS SYNDICATE, TORONTO
Lot 5, con. III, Canborough tp.
Completed July 8, 1933.
Open flow: 43,000 cu. ft.
Rock pressure: 235 lbs.

Formation	Thickness, ft.
Surface	54
Shale and lime	176
Niagara	230
Shale	56
Clinton	30
Red Medina	37
Shale	63
White Medina	12
Red shale	50
Total depth	708

Gas at 554, 558, and 656 feet.
Fresh water at 60 feet; sulphur water at 230 feet.

COLONIAL NATURAL GAS AND OIL CO., HAMILTON
Lot 1, N.E. pt., con. III, Canborough tp.
Completed October 27, 1933.
Open flow: 15,000 cu. ft.
Rock pressure: 200 lbs.

Formation	Thickness, ft.
Surface	50
Lime and shale	215
Niagara	220
Shale	64
Clinton	32
Red Medina	37
Shale	58
White Medina	12
Red shale	50
Total depth	738

Gas at 615 and 670 feet.
Fresh water at 50 feet.

COLONIAL NATURAL GAS AND OIL CO., HAMILTON
Lot 1, N.E. pt., con. III, Canborough tp.
Completed September 30, 1933.
Open flow: 22,000 cu. ft.
Rock pressure: 200 lbs.

Formation	Thickness ft.
Surface	80
Lime and shale	185
Niagara	220
Shale	59
Clinton	31
Red Medina	41
Shale	57
White Medina	12
Red shale	50
Total depth	735

Gas at 600 and 675 feet.
Fresh water at 80 feet.

MCKECHNIE AND HUSSEY, DUNNVILLE
Lot 6, con. III, Canborough tp.
Completed May, 1933.
Open flow: 15,000 cu. ft.
Rock pressure: 110 lbs.

Formation	Thickness ft.
Surface	56
Lime and shale	174
Niagara	233
Shale	52
Clinton	28
Red Medina	36
Shale	60
White Medina	12
Red shale	50
Total depth	701

Fresh water at 60 feet; black water at 230 feet.

HARRY L. EMERSON, R.R. No. 1, DUNNVILLE
Pt. lots 5 and 6, con. II, Canborough tp.
Completed May 25, 1933.
Open flow: 45,000 cu. ft.
Rock pressure: 125 lbs.

Formation	Thickness ft.
Surface	73
Lime and shale	157
Niagara	200
Shale	30
Clinton	30
Red Medina	40
Grey shale	55
White Medina	12
Red shale	50
Total depth	647

Gas at 490, 530, 585, and 597 feet.
Artesian water about 80 feet.

BEN NATURAL GAS CO., DUNNVILLE

Lot 9, N.E. centre, con. II, Canborough tp.

Completed September 23, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	77
Lime and shale	85
Niagara lime	225
Shale	50
Clinton	27
Red Medina	39
Grey shale	45
White Medina	16
Red shale	1
Total depth	565

Fresh water at 78 feet; salt water at 215 feet.

BEN NATURAL GAS CO., DUNNVILLE

Lot 9, N.E. centre, con. II, Canborough tp.

Completed October 14, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	71
Lime and shale	86
Niagara lime	225
Shale	50
Clinton	27
Red Medina	38
Grey shale	50
White Medina	18
Red shale	15
Total depth	580

Fresh water at 80 feet; salt water at 215 feet.

BEN NATURAL GAS CO., DUNNVILLE

Lot 9, N.E. centre, con. II, Canborough tp.

Completed November 28, 1933.
Open flow: 20,000 cu. ft.
Rock pressure: 115 lbs.

Formation	Thickness, ft.
Surface	65
Lime and shale	90
Niagara lime	225
Shale	50
Clinton	29
Red Medina	36
Grey shale	52
White Medina	18
Red shale	17
Total depth	582

Fresh water at 110 feet.

DUNN NATURAL GAS CO., DUNNVILLE

W. well, S. side of island in front of lot 17, con. I, Dunn tp.

Completed June 13, 1933.
Open flow: 38,000 cu. ft.
Rock pressure: 175 lbs.

Formation	Thickness, ft.
Surface	54
Brown lime	75
Lime and shale	213
Niagara	225
Shale	55
Clinton	30
Red Medina	40
Grey shale	53
White Medina	18
Red shale	57
Total depth	820

Gas at 751 feet.
Fresh water at 40 feet; salt water at 450 feet.

W. C. PATTERSON, JAMESTOWN, N.Y.

Lot 8, N. ½, con. I, S.D.R., Dunn tp.

Completed January 17, 1933.
Open flow: 65,000 cu. ft.
Rock pressure: 415 lbs.

Formation	Thickness, ft.
Surface	22
Lime and shale	378
Niagara	225
Shale	55
Clinton	30
Red Medina	40
Shale	60
White Medina	15
Red shale	37
Total depth	862

Fresh water at 22 feet; sulphur water at 400 feet.

W. C. PATTERSON, JAMESTOWN, N.Y.

Lot 13, W. ½, con. I, N.D.R., Dunn tp.

Completed June 3, 1933.
Open flow: 112,000 cu. ft.
Rock pressure: 325 lbs.

Formation	Thickness, ft.
Surface	76
Lime and shale	289
Niagara	237
Shale	55
Clinton	31
Red Medina	35
Shale	63
White Medina	10
Red shale	31
Total depth	827

Fresh water at 74 feet; sulphur water at 335 feet.

W. C. PATTERSON, JAMESTOWN, N.Y.

Lot 13, W. ½, con. I, N.D.R., Dunn tp.

Completed June 9, 1933.
Open flow: 27,000 cu. ft.
Rock pressure: 325 lbs.

Formation	Thickness, ft.
Surface	55
Lime and shale	285
Niagara	235
Shale	50
Clinton	26
Red Medina	37
Grey shale	69
White Medina	12
Red shale	27
Total depth	796

Fresh water at 55 feet; sulphur water at 340 feet.

W. C. PATTERSON, JAMESTOWN, N.Y.

Lot 8, S. ½, con. I, S.D.R., Dunn tp.

Completed July 20, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	30
Lime and shale	415
Niagara	210
Shale	52
Clinton	28
Red Medina	38
Shale	63
White Medina	12
Red shale	2
Total depth	850

Fresh water at 35 feet; sulphur water at 445 feet.

W. C. PATTERSON, JAMESTOWN, N.Y.
Lot 8, S. ½, con. I, S.D.R., Dunn tp.

Completed August 18, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	32
Lime and shale	407
Niagara	214
Shale	54
Clinton	28
Red Medina	38
Shale	65
White Medina	12
Red shale	2
Total depth	852

Fresh water at 35 feet; sulphur water at 440 feet.

W. C. PATTERSON JAMESTOWN, N.Y.
Lot 8, S. ½, con. I, S.D.R., Dunn tp.

Completed September 12, 1933.
Open flow: 112,000 cu. ft.
Rock pressure: 415 lbs.

Formation	Thickness, ft.
Surface	32
Lime and shale	407
Niagara	210
Shale	52
Clinton	28
Red Medina	38
Shale	62
White Medina	13
Red shale	50
Total depth	892

Fresh water at 35 feet; sulphur water at 440 feet.

W. C. PATTERSON, JAMESTOWN, N.Y.
Lot 7, con. I, S.D.R., Dunn tp.

Completed October 10, 1933.
Open flow: 60,000 cu. ft.
Rock pressure: 415 lbs.

Formation	Thickness, ft.
Surface	29
Lime and shale	421
Niagara	200
Shale	57
Clinton	35
Red Medina	35
Grey shale	62
White Medina	11
Red shale	38
Total depth	888

Fresh water at 30 feet; sulphur water at 450 feet.

W. C. PATTERSON, JAMESTOWN, N.Y.
Lot 9, S. ½, con. I, S.D.R., Dunn tp.

Completed November 21, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	30
Lime and shale	420
Niagara	200
Shale	55
Clinton	28
Red Medina	35
Shale	62
White Medina	12
Red shale	3
Total depth	845

Fresh water at 40 feet; sulphur water at 190 feet.

W. C. PATTERSON, JAMESTOWN, N.Y.
Lot 5, con. I, S.D.R., Dunn tp.

Completed July 1, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	8
Flint	30
Lime and shale	394
Niagara	244
Shale	45
Clinton	30
Red Medina	37
Shale	58
White Medina	12
Red shale	3
Total depth	861

Fresh water at 38 feet; sulphur water at 400 feet.

COLONIAL NATURAL GAS AND OIL CO., HAMILTON
Lot 12, Earl tract, N.E. corner, Dunn tp.

Completed November 6, 1933.
Open flow: 65,000 cu. ft.
Rock pressure: 265 lbs.

Formation	Thickness, ft.
Surface	6
Limestone and flint	65
Blue shale	120
Brown limestone	199
Niagara lime	210
Grey lime	42
Casing shale	40
Clinton	29
Red Medina	39
Grey shale	60
White Medina	16
Red shale	50
Total depth	876

Sulphur gas at 385 feet; gas at 687, 733 to 737, and 820 feet.
Fresh water at 55, 65, and 75 feet; black water at 550 feet.

WESTERN ONTARIO NATURAL GAS CO., DUNNVILLE
Lot 28, N. ½, Haldimand tract, con. I N., Dunn tp.

Completed January 10, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	62
Lime and shale	311
Niagara	225
Shale	55
Clinton	32
Red Medina	42
Grey shale	55
White Medina	18
Red shale	3
Total depth	803

Fresh water at 65 feet; salt water at 450 feet.

WESTERN ONTARIO NATURAL GAS CO., DUNNVILLE
Lot 28, N. ½, Haldimand tract, con. I N., Dunn tp.

Completed February 9, 1933.
Open flow: 17,000 cu. ft.
Rock pressure: 260 lbs.

Formation	Thickness, ft.
Surface	70
Lime and shale	310
Niagara	225
Shale	55
Clinton	31
Red Medina	40
Grey shale	53
White Medina	18
Red shale	27
Total depth	829

Fresh water at 60 and 95 feet; salt water at 450 feet.

WESTERN ONTARIO NATURAL GAS CO., DUNNVILLE
Lot 28, N. ½, Haldimand tract, con. I N., Dunn tp.
Completed March 8, 1933.
Open flow: 192,000 cu. ft.
Rock pressure: 315 lbs.

Formation	Thickness, ft.
Surface	83
Lime and shale	269
Niagara	225
Shale	55
Clinton	32
Red Medina	40
Grey shale	53
White Medina	18
Red shale	59
Total depth	834

Fresh water at 90 feet; salt water at 450 feet.

WESTERN ONTARIO NATURAL GAS CO., DUNNVILLE
Lot 28, N. ½, Haldimand tract, con. I N., Dunn tp.
Completed March 30, 1933.
Open flow: 131,000 cu. ft.
Rock pressure: 290 lbs.

Formation	Thickness, ft.
Surface	72
Lime and shale	278
Niagara	225
Shale	55
Clinton	31
Red Medina	40
Grey shale	52
White Medina	18
Red shale	59
Total depth	830

Fresh water at 73 feet; salt water at 450 feet.

WESTERN ONTARIO NATURAL GAS CO., DUNNVILLE
Lot 28, N. ½, Haldimand tract, con. I N., Dunn tp.
Completed May 10, 1933.
Open flow: 70,000 cu. ft.
Rock pressure: 290 lbs.

Formation	Thickness, ft.
Surface	76
Lime and shale	287
Niagara	225
Shale	55
Clinton	32
Red Medina	40
Grey shale	53
White Medina	18
Red shale	36
Total depth	822

Fresh water at 76 feet; salt water at 450 feet.

WESTERN ONTARIO NATURAL GAS CO., DUNNVILLE
Lot 28, N. ½, Haldimand tract, con. I N., Dunn tp.
Completed May 20, 1933.
Open flow: 270,000 cu. ft.
Rock pressure: 290 lbs.

Formation	Thickness, ft.
Surface	78
Lime and shale	272
Niagara	225
Shale	55
Clinton	32
Red Medina	40
Grey shale	53
White Medina	18
Red shale	45
Total depth	818

Fresh water at 80 feet; salt water at 450 feet.

WESTERN ONTARIO NATURAL GAS CO., DUNNVILLE
Lot 28, N. ½, Haldimand tract, con. I N., Dunn tp.
Completed July 7, 1933.
Open flow: 170,000 cu. ft.
Rock pressure: 175 lbs.

Formation	Thickness, ft.
Surface	80
Lime and shale	267
Niagara	225
Shale	55
Clinton	32
Red Medina	40
Grey shale	53
White Medina	18
Red shale	45
Total depth	815

Fresh water at 80 feet; salt water at 450 feet.

WESTERN ONTARIO NATURAL GAS CO., DUNNVILLE
Lot 28, N. ½, Haldimand tract, con. I N., Dunn tp.
Completed September 13, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	78
Lime and shale	265
Niagara	225
Shale	55
Clinton	32
Red Medina	40
Grey shale	53
White Medina	17
Red shale	2
Total depth	767

Fresh water at 80 feet; salt water at 586 feet.

AIKENS GAS SYNDICATE, VINELAND
Centre well, S. side of island in front of lot 17, con. I, Dunn tp.
Completed July 20, 1933.
Open flow: 112,000 cu. ft.
Rock pressure: 380 lbs.

Formation	Thickness, ft.
Surface	60
Lime and shale	281
Niagara	225
Shale	55
Clinton	30
Red Medina	40
Grey shale	53
White Medina	20
Red shale	51
Total depth	815

Gas at 621 feet.

WESTERN ONTARIO NATURAL GAS CO., DUNNVILLE
E. well, S. side of island in front of lot 17, con. I, Dunn tp.
Completed August 18, 1933.
Open flow: 42,000 cu. ft.
Rock pressure: 250 lbs.

Formation	Thickness, ft.
Surface	66
Lime and shale	275
Niagara	225
Shale	55
Clinton	30
Red Medina	40
Grey shale	53
White Medina	20
Red Medina	54
Total depth	818

WESTERN ONTARIO NATURAL GAS CO., DUNNVILLE
Lot 6, Earl tract, Dunn tp.

Completed December 23, 1933.
Open flow: 12,000 cu. ft.
Rock pressure: 210 lbs.

Formation	Thickness, ft.
Surface	48
Lime and shale	331
Niagara	225
Shale	55
Clinton	30
Red Medina	40
Grey shale	52
White Medina	18
Red shale	25
Total depth	824

Fresh water at 48 feet; salt water at 475 feet.

WESTERN ONTARIO NATURAL GAS CO., DUNNVILLE
Pt. lots 1 and 2, Earl tract, Dunn tp.

Completed September 21, 1933.
Open flow: 17,000 cu. ft.
Rock pressure: 205 lbs.

Formation	Thickness, ft.
Surface	50
Lime and shale	306
Niagara	225
Shale	55
Clinton	32
Red Medina	40
Grey shale	52
White Medina	18
Red shale	40
Total depth	818

Fresh water at 51 feet; salt water at 450 feet.

WESTERN ONTARIO NATURAL GAS CO., DUNNVILLE
Pt. lots 1 and 2, Earl tract, Dunn tp.

Completed October 7, 1933.
Open flow: 55,000 cu. ft.
Rock pressure: 270 lbs.

Formation	Thickness, ft.
Surface	52
Lime and shale	295
Niagara	225
Shale	55
Clinton	32
Red Medina	40
Grey shale	52
White Medina	17
Red shale	58
Total depth	826

Fresh water at 50 feet; salt water at 450 feet.

WESTERN ONTARIO NATURAL GAS CO., DUNNVILLE
Pt. lots 1 and 2, Earl tract, Dunn tp.

Completed October 23, 1933.
Open flow: 50,000 cu. ft.
Rock pressure: 270 lbs.

Formation	Thickness, ft.
Surface	51
Lime and shale	306
Niagara	225
Shale	55
Clinton	30
Red Medina	40
Grey shale	53
White Medina	20
Red shale	60
Total depth	840

Fresh water at 51 feet; salt water at 450 feet.

W. C. PATTERSON, JAMESTOWN, N.Y.
Lot 7, con. I, S.D.R., Dunn tp.

Completed February 27, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	24
Lime and shale	391
Niagara	227
Shale	55
Clinton	32
Red Medina	40
Shale	60
White Medina	12
Red shale	2
Total depth	843

Fresh water at 60 feet; sulphur water at 435 feet.

W. C. PATTERSON, JAMESTOWN, N.Y.
Lot 6, con. I, S.D.R., Dunn tp.

Completed March 24, 1933.
Open flow: 45,000 cu. ft.
Rock pressure: 400 lbs.

Formation	Thickness, ft.
Surface	31
Lime and shale	389
Niagara	222
Shale	55
Clinton	32
Red Medina	40
Shale	60
White Medina	13
Red shale	50
Total depth	892

Fresh water at 60 feet; sulphur water at 442 feet.

WESTERN ONTARIO NATURAL GAS CO., DUNNVILLE
Lot 28, N. ½, Haldimand tract, con. I N., Dunn tp.

Completed May 31, 1933.
Open flow: 39,000 cu. ft.
Rock pressure: 250 lbs.

Formation	Thickness, ft.
Surface	87
Lime and shale	263
Niagara	225
Shale	55
Clinton	32
Red Medina	40
Grey shale	53
White Medina	18
Red shale	45
Total depth	818

Fresh water at 112 feet; salt water at 450 feet.

W. H. CULVER, JR., DUNNVILLE
Town of Dunnville, Moulton tp.

Completed November 6, 1933.
Open flow: 5,000 cu. ft.
Rock pressure: 155 lbs.

Formation	Thickness, ft.
Surface	72
Lime and shale	250
Niagara	230
Shale	51
Clinton	30
Red Medina	40
Grey shale	60
White Medina	10
Red shale	38
Total depth	781

Gas at 618 and 740 feet.
Fresh water at 90 feet.

EMERALD GAS SYNDICATE, TORONTO
Lot 3, con. II C., Moulton tp.

Completed January 9, 1933.
Open flow: 15,000 cu. ft.
Rock pressure: 145 lbs.

Formation	Thickness, ft.
Surface	86
Lime and shale	98
Niagara	225
Shale	52
Clinton	32
Red Medina	35
Grey shale	43
White Medina	24
Red shale	57
Total depth	652

Gas at 470 and 700 feet.
Fresh water at 160 feet; salt water at 250 feet.

RICH GAS CO., TORONTO
Lot 19, con. II, Moulton tp.

Completed February 4, 1933.
Open flow: 10,000 cu. ft.

Formation	Thickness, ft.
Surface	98
Lime and shale	88
Niagara	232
Shale	37
Clinton	30
Red Medina	40
Shale	55
White Medina	18
Red shale	50
Total depth	648

Gas at 505 and 584 feet.
Fresh water at 104 feet; black water at 310 feet.

RICH GAS CO., TORONTO
Lot 19, con. II, Moulton tp.

Completed March 20, 1933.
Open flow: 10,000 cu. ft.

Formation	Thickness, ft.
Surface	93
Lime and shale	80
Niagara	239
Shale	40
Clinton	29
Red Medina	38
Shale	51
White Medina	20
Red shale	51
Total depth	641

Gas at 481 and 580 feet.
Fresh water at 95 feet; sulphur water at 313 feet.

SELECTED NATURAL GAS AND OIL SYNDICATE, TORONTO
Lot 3, E. pt., con. I C., Diltz Rd., Moulton tp.

Completed April 25, 1933.
Open flow: 22,000 cu. ft.
Rock pressure: 120 lbs.

Formation	Thickness, ft.
Surface	88
Lime and shale	177
Niagara	250
Shale	40
Clinton	30
Red Medina	40
Shale	65
White Medina	18
Red shale	51
Total depth	759

Gas at 558, 595, 622, and 693 feet.
Fresh water at 88 feet; black water at 370 feet.

LYMBURNER BROS. AND WEBBER, DUNNVILLE
Lot 11, con. I, Moulton tp.

Completed November 7, 1933.
Open flow: 15,000 cu. ft.
Rock pressure: 90 lbs.

Formation	Thickness ft.
Surface	80
Lime and shale	224
Niagara	191
Shale	44
Clinton	31
Red Medina	40
Grey shale	60
White Medina	10
Red shale	3
Total depth	683

Gas at 541 and 593 feet.
Water at 12 feet.

LYMBURNER BROS. AND WEBBER, DUNNVILLE
Lot 11, con. II, Moulton tp.

Completed November 25, 1933.
Open flow: 45,000 cu. ft.
Rock pressure: 155 lbs.

Formation	Thickness, ft.
Surface	72
Lime and shale	193
Niagara	223
Shale	37
Clinton	29
Red Medina	38
Grey shale	60
White Medina	11
Red shale	50
Total depth	713

Gas at 540 and 657 feet.
Water at 13 feet.

LINCOLN GAS CO., TORONTO
Attercliffe Station, Moulton tp.

Completed August, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	91
Lime and shale	89
Niagara	240
Shale	41
Clinton	27
Red Medina	28
Shale	60
White Medina	13
Red shale	5
Total depth	594

Fresh water at 91 feet; black water at 180 feet.

LINCOLN GAS CO., TORONTO
Attercliffe Station, Moulton tp.

Completed September 14, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	88
Lime and shale	82
Niagara	240
Shale	50
Clinton	30
Red Medina	36
Shale	60
White Medina	12
Red shale	13
Total depth	611

Fresh water at 91 feet; black water at 180 feet.

ROBT. H. SMITH, LOWBANKS
Lot W. 7, W. ½, N.F.R., Moulton tp.

Completed January 21, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	115
Lime and shale	95
Niagara	218
Shale	59
Clinton	34
Red Medina	32
Shale	61
White Medina	14
Red shale	1
Total depth	629

Sulphur water at 115 feet.

CANADIAN NATURAL GAS SYNDICATE, SIMCOE
Lot 20, N.F.R., Moulton tp.

Completed November 22, 1933.
Open flow: 46,000 cu. ft.
Rock pressure: 235 lbs.

Formation	Thickness, ft.
Surface	93
Lime and shale	169
Niagara	220
Shale	57
Clinton	30
Red Medina	39
Shale	57
White Medina	12
Red shale	50
Total depth	727

Gas at 571 and 581 feet.
Sulphur water at 93 feet.

AMITY GAS AND OIL CO., LOWBANKS
Lots 18 and 19, con. I, Moulton tp.

Completed May 10, 1933.
Open flow: 25,000 cu. ft.
Rock pressure: 100 lbs.

Formation	Thickness, ft.
Surface	96
Lime and shale	114
Niagara	220
Shale	57
Clinton	35
Red Medina	32
Shale	58
White Medina	12
Red shale	50
Total depth	674

Gas at 510 feet.
Sulphur water at 95 feet.

ROBT. H. SMITH, LOWBANKS
Lot W. 7, N.F.R., Moulton tp.

Completed January 8, 1933.
Open flow: 50,000 cu. ft.
Rock pressure: 100 lbs.

Formation	Thickness, ft.
Surface	114
Lime and shale	101
Niagara	220
Shale	59
Clinton	37
Red Medina	32
Shale	56
White Medina	12
Red shale	50
Total depth	681

Gas at 514 feet.
Sulphur water at 114 feet.

COLONIAL NATURAL GAS AND OIL CO., HAMILTON
Lots 2 and 3, N.W. pts., con. I C, Moulton tp.

Completed March 2, 1933.
Open flow: 50,000 cu. ft.
Rock pressure: 175 lbs.

Formation	Thickness, ft.
Surface	80
Lime and shale	200
Niagara	220
Shale	59
Clinton	33
Red Medina	40
Shale	55
White Medina	12
Red shale	50
Total depth	749

Gas at 592, 632, and 699 feet.
Fresh water at 80 feet.

COLONIAL NATURAL GAS AND OIL CO., HAMILTON
Lot 4, N. pt., con. I C, Moulton tp.

Completed September 2, 1933.
Open flow: 25,000 cu. ft.
Rock pressure: 180 lbs.

Formation	Thickness, ft.
Surface	78
Lime and shale	194
Niagara	220
Shale	59
Clinton	30
Red Medina	40
Shale	58
White Medina	10
Red shale	51
Total depth	740

Gas at 551 and 679 feet.
Fresh water at 68 feet.

COLONIAL NATURAL GAS AND OIL CO., HAMILTON
Lot 3, N.W. pt., con. I C, Moulton tp.

Completed August 2, 1933.
Open flow: 28,000 cu. ft.
Rock pressure: 180 lbs.

Formation	Thickness, ft.
Surface	88
Lime and shale	182
Niagara	220
Shale	63
Clinton	30
Red Medina	40
Shale	56
White Medina	14
Red shale	50
Total depth	743

Gas at 553 and 679 feet.
Fresh water at 78 feet.

COLONIAL NATURAL GAS AND OIL CO., HAMILTON
Lots 2 and 3, N.W. pts., con. I C, Moulton tp.

Completed March 2, 1933.
Open flow: 65,000 cu. ft.
Rock pressure: 190 lbs.

Formation	Thickness, ft.
Surface	89
Blue shale	80
Brown lime	110
Niagara limestone	210
Grey limestone	43
Shale	30
Clinton	31
Red Medina	40
Grey shale	55
White Medina	12
Red shale	50
Total depth	750

Gas at 566, 601, and 684 feet.
Fresh water at 90 feet.

COLONIAL NATURAL GAS AND OIL CO., HAMILTON
Lots 2 and 3, N.W. pts., con. I C, Moulton tp.

Completed January 15, 1933.
Open flow: 34,500 cu. ft.
Rock pressure: 180 lbs.

Formation	Thickness, ft.
Surface	84
Lime and shale	191
Niagara	212
Lime and shale	81
Clinton	28
Red Medina	39
Grey shale	58
White Medina	16
Red shale	50
Total depth	759

Gas at 572, 626, and 703 feet.
Fresh water at 86 feet; black sulphur water at 275 feet.

COLONIAL NATURAL GAS AND OIL CO., HAMILTON
Lot 4, N. pt., con. I C, Moulton tp.

Completed September 2, 1933.
Open flow: 25,000 cu. ft.
Rock pressure: 180 lbs.

Formation	Thickness, ft.
Surface	78
Lime and shale	194
Niagara	220
Shale	59
Clinton	30
Red Medina	40
Shale	58
White Medina	10
Red shale	51
Total depth	740

Gas at 551 and 679 feet.
Fresh water at 68 feet.

AIKENS GAS SYNDICATE, VINELAND
Lot 5, con. II, North Cayuga tp.

Completed March 11, 1933.
Open flow: 50,000 cu. ft.
Rock pressure: 200 lbs.

Formation	Thickness, ft.
Surface	51
Lime and shale	216
Niagara	225
Shale	50
Clinton	30
Red Medina	40
Grey shale	53
White Medina	18
Red shale	60
Total depth	743

Gas at 681 feet.
Fresh water at 51 feet; salt water at 300 feet.

AIKENS GAS SYNDICATE, VINELAND
Lot 5, con. II, North Cayuga tp.

Completed May 9, 1933.
Open flow: 40,000 cu. ft.
Rock pressure: 200 lbs.

Formation	Thickness, ft.
Surface	38
Lime and shale	236
Niagara	225
Shale	50
Clinton	27
Red Medina	40
Grey shale	50
White Medina	16
Red shale	60
Total depth	742

Gas at 681 feet.
Fresh water at 37 feet; salt water at 300 feet.

NORTH CAYUGA GAS SYNDICATE, CAYUGA
Lots 1 and 2, Huff tract, North Cayuga tp.

Completed October 5, 1933.
Open flow: 23,000 cu. ft.
Rock pressure: 260 lbs.

Formation	Thickness, ft.
Surface	69
Lime and shale	241
Niagara	246
Shale	45
Clinton	25
Red Medina	30
Grey shale	64
White Medina	15
Red shale	29
Total depth	764

Gas at 602, 605, and 634 feet.
Sulphur water at 100 feet.

NORTH CAYUGA GAS SYNDICATE, CAYUGA
Lots 1 and 2, Huff tract, North Cayuga tp.

Completed September 21, 1933.
Open flow: 95,000 cu. ft.
Rock pressure: 150 lbs.

Formation	Thickness, ft.
Surface	60
Lime and shale	240
Niagara	236
Shale	55
Clinton	28
Red Medina	30
Grey shale	64
White Medina	15
Red shale	35
Total depth	763

Gas at 596 and 727 feet.
Fresh water at 90 feet.

NORTH CAYUGA GAS SYNDICATE, CAYUGA
Jones tract, North Cayuga tp.

Completed October 7, 1933.
Open flow: 50,000 cu. ft.
Rock pressure: 355 lbs.

Formation	Thickness, ft.
Surface	49
Lime and shale	268
Niagara	221
Shale	60
Clinton	27
Red Medina	40
Grey shale	60
White Medina	10
Red shale	4
Total depth	739

Gas at 601 and 627 feet.
Fresh water at 80 feet.

NORTH CAYUGA GAS SYNDICATE, CAYUGA
Jones tract, North Cayuga tp.

Completed September 20, 1933.
Open flow: 90,000 cu. ft.
Rock pressure: 345 lbs.

Formation	Thickness, ft.
Surface	38
Lime and shale	262
Niagara	220
Shale	56
Clinton	28
Red Medina	40
Shale	61
White Medina	10
Red shale	50
Total depth	765

Gas at 601 and 709 feet.
Fresh water at 70 feet.

GRAND RIVER GAS AND OIL SYNDICATE, CANFIELD
Lots 4, 5, and 6, Jones tract, North Cayuga tp.
Completed July 8, 1933.
Open flow: 37,000 cu. ft.
Rock pressure: 360 lbs.

Formation	Thickness, ft.
Surface	52
Lime and shale	265
Niagara	200
White lime	53
Clinton shale	35
Clinton	25
Red Medina	38
Blue shale	65
White Medina	10
Red shale	2
Total depth	745

Gas at 648 feet.
Water at 110 feet.

GRAND RIVER GAS AND OIL SYNDICATE, CANFIELD
I ot 3, Jones tract, North Cayuga tp.
Completed August 21, 1933
Dry hole.

Formation	Thickness, ft.
Surface	50
Lime and shale	265
Niagara	200
White lime	55
Shale	41
Clinton	28
Red Medina	38
Blue shale	65
White Medina	12
Red shale	1
Total depth	755

Water at 130 feet.

GRAND RIVER GAS AND OIL SYNDICATE, CANFIELD
Lots 1, 2, 3, and 4, Huff and Jones tracts, North Cayuga tp.
Completed September 25, 1933.
Open flow: 73,000 cu. ft.
Rock pressure: 360 lbs.

Formation	Thickness, ft.
Surface	30
Lime and shale	245
Niagara	200
White lime	45
Shale	38
Clinton	25
Red Medina	35
Blue shale	65
White Medina	12
Red shale	5
Total depth	700

Gas at 604 feet.
Water at 30 feet; sulphur water at 270 feet.

GRAND RIVER GAS AND OIL SYNDICATE, CANFIELD
Lots 4, 5, and 6, Jones tract, North Cayuga tp.
Completed November 1, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	29
Lime and shale	245
Niagara	200
White lime	46
Shale	37
Clinton	25
Red Medina	35
Blue shale	65
White Medina	12
Red shale	3
Total depth	697

Water at 30 feet.

GRAND RIVER GAS AND OIL SYNDICATE, CANFIELD
Lots 4, 5, and 6, Jones tract, North Cayuga tp.
Completed December 16, 1933.
Open flow: 85,000 cu. ft.
Rock pressure: 365 lbs.

Formation	Thickness, ft.
Surface	58
Lime and shale	242
Niagara	200
White lime	50
Casing shale	44
Clinton	27
Red Medina	35
Blue shale	65
White Medina	10
Red shale	2
Total depth	733

Gas at 641 feet.
Water at 75 feet.

GRAND RIVER GAS AND OIL SYNDICATE, CANFIELD
Lot 4, Huff and Jones tracts, North Cayuga tp.
Completed June 10, 1933.
Open flow: 150,000 cu. ft.
Rock pressure: 350 lbs.

Formation	Thickness, ft.
Surface	56
Lime and shale	253
Niagara	200
White lime	50
Shale	32
Clinton	25
Red Medina	39
Blue shale	65
White Medina	12
Red shale	3
Total depth	735

Gas at 610, 620, and 638 feet.
Water at 65 feet.

GRAND RIVER GAS AND OIL SYNDICATE, CANFIELD
Lots 1 and 4, Huff and Jones tracts, North Cayuga tp.
Completed March 13, 1933.
Open flow: 21,000 cu. ft.
Rock pressure: 300 lbs.

Formation	Thickness, ft.
Surface	34
Lime and shale	251
Niagara	200
White lime	50
Clinton shale	34
Clinton	28
Red Medina	38
Blue shale	65
White lime	9
Red shale	3
Total depth	712

Gas at 575 feet.
Water at 40 feet.

GRAND RIVER GAS AND OIL SYNDICATE, CANFIELD
Lots 1 and 4, Huff and Jones tracts, North Cayuga tp.
Completed February 9, 1933.
Open flow: 50,000 cu. ft.
Rock pressure: 300 lbs.

Formation	Thickness, ft.
Surface	39
Lime and shale	241
Niagara	200
White lime	50
Clinton shale	34
Clinton	28
Red Medina	38
Blue shale	65
White lime	12
Red shale	4
Total depth	711

Gas at 356 and 373 feet.
Water at 40 feet.

LYNN VALLEY NATURAL GAS SYNDICATE, TORONTO
Lot 19, con. II, Oneida tp.

Completed January 27, 1933.
Open flow: 29,000 cu. ft.
Rock pressure: 385 lbs.

Formation	Thickness, ft.
Surface	48
Lime and shale	282
Niagara	231
Shale	48
Clinton	24
Red Medina	32
Grey shale	60
White Medina	15
Red shale	2
Total depth	742

Gas at 612 and 623 feet.
Sulphur water at 95 feet.

MELROSE GAS AND OIL SYNDICATE, TORONTO
Lot 19, con. IV, Oneida tp.

Completed February 14, 1933.
Open flow: 10,000 cu. ft.

Formation	Thickness, ft.
Surface	53
Lime and shale	255
Niagara	240
Shale	29
Clinton	29
Red Medina	31
Shale	90
White Medina	23
Red shale	50
Total depth	800

Gas at 589 and 737 feet.
Fresh water at 130 feet; sulphur water at 310 feet.

MELROSE GAS AND OIL SYNDICATE, TORONTO
Lot 19, N. ½, con. III, Oneida tp.

Completed March 28, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	48
Lime and shale	226
Niagara	240
Shale	40
Clinton	28
Red Medina	35
Blue shale	95
White Medina	24
Red shale	9
Total depth	745

Fresh water at 95 feet; sulphur water at 300 feet.

W. H. CULVER, JR., DUNNVILLE
Lot 54, con. I, Oneida tp.

Completed August 1, 1933.
Open flow: 20,000 cu. ft.
Rock pressure: 435 lbs.

Formation	Thickness, ft.
Surface	3
Flint	49
Lime and shale	375
Niagara	241
Shale	46
Clinton	30
Red Medina	35
Grey shale	54
White Medina	11
Red shale	2
Total depth	846

Gas at 719 and 728 feet.
Sulphur water at 32 feet.

W. H. CULVER, DUNNVILLE
Lot 54, con. I, Oneida tp.

Completed July, 1933.
Open flow: 20,000 cu. ft.
Rock pressure: 385 lbs.

Formation	Thickness, ft.
Surface	3
Flint	53
Lime and shale	370
Niagara	240
Shale	48
Clinton	29
Red Medina	34
Grey shale	55
White Medina	10
Red shale	1
Total depth	843

Gas at 717 and 730 feet.
Sulphur water at 30 feet.

R. B. POPE, TORONTO
Lot 14, con. III, Oneida tp.

Completed August 20, 1933.
Dry hole.

Formation	Thickness ft.
Surface	56
Lime and shale	264
Niagara	240
Shale	52
Clinton	22
Red Medina	33
Grey shale	59
White Medina	15
Red shale	2
Total depth	743

Sulphur water at 70 feet.

STANDARD GAS AND OIL SYNDICATE, FISHERVILLE
Lot 1, con. VI, Rainham tp.

Completed January 12, 1933.
Dry hole.

Formation	Thickness ft.
Surface	14
Flint	80
Lime and shale	363
Niagara	251
Shale	51
Clinton	27
Red Medina	37
Grey shale	55
White Medina	14
Red shale	1
Total depth	893

R. B. POPE AND W. T. RYAN, TORONTO
Lot 7, S. ½ of N. ½, con. VI, Rainham tp.

Completed February 25, 1933.
Open flow: 26,000 cu. ft.
Rock pressure: 335 lbs.

Formation	Thickness, ft.
Surface	14
Flint	68
Lime and shale	363
Niagara	232
Shale	47
Clinton	24
Red Medina	35
Grey shale	69
White Medina	10
Red shale	5
Total depth	867

Gas at 738, 751, and 757 feet.
Fresh water at 35 feet.

STANDARD GAS AND OIL SYNDICATE, FISHERVILLE
Lot 1, con. VI, Rainham tp.

Completed March 4, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	9
Flint	75
Lime and shale	366
Niagara	242
Shale	60
Clinton	28
Red Medina, soft	42
Grey shale	55
White Medina	15
Red shale	6
Total depth	898

Fresh water at 18 feet; sulphur water at 48 feet.

CYCLOPS GAS SYNDICATE, TORONTO
Lot 2, con. VII, Rainham tp.

Completed March 27, 1933.
Open flow: 15,000 cu. ft.

Formation	Thickness, ft.
Surface	16
Flint	67
Lime and shale	372
Niagara	231
Shale	55
Clinton	26
Red Medina	41
Grey shale	54
White Medina	11
Red shale	1
Total depth	874

Gas at 759 feet.
Sulphur water at 62 feet.

STANDARD GAS AND OIL SYNDICATE, FISHERVILLE
Lot 1, con. VI, Rainham tp.

Completed April 4, 1933.
Open flow: 27,400 cu. ft.
Rock pressure: 375 lbs.

Formation	Thickness, ft.
Surface	15
Flint	72
Lime and shale	372
Niagara	243
Shale	52
Clinton	30
Red Medina	38
Grey shale	55
White Medina	17
Red shale	4
Total depth	898

Gas at 757 and 774 feet.
Black water at 48 feet.

R. B. POPE AND W. T. RYAN, TORONTO
Lot 7, S. ½ of N. ½, con. VI, Rainham tp.

Completed March 21, 1933.
Open flow: 50,000 cu. ft.
Rock pressure: 425 lbs.

Formation	Thickness, ft.
Surface	24
Flint	65
Lime and shale	346
Niagara	238
Shale	47
Clinton	26
Red Medina	43
Grey shale	59
White Medina	10
Red shale	2
Total depth	860

Gas at 746, 756, and 786 feet.
Fresh water at 40 feet.

CYCLOPS GAS SYNDICATE, TORONTO
Lot 7, con. V, Rainham tp.

Completed April 13, 1933.
Open flow: 25,000 cu. ft.
Rock pressure: 280 lbs.

Formation	Thickness, ft.
Surface	14
Flint	84
Lime and shale	352
Niagara	230
Shale	61
Clinton	27
Red Medina	50
Grey shale	50
White Medina	10
Red shale	2
Total depth	880

Gas at 746, 783, and 793 feet.
Sulphur water at 105 feet.

CYCLOPS GAS SYNDICATE, TORONTO
Lot 8, con. V, Rainham tp.

Completed May 4, 1933.
Open flow: 26,000 cu. ft.
Rock pressure: 270 lbs.

Formation	Thickness, ft.
Surface	6
Flint	80
Lime and shale	369
Niagara	236
Shale	51
Clinton	24
Red Medina	46
Grey shale	59
White Medina	10
Red shale	4
Total depth	885

Gas at 747, 761, 781, and 791 feet.
Sulphur water at 68 feet.

OTTERVILLE NATURAL GAS CO., OTTERVILLE
Lots 1 and 2, con. VIII, Rainham tp.

Completed June 1, 1933.
Open flow: 44,000 cu. ft.
Rock pressure: 350 lbs.

Formation	Thickness ft.
Surface	20
Flint	65
Lime and gypsum	385
Niagara	240
Shale	35
Clinton	30
Red Medina	35
Shale	65
White Medina	20
Red shale	40
Total depth	935

Gas at 748, 777, and 882 feet.
Fresh water at 20 feet; sulphur water at 305 feet.

REGAL GAS SYNDICATE, TORONTO
Lot 7, con. III, Rainham tp.

Completed May 17, 1933.
Open flow: 35,400 cu. ft.
Rock pressure: 385 lbs.

Formation	Thickness ft.
Surface	19
Flint	51
Lime and shale	368
Niagara	224
Shale	58
Clinton	29
Red Medina	38
Grey shale	65
White Medina	6
Red shale	4
Total depth	862

Gas at 728, 748, 765, and 773 feet.
Fresh water at 37 feet.

OTTERVILLE NATURAL GAS CO., OTTERVILLE
Lots 1 and 2, con. VIII, Rainham tp.

Completed June 30, 1933.
Open flow: 5,000 cu. ft.
Rock pressure: 500 lbs.

Formation	Thickness, ft.
Surface	14
Flint	65
Lime	383
Niagara lime	240
Shale	35
Clinton	30
Red Medina	35
Blue shale	75
White Medina	19
Red shale	5
Total depth	901

Gas at 740 and 795 feet.
Fresh water at 14 feet; sulphur water at 300 feet.

OTTERVILLE NATURAL GAS CO., OTTERVILLE
Lots 1 and 2, con. VIII, Rainham tp.

Completed August 16, 1933.
Open flow: 90,000 cu. ft.
Rock pressure: 480 lbs.

Formation	Thickness, ft.
Surface	27
Flint	65
Lime and gypsum	353
Niagara	240
Shale	51
Clinton	30
Red Medina	35
Blue shale	65
White Medina	20
Red shale	41
Total depth	927

Gas at 739, 785, and 889 feet.
Fresh water at 28 feet; black water at 310 feet.

LYMBURNER BROS. AND WEBBER, DUNNVILLE
Lot 15, con. II, Rainham tp.

Completed February 2, 1933.
Open flow: 100,000 cu. ft.
Rock pressure: 200 lbs.

Formation	Thickness, ft.
Surface	12
Flint	68
Lime and shale	365
Niagara	229
Shale	61
Clinton	28
Red Medina	40
Grey shale	62
White Medina	12
Red shale	51
Total depth	928

Gas at 767, 773, 778, and 869 feet.
Fresh water at 93 feet.

LYMBURNER BROS. AND WEBBER, DUNNVILLE
Lot 15, con. II, Rainham tp.

Completed March 7, 1933.
Open flow: 70,000 cu. ft.
Rock pressure: 200 lbs.

Formation	Thickness, ft.
Surface	12
Flint	65
Lime and shale	372
Niagara	229
Shale	57
Clinton	27
Red Medina	42
Grey shale	60
White Medina	10
Red shale	3
Total depth	877

Gas at 769 feet.
Fresh water at 52 and 125 feet.

LYMBURNER BROS. AND WEBBER, DUNNVILLE
Lot 15, con. II, Rainham tp.

Completed June 6, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	14
Flint	56
Lime and shale	382
Niagara	224
Shale	54
Clinton	26
Red Medina	40
Grey shale	60
White Medina	10
Red shale	3
Total depth	869

Water at 15 feet.

LYMBURNER BROS. AND WEBBER, DUNNVILLE
Lot 17, con. II, Rainham tp.

Completed July 13, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	11
Flint	72
Lime and shale	369
Niagara	224
Shale	58
Clinton	32
Red Medina	41
Shale	60
White Medina	10
Red shale	3
Total depth	880

Fresh water at 30 feet.

LYMBURNER BROS. AND WEBBER, DUNNVILLE
Lot 17, con. II, Rainham tp.

Completed September 18, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	11
Flint	72
Lime and shale	369
Niagara	224
Shale	58
Clinton	32
Red Medina	41
Shale	60
White Medina	10
Red shale	3
Total depth	880

Water at 50 feet.

OTTERVILLE NATURAL GAS CO., OTTERVILLE
Lot 1, con. VIII, Rainham tp.

Completed November 15, 1933.
Open flow: 60,000 cu. ft.
Rock pressure: About 400 lbs.

Formation	Thickness, ft.
Surface	30
Flint	60
Lime and shale	360
Niagara lime	240
Shale	48
Clinton lime	27
Red Medina	34
Medina shale	70
White Medina	16
Red shale	50
Total depth	935

Gas at 747, 779, and 875 feet.
Fresh water at 65 feet; black water at 540 feet.

SUPERIOR GAS SYNDICATE, FISHERVILLE
Lot 8, con. III, Rainham tp.

Completed December 19, 1933.
Open flow: 29,000 cu. ft.
Rock pressure: 270 lbs.

Formation	Thickness, ft.
Surface	18
Flint	75
Lime and shale	357
Niagara	241
Shale	60
Clinton	30
Red Medina	35
Grey shale	70
White Medina	10
Red shale	2
Total depth	898

Gas at 755 and 806 feet.
Sulphur water at 40 feet.

SUPERIOR GAS SYNDICATE, FISHERVILLE
Lot 12, con. II, Rainham tp.

Completed November 24, 1933.
Open flow: 30,000 cu. ft.
Rock pressure: 300 lbs.

Formation	Thickness, ft.
Surface	15
Flint	70
Lime and shale	370
Niagara	234
Shale	60
Clinton	30
Red Medina	41
Grey shale	60
White Medina	10
Red shale	5
Total depth	895

Gas at 755, 772, and 783 feet.
Sulphur water at 550 feet.

BROADWAY GAS SYNDICATE, CAYUGA
Lot 1, N.E. ¼, con. VII, Rainham tp.

Completed about June 1, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	30
Flint	80
Brown lime	40
Shale and lime	100
Brown lime	100
Shale and lime	90
Shale	10
Niagara	210
White lime	43
Shale	41
Clinton	25
Red Medina	42
Grey shale	47
White Medina	14
Red shale	1
Total depth	873

ALEX. McDOUGALL, OAKVILLE
Lot 15, con. III, Rainham tp.

Completed January 25, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	13
Flint	80
Lime and shale	365
Niagara	247
Shale	39
Clinton	28
Red Medina	45
Grey shale	60
White Medina	6
Red shale	2
Total depth	885

Fresh water at 40 feet; sulphur water at 458 feet.

ALEX. McDOUGALL, OAKVILLE
Lot 15, con. I, Rainham tp.

Completed February 24, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	8
Flint	72
Lime and shale	365
Niagara	240
Clinton shale	52
Clinton	29
Red Medina	40
Grey shale	60
White Medina	12
Red shale	3
Total depth	881

Black water at 35 feet; sulphur water at 410 feet.

ALEX. McDOUGALL, OAKVILLE
Lot 14, con. I, Rainham tp.

Completed October, 1933.
Open flow: 27,000 cu. ft.
Rock pressure: 280 lbs.

Formation	Thickness, ft.
Surface	8
Flint	65
Lime and shale	387
Niagara	245
Shale	45
Clinton	29
Red Medina	35
Shale	60
White Medina	12
Red shale	4
Total depth	890

Mineral water at 30 feet; sulphur water at 460 feet.

ALEX. McDOUGALL, OAKVILLE
Lot 14, con. I, Rainham tp.

Completed November, 1933.
Open flow: 200,000 cu. ft.
Rock pressure: 270 lbs.

Formation	Thickness, ft.
Surface	25
Flint	35
Lime and shale	385
Niagara	250
Shale	50
Clinton	30
Red Medina	35
Shale	60
White Medina	11
Shale	5
Total depth	886

Mineral water at 30 feet.
Sulphur water at 460 feet.

ALEX. McDOUGALL, OAKVILLE
Lot 13, con. I, Rainham tp.

Completed December 1, 1933.
Open flow: 83,000 cu. ft.
Rock pressure: 282 lbs.

Formation	Thickness, ft.
Surface	16
Flint	86
Lime and shale	345
Niagara	250
Shale	50
Clinton	30
Red Medina	40
Shale	60
White Medina	12
Red shale	5
Total depth	894

Mineral water at 30 feet.
Sulphur water at 460 feet.

ALEX. McDOUGALL, OAKVILLE
Lot 14, con. I, Rainham tp.

Completed December 30, 1933.
Open flow: 73,000 cu. ft.
Rock pressure: 310 lbs.

Formation	Thickness, ft.
Surface	7
Flint	65
Lime and shale	380
Niagara	265
Shale	16
Clinton	28
Red Medina	42
Shale	60
White Medina	10
Red shale	2
Total depth	875

Fresh water at 40 feet; sulphur water at 442 feet.

KELLY GAS AND OIL SYNDICATE, TORONTO
Lot 12, con. I, Rainham tp.

Completed July 20, 1933.
Open flow: 50,000 cu. ft.
Rock pressure: 335 lbs.

Formation	Thickness, ft.
Surface	9
Flint	81
Lime and shale	375
Niagara	220
Casing shale	65
Clinton	30
Red Medina sand	28
Red Medina shale	12
Grey shale	58
White Medina	14
Red shale	6
Total depth	898

Gas in Clinton and Red Medina.
Water at 50 and 90 feet.

KELLY GAS AND OIL SYNDICATE, TORONTO
Lot 12, con. II, Rainham tp.

Completed March 29, 1933.
Open flow: 150,000 cu. ft.
Rock pressure: 310 lbs.

Formation	Thickness, ft.
Surface	18
Flint	122
Lime and shale	330
Niagara	225
Casing shale	53
Clinton	30
Red Medina sand	30
Red Medina shale	10
Grey shale	65
White Medina	14
Red shale	3
Total depth	900

Gas in Clinton and Red Medina.
Water at 50 feet.

KELLY GAS AND OIL SYNDICATE, TORONTO
Lot 12, con. II, Rainham tp.

Completed May 5, 1933.
Open flow: 40,000 cu. ft.
Rock pressure: 300 lbs.

Formation	Thickness, ft.
Surface	28
Flint	107
Lime and shale	338
Niagara	234
Casing shale	41
Clinton	32
Red Medina sand	10
Red Medina shale	28
Grey shale	62
White Medina	20
Red shale	4
Total depth	904

Gas in Clinton.
Water at 45 feet.

KELLY GAS AND OIL SYNDICATE, TORONTO
Lot 12, con. II, Rainham tp.

Completed June 9, 1933.
Open flow: 35,000 cu. ft.
Rock pressure: 339 lbs.

Formation	Thickness, ft.
Surface	19
Flint	101
Lime and shale	345
Niagara	230
Casing shale	55
Clinton	30
Red Medina sand	30
Red Medina shale	10
Grey shale	65
White Medina	15
Red shale	3
Total depth	903

Gas in Clinton and Red Medina.
Water at 55 feet.

KELLY GAS AND OIL SYNDICATE, TORONTO
Lot 11, con. I, Rainham tp.

Completed September 19, 1933.
Open flow: 23,000 cu. ft.
Rock pressure: 330 lbs.

Formation	Thickness, ft.
Surface	15
Flint	90
Lime and shale	355
Niagara	250
Casing shale	60
Clinton	25
Red Medina sand	10
Red Medina shale	29
Grey shale	56
White Medina	16
Red shale	3
Total depth	909

Gas at 780 and 826 feet.
Water at 75 feet.

PORT COLBORNE–WELLAND GAS AND OIL CO., PORT COLBORNE
Lot 34, R.R., Seneca tp.

Completed December 31, 1933.
Open flow: 20,000 cu. ft.
Rock pressure: 135 lbs.

Formation	Thickness, ft.
Surface	27
Lime and shale	58
Niagara	238
Casing shale	42
Clinton	35
Red Medina	37
Grey shale	52
White Medina	5
Red shale	50
Total depth	544

Gas at 367 feet.
Water at 60 feet.

PORT COLBORNE–WELLAND GAS AND OIL CO., PORT COLBORNE
Lot 37, R.R., Seneca tp.

Completed September 26, 1933.
Open flow: 30,000 cu. ft.
Rock pressure: 132 lbs.

Formation	Thickness, ft.
Surface	34
Lime and shale	76
Niagara	242
Casing shale	39
Clinton	35
Red Medina	30
Grey shale	55
White Medina	5
Red shale	75
Total depth	591

Gas at 393 feet.
Water at 170 feet.

PORT COLBORNE-WELLAND GAS AND OIL CO., PORT COLBORNE

Lot 37, R.R., Seneca tp.

Completed September 1, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	16
Lime and shale	69
Niagara	241
Casing shale	39
Clinton	32
Red Medina	32
Grey shale	55
White Medina	7
Red shale	6
Total depth	497

Small show of gas at 367, 380, and 391 feet.
Fresh water at 15 feet.

PORT COLBORNE-WELLAND GAS AND OIL CO., PORT COLBORNE

Lot 36, R.R., Seneca tp.

Completed October 20, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	54
Lime and shale	81
Niagara	245
Casing shale	33
Clinton	30
Red Medina	30
Grey shale	55
White Medina	10
Red shale	2
Total depth	540

Show of gas at 425, 431, and 532 feet.
Water at 60 feet.

PORT COLBORNE-WELLAND GAS AND OIL CO. PORT COLBORNE

Lot 37, R.R., Seneca tp.

Completed November 18, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	47
Lime and shale	80
Niagara	244
Casing shale	34
Clinton	30
Red Medina	34
Grey shale	55
White Medina	10
Red shale	2
Total depth	536

Water at 60 feet.

PORT COLBORNE-WELLAND GAS AND OIL CO., PORT COLBORNE

Pt. Nelles tract, Seneca tp.

Completed August 7, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	68
Lime and shale	102
Niagara	243
Casing shale	39
Clinton	24
Red Medina	33
Grey shale	58
White Medina	12
Red shale	2
Total depth	581

Water at 70 feet.

CENTRAL SENECA GAS SYNDICATE, CAYUGA

Lot 12, N. ½, con. IV, Seneca tp.

Completed October 28, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	55
Lime and shale	120
Niagara	161
Casing shale	36
Clinton	26
Red Medina shale	30
Grey shale	62
White Medina	12
Red shale	3
Total depth	505

Water at 70 feet.

CENTRAL SENECA GAS SYNDICATE, CAYUGA

Lot 11, N. ½, con. IV, Seneca tp.

Completed November 18, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	60
Lime and shale	115
Niagara	159
Casing shale	31
Clinton	23
Red Medina sand	6
Red Medina shale	29
Grey shale	55
White Medina	12
Red shale	6
Red shale (pocket)	40
Total depth	536

Gas in White Medina.
Water at 80 feet.

CENTRAL SENECA GAS SYNDICATE, CAYUGA

Lot 17, N. ½, con. IV, Seneca tp.

Completed December 8, 1933.
Open flow: 500,000 cu. ft.
Rock pressure: 95 lbs.

Formation	Thickness, ft.
Surface	64
Lime and shale	96
Niagara	190
Casing shale	43
Clinton	23
Red Medina sand	20
Red Medina shale	10
Grey shale	50
White Medina	12
Red shale	24
Total depth	532

Gas at 409, 434, and 502 feet.
Water at 73 feet.

CENTRAL SENECA GAS SYNDICATE, CAYUGA

Lot 16, N. ½, con. IV, Seneca tp.

Completed December 28, 1933.
Open flow: 500,000 cu. ft.
Rock pressure: 95 lbs.

Formation	Thickness, ft.
Surface	64
Lime and shale	101
Niagara	190
Casing shale	37
Clinton	26
Red Medina sand	20
Red Medina shale	12
Grey shale	50
White Medina	15
Red shale	18
Total depth	533

Gas in White Medina.
Water at 80 feet.

RAINHAM GAS SYNDICATE, FISHERVILLE
Lot 25, con. II, Seneca tp.

Completed January 24, 1933.
Open flow: 50,000 cu. ft.

Formation	Thickness, ft.
Surface	77
Lime and shale	139
Niagara	249
Casing shale	58
Clinton	26
Red Medina sand	20
Red Medina shale	29
Grey shale	45
White Medina	24
Red shale	5
Total depth	672

Gas at 538 and 566 feet.
Water at 80 feet.

STERLING GAS SYNDICATE, TORONTO
Lot 14, con. II, Walpole tp.

Completed February 3, 1933.
Open flow: 70,000 cu. ft.
Rock pressure: 235 lbs.

Formation	Thickness, ft.
Surface	25
Flint	120
Lime and shale	364
Niagara	280
Shale	51
Clinton	25
Red Medina	43
Grey shale	65
White Medina	15
Red shale	2
Total depth	990

Gas at 845, 872, and 887 feet.
Sulphur water at 85 feet.

EMPIRE NATURAL GAS, LIMITED, TORONTO
Lot 1, con. I, Walpole tp.

Completed March 18, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	9
Flint	150
Lime and shale	400
Niagara lime	250
Lime and shale	71
Clinton lime	24
Red Medina	40
Grey shale	58
White Medina	9
Red shale	2
Total depth	1,013

Show of gas at 932 and 1,008 feet.
Fresh water at 90 feet.

EMPIRE NATURAL GAS, LIMITED, TORONTO
Lot 1, con. II, Walpole tp.

Completed May 15, 1933.
Open flow: 900,000 cu. ft.
Rock pressure: 450 lbs.

Formation	Thickness, ft.
Surface	31
Lime and shale	535
Niagara lime	250
White lime	18
Shale and lime	41
Shale	10
Clinton	25
Red Medina	42
Shale	37
Total depth	989

Gas at 920 feet.
Fresh water at 60 feet; black water at 700 feet.

EMPIRE GAS AND OIL SYNDICATE, TORONTO
Lot 1, con. II, Walpole tp.

Completed May 13, 1933.
Open flow: 825,000 cu. ft.
Rock pressure: 480 lbs.

Formation	Thickness, ft.
Surface	31
Lime and shale	535
Niagara lime	250
White lime	18
Shale and lime	41
Shale	10
Clinton	25
Red Medina	42
Shale	37
Total depth	989

Gas at 918 to 938 feet.
Fresh water at 60 feet; black water at 700 feet.

STANDARD GAS AND OIL SYNDICATE, FISHERVILLE
Lot 24, S. ½ of E. ½ of N. ½, con. VI, Walpole tp.

Completed June 7, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	7
Flint	80
Lime and shale	361
Niagara	252
Shale	61
Clinton	27
Red Medina	35
Grey shale	55
White Medina	13
Red shale	2
Total depth	893

Fresh water at 39 feet; sulphur water at 115 feet.

CYCLOPS GAS SYNDICATE, TORONTO
Lot 19, con. VIII, Walpole tp.

Completed June 27, 1933.
Open flow: 20,000 cu. ft.
Rock pressure: 390 lbs.

Formation	Thickness, ft.
Surface	26
Flint	45
Lime and shale	379
Niagara	248
Shale	57
Clinton	24
Red Medina	30
Grey shale	66
White Medina	13
Red shale	3
Total depth	891

Gas at 758, 771, and 794 feet.
Fresh water at 42 feet.

STANDARD GAS AND OIL SYNDICATE, FISHERVILLE
Lot 24, S. ½ of E. ½ of N. ½, con. VI, Walpole tp.

Completed July 6, 1933.
Open flow: 28,000 cu. ft.
Rock pressure: 375 lbs.

Formation	Thickness, ft.
Surface	16
Flint	70
Lime and shale	371
Niagara	251
Shale	46
Clinton	30
Red Medina	35
Grey shale	55
White Medina	17
Red shale	3
Total depth	894

Gas at 759, 774, 783, and 819 feet.
Fresh water at 38 feet; sulphur water at 115 feet.

EMPIRE NATURAL GAS, LIMITED, TORONTO
Lot 1, con. II, Walpole tp.

Completed July 4, 1933.
Open flow: 87,000 cu. ft.
Rock pressure: 475 lbs.

Formation	Thickness, ft.
Surface	30
Flint	130
Lime and shale	400
Niagara lime	248
Lime and shale	56
Shale	28
Clinton	27
Red Medina	48
Shale	42
White Medina	21
Red shale	1
Total depth	1,031

Gas at 895 and 943 feet.
Fresh water at 24 feet; black water at 740 feet.

WALPOLE NATURAL GAS SYNDICATE, TORONTO
Lot 17, con. IX, Walpole tp.

Completed June 22, 1933.
Open flow: 30,000 cu. ft.
Rock pressure: 400 lbs.

Formation	Thickness, ft.
Surface	19
Flint	50
Brown lime Shale	356
Niagara	205
Grey shale	43
Guelph lime	23
Blue shale	42
Clinton	32
Red Medina	32
Shale	50
White Medina	18
Red shale	50
Total depth	920

Gas at 742, 770, 794, and 861 feet.
Fresh water at 25 feet; sulphur water at 225 feet.

CYCLOPS GAS SYNDICATE, TORONTO
Lot 19, con. VIII, Walpole tp.

Completed July 21, 1933.
Open flow: 20,000 cu. ft.
Rock pressure: 405 lbs.

Formation	Thickness, ft.
Surface	14
Flint	50
Lime and shale	396
Niagara	248
Shale	58
Clinton	25
Red Medina	30
Grey shale	69
White Medina	13
Red shale	4
Total depth	907

Gas at 776, 791, and 806 feet.
Fresh water at 42 feet.

W. B. LINDSAY FSTATE, EDMONTON, ALTA.
Lot 24, con. II, Walpole tp.

Completed June 28, 1933.
Open flow: 15,000 cu. ft.

Formation	Thickness, ft.
Surface	16
Flint lime	120
Lime and shale	354
Niagara lime	275
Grey shale	54
Clinton gas sand	26
Red Medina gas sand	37
Blue shale	60
White Medina sand	15
Red shale	3
Total depth	960

Gas at 839 and 875 feet.
Fresh water at 48 feet.

OTTERVILLE NATURAL GAS CO., OTTERVILLE
Lot 1, con. III, Walpole tp.

Completed July 26, 1933.
Open flow: 9,000 cu. ft.
Rock pressure: 500 lbs.

Formation	Thickness, ft.
Surface	34
Flint	154
Brown lime, shale, and slate	360
Niagara	287
Blue shale	51
Clinton	60
Red Medina	21
Blue shale	45
White Medina	15
Red shale	3
Total depth	1,030

Gas at 916 and 953 feet.
Fresh water at 60 feet; sulphur water at 490 feet.

STANDARD GAS AND OIL SYNDICATE, FISHERVILLE
Lot 24, S. ½, con. IV, Walpole tp.

Completed September 28, 1933.
Open flow: 40,000 cu. ft.
Rock pressure: 330 lbs.

Formation	Thickness, ft.
Surface	27
Flint	78
Lime and shale	369
Niagara	243
Shale	55
Clinton	26
Red Medina	39
Grey shale	55
White Medina	18
Red shale	4
Total depth	914

Gas at 784, 804, and 832 feet.
Fresh water at 27 feet.

EMPIRE NATURAL GAS, LIMITED, TORONTO
Lot 2, con. I, Walpole tp.

Completed September 4, 1933.
Open flow: 37,000 cu. ft.
Rock pressure: 400 lbs.

Formation	Thickness, ft.
Surface	32
Flint	160
Lime and shale	380
Niagara	240
Lime and shale	66
Shale	13
Clinton	26
Red Medina	55
Shale	48
White Medina	12
Total depth	1,032

Gas at 901 and 927 feet.
Fresh water at 80 feet; sulphur water at 160 feet; black water at 600 feet.

WALPOLE NATURAL GAS SYNDICATE, TORONTO
Lot 17, con. IX, Walpole tp.

Completed August 30, 1933.
Open flow: 20,000 cu. ft.
Rock pressure: 480 lbs.

Formation	Thickness, ft.
Surface	21
Flint	54
Brown lime	350
Niagara	277
Slate and shale	49
Clinton	30
Red Medina	28
Blue shale	64
White Medina	14
Red shale	25
Total depth	912

Gas at 755, 766, and 796 feet.
Fresh water at 62 feet; sulphur water at 450 feet.

R. B. Pope, Toronto
Lot 13, con. IV, Walpole tp.

Completed October 9, 1933.
Open flow: 32,000 cu. ft.
Rock pressure: 360 lbs.

Formation	Thickness, ft.
Surface	0
Flint	95
Lime and shale	395
Niagara	268
Shale	51
Clinton	23
Red Medina	35
Grey shale	55
White Medina	10
Red shale	4
Total depth	936

Gas at 814, 831, and 854 feet.
Fresh water at 33 feet.

Standard Gas and Oil Syndicate, Fisherville
Lot 24, S. ½, con. IV, Walpole tp.

Completed October 27, 1933.
Open flow: 195,000 cu. ft.
Rock pressure: 465 lbs.

Formation	Thickness, ft.
Surface	24
Flint	81
Lime and shale	367
Niagara	236
Shale	55
Clinton	30
Red Medina	42
Grey shale	55
White Medina	20
Red shale	4
Total depth	914

Gas at 783 and 803 feet.
Fresh water at 32 feet.

Standard Gas and Oil Syndicate, Fisherville
Lot 24, S. ½, con. IV, Walpole tp.

Completed December 2, 1933.
Open flow: 45,000 cu. ft.
Rock pressure: 425 lbs.

Formation	Thickness, ft.
Surface	29
Flint	81
Lime and shale	364
Niagara	238
Shale	60
Clinton	30
Red Medina	42
Shale	55
White Medina	20
Red shale	1
Total depth	920

Gas at 815, 820, and 830 feet.
Black sulphur water at 82 feet.

R. B. Pope, Toronto
Lot 13, con. IV, Walpole tp.

Completed November 17, 1933.
Open flow: 50,000 cu. ft.
Rock pressure: 485 lbs.

Formation	Thickness, ft.
Surface	14
Flint	96
Lime and shale	385
Niagara	270
Shale	50
Clinton	23
Red Medina	35
Grey shale	58
White Medina	10
Red shale	2
Total depth	943

Gas at 837, 848, and 863 feet.
Sulphur water at 62 feet.

Standard Gas and Oil Syndicate, Fisherville
Lot 24, S. ½, con. V, Walpole tp.

Completed September 1, 1933.
Open flow: 38,000 cu. ft.
Rock pressure: 350 lbs.

Formation	Thickness, ft.
Surface	29
Flint	77
Lime and shale	367
Niagara	246
Shale	50
Clinton	27
Red Medina	40
Grey shale	55
White Medina	20
Red shale	4
Total depth	915

Gas at 801, 811, 816, and 826 feet.
Sulphur water at 58 feet.

Otterville Natural Gas Co., Otterville
Lot 24, con. VIII, Walpole tp.

Completed September 28, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	13
Flint	75
Lime and gypsum	358
Niagara	240
Shale	53
Clinton	31
Red Medina	34
Blue shale	68
White Medina	20
Total depth	892

Gas at 750 feet.
Fresh water at 35 feet; black water at 315 feet.

Otterville Natural Gas Co., Otterville
Lot 2, con. VIII, Walpole tp.

Completed December 23, 1933.
Open flow: 30,000 cu. ft.
Rock pressure: 425 lbs.

Formation	Thickness, ft.
Surface	30
Flint	70
Lime and gypsum	382
Niagara	240
Shale	27
Clinton	27
Red Medina	35
Shale	69
White Medina	19
Total depth	899

Gas at 752 and 796 feet.
Fresh water at 30 feet; sulphur water at 300 feet.

Otterville Natural Gas Co., Otterville
Lot 17, con. V, Walpole tp.

Completed December 23, 1933.
Open flow: 50,000 cu. ft.
Rock pressure: About 400 lbs.

Formation	Thickness, ft.
Surface	32
Flint	100
Lime and shale	341
Niagara	267
Casing shale	54
Clinton	27
Red Medina	40
Shale	55
White Medina	12
Red shale	3
Total depth	931

Gas at 809 and 834 feet.
Fresh water at 70 feet.

OTTERVILLE NATURAL GAS CO., OTTERVILLE
Lot 1, con. II, Walpole tp.

Completed December 22, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	30
Flint	152
Brown lime, slate, and shale	359
Niagara	296
Shale	38
Clinton	21
Red Medina	48
Shale	60
White Medina	16
Red shale	1
Total depth	1,021

Fresh water at 70 feet; sulphur water at 180 feet.

OTTERVILLE NATURAL GAS CO., OTTERVILLE
Lot 1, con. II, Walpole tp.

Completed December 20, 1933.
Open flow: 50,000 cu. ft.
Rock pressure: 435 lbs.

Formation	Thickness, ft.
Surface	28
Flint	162
Brown lime and slate	370
Niagara	270
Shale	53
Clinton	23
Red Medina	46
Shale	51
White Medina	12
Total depth	1,015

Gas at 885, 907, and 930 feet.
Fresh water at 146 feet; sulphur water at 565 feet.

OTTERVILLE NATURAL GAS CO., OTTERVILLE
Lot 1, con. II, Walpole tp.

Completed November 18, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	29
Flint	146
Brown lime and shale	356
Niagara	300
Shale	53
Clinton	28
Red Medina	30
Blue shale	61
White Medina	17
Red shale	2
Total depth	1,022

Gas at 917 feet.
Sulphur water at 110 feet; black water at 580 feet.

OTTERVILLE NATURAL GAS CO., OTTERVILLE
Lot 3, con. III, Walpole tp.

Formation	Thickness, ft.
Surface	40
Flint	140
Lime and shale	395
Niagara	235
Grey lime	15
Shale	54
Clinton	33
Red Medina	39
Grey shale	56
White Medina	12
Red shale	48
Total depth	1,067

Gas at 907, 932, and 1,017 feet.
Fresh water at 100 feet; sulphur water at 310 feet.

GLENGROVE GAS CO., TORONTO
Lot 20, con. VI, Walpole tp.

Completed October 23, 1933.
Open flow: 60,000 cu. ft.
Rock pressure: About 340 lbs.

Formation	Thickness, ft.
Surface	22
Flint	93
Lime and shale	330
Niagara	279
Shale	60
Clinton	34
Red Medina	38
Grey shale	58
White Medina	12
Red shale	25
Total depth	951

Gas at 794, 804, 826, and 920 feet.
Fresh water at 80 feet; sulphur water at 200 feet.

OTTERVILLE NATURAL GAS CO., OTTERVILLE
Lot 1, con. III, Walpole tp.

Completed October 4, 1933.
Open flow: 300,000 cu. ft.
Rock pressure: 350 lbs.

Formation	Thickness, ft.
Surface	32
Flint	155
Brown lime, slate, and shale	355
Niagara	288
Slate	59
Clinton	27
Red Medina	30
Blue shale	40
Total depth	986

Gas at 924 feet.
Fresh water at 126 feet; sulphur water at 300 feet.

STERLING GAS SYNDICATE, TORONTO
Lot 15, con. III, Walpole tp.

Completed December 15, 1933.
Open flow: 60,000 cu. ft.
Rock pressure: 325 lbs.

Formation	Thickness, ft.
Surface	15
Flint	150
Lime and shale	360
Niagara	264
Shale	49
Clinton	25
Red Medina	40
Grey shale	65
White Medina	10
Red shale	4
Total depth	982

Gas at 841 and 880 feet.
Sulphur water at 56 feet.

STERLING GAS SYNDICATE, TORONTO
Lot 15, con. II, Walpole tp.

Completed November 11, 1933.
Open flow: 100,000 cu. ft.
Rock pressure: 275 lbs.

Formation	Thickness, ft.
Surface	16
Flint	150
Lime and shale	359
Niagara	268
Shale	53
Clinton	30
Red Medina	40
Grey shale	64
White Medina	10
Red shale	35
Total depth	1,025

Gas at 860, 864, and 984 feet.
Sulphur water at 55 feet.

STERLING GAS SYNDICATE, TORONTO
Lot 12, con. III, Walpole tp.

Completed April 6, 1933.
Open flow: 27,000 cu. ft.
Rock pressure: 305 lbs.

Formation	Thickness, ft.
Surface	10
Flint	145
Lime and shale	360
Niagara	272
Shale	55
Clinton	23
Red Medina	35
Grey shale	60
White Medina	15
Red shale	7
Total depth	982

Gas at 862 and 888 feet.
Fresh water at 34 feet.

STERLING GAS SYNDICATE, TORONTO
Lot 13, con. III, Walpole tp.

Completed March 1, 1933.
Open flow: 70,000 cu. ft.
Rock pressure: 285 lbs.

Formation	Thickness, ft.
Surface	16
Flint	145
Lime and shale	371
Niagara	275
Shale	46
Clinton	28
Red Medina	40
Grey shale	60
White Medina	15
Red shale	13
Total depth	1,009

Gas at 856, 898, and 903 feet.
Sulphur water at 80 feet.

STERLING GAS SYNDICATE, TORONTO
Lot 12, con. III, Walpole tp.

Completed June 23, 1933.
Open flow: 40,000 cu. ft.
Rock pressure: 295 lbs.

Formation	Thickness, ft.
Surface	14
Flint	135
Lime and shale	366
Niagara	280
Shale	53
Clinton	30
Red Medina	44
Grey shale	65
White Medina	15
Red shale	40
Total depth	1,042

Gas at 873 and 998 feet.
Sulphur water at 50 feet.

STERLING GAS SYNDICATE, TORONTO
Lot 12, con. III, Walpole tp.

Completed June 2, 1933.
Open flow: 40,000 cu. ft.
Rock pressure: 300 lbs.

Formation	Thickness, ft.
Surface	23
Flint	130
Lime and shale	355
Niagara	270
Shale	54
Clinton	31
Red Medina	43
Grey shale	63
White Medina	15
Red shale	2
Total depth	986

Gas at 835, 850, and 885 feet.
Sulphur water at 65 feet.

W. C. PATTERSON, JAMESTOWN, N.Y.
Lot 13, N.W. pt., con. VIII, Walpole tp.

Completed September 5, 1933.
Open flow: 325,000 cu. ft.
Rock pressure: 400 lbs.

Formation	Thickness, ft.
Surface	7
Flint	80
Lime and shale	392
Niagara	250
Shale	48
Clinton	40
Red Medina	43
Shale	48
White Medina	12
Red shale	5
Total depth	925

Fresh water at 25 feet; sulphur water at 480 feet.

W. C. PATTERSON, JAMESTOWN, N.Y.
Lot 17, S.W. ¼, con. IX, Walpole tp.

Completed October 16, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	5
Flint	80
Lime and shale	370
Niagara	258
Shale	49
Clinton	24
Red Medina	39
Shale	60
White Medina	10
Red shale	3
Total depth	898

Fresh water at 30 feet; sulphur water at 455 feet.

W. C. PATTERSON, JAMESTOWN, N.Y.
Lot 13, E. ½, con. VII, Walpole tp.

Completed November 18, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	25
Flint	84
Lime and shale	371
Niagara	256
Shale	67
Clinton	29
Red Medina	36
Shale	89
White Medina	12
Red shale	4
Total depth	943

Fresh water at 26 feet; sulphur water at 480 feet.

W. C. PATTERSON, JAMESTOWN, N.Y.
Lot 13, W. ½, con. VII, Walpole tp.

Completed December 28, 1933.
Open flow: 100,000 cu. ft.
Rock pressure: 500 lbs.

Formation	Thickness, ft.
Surface	3
Flint	78
Lime and shale	379
Niagara	268
Shale	47
Clinton	32
Red Medina	33
Shale	61
White Medina	12
Red shale	50
Total depth	963

BROADWAY GAS SYNDICATE, CAYUGA
Lot 21, con. VI, Walpole tp.

Completed July 14, 1933.
Open flow: 37,000 cu. ft.
Rock pressure: 450 lbs.

Formation	Thickness, ft.
Surface	11
Flint	100
Shale	50
Brown lime	90
Shale and lime	100
Brown lime	90
Shale	14
Niagara lime	200
White lime	65
Shale	38
Clinton	29
Red Medina	39
Grey shale	56
White Medina	12
Red shale	1
Total depth	895

BROADWAY GAS SYNDICATE, CAYUGA
Lot 20, con. VI, Walpole tp.

Completed October 9, 1933.
Open flow: 62,000 cu. ft.
Rock pressure: 440 lbs.

Formation	Thickness, ft.
Surface	19
Flint	90
Brown lime	80
Shale	200
Brown lime	60
Shale	11
Niagara	210
White lime	80
Shale	36
Clinton	30
Red Medina	40
Grey shale	52
White Medina	12
Red shale	1
Total depth	921

Water at 60 feet.

BROADWAY GAS SYNDICATE, CAYUGA
Lot 21, con. VI, Walpole tp.

Completed August 8, 1933.
Open flow: 325,000 cu. ft.
Rock pressure: 455 lbs.

Formation	Thickness, ft.
Mud	16
Flint	84
White lime	20
Brown lime	100
Shale and lime	80
Brown lime	100
Shale	50
Niagara lime	210
White lime	66
Shale	35
Clinton	29
Red Medina	40
Grey shale	56
White Medina	12
Red shale	1
Total depth	899

Gas at 776 and 810 feet.

BROADWAY GAS SYNDICATE, CAYUGA
Lot 20, con. VI, Walpole tp.

Completed November 9, 1933.
Open flow: 57,000 cu. ft.
Rock pressure: 420 lbs.

Formation	Thickness, ft.
Surface	14
Flint	100
Lime and shale	100
Brown lime	150
Shale and lime	96
Niagara	210
White lime	83
Slate	31
Clinton	27
Red Medina	40
Grey shale	54
White Medina	12
Red shale	1
Total depth	918

Gas at 799 and 831 feet.
Water at 70 feet.

BROADWAY GAS SYNDICATE, CAYUGA
Lot 20, con. VI, Walpole tp.

Completed September 13, 1933.
Open flow: 62,000 cu. ft.
Rock pressure: 440 lbs.

Formation	Thickness, ft.
Surface	37
Flint	80
Shale	100
Brown lime	150
Lime and shale	101
Niagara	210
White lime	64
Shale	38
Clinton	30
Red Medina	40
Grey shale	49
White Medina	14
Total depth	913

Gas at 795 and 832 feet.
Water at 62 feet.

BROADWAY GAS SYNDICATE, CAYUGA
Lot 20, con. V, Walpole tp.

Completed December 14, 1933.
Open flow: 65,000 cu. ft.
Rock pressure: 430 lbs.

Formation	Thickness, ft.
Surface	21
Flint	100
Lime and shale	349
Niagara	210
White lime	73
Casing shale	42
Clinton	22
Red Medina	40
Grey shale	50
White Medina	12
Red shale	3
Total depth	922

Gas at 803 and 832 feet.
Sulphur water at 80 feet.

WALPOLE NATURAL GAS SYNDICATE, CAYUGA
Lot 16, S.W. ¼, con. VII, Walpole tp.

Completed January 17, 1933.
Open flow: 87,000 cu. ft.
Rock pressure: 435 lbs.

Formation	Thickness, ft.
Surface	13
Flint	79
Lime and shale	362
Niagara	276
Casing shale	59
Clinton	27
Red Medina sand	19
Red Medina shale	15
Grey shale	64
White Medina	8
Red shale	2
Total depth	924

Gas in the Clinton.
Water at 44 feet.

WALPOLE NATURAL GAS SYNDICATE, CAYUGA
Lot 18, con. VII, Walpole tp.

Completed January 31, 1933.
Open flow: 31,000 cu. ft.
Rock pressure: 430 lbs.

Formation	Thickness, ft.
Surface	19
Flint	100
Brown lime	150
Slate gypsum	100
Brown lime	50
Shale gypsum	70
Niagara lime	210
White lime	35
Shale	45
Clinton	25
Red Medina	35
Grey shale	60
White Medina	12
Red shale	3
Total depth	914

Gas at 794, 810, and 818 feet.

WALPOLE NATURAL GAS SYNDICATE, CAYUGA
Lot 16, S.W. ¼, con. VII, Walpole tp.

Completed February 7, 1933.
Open flow: 46,000 cu. ft.

Formation	Thickness, ft.
Surface	16
Flint	74
Lime and shale	367
Niagara	277
Casing shale	63
Clinton	28
Red Medina sand	21
Red Medina shale	17
Grey shale	56
White Medina	10
Red shale	2
Total depth	931

Gas at 813 and 837 feet.
Water at 45 feet.

WALPOLE NATURAL GAS SYNDICATE, CAYUGA
Lot 16, S.W. ¼, con. VII, Walpole tp.

Completed February 27, 1933.
Open flow: 14,000 cu. ft.

Formation	Thickness, ft.
Surface	13
Flint	75
Lime and shale	370
Niagara	268
Casing shale	62
Clinton	21
Red Medina sand	22
Red Medina shale	19
Grey shale	62
White Medina	8
Red shale	2
Total depth	932

Water at 38 feet.

WALPOLE NATURAL GAS SYNDICATE, CAYUGA
Lot 17, con. VI, Walpole tp.

Completed March 11, 1933.
Open flow: 40,000 cu. ft.

Formation	Thickness, ft.
Mud	14
Flint	90
Brown lime	80
Shale and gypsum	90
Brown lime	50
Shale and lime	100
Shale	30
Niagara	220
White lime	70
Shale	35
Clinton	27
Red Medina	40
Grey shale	55
White Medina	12
Red shale	1
Total depth	914

Gas at 791 and 818 feet.

WALPOLE NATURAL GAS SYNDICATE, CAYUGA
Lot 16, con. VI, Walpole tp.

Completed July 12, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	27
Flint	73
Lime and shale	363
Niagara	286
Casing shale	54
Clinton	26
Red Medina	38
Grey shale	61
White Medina	8
Total depth	936

Gas in the Clinton.
Water at 34 feet.

WALPOLE NATURAL GAS SYNDICATE, CAYUGA
Lot 15, con. VII, Walpole tp.

Completed August 5, 1933.
Open flow: 26,000 cu. ft.
Rock pressure: 425 lbs.

Formation	Thickness, ft.
Surface	24
Flint	71
Lime and shale	359
Niagara	289
Casing shale	57
Clinton	23
Red Medina	38
Grey shale	59
White Medina	10
Red shale	1
Total depth	931

Water at 46 feet.

WALPOLE NATURAL GAS SYNDICATE, CAYUGA
Lot 15, S. ½, con. VII, Walpole tp.

Completed August 29, 1933.
Open flow: 28,000 cu. ft.
Rock pressure: 425 lbs.

Formation	Thickness, ft.
Surface	31
Flint	58
Lime and shale	360
Niagara	289
Casing shale	47
Clinton	30
Red Medina and shale	37
Grey shale	63
White Medina	9
Red shale	1
Total depth	925

Sulphur water at 57 feet.

WALPOLE NATURAL GAS SYNDICATE, CAYUGA
Lot 17, con. VI, Walpole tp.

Completed September 26, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	19
Flint	74
Lime and shale	360
Niagara	285
Casing shale	57
Clinton	31
Red Medina sand	28
Red Medina shale	14
Grey shale	47
White Medina	12
Red shale	6
Total depth	933

Water at 56 feet.

WALPOLE NATURAL GAS SYNDICATE, CAYUGA
Lot 17, con. VI, Walpole tp.

Completed October 21, 1933.
Open flow: 175,000 cu. ft.
Rock pressure: 435 lbs.

Formation	Thickness, ft.
Surface	3
Flint	82
Lime and shale	352
Niagara	286
Casing shale	52
Clinton	23
Red Medina sand	22
Red Medina shale	20
Grey shale	61
White Medina	10
Red shale	3
Total depth	914

Gas in the Clinton and Red Medina.
Water at 28 feet.

WALPOLE NATURAL GAS SYNDICATE, CAYUGA
Lot 17, con. VI, Walpole tp.

Completed November 16, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	4
Flint	80
Lime and shale	344
Niagara	306
Casing shale	50
Clinton	26
Red Medina sand	18
Red Medina shale	24
Grey shale	54
White Medina	11
Red shale	5
Total depth	922

Water at 60 feet.

WALPOLE NATURAL GAS SYNDICATE, CAYUGA
Lot 18, con. VII, Walpole tp.

Completed December 20, 1933.
Open flow. 325,000 cu. ft.
Rock pressure: 445 lbs.

Formation	Thickness, ft.
Surface	20
Flint	67
Lime and shale	362
Niagara	285
Casing shale	45
Clinton	26
Red Medina sand	18
Red Medina shale	17
Grey shale	65
White Medina	13
Red shale	6
Total depth	924

Gas in Clinton and Red Medina.
Water at 63 feet.

WALPOLE NATURAL GAS SYNDICATE, CAYUGA
Lot 16, con. VI, Walpole tp.

Completed March 18, 1933.
Open flow: 70,000 cu. ft.
Rock pressure: 430 lbs.

Formation	Thickness, ft.
Surface	14
Flint	76
Lime and shale	361
Niagara	285
Casing shale	59
Clinton	27
Red Medina sand	22
Red Medina shale	16
Grey shale	61
White Medina	9
Red shale	2
Total depth	932

Gas in Clinton and Red Medina.
Water at 45 feet.

WALPOLE NATURAL GAS SYNDICATE, CAYUGA
Lot 16, con. VI, Walpole tp.

Completed March 18, 1933.
Open flow: 70,000 cu. ft.
Rock pressure: 430 lbs.

Formation	Thickness, ft.
Surface	14
Flint	76
Lime and shale	361
Niagara	285
Casing shale	59
Clinton	27
Red Medina sand	22
Red Medina shale	16
Grey shale	61
White Medina	9
Red shale	2
Total depth	932

Gas in Clinton and Red Medina.
Water at 45 feet.

WALPOLE NATURAL GAS SYNDICATE, CAYUGA
Lot 16, con. VI, Walpole tp.

Completed May 3, 1933.
Open flow: 230,000 cu. ft.
Rock pressure: 440 lbs.

Formation	Thickness, ft.
Surface	14
Flint	80
Lime and shale	362
Niagara	279
Casing shale	57
Clinton	23
Red Medina sand	20
Red Medina shale	16
Grey shale	62
White Medina	12
Red shale	41
Total depth	966

Gas in Clinton, Red Medina, and White Medina.
Water at 35 feet.

WALPOLE NATURAL GAS SYNDICATE, CAYUGA
Lot 16, con. VI, Walpole tp.

Completed June 13, 1933.
Open flow: 275,000 cu. ft.
Rock pressure: 450 lbs.

Formation	Thickness, ft.
Surface	13
Flint	84
Lime and shale	358
Niagara	274
Casing shale	57
Clinton	25
Red Medina	35
Grey shale	63
White Medina	8
Red shale	2
Total depth	919

Gas at 798 feet.
Water at 56 feet.

WALPOLE NATURAL GAS SYNDICATE, CAYUGA
Lot 16, con. VI, Walpole tp.

Completed April 6, 1933.
Open flow: 37,000 cu. ft.
Rock pressure: 435 lbs.

Formation	Thickness, ft.
Surface	9
Flint	88
Lime and shale	355
Niagara	283
Casing shale	55
Clinton	26
Red Medina	34
Grey shale	61
White Medina	12
Red shale	2
Total depth	925

Gas at 790 to 850 feet.
Fresh water at 33 feet.

Kent County

DR. LUKE SMITH, CHATHAM
Lot 23, con. I, Chatham Gore

Completed September 11, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	63
Black shale	212
Top lime	50
Upper shale	112
Middle lime	11
Lower shale	26
Dark streak	2
Lower limestone	74
Brown and grey limestone	185
Gypsum	5
Grey and brown limestone	90
Brown limestone and gypsum	30
Grey and brown limestone	255
Blue and brown limestone	45
Blue limestone and gypsum	10
Grey and brown limestone	295
Grey limestone and gypsum	40
Grey and brown limestone	270
Grey and brown lime and gypsum	15
Grey and brown limestone	165
Blue and red shale	73
Total depth	2,028

Salt water at 550, 640, and 1,910 feet.

RALEIGH DEVELOPMENT SYNDICATE, TORONTO
Lot 2, F.C., Dover tp.

Completed July 14, 1933.
Open flow: 535,000 cu. ft.
Oil yield: 4 bbls. per hr.
Rock pressure: 1,160 lbs.

Formation	Thickness, ft.
Surface	96
Soapstone	158
Lower lime	181
Oriskany	65
Detroit River	400
Salina	650
Guelph	200
Niagara	195
Blue shale	30
Rochester shale	115
White Medina	52
Queenston shale	288
Hudson River	345
Utica shale	109
Trenton	417
Total depth	3,301

Gas at 3,012 to 3,016 and 3,150 to 3,170 feet.
Oil at 3,275 to 3,290 feet.
Salt water at 420 and 1,705 feet.

AJAX OIL AND GAS CO., TORONTO
Lot 1, con. IV, Dover tp.

Completed January 4, 1934.
Open flow: 300,000 cu. ft.

Formation	Thickness, ft.
Surface	96
Soap and lime	204
Lime	1,660
Shale	939
Trenton	273
Total depth	3,172

Gas at 2,910, 3,030, 3,037, 3,070, 3,106, and 3,114 feet

VACUUM GAS AND OIL CO., TORONTO
Lot 53, N.T.R., Orford tp.

Completed January 9, 1933.
Open flow: 15,000 cu. ft.

Formation	Thickness, ft.
Surface	185
Soap and lime shells	174
Lime	1,501
Shale	35
Clinton	5
Red shale	50
Grey shale	70
White Medina	50
Red shale	3
Total depth	2,073

Gas at 1,583, 1,595, and 1,605 feet.
Salt water at 525, 935, and 1,635 to 1,640 feet.

VACUUM GAS AND OIL CO., TORONTO
Lot 53, L.F., Orford tp.

Completed March 30, 1933.
Open flow: 10,000 cu. ft.

Formation	Thickness, ft.
Surface	180
Soapstone and lime shells	185
Onondaga	160
Oriskany sand	425
Detroit River lime series	200
Salina	350
Guelph	117
Total depth	1,617

Gas at 1,595 to 1,610 feet.
Salt water at 525, 945, and 1,615 feet.

MID-CONTINENT BOND CORPORATION, TORONTO
Lot 55, S.T.R., Orford tp.

Completed August, 1932.

Formation	Thickness, ft.
Surface	150
Shales	115
Widder beds—limestone	9
Olentangy shale	49
Delaware-Onondaga lime	192
Oriskany sandstone	2
Total depth	517

Show of oil at 332 and 425 feet.
Salt water at 515 feet.

SOUTHERN ONTARIO GAS CO., BUFFALO, N.Y.
Lot 3, S. ½, con. XII, Raleigh tp.

Completed December 5, 1933.
Open flow: 12,000 cu. ft.
Oil yield: 5 bbls. (est.).

Formation	Thickness, ft.
Surface clay	135
Shale	58
Soapstone	52
Lime shale	5
Soapstone	28
Lime shale	10
Grey lime	112
Brown lime	150
Sand	5
Grey lime	35
Sharp sand	150
Water sand	10
Brown lime and gypsum	98
Hard grey lime	52
Brown and grey lime	250
Brown lime and grey shale	50
Brown lime	135
Grey lime	18
Total depth	1,353

Gas at 1,253, 1,262, 1,329, 1,335, and 1,346 feet.
Fresh water at 134 feet; black water at 740 feet; salt water at 1,352 feet.

OLGA GAS AND OIL CO., TORONTO
Lot 20, con. IX, Raleigh tp.

Completed August 24, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	90
Soap	204
Lime	160
Oriskany	250
Lime	800
Guelph	146
Total depth	1,650

Show of gas at 1,605 and 1,620 feet.
Salt water at 429 feet; salt-sulphur water at 800 feet; salt water at 1,650 feet.

PRODUCERS GAS CORPORATION, TORONTO
Lot 19, con. VIII, Raleigh tp.

Completed January 20, 1933.
Open flow: 100,000 cu. ft.
Oil yield: 50 bbls. (est.)
Rock pressure: 900 lbs.

Formation	Thickness, ft.
Surface	87
Soap	203
Lime	160
Oriskany	250
Lime	800
Guelph	170
Total depth	1,670

Gas at 1,625 and 1,650 feet.
Oil at 1,655 to 1,665 feet.
Salt water at 1,655 to 1,665 feet.

PRODUCERS GAS CORPORATION, TORONTO
Lot 17, con. VIII, Raleigh tp.

Completed April 12, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	96
Soap and lime	244
Lime, Onondaga, and Oriskany	500
Detroit River lime series	300
Salina	360
Guelph	200
Niagara lime	27
Total depth	1,727

Gas at 1,507 and 1,580 to 1,585 feet.
Show of oil at 1,585 to 1,630 feet.
Salt water at 430 and 1,685 feet.

PRODUCERS GAS CORPORATION, TORONTO
Lot 19, con. VIII, Raleigh tp.

Completed October 11, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	87
Soap	203
Lime	160
Oriskany	250
Lime	800
Guelph	170
Total depth	1,670

Show of gas at 1,610 feet.
Salt water at 1,655 feet.

RALPH DAWSON, MERLIN
Lot 2, con. XVI, Tilbury East tp.

Completed May 27, 1933.
Open flow: 36,000 cu. ft.
Rock pressure: 430 lbs.

Formation	Thickness, ft.
Surface	148
Soap and shale	146
Brown lime	251
Sharp sand	135
Grey lime	85
Brown lime	13
Grey lime	7
Brown lime	70
Blue shale and brown lime	460
Brown and grey lime	195
Total depth	1,510
Plugged off	210
Net depth	1,300

Gas at 1,230 feet.
Fresh water at 138 feet, black water at 450 feet, salt water at 1,510 feet.

GLENWOOD SYNDICATE, CHATHAM
Pt. lot 10, con. XIII, Tilbury East tp.

Completed March 19, 1933.
Open flow: 34,000 cu. ft.
Rock pressure: 250 lbs.

Formation	Thickness, ft.
Surface	147
Sand and gravel	2
Soap	90
Dark-grey lime	283
Sandy lime	185
White sandy lime	20
Blue lime	55
Grey lime	18
Brown lime	57
Blue lime	295
Grey lime	175
Blue lime	10
Dark-grey lime	48
Total depth	1,385

Gas at 1,228, 1,250, and 1,345 feet.
Sulphur water at 540 and 700 feet, salt and sulphur water at 785 feet.

GLENWOOD SYNDICATE, CHATHAM

Pt. lot 10, con. XIII, Tilbury East tp.

Completed May 8, 1933.
Open flow: 100,000 cu. ft.
Rock pressure: 250 lbs.

Formation	Thickness, ft.
Surface	147
Sand and gravel	4
Soap	88
Dark-grey lime	283
Sandy lime	185
White sandy lime	20
Blue lime	55
Grey lime	18
Brown lime	57
Blue lime	295
Grey lime	175
Blue lime	15
Dark-grey lime	59
Total depth	1,401

Gas at 1,228, 1,255, 1,320, and 1,345 feet.
Sulphur water at 540 and 700 feet; salt and sulphur water at 785 feet.

SOUTHERN ONTARIO GAS CO., MERLIN

Lot 5, con. XV, Tilbury East tp.

Completed September 7, 1933.
Open flow: 33,000 cu. ft.
Rock pressure: 365 lbs.

Formation	Thickness, ft.
Surface	138
Soapstone	146
Grey lime	86
Brown and grey lime	210
Sharp sand	140
Brown and grey lime	380
Brown lime	270
Grey lime	20
Water sand	25
Total depth	1,415

Gas at 1,249 and 1,287 feet.
Fresh water at 138 feet; black water at 550 to 740 feet; show of oil and salt water at 1,390 feet; salt water at 1,415 feet.

SALINA GAS CO., CHATHAM

Lot 10, N.W. ¼, con. XIII, Tilbury East tp.

Completed August 3, 1933.
Open flow: 200,000 cu. ft.
Rock pressure: 250 lbs.

Formation	Thickness, ft.
Surface	147
Hamilton shale	83
Delaware and Onondaga:	
brown and grey lime	145
Detroit River series:	
brown and grey lime	75
water sand (sandy lime)	5
grey and brown lime	250
Sylvania(?) water sand (sandy dolomite)	5
Bass Island brown and grey dolomite	90
Salina:	
streaky gypsum and dolomite	15
brown and grey dolomite	60
blue broken dolomite	80
grey dolomite	10
brown dolomite	50
grey and light-brown dolomite	90
soft pepper-and-salt dolomite	20
grey dolomite	10
dark brown dolomite	75
grey dolomite	10
light and dark brown dolomite	31
grey dolomite	9
broken dolomite	10
light and dark brown dolomite	45
grey dolomite	65
Total depth	1,380

Gas at 1,224, 1,245, 1,251, 1,274, 1,324, and 1,333 feet.
Fresh water at 147 feet; sulphur water at 700 and 785 feet.
NOTE.—Log condensed from driller's notes; formation names and thicknesses only approximate.

SALINA GAS CO., CHATHAM

Lot 10, N.E. pt., con. XIII, Tilbury East tp.

Completed September 29, 1933.
Open flow: 122,000 cu. ft.
Rock pressure: 275 lbs.

Formation	Thickness, ft.
Surface	150
Hamilton shale	83
Delaware and Onondaga:	
grey and brown lime	151
Detroit River series:	
grey and brown lime	112
fine brown lime	6
grey and brown lime	173
Sylvania(?) sharp brown dolomite	35
Bass Island grey and brown dolomite	96
Salina:	
grey dolomite and gypsum	13
brown and grey dolomite	46
blue dolomite and some gypsum	52
grey and brown dolomite	58
grey dolomite and gypsum	40
brown dolomite	68
brown dolomite and gypsum	6
brown dolomite	6
blue dolomite with soft streak	22
brown dolomite	35
blue and brown dolomite	16
brown dolomite	47
very dark brown dolomite	11
brown dolomite	46
grey dolomite	12
brown dolomite	45
grey dolomite	31
Total depth	1,360

Gas at 1,223, 1,235, 1,250 to 1,255, 1,328 to 1,332, and 1,340 to 1,344 feet.
Fresh water at 150 feet; sulphur water at 385, 504, and 710 feet.
NOTE.—Log condensed from driller's notes; formation names and thicknesses only approximate.

SALINA GAS CO., CHATHAM

Lot 9, N.E. pt., con. XIII, Tilbury East tp.

Completed October 25, 1933.
Open flow: 6,000 cu. ft.
Rock pressure: 285 lbs. (est.).

Formation	Thickness, ft.
Surface	142
Hamilton shale	91
Delaware and Onondaga:	
grey and brown lime	151
Detroit River series:	
grey and brown lime	112
fine brown lime	6
grey and brown lime	173
Sylvania(?) sharp brown dolomite	35
Bass Island grey and brown dolomite	96
Salina:	
grey dolomite and some gypsum	13
brown and grey dolomite	46
blue dolomite and some gypsum	52
grey and brown dolomite	58
grey dolomite and gypsum	40
brown dolomite	68
brown dolomite and gypsum	6
brown dolomite	6
blue dolomite with soft streak	22
brown dolomite	35
blue and brown dolomite	16
brown dolomite	45
very dark brown dolomite	13
brown dolomite	103
grey dolomite	91
Total depth	1,420

Gas at 1,255, 1,277, and 1,365 feet.
Fresh water at 142 feet; sulphur water at 385, 504, and 710 feet.
NOTE.—Log condensed from driller's notes; formation names and thicknesses only approximate.

ROMNEY GAS AND OIL CO., LONDON

Lot 3, S.E. ½ of N.W. ¼, con. XV, Tilbury East tp.

Completed September 2, 1933.
Open flow: 15,000 cu. ft.
Rock pressure: 285 lbs.

Formation	Thickness, ft.
Drift	136
Top rock and soap	146
Grey lime	266
Sharp sand	140
Lime	112
Gypsum and lime	10
Dark-grey lime	327
Light-grey lime	55
Brown lime	20
Grey lime	10
Hard brown lime	21
Lime and shells	7
Brown lime and shells	17
Light-brown lime	5
Hard brown lime	13
Light-brown lime	5
Grey lime	10
Light-grey lime	13
Water sand	1
Total depth	1,314

Gas at 1,200 and 1,257 feet.
Fresh water at 135 feet; salt water at 680 and 1,313 feet.

Lambton County

SULLIVAN, BROWN AND CO., DETROIT, MICH.

Lot 23, con. XIII, Brooke tp.

Completed December 19, 1933.
Open flow: 15,000 cu. ft.
Oil yield: 25 bbls.

Formation	Thickness, ft.
Surface	62
Grey and brown shale	29
Top rock	49
Upper soap	160
Middle lime	19
Lower soap	29
Black streak	4
Big lime	124
Total depth	476

Gas at 185, 405, and 465 feet.

UNION GAS CO. OF CANADA, CHATHAM

Lot 25, con. II, Dawn tp.

Completed November 15, 1933.
Oil yield: 10 bbls. (est.).

Formation	Thickness, ft.
Surface	70
Huron shale	180
Hamilton shale and lime	227
Onondaga and Detroit River:	
brown lime	388
sharp (sand) lime	105
Brown and grey lime	85
Blue lime and gypsum and brown lime	305
Blue shale	45
Blue and brown lime	25
Salt	160
Brown lime	60
Black lime	50
Blue lime	35
Lime and salt	10
Salt	35
Black and grey lime	10
Brown lime	80
Black lime	10
Brown and grey lime	85
Total depth	1,865

Oil at 1,920, 1,925, and 1,955 feet.
Show of gas at 1,920 feet.
Fresh water at 70 feet; sulphur water at 535 and 560 feet.

UNION GAS CO. OF CANADA, CHATHAM

Lot 24, con. V, Dawn tp.

Completed November 24, 1933.
Open flow: 212,700 cu. ft.
Rock pressure: 800 lbs.

Formation	Thickness ft.
Surface	70
Huron shale	205
Hamilton shale and lime	285
Onondaga and Detroit River:	
grey and brown lime	400
sharp (sand) lime	140
Grey and brown lime	105
Brown lime and gypsum	5
Blue lime and gypsum	5
Blue and brown lime	480
Blue shale	40
Blue and brown lime	110
Black lime	20
Grey and brown lime	70
Light-grey lime	62
Shale	34
Clinton	8
Red shale	2
Total depth	2,041

Gas at 1,614 and 1,875 feet.
Sulphur water at 700 feet; salt water at 1,645 feet.

UNION GAS CO. OF CANADA, CHATHAM

Lot 24, con. II, Dawn tp.

Completed January 25, 1933
Open flow: 1,328,700 cu. ft.
Rock pressure: 835 lbs.

Formation	Thickness. ft.
Surface	73
Huron shale	182
Hamilton shale and lime	225
Onondaga and Detroit River:	
brown lime	365
sharp (sand) lime	120
brown lime	110
Grey, brown, and blue lime	340
Blue lime	35
Salt	170
Brown lime	128
Salt	24
Brown lime	74
Grey lime	9
Brown lime	2
Grey and brown lime	79
Grey lime	119
Shale	5
Total depth	2,060

Gas at 1,645, 1,777, 1,855, and 1,880 feet.
Salt water at 1,658 feet.

UNION GAS CO. OF CANADA, CHATHAM

Lot 24, con. IX, Dawn tp.

Completed October 19, 1933.
Open flow: 1,199,500 cu. ft.

Formation	Thickness, ft.
Surface	67
Huron shale	100
Hamilton shale and lime	280
Onondaga and Detroit River:	
grey and brown lime	443
sharp (sand) lime	175
Brown and grey lime	105
Grey lime and gypsum	10
Grey and brown lime	25
Brown and grey lime and gypsum	25
Brown and grey lime	35
Blue lime and gypsum	55
Brown and grey lime	145
Blue shale and gypsum	35
Mixed lime and brown and grey lime	120
Blue shale and shells	20
(No information)	145
Brown and grey lime	185
Grey shale	47
Brown lime	7
Red shale	1
Total depth	2,025

Gas at 1,561, 1,713, and 1,850 feet.
Fresh water at 67 feet; sulphur water at 505 and 590 feet; salt water at 1,785 feet.

JAS. WADE AND D. E. WILLITS, BOTHWELL
Lot 25, con. IX, Enniskillen tp.

Completed June 10, 1933.
Dry hole.

Formation	Thickness, ft.
Surface clay	63
Shale	19
Top rock	33
Upper soapstone	170
Middle lime	15
Lower soapstone	38
Dark shell	2
Lower lime	125
Sand streak	5
Brown lime	10
Total depth	480

Fresh water at 82 feet.

NISBET AND MILLER, PETROLIA
Lot 15, con. XI, Enniskillen tp.

Completed August 19, 1933.
Oil yield: 1 barrel per day.

Formation	Thickness, ft.
Clay	50
Top rock	50
Grey shale	135
Limestone	15
Grey shale	45
Limestone	128
Oil sand	5
Sand rock	2
Total depth	430

Oil at 51, 245, and 423 feet.

J. F. MARSHANT, PETROLIA
Lot 31, con. VIII, Euphemia tp.

Completed May, 1933.

Formation	Thickness, ft.
Clay	69
Soap and hard shells	31
Soap	159
Middle lime	17
Soap	23
Onondaga	71
Oriskany	55
Brown lime	20
Total depth	445

UNION GAS CO. OF CANADA, CHATHAM
Lot 22, con. VI, Sombra tp.

Completed March 26, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	68
Huron shale	204
Hamilton shale and lime	216
Onondaga and Detroit River:	
brown and some grey lime	332
sharp (sand) lime	130
brown lime	90
blue lime and gypsum	15
brown and blue lime	355
salt and shale	195
Brown and grey lime shale	140
Salt and lime shale	50
Brown and grey lime	55
Black and brown lime	30
Brown and grey lime	20
Black and black-grey lime	15
Brown and grey lime	132
Grey shale	28
Pink shale	35
Grey shale	105
Sharp grey lime	5
Grey shale	27
Red shale	5
Total depth	2,252

Show of gas at 1,935 feet.
Sulphur water at 565, 600, and 720 feet.

DEMARAY AND CARROTHERS, KERWOOD
Lot 2, con. VI, S.L.R., Warwick tp.

Completed February, 1933.
Dry hole.

Formation	Thickness ft.
Clay	50
Gravel	1
Black shale	15
Black shale and soapstone	60
Lime with soapstone	5
Lime	5
Soap	10
Lime	41
Upper soap	143
Middle lime	25
Lower soap	32
Lower lime	153
Total depth	540

Show of gas at 52 feet.
Fresh water at 52 feet; sulphur water at 525 feet.

Middlesex County

UNION GAS CO. OF CANADA, CHATHAM
Lot 8, range II, S.L.R., Ekfrid tp.

Completed September 11, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	215
Hamilton	65
Onondaga and Detroit River:	
grey and brown lime	350
sharp (sand) lime	180
brown lime	110
gypsum	15
blue lime and gypsum	53
Blue, brown, and grey lime	627
Blue shale	40
Clinton	28
Shale	67
White Medina and shale	37
Grey shale	10
Red and grey shale	8
Red shale	6
Total depth	1,811

Show of gas and oil at 275 and 1,340 feet.
Fresh water at 145 and 210 feet; sulphur water at 345 and 700 feet; salt water at 1,450 feet.

FRANK MERCHANT, PETROLIA
Lot 13, con. II, Mosa tp.

Completed August, 1933.
Oil yield: 2 bbls. per day.

Formation	Thickness, ft.
Surface	100
Top soap	160
Middle lime	20
Lower soap	20
Big lime	85
Total depth	385

Oil at 315 to 335 feet.
Water and oil at 355 to 360 feet; oil at 375 to 385 feet.

F. J. CARMAN, NEW YORK, N.Y.
Lot 13, range 2, N.L.R., Mosa tp.

Completed December 2, 1933.
Dry hole.

Formation	Thickness, ft.
Surface (clay, hardpan, and gravel)	202
Soapstone	51
Middle lime and lower soap	35
Onondaga	102
Detroit River lime	61
Total depth	451

No water below 200 feet.

BERT WILSON, SARNIA
Lot 6, con. VIII, Mosa tp.

Completed December 6, 1933.
Dry hole.

Formation	Thickness, ft.
Sand	7
Clay	32
Sand	32
Hardpan	15
Lime	22
Lime and shale stones	5
Lime	57
Soap	83
Lime	3
Soap	13
Lime	6
Soap	35
Lime	20
Grey shale	20
Lime	10
Very soft soap	5
Lime	60
Total depth	425

Fresh water at 86 feet; salt water at 411 feet.

Norfolk County

MIDWAL OIL AND GAS SYNDICATE, TORONTO
Lot 32, con. III, S.T.R., Middleton tp.

Completed January 7, 1933.
Open flow: 82,000 cu. ft.
Rock pressure: 500 lbs.

Formation	Thickness, ft.
Surface	210
Lime and shale	165
Flint	120
Lime and shale	398
Niagara	219
Shale	56
Clinton	30
Red Medina	16
Shale	37
Total depth	1,251

Gas at 1,184 to 1,194 feet.
Water at 214 feet.

MIDWAL OIL AND GAS CO., TORONTO
Lot 32, con. III, Middleton tp.

Completed June 2, 1933.
Open flow: 175,000 cu. ft.
Rock pressure: 521 lbs.

Formation	Thickness, ft.
Surface	238
Lime and shale	147
Flint	110
Lime and shale	401
Niagara	234
Shale	53
Clinton	28
Red Medina	25
Grey shale	25
Total depth	1,261

Gas at 1,197 and 1,202 feet.
Fresh water at 239 feet.

MIDWAL OIL AND GAS CO., TORONTO
Lot 33, con. III, S.T.R., Middleton tp.

Completed August 24, 1933.
Open flow: 94,000 cu. ft.
Rock pressure: 545 lbs.

Formation	Thickness, ft.
Surface	246
Lime and shale	160
Flint	114
Lime and shale	387
Niagara	227
Shale	59
Clinton	18
Red Medina	30
Grey shale	19
Total depth	1,260

Gas at 1,204 feet.
Fresh water at 250 feet.

MIDWAL OIL AND GAS CO., TORONTO
Lot 32, con. III, S.T.R., Middleton tp.

Completed October 10, 1933.
Open flow: 46,000 cu. ft.
Rock pressure: 460 lbs.

Formation	Thickness, ft.
Surface	224
Lime and shale	151
Flint	110
Lime and shale	410
Niagara	225
Shale	59
Clinton	23
Red Medina	18
Grey shale	36
Total depth	1,256

Gas at 1,193 feet.
Fresh water at 230 feet.

WALTER GAS SYNDICATE, ORCHARD PARK, N.Y.
Lot 4, con. I, N.T.R., Middleton tp.

Completed January 24, 1933.
Dry hole.

Formation	Thickness, ft.
Sand and clay	225
Brown and grey lime	185
Flint	125
Lime and shale	425
Niagara lime	245
Shale	49
Clinton	30
Red Medina	15
Blue and grey shale	30
Total depth	1,329

Sulphur water at 240 and 360 feet; salt water at 1,010 feet.

WALTER GAS SYNDICATE, ORCHARD PARK, N.Y.
Lot 30, N. ½, con. I, N.T.R., Middleton tp.

Completed June 17, 1933.
Dry hole.

Formation	Thickness, ft.
Sand and clay	225
Brown and grey lime	185
Flint	90
Lime and shale	460
Niagara lime	275
Shale	48
Clinton	30
Red shale	21
Total depth	1,334

Sulphur water at 235 and 258 feet; salt water at 1,007 feet.

WALTER GAS SYNDICATE, ORCHARD PARK, N.Y.
Lot 3, S. ½, con. I, N.T.R., Middleton tp.

Completed August 26, 1933.
Dry hole.

Formation	Thickness, ft.
Sand and clay	238
Brown and grey lime	178
Flint	138
Lime and shale	430
Niagara lime	265
Shale	52
Clinton	31
Red shale	18
Total depth	1,350

Sulphur water at 233 and 254 feet; salt water at 1,004 feet.

WALTER GAS SYNDICATE, ORCHARD PARK, N.Y.
Lot 21, con. I, S.T.R., Middleton tp.
Completed December 18, 1933.
Dry hole.

Formation	Thickness, ft.
Sand and clay	162
White lime	187
Flint	121
Lime and shale	430
Niagara lime	225
Shale	44
Clinton	20
Red Medina and blue shale	80
White Medina	10
Red shale	8
Total depth	1,287

Sulphur water at 170 feet; salt water at 1,015 feet.

MIDWAL OIL AND GAS CO., TORONTO
Lot 21, N.W. ¼, con. XIV, North Walsingham tp.
Completed November 29, 1933.
Open flow: 45,000 cu. ft.
Rock pressure: 410 lbs.

Formation	Thickness, ft.
Surface	218
Lime and shale	172
Flint	125
Lime and shale	380
Niagara	248
Shale	46
Clinton	28
Red Medina	20
Grey shale	25
Total depth	1,262

Gas at 1,204 feet.
Fresh water at 235 feet.

REGAL GAS SYNDICATE, TORONTO
Lot 10, con. B, South Walsingham tp.
Completed August 15, 1933.
Open flow: 280,000 cu. ft.
Rock pressure: 370 lbs.

Formation	Thickness, ft.
Surface	302
Lime and shale	200
Flint and sand	150
Lime and shale	318
Niagara	268
Shale	66
Clinton	29
Red Medina	31
Grey shale	31
Total depth	1,395

Gas at 1,311 and 1,338 feet.
Fresh water at 560 feet.

ERIE GAS, LIMITED, TORONTO
Lot 6, con. III, Woodhouse tp.
Completed October 21, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	44
Flint and lime	149
Brown lime	38
Lime and shale	354
Niagara lime	280
Shale	57
Clinton	34
Red Medina	14
Blue shale and white Medina	92
Total depth	1,062

Show of gas at 939 and 945 feet.
Sulphur water at 70 to 124 feet.

Welland County

BERTIE TOWNSHIP GAS AND OIL SYNDICATE, SELKIRK
Lot 16, con. XII, N.R., Bertie tp.
Completed April 5, 1933.
Open flow: 23,000 cu. ft.
Rock pressure: 80 lbs.

Formation	Thickness, ft.
Surface	45
Salina	185
Guelph and Niagara	220
Rochester	80
Clinton	32
Red Medina	78
Manitoulin	23
White Medina	24
Queenston	51
Total depth	738

Gas at 538, 542, 622, 673, and 683 feet.
Fresh water at 50 and 180 feet.

BERTIE TOWNSHIP GAS AND OIL SYNDICATE, SELKIRK
Lot 16, con. XII, N.R., Bertie tp.
Completed August 4, 1933.
Open flow: 25,000 cu. ft.
Rock pressure: 65 lbs.

Formation	Thickness, ft.
Surface	38
Salina	190
Guelph and Niagara	226
Rochester	76
Clinton	32
Red Medina	80
Manitoulin	24
White Medina	12
Queenston	55
Total depth	733

Gas at 538 and 675 feet.
Fresh water at 40 and 76 feet; sulphur water at 306 feet.

WELLAND COUNTY GAS SYNDICATE, STEVENSVILLE
Lot 15, con. XII, Bertie tp.
Completed June 26, 1933.
Open flow: 30,000 cu. ft.
Rock pressure: 80 lbs.

Formation	Thickness, ft.
Surface	40
Salina	190
Guelph and Niagara	234
Rochester	82
Clinton	32
Red Medina	75
Manitoulin	4
White Medina	40
Queenston	53
Total depth	750

Gas at 551, 554, 643, 677, and 695 feet.
Fresh water at 50 and 90 feet.

HALDIMAND NATURAL GAS SYNDICATE, STEVENSVILLE
Lot 3, con. II, N.R., Bertie tp.
Completed November 10, 1933.
Open flow: 25,000 cu. ft.
Rock pressure: 115 lbs.

Formation	Thickness, ft.
Surface	135
Salina	195
Guelph and Niagara	185
Rochester	102
Clinton	31
Red Medina	65
Manitoulin	17
White Medina	20
Queenston	82
Total depth	832

Gas at 684, 713, and 746 feet.
Fresh and sulphur water at 155 feet.

HALDIMAND NATURAL GAS SYNDICATE, STEVENSVILLE
Lot 3, con. II, N.R., Bertie tp.

Completed September 7, 1933.
Open flow: 125,000 cu. ft.
Rock pressure: 125 lbs.

Formation	Thickness, ft.
Surface	118
Salina	212
Guelph and Niagara	220
Rochester	68
Clinton	32
Red Medina	75
White Medina	30
Queenston	75
Total depth	830

Gas at 670, 700, 725, and 747 feet.
Fresh water at 109 feet; sulphur water at 215 feet.

W. C. PATTERSON, JAMESTOWN, N.Y.
Lot 2, con. VII, Willoughby tp.

Completed June 3, 1933.
Open flow: 24,500 cu. ft.
Rock pressure: 300 lbs.

Formation	Thickness, ft.
Surface	78
Shale and lime	132
Niagara	206
Shale	56
Clinton	40
Red Medina	59
Grey shale	35
White Medina	14
Red shale	49
Total depth	669

Gas at 537, 612, and 618 feet.
Fresh water at 132 feet; sulphur water at 280 feet.

W. C. PATTERSON, JAMESTOWN, N.Y.
Lot 2, con. VII, Willoughby tp.

Completed July 14, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	73
Shale and lime	140
Niagara	206
Shale	57
Clinton	37
Red Medina	61
Grey shale	34
White Medina	15
Red shale	2
Total depth	625

Fresh water at 135 feet; sulphur water at 285 feet.

W. C. PATTERSON, JAMESTOWN, N.Y.
Lot 2, con. VII, Willoughby tp.

Completed August 12, 1933.
Open flow: 35,000 cu. ft.
Rock pressure: 300 lbs.

Formation	Thickness, ft.
Surface	77
Shale and lime	135
Niagara	208
Shale	57
Clinton	40
Red Medina	59
Grey shale	30
White Medina	19
Red shale	75
Total depth	700

Gas at 616 feet.
Fresh water at 127 feet; sulphur water at 290 feet.

W. C. PATTERSON, JAMESTOWN, N.Y.
Lot 1, con. VII, Willoughby tp.

Completed September 20, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	76
Shale and lime	137
Niagara	210
Shale	55
Clinton	40
Red Medina	60
Shale	29
White Medina	16
Red shale	2
Total depth	625

Fresh water at 130 feet; sulphur water at 295 feet.

W. C. PATTERSON, JAMESTOWN, N.Y.
Lot 3, con. VII, Willoughby tp.

Completed October 20, 1933.
Open flow: 65,000 cu. ft.
Rock pressure: 285 lbs.

Formation	Thickness, ft.
Surface	82
Shale and lime	124
Niagara	209
Shale	55
Clinton	39
Red Medina	59
Shale	26
White Medina	17
Red shale	59
Total depth	670

Gas at 596 feet.
Fresh water at 60 and 125 feet; sulphur water at 270 feet.

W. C. PATTERSON, JAMESTOWN, N.Y.
Lot 2, con. VII, Willoughby tp.

Completed December 5, 1933.
Open flow: 17,000 cu. ft.
Rock pressure: 300 lbs.

Formation	Thickness, ft.
Surface	86
Shale and lime	126
Niagara	209
Shale	55
Clinton	36
Red Medina	59
Shale	30
White Medina	18
Red shale	41
Total depth	660

Gas at 612 feet.
Fresh water at 125 feet; sulphur water at 295 feet.

Wellington County

ALOKA OIL COMPANY, TORONTO
Lot 7, con. IV, Puslinch tp.

Completed July 25, 1933.
Dry hole.

Formation	Thickness, ft.
Surface	52
Guelph and Lockport	303
Rochester shale	24
Clinton	3
Clinton shale	8
Cabot Head shale	13
Manitoulin dolomite	45
Big red shale	447
Big grey shale	675
Utica shale	120
Trenton	647
Arkose	23
Granite	171
Total depth	2,531

Show of gas at 2,357 feet.
Fresh water at 60 to 80 and 240 feet; salt water at 403 to 448 feet.

PETROLEUM IN 1933

By R. B. Harkness

General

After reaching an all-time low point in 1930, the production of petroleum in Ontario has shown an increase for the third consecutive year. This increase is mainly accounted for by the three deep oil wells in Dawn township, but the old shallow fields have either sustained or increased their production. The mild season has been a factor of some importance, but the main reason can be attributed to a return of confidence in the operators, following the improvement in the price of oil and general operating conditions in the United States.

The total production for 1933 was 136,058 barrels, 5,718 barrels more than in 1932, and the value $253,486, an increase of $6,018. The average price per barrel was $1.86, against $1.90 in 1932. This is the price to the producer and includes certain bonuses given by the Imperial Oil Refineries.

The experiment with acid for treating wells, in order to increase production, has not met with the success in Ontario that it has had in the United States. This is partly due to the condition of the equipment in the old wells, which is unsuitable to the process used. Thin casing and old packers will not stand up under high pressure.

TABLE I—OIL PRODUCED IN ONTARIO BY FIELDS, 1926–1933

Field	1926	1927	1928	1929	1930	1931	1932	1933
	bbls.	bbls.	bbls.	bbls.	bbls.	bbls.	bbls.	bbls.
Petrolia and Enniskillen	55,485	59,424	60,547	56,284	55,130	57,515	58,871	57,298
Oil Springs	38,349	37,281	35,653	30,737	29,160	30,792	31,438	31,343
Moore tp	2,438	2,112	2,148	1,230	1,576	3,739	3,272	2,192
Sarnia tp	1,890	1,590	1,221	749	1,149	1,466	1,227	2,181
Plympton tp	1,047	1,241	371	315	296	296	274	211
Bothwell	25,382	25,224	24,255	23,236	21,176	18,024	19,460	22,935
Tilbury East tp	.....	60	736	138	149	.....	.....	.....
Dover West tp	959	602	773	715	457	891	453	763
Raleigh tp	676	276	.....	.....	.....	.....	.....	239
Onondaga tp	361	210	186	243	231	34	543	946
Mosa tp	7,868	7,447	7,268	6,851	7,166	8,517	8,429	8,168
Thamesville	2,376	4,139	1,006	427	447	462	534	847
Euphemia tp	.....	.....	.....	.....	.....	121	496	510
Dunwich tp	139	.....	.....	148	365	507	285	346
Brooke tp	.....	.....	.....	52	.....	.....	.....	.....
Dawn tp	.....	.....	.....	.....	.....	.....	5,061	8,079
Total	136,971	139,606	134,164	121,125	117,302	122,364	130,343	136,058
Value	$376,822	$289,391	$249,981	$253,678	$235,746	$219,993	$247,468	$253,486
Average price	$2.73	$2.11	$1.86	$2.09	$2.00	$1.80	$1.89	$1.86

The capital employed in producing crude petroleum is $1,310,000; the number of employees, 178; and the wages paid, $97,763. This information is furnished by the Dominion Bureau of Statistics, Ottawa.

TABLE II—OIL WELLS AND THEIR PRODUCTION, 1933

Field	Wells			Wells drilled		Production[1]		Gain or loss in 1933	
	Operating	Not operating	Abandoned	Producing	Dry			Gain	Loss
						bbls.	gals.	bbls.	bbls.
Petrolia and Enniskillen	792	697	102	1	1	57,298	17	.....	1,572
Oil Springs	906	112	68	.....	.....	31,342	33	.....	96
Moore tp	53	34	8	.....	.....	2,192	11	.....	1,080
Sarnia tp	68	36	15	.....	.....	2,180	34	954	.....
Plympton tp	22	9	.....	.....	.....	210	18	.....	63
Bothwell	191	77	35	.....	.....	22,935	5	3,475	.....
Dover West tp	2	.....	.....	.....	.....	763	10	311	.....
Raleigh tp	.....	6	.....	.....	.....	239	4	239	.....
Onondaga tp	16	21	.....	.....	.....	945	20	402	.....
Mosa tp	94	21	9	1	1	8,167	18	.....	261
Thamesville	.....	24	.....	.....	.....	846	25	312	.....
Euphemia tp	1	79	.....	.....	.....	510	15	14	.....
Dunwich tp	.....	99	.....	.....	.....	346	17	62	.....
Dawn tp	4	40	.....	1	.....	8,078	24	3,018	.....
Brooke tp	2	3	.....	2	.....	.....	.....	.....	.....
Tilbury East tp	.....	1	.....	.....	.....	.....	.....	.....	.....
Other fields	.....	1[2]	.....	.....	1[3]	.....	.....	.....	.....
Total	2,151	1,260	237	5	3	136,058	6	8,787	3,072
								Net gain 5,715	

[1]Production figures from Imperial Oil Company.
[2]Nottawasaga.
[3]Warwick.

Exploratory Drilling

Exploratory drilling is also covered under the heading of "Gas Wells Drilled in 1933," on page 2. Wells drilled below the shallow oil horizon, in the Onondaga formation, are usually drilled in search of gas. The Guelph formation, however, produces both oil and gas, and wells into that formation can be treated as test wells for either oil or gas; the development in Dawn township may be taken as an example.

A discovery of oil made in Brooke township, in lot 26, concession XIII, is leading to considerable drilling activity. The oil is at the same horizon and depth as in the Petrolia field. No samples of the rock are available, and, as yet, there is no information as to the porosity of the rock and the thickness of the producing horizon.

Further drilling in the vicinity of the well discovered in Mosa township in 1932 has failed to find a producing field.

There were eight wells drilled in 1933, with a total of 5,213 feet of drilling. Five drilling rigs were employed, and there was an investment of $8,500 in drilling rigs and equipment. The men employed and wages paid are included in the natural gas statistics.

Petroleum Refining

Seven refineries were in operation in Ontario in 1933, and one, The Simrall Refining Corporation of Canada, Limited, was closed down. Lloyds Refinery, Port Credit, was in operation about six weeks.

PETROLEUM REFINERIES, 1933

Company	Location of refinery	Head office address
British American Oil Co., Ltd.	Foot of Cherry St., Toronto	Royal Bank Bldg., Toronto.
Canadian Oil Companies, Ltd.	Petrolia	12 Strachan Ave., Toronto.
Goodrich Refining Co., Ltd.	Scarboro	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	117 Harbour St., Toronto.
Sava Oil Refineries, Ltd	250 Sandwich St. E., Windsor	19 McDougall St., Windsor.

The Dominion Bureau of Statistics gives the following information: Total capacity of all refineries, 38,675 barrels per day; total number of employees, 2,036; salaries and wages paid, $2,752,718; capital invested, $22,947,812.

Table III shows the quantity of crude oil distilled and the products derived from this crude oil. The salient points in 1933 are the lower price of crude oil, the decrease in the quantity of cracked gasoline, and the increase in straight run gasoline, kerosene, lubricating oil, naphtha, and fuel oil.

TABLE III—PETROLEUM REFINING OPERATIONS, 1928–1933[1]

Schedule	Unit of measure	1928	1929	1930	1931	1932	1933
Imported crude distilled	Gallons[2]	257,929,514	321,687,678	343,372,124	364,871,253	327,524,704	328,873,387
	Value	$17,617,756	$23,341,514	$23,273,547	$17,035,028	$19,197,691	$15,871,124
Imported fuel oil	Gallons	.....	.....	.....	.....	1,669,675	.....
	Value	.....	.....	.....	.....	$51,092	.....
Canadian crude distilled	Gallons	4,484,858	4,426,863	3,944,969	4,382,806	4,704,609	4,823,639
	Value	$283,959	$292,949	$264,008	$261,334	$290,752	$299,793
Percentage of total	.....	1.71	1.35	1.13	1.19	1.43	1.45
PRODUCTS							
Gasoline:							
Straight run	Gallons	83,067,789	101,276,701	97,806,121	95,934,920	61,297,731	89,429,293
	Selling value	$12,403,342	$14,521,648	$12,334,586	$9,886,611	$6,378,577	$7,793,607
By cracking process	Gallons	39,724,303	49,884,248	84,496,056	100,120,768	109,519,770	70,519,864
	Selling value	$5,803,963	$7,176,654	$11,066,369	$10,544,926	$10,673,010	$5,736,708
Kerosene	Gallons	21,304,385	19,138,614	17,973,730	14,656,833	18,666,252	26,499,830
	Selling value	$2,650,877	$2,516,618	$1,980,546	$1,397,607	$1,736,164	$2,022,408
Lubricating oil	Gallons	16,822,292	20,452,106	16,451,717	13,963,545	14,187,555	16,299,872
	Selling value	$2,813,371	$3,707,592	$2,756,579	$2,445,410	$3,476,341	$2,854,787
Engine distillate and naphtha	Gallons	3,062,787	5,845,447	4,272,751	3,652,973	6,098,784	8,384,517
	Selling value	$445,526	$811,240	$504,206	$327,717	$573,585	$490,728
Gas oil	Gallons	76,469,354	99,035,616	80,742,218	101,370,904	85,233,170	37,860,532
	Selling value	$4,104,338	$5,016,370	$3,792,757	$3,627,041	$3,550,598	$1,874,878
Fuel oils	Gallons						55,394,540
	Selling value						$2,112,522
Tar and grease	Gallons	14,626,752	18,078,346	14,486,464	9,716,022	8,751,758	8,342,446[3]
	Selling value	$267,563	$325,206	$276,649	$180,056	$492,339	$357,316
Paraffin wax and candles	Pounds	17,030,064	10,784,609	10,153,924	10,097,478	9,196,156	8,978,068
	Selling value	$599,341	$538,233	$453,601	$368,686	$417,336	$355,323
Petroleum coke	Short tons	49,409	67,599	56,946	54,223	62,836	62,601
	Value	$314,794	$396,565	$316,180	$285,051	$328,067	$344,686
Still gas	M cu. ft	823,320	1,103,142	1,551,334	2,128,739	1,942,741	1,574,451
	Value	$185,595	$270,479	$421,500	$505,156	$410,222	$306,984
Asphalt	Gallons	1,276,098	2,664,199	6,029,624	8,778,452	6,885,142	6,494,707
	Selling value	$65,003	$137,714	$285,460	$318,005	$555,654	$524,532
Miscellaneous	Value	$387,544	$258,113	$291,404	$219,900	$222,545	$50,498
Total value of refined products	.....	$30,033,257	$35,676,432	$34,479,837	$30,106,166	$28,814,438	$24,824,977
Employees	Average No.	1,853	2,313	2,449	1,984	1,937	2,036
	Wages paid	$3,013,872	$3,657,619	$3,760,870	$2,840,794	$2,764,208	$2,752,718
Capital invested	.....	$19,570,531	$26,784,547	$26,761,273	$25,282,459	$25,732,687	$22,947,812

[1]Information furnished by the Dominion Bureau of Statistics, Ottawa. [2]Gallons refer to Imperial gallons.
[3]In 1933 this item is grease only.

Price of Crude Oil

The market price paid by the Imperial Oil Company to the producers for Petrolia crude oil, delivered at Petrolia, is as follows:—

January 1 to January 9	$1.90
January 10 to January 17	1.80
January 18 to August 24	1.75
August 25 to September 8	1.85
September 9 to December 31	2.10

Oil Springs crude commands a premium of 7 cents. Prices paid for crude at other stations vary with the freight rate.

Refined Products Imported into Ontario

Table IV gives a comparative statement for 1932 and 1933 of the refined products imported into Ontario and their value. It is noteworthy that there is a very marked decline in every item, except lubricating oil of certain types and toilet products. The outstanding decrease is in gasoline, owing, no doubt, to the increased duty on this item.

TABLE IV—PETROLEUM AND REFINED PRODUCTS IMPORTED IN 1932 AND 1933

Import	1933		1932	
	Imperial gallons	Value	Imperial gallons	Value
CRUDE PETROLEUM:				
Petroleum, 0.790 specific gravity or heavier, for refining	233,694,540	$4,938,131	261,887,861	$7,902,649
REFINED PETROLEUM:				
For use in concentrating ores	41,048	$23,594	52,387	$30,842
Gasoline lighter than 0.669 specific gravity (casing head)	2,600,405	111,433	3,597,652	126,350
Gasoline lighter than 0.8235 specific gravity	7,572,627	586,077	36,900,104	4,022,485
Gas oils, other than naphtha and gasoline, between 0.8235 and 0.775 specific gravity	55	2	169,789	6,244
Kerosene and illuminating oils	959,855	57,231	1,242,319	77,819
Fuel oil, 0.8235 specific gravity and heavier	2,808,543	137,678	6,067,653	303,417
Engine distillate lighter than 0.8235 specific gravity	41,261	3,919	.....	.....
Lubricating oils, consisting wholly or in part of petroleum, costing less than 25 cents a gallon	2,943,286	506,210	3,781,328	683,421
Lubricating oils, all other	1,652,113	646,032	1,454,902	611,749
All other oils	164,303	54,966	152,867	62,424
Total	18,783,496	$2,127,142	53,419,001	$5,924,751
PETROLEUM PRODUCTS:				
Axle grease ..... lbs.	1,467,456	$65,427	1,936,308	$86,809
Vaseline, toilet and medicinal petroleum	.....	112,797	.....	97,371
Paraffin wax ..... lbs.	462,652	28,121	598,449	25,224
Paraffin wax candles ..... lbs.	120,019	22,573	244,832	46,575
Other petroleum products lighter than 0.8235 specific gravity ..... gals.	950,561	84,225	1,135,496	117,764
Total	3,000,688	$313,143	.....	$373,743
Total value	.....	$7,378,416	.....	$14,201,143

TABLE IV—PETROLEUM AND REFINED PRODUCTS IMPORTED IN 1932 AND 1933—*Continued*

Import	1933	1932
Total net value of petroleum and refined products imported[1]	$7,378,416	$14,201,143
Duty paid on the above, calculated on the existing tariff schedule	525,813	1,326,567
Sales tax at 6 per cent.[2]	474,254	607,759
Freight, approximately	6,000,000	8,000,000
Exchange, approximately[3]	80,764	3,020,000[2]
Total value delivered in Ontario	$14,459,247	$27,155,469

[1]These statistics are furnished through the courtesy of the Department of Customs and Excise.
[2]Sales tax in 1932 was 4 per cent., with certain exemptions.
[3]1.0946 per cent.

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