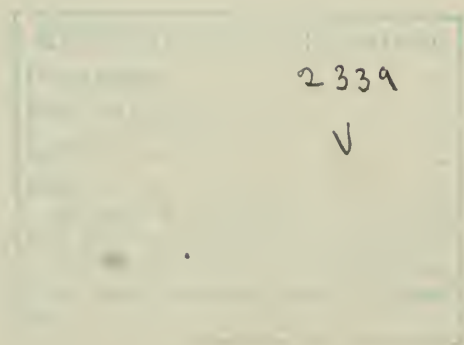
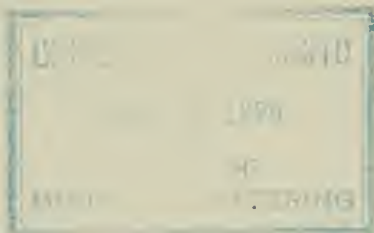
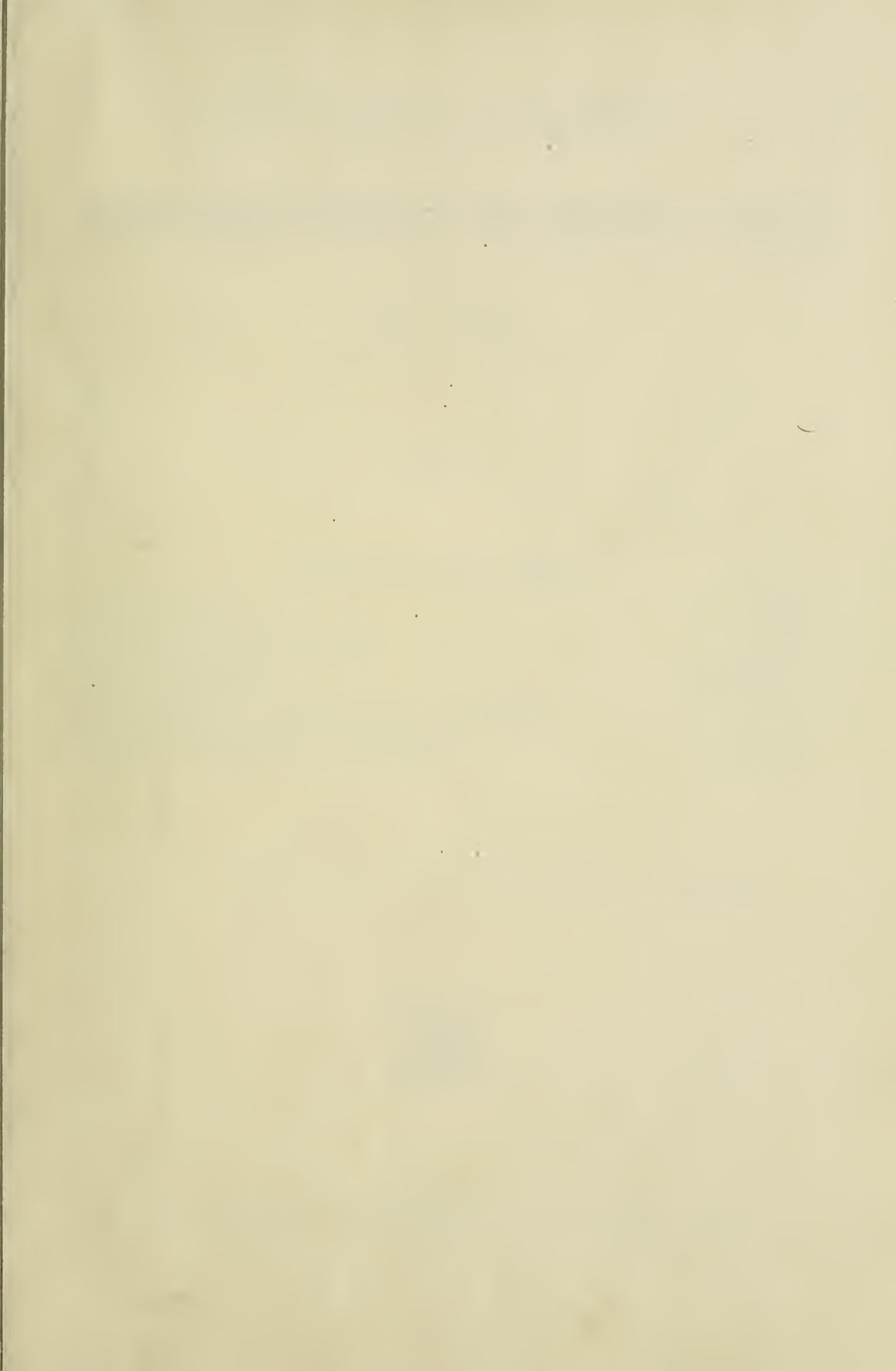


TWENTY-EIGHTH ANNUAL REPORT
OF THE
ONTARIO BUREAU OF MINES
1919
PART I







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TWENTY-EIGHTH ANNUAL REPORT
OF THE
ONTARIO BUREAU OF MINES, 1919,
BEING
VOL. XXVIII
AND CONSISTING OF PARTS I AND II

PART I

CONTENTS OF PART I

	PAGES
Statistical Review - - - - -	1-95
Mining Accidents in 1918 - - - - -	96-103
Mines of Ontario - - - - -	104-186
First Report of Joint Peat Committee - -	187-192
Report of Advisory Gas Board - - - -	193-227

PRINTED BY ORDER OF THE LEGISLATIVE ASSEMBLY OF ONTARIO



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1919



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CONTENTS

Part I

	PAGE		PAGE
LETTER OF TRANSMISSION	vii	Iron Blast Furnaces in Operation, 1918	33
INTRODUCTORY LETTER	ix	Table XI—Production Iron and Steel, 1914 to 1918	33
STATISTICAL REVIEW			
Table I—Mineral Statistics of Ontario for 1918	2	Lead	34
Table II—Value of Mineral Production, 1914 to 1918	4	Molybdenite	34
Table III—Total Production of Metals in Ontario	5	Molybdenite Concentrating Plants, 1918	34
Present Situation and Outlook	5	Producers of Molybdenite, 1918	35
Ontario War Minerals	6	Materials of Construction	35-47
Gold	8	Clay Products	35
Table IV—Gold Production in 1918, Gold Camps being Developed	9	Table XII—Output and Value of Brick and Tile, 1918	36
Producing Gold Mines, 1918	11	Fuel Consumption	37
Dividends	12	Brick and Tile Plants	37
Table V—Dividends and Bonuses Paid by Gold Mining Companies to December 31, 1918	13	Pottery Manufacturers, 1918	39
Silver	12	Sewer Pipe Works, 1918	39
The Ontario Output	14	Brick, Tile, Sewer Pipe and Por- ttery	40
Producing Silver Mines in 1918	15	Table XIII—Value of Clay Pro- ducts, 1914-1918	40
Table VI—Silver Production, Cobalt Mines, 1904 to 1918	16	Sand-Lime Brick Producers, 1918	40
Table VII—Total Production, Cobalt Silver Mines, 1904 to 1918	17	Lime Producers, 1918	41
Treating and Refining the Ore	17	Portland Cement Plants, 1918	42
Custom Ore Sampling, Concentration and Reduction Works, 1918	17	Manufacture of Cement Products, 1918	43
Refiners of Silver-Cobalt Ores, 1918	18	Manufacturers of Cement Products, 1918	43
Operation of Ontario Silver-Cobalt Refineries, 1918	18	Sand and Gravel Operators, 1918	44
Re-treatment of Tailings	18	Table XIV—Stone Production, 1915- 1918	46
Dividends	19	Limestone and Sandstone Quarries, 1918	46
Table VIII—Dividends and Bonuses Paid by Silver Mining Companies to December 31, 1918	20, 21	Granite and Trap Quarries, 1918	47
Copper	22	Quartz	47
Nickel	22	Actinolite	48
Nickel-Copper Mining Companies, 1918	24	Barite	48
Table IX—Nickel-Copper Mining and Smelting, 1914-1918	24	Corundum	49
Table X—Nickel-Copper Refining, 1918	24	Feldspar	49
New Nickel Areas in Ontario	25	Feldspar Producers, 1918	49
New Sources of Nickel Elsewhere	26	Fluorspar	50
Iron and Sulphur	27	Fluorspar Producers, 1918	50
The "Precious" and "Rare" Metals	28	Graphite	50
Precious and Rare Metals from Can- Copper Company's Mattes	30	Graphite Operators, 1918	51
Improving Electrolytic Process of Re- fining	30	Gypsum	51
Iron Ore and Pig Iron	30	Iron Pyrites	52
The Helen Mine	31	Iron Pyrites Shippers, 1918	53
Beneficiation of Low Grade Ore	31	Manufacturers of Sulphuric Acid, 1918	53
Government Aid asked for	32	Mica	53
Iron Ore Mining Companies	32	Mica Producers, 1918	54
		Mineral Water	55
		Shippers of Mineral Waters, 1918	55
		Natural Gas	56
		Table XV—Natural Gas Statistics, 1918	56
		Natural Gas Producers, 1918	56
		Pipe Line Companies or Distributors of Natural Gas	59

	PAGE
Wells Abandoned and Plugged.....	60
Summary	60
Natural Gas Legislation	60
The Natural Gas Act	60
Industrial Use of Gas from Kent Field	61
Industrial Consumption Kent County Gas in 1917	61
Appointment of Natural Gas Advi- sory Board	63
The Natural Gas Act, 1919	63
Conditions in the Several Fields	63
The Licensing Regulations	65
General Notes	65
Well-Drilling in 1918 and 1919	66
Present Drilling Operations, 1919... ..	67
List of Cities, Towns and Villages in the Province of Ontario Supplied with Natural Gas	68
Natural Gas Industry in 1918	68
Analysis of the Domestic Consump- tion of Natural Gas	69
Influence of Variations in Tempera- ture on Domestic Consumption.... ..	70
Relation Between Temperature and Gas Consumption	72
Influence of Wind on Consumption of Natural Gas	73
Summary of Wind Velocity at East- ern Gap, Toronto	75
Petroleum	76
Petroleum Production by Fields, 1917 and 1918	76
Oil Wells in Ontario, 1918	77
Salt	78
Salt Companies, 1918	79
Strontium	79
Talc	79
Table XVI—Production of Talc, 1914-1918	80
Talc Operators, 1918	81
Mining Divisions	81
Table XVII—Receipts from Mining Divisions, 1917-18	82
Reports from Mining Recorders	82
Mining Companies	83
Mining Companies Incorporated in 1918	84
Mining Companies Licensed in 1918	85
Mining Company Charters Surren- dered in 1918	85
Mining Revenue	85
Table XVIII—Mining Lands Sold and Leased During 1917-18..... ..	86
Provincial Assay Office	88
Tariff of Fees for Analyses and Assays	89
Minerals New to Ontario	90
Elaterite or Elastic Bitumen	90
Kalgoorlite; Coloradoite	93
A New Discovery of Pitchblende.... ..	91
MINING ACCIDENTS IN 1918	
Table of Fatalities	96
Table of Fatal Accidents in Mines, Metallurgical Works and Quarries, 1901 to 1918	97

	PAGE
Table of Fatal Accidents in or about the Mines, 1918	98, 99
Table of Fatal Accidents in Metallur- gical Works, 1918..... ..	100, 101
Table of Fatal Accidents at Quarries, 1918	100, 101
Cause and Place of Fatalities in Mines	102
Prosecutions	103

MINES OF ONTARIO

I—NORTHWESTERN ONTARIO	104
Iron Pyrites	104
Gold	104
II—SUDBURY, NORTH SHORE AND MICH- PICOTEN	104
Michipicoten Area	104
Iron	105
Pyrite	105
Nickel and Copper	106
British America Nickel Corpora- tion	106
International Nickel Company of Canada	108
Mond Nickel Company	109
Miscellaneous Mines	112
Quarries	114
III—DISTRICT OF TIMISKAMING..... ..	115
Gold	115
Boston Creek and Munro	115
Kirkland Lake	116
Larder Lake	122
Poreupine	122
West Shining Tree	129
Northern Section	129
Southern Section	130
Miscellaneous Mines	131
Cobalt Silver Area	131
Elk Lake and Gowganda Silver Area	150
South Lorrain Area	153
IV—EASTERN ONTARIO	153
Pyrite	153
Gold	154
Iron	155
Talc	155
Fluorite	156
Lead	157
Feldspar	158
Mica	159
Molybdenite	160
Graphite	162
Marble	164
Other Quarries	164
V—SOUTHWESTERN ONTARIO	165
Gypsum	165
Quarries	166
Brickyards	171
VI—SMELTING AND REFINING WORKS..... ..	173
Blast Furnaces..... ..	173
Refineries	175
Nickel Refining Plant	176
Lead Smelters	186

FIRST REPORT OF JOINT PEAT COMMITTEE		PAGE
Introduction		187
Appointment of Peat Committee		188
Selecting a Bog		188
Designing and Making the Peat Machines		190
Failure to Deliver Machinery Causes Delay		190
Expenditure to December 31, 1918..		191
 REPORT OF ADVISORY GAS BOARD		
Letter Transmitting Report		193
Introduction		194
Conservation of Supply		195
Prevention of Waste		198
Syndicate Gas Lines Tapping High Pressure Lines		198
Semi-Annual Reports Showing Line Leakages		199
Measuring all Gas Through a Standard Meter		199
Control of Gas from Oil Wells		200
Protecting Gas Wells from Injurious Interference		200
Allotting Gas Supply to the Homes...		200
Classification of Gas Consumers.....		201
Rights under Agreements		201
Providing Appeal		202
Encouraging Search and Development Work		202
Expropriation for Rights of Way		203
The Protection of New Discoveries...		203
Administration of New Gas Fields		203
Adjustment of Rates		203
Supplying New Domestic Consumers..		204
Additional Matters for Regulation...		204
Licensing of Drillers and Prospectors.		204
Protection Against "Boosters"		204
Drilling for Gas on Public Highways.		205
The Ontario Gas Fields		205
General Conditions		205
The Possibility of New Fields		206
The Welland County Gas Field.....		207
Haldimand and Norfolk Counties...		209
Dominion Natural Gas Company, Limited		209
Summary of Open Flow of Gas Fields		209
The Tilbury Field		210
Increasing Yield of Tilbury Field and Decreasing Pressures		212
Decline in Wells of Union Natural Gas Co.		212
Life of the Tilbury Field		212
Salt Water		212
Compressor Stations in Tilbury Field		213
The Essex Gas Field		213
Chronological Summary		214
Conclusions		214
 APPENDIX. 		
Waste of Natural Gas		215
The Waste Problem in the United States		216
Prevention of Excessive Drilling.....		219
Adjustment of Rates		223
Basis for Rate Adjustment		225

ILLUSTRATIONS

	PAGE
Diagram showing output in million cubic feet of Kent Gas Field	61
Chart showing total mileage of wind with departure from normal	74
The dark parts of the illustration represent "elaterite" or elastic bitumen	91
Fluorite concentrating mill on property of Industrial Minerals, Ltd., Madoc	92
Diagram showing Mining Fatalities per thousand men employed between the years 1901-18	97
International Nickel Company of Canada, Limited—General view of the Port Colborne plant	107
Bird's-eye view of the Port Colborne plant from the southwest	107
Flow Sheet of the Moose Mountain Concentrating Plant	113
Lake Shore mine, Kirkland Lake, June, 1919	118
Teck-Hughes mine, June, 1919. The two buildings with verandah in the foreground on the left belong to the Kirkland-Porphry	120
Wright-Hargreaves mine, June, 1919	122
Electric furnace for producing ferro-chrome, Cordova Mines	151
International Nickel Company of Canada, Port Colborne—Nickel room interior.....	177
International Nickel Company of Canada, Port Colborne—Men shovelling in nickel room	179
International Nickel Company of Canada, Port Colborne—Nickel room, three large vats	181
International Nickel Company of Canada, Port Colborne—Bird's-eye view of casting room	183
International Nickel Company of Canada, Port Colborne—Pouring molten blister copper into casting ladle after separation from nickel	184

	PAGE
International Nickel Company of Canada, Port Colborne—Main power house, showing turbo-blowers running at 8,500 r.p.m., supplying air to the copper converters.....	185
Moore-Anrep peat machine, showing 150-ft. arm carrying conveyor belt. The excavator is seen on the right and the belt conveyor arm on the left	189
Drilling a gas well	220
First operation of tubing a seven million well, 3-inch tubing being used	220
Swinging a length of 3-inch tubing to place over the high pressure gas flow	221
"Bucking up" the tubing. "No sleep until the well is closed in"	221
Well tubed and closed in	222
Gas well after derrick is removed. Ready to turn into the line	222

MAPS

Sketch Map showing distribution of natural gas by pipe line from Ontario Gas Fields (insert)	Facing page 60
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LETTER OF TRANSMISSION

TO HIS HONOUR SIR JOHN STRATHEARN HENDRIE, C.V.O.,

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 Twenty-eighth Annual Report of the Bureau of Mines.

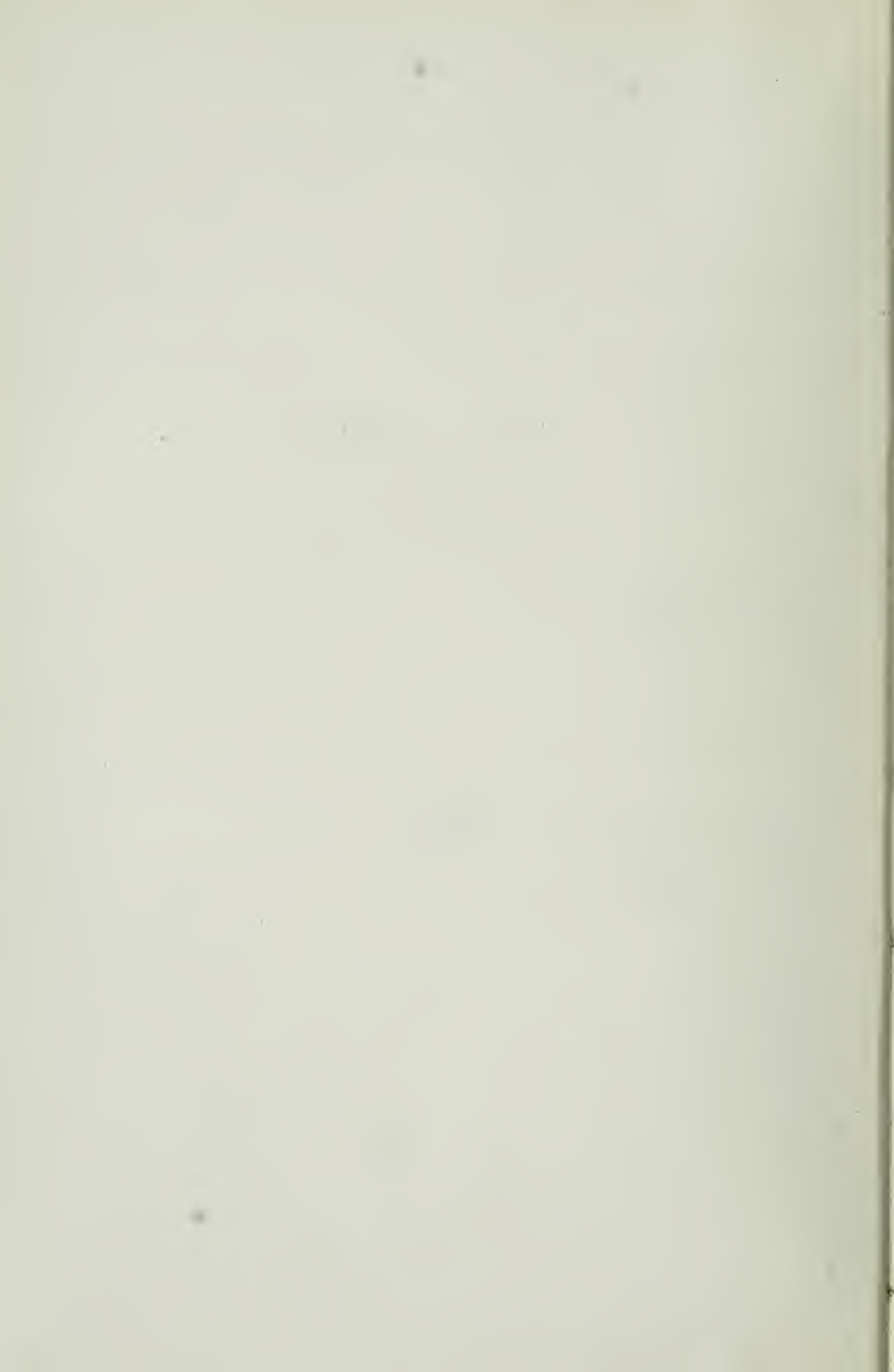
I have the honour to be, Sir,

Your obedient servant,

G. H. FERGUSON,

Minister of Lands, Forests and Mines.

Department of Lands, Forests and Mines.
Toronto, 1919.



INTRODUCTORY LETTER

TO THE HONOURABLE GEORGE HOWARD FERGUSON, K.C.,

Minister of Lands, Forests and Mines.

SIR,—I beg to lay before you, to be submitted to His Honour the Lieutenant-Governor in Council, the Twenty-eighth Annual Report of the Bureau of Mines, which is published in two Parts.

Part I passes in review the mining industry for the year 1918, and gives statistics regarding the output of metallic and non-metallic products, together with many details in tabular and other form.

The aggregate value of the mineral production in 1918 exceeded that of any previous year. This fact was due, for the most part, to the great war for the liberties of mankind, which came to a victorious end by the signing of the armistice on 11th November. Several of the leading minerals produced in Ontario were in great demand for war purposes. The chief of these was nickel, and hence the nickel mines of Ontario were worked to the full extent of their capacity up to the close of the struggle, the output being considerably in excess of that for 1917, previously the largest on record. Ore from the nickel mines contains copper as well, and there was a corresponding increase in the production of that metal as compared with 1917. Another necessary substance was iron pyrites, used in the manufacture of sulphuric acid for producing explosives. On account of the stoppage of importations from Spain, recourse was had by munition makers in the United States to the pyrite deposits of Ontario, mainly in the Lake Superior region, where the abundant supplies enabled them to meet their requirements. Reference in greater detail is made to these and other "war" minerals in the Statistical Review, and the effect of the war upon the several departments of mining is discussed. With the sudden coming of peace, this demand fell off greatly, and it cannot be doubted that so far as production is concerned, the result will be to materially lower the figures for 1919.

The Mining Accidents during 1918 are dealt with by T. F. Sutherland, Chief Inspector of Mines.

Under the heading Mines of Ontario, Mr. Sutherland and Assistant Inspectors E. A. Collins, J. H. Stovel and A. R. Webster describe the mines, quarries and metallurgical plants in operation during the year.

Much space is given in Part I to natural gas. The present sources of this important substance, which heats the homes and cooks the meals for about 100,000 people in the south-western peninsula of Ontario, and which is also in large use for industrial purposes, are failing. In consequence, the Legislature has adopted the policy of conserving the supply of gas, with the view of its being used, so far as possible, for domestic and not for industrial purposes. This policy was embodied in the Natural Gas Act, 1919, which took the place of the measure of the same name, passed in 1918. The legislation was preceded by a preliminary study of the gas situation, made by the Natural Gas Advisory Board appointed for the purpose, whose Report is printed in this volume.

The fuel question is always a live one in Ontario, and another aspect of it is

dealt with in a preliminary way, in Part I, by the Peat Committee, appointed jointly by the governments of Canada and Ontario, to investigate the possibilities of obtaining fuel from peat. The work of this committee will be more fully described when the experiments now being made on the Alfred peat bog are completed.

Part II of the Report is entitled "Abitibi-Night Hawk Gold Area," the authors being C. W. Knight, A. G. Burrows and P. E. Hopkins, Assistant Provincial Geologists, and Professor A. L. Parsons, of the University of Toronto. This is supplemented by notes on Larder Lake Gold Area by Mr. Hopkins. The Reports are accompanied by maps of the respective areas. Gold has been found in various places in the territory covered by the Reports, and the latter, together with the maps, will enable the areas to be prospected to better advantage.

A Bureau, entitled the Imperial Mineral Resources Bureau, has been established in London, England, for the collection of information with reference to the Mineral Resources of all parts of the Empire, and for the promotion of the development and utilization of such resources. The Governors of the Bureau consist of one representative from each of the five Dominions, Canada, Australia, New Zealand, South Africa and Newfoundland, one representing India and one the Crown Colonies, together with a chairman appointed by the British government and six representatives of the mining, metallurgical and allied interests in the United Kingdom. The representative of Canada on the Bureau is Dr. W. G. Miller, Provincial Geologist of Ontario.

I have the honour to be Sir,

Your obedient servant,

THOS. W. GIBSON,

Deputy Minister of Mines.

BUREAU OF MINES,

DEPARTMENT OF LANDS, FORESTS AND MINES,

Toronto, 1919.

STATISTICAL REVIEW

of the

MINERAL INDUSTRY OF ONTARIO FOR 1918

By Thos. W. Gibson, Deputy Minister of Mines

A new record was again set for the mineral industry of Ontario by the figures for 1918. In 1917 the total value of the output, metallic and non-metallic, was \$72,093,832, being the highest up to that time, and exceeding the production of 1916 in value by 10.3 per cent. For the year 1918 the production had a value of \$80,308,972, or 11.3 per cent. in excess of that for the previous year. Table I, printed on page 2, gives the statistics of production, including the number of employees in each branch of the industry and the wages paid them.

Examination of the tables given in this Report will show that the increase was wholly in the metallic class of minerals, and that in fact the production of non-metallic substances was less in value than that of 1917 by \$1,131,062, or 8 per cent. On the other hand, metals and metal-bearing products footed up \$9,316,202 more than in 1917, an increase of 16.4 per cent. This result was contributed to by higher prices in some cases, by larger production in others, and in some by both causes. Practically all the metals save gold and lead, of which latter the Ontario output is comparatively small, show an increase in value. The falling-off in gold is not great, considering the circumstances, being only \$196,255, or 2.3 per cent. In lead the decrease in value was \$22,760, or 15.1 per cent., and was due in part to a smaller output and in part to a lower price.

On the other hand, silver, notwithstanding a diminution in output of nearly one and three-quarters of a million ounces, or 9.8 per cent., shows a gain in value of \$1,232,674, or 7.6 per cent. Copper in ore shows an increase both in quantity and value: so also do copper in matte, nickel in matte, pig iron, metallic cobalt, cobalt oxide, metallic nickel and "other" nickel and cobalt compounds. Molybdenite concentrates decreased both in quantity and value.

Metallic nickel requires a word or two of comment. The increase of 3,225,070 pounds in production and \$1,170,193 in value was due almost entirely to the fact that about the middle of 1918 the newly completed nickel refinery of the International Nickel Company of Canada, Limited, at Port Colborne, came into operation. Although refined nickel had already been made in Ontario, from the cobalt-nickel-silver ores of Cobalt, it was merely as a by-product, and the quantity was small. But at the Port Colborne works is treated a considerable proportion of the nickel-copper matte into which the Sudbury ores are converted by the International Nickel Company at Copper Cliff. The matte contains about 54 per cent. of nickel and 25 per cent. of copper, the remainder being mostly sulphur and a little iron. The precious metals, gold, silver, platinum and palladium are also constituents of the matte in small quantities. Nickel is produced in shot and ingot form, and copper as blister, the latter being sent to New Jersey for refining.

TABLE 1.—MINERAL STATISTICS OF ONTARIO FOR 1918.

Product.	Quantity	Value	Employees	Wages		
METALLIC:						
		\$		\$		
Gold..... ounces	411,878	8,502,480	2,128	2,647,155		
Silver..... "	17,738,153	17,415,882	2,539	3,283,179		
Copper..... lbs.	1,211,922	270,430	}	}		
Copper in matte (a)..... tons	22,951	8,262,360			3,735	7,233,289
Nickel in matte (a)..... "	44,297	26,578,200				
Iron ore, exported (b)..... "	107,273	624,564	471	615,629		
Iron, pig (c)..... "	50,072	1,364,736	851	1,241,232		
Cobalt (metallic)..... lbs.	404,348	887,960	}	}		
Cobalt, oxide..... "	477,583	727,170			643	750,237
Nickel, oxide..... "	406	106				
Nickel (metallic)..... "	3,450,550	1,262,116				
Other Nickel and Cobalt com- pounds..... "	453,515	73,347				
Lead, pig..... "	1,670,251	149,841	37	41,238		
Molybdenite, (concentrates).... "	47,614	59,067	92	69,907		
Total Metallic.....		66,178,059	10,496	15,881,866		
NON-METALLIC:						
Actinolite..... tons	228	2,508	10	1,556		
Arsenic, crude and white..... lbs.	5,090,818	566,332	(d)	(d)		
Barite..... tons	60	900	17	12,700		
Brick, fancy and pressed..... M	25,377	396,698	}	}		
Brick, common..... "	49,498	665,454			1,027	667,715
Brick, sand-lime..... "	7,941	91,508			68	35,577
Cement, Portland..... bbls.	1,226,244	1,910,839	425	423,580		
Corundum..... tons	137	26,120	35	13,428		
Feldspar..... "	19,784	111,173	138	100,302		
Fluorspar..... "	7,286	153,190	129	85,783		
Graphite, crude and refined.... "	2,934	208,848	128	102,777		
Gypsum, crushed, ground and calcined..... "	38,214	151,564	71	65,574		
Iron pyrites..... "	270,966	1,144,737	621	707,020		
Lime..... bush.	2,650,285	872,177	287	300,746		
Mica..... tons	275	49,575	44	30,612		
Mineral Water..... Imp. gals.	298,498	133,808	45	20,769		
Natural Gas..... M. cu. ft.	13,075,742	2,498,769	872	756,225		
Petroleum, crude..... Imp. gals.	10,106,615	781,097	84	93,810		
Pottery..... "		88,275	22	22,061		
Quartz..... tons	213,420	452,711	207	187,635		
Salt..... "	131,726	1,287,039	302	275,842		
Sand and gravel..... cu. yds.	1,023,497	553,638	353	252,760		
Sewer pipe..... "		362,536	171	139,775		
Stone, building (trap, granite, etc.).....		869,239	631	478,070		
Talc, crude and ground..... tons	17,465	246,691	43	41,936		
Tile, drain..... M	13,087	309,899	(e)	(e)		
Tile, hollow building..... "		195,588	(e)	(e)		
Total non-metallic.....		14,130,913	5,730	4,816,253		
Add metallic.....		66,178,059	10,496	15,881,866		
Grand Total.....		80,308,972	16,226	20,698,119		

(a) Copper and Nickel in the matte valued at 18 and 30 cents per pound, respectively.

(b) Total shipments of iron ore, 198,882 tons. (c) Production from Ontario ore only. Total production of pig iron 751,650 tons, valued at \$20,522,356.

(d) Included in the figures for Cobalt. (e) Included in brick.

Turning to the non-metallic list, the following show decreased production but increased value: sand-lime brick, lime, gypsum, iron pyrites, salt, sand and gravel. The following show decreases in both: arsenic, brick fancy and pressed, ditto

common. Portland cement, corundum, graphite, mica, natural gas, tile, both drain and building; pottery, sewer pipe and stone were also lower in value. The list of increases in quantity and value is short, being composed of actinolite, feldspar, fluorspar, petroleum, quartz, talc; to these may be added barite and mineral water, both of which appear for the first time in the production table. It will be noted that there was a heavy falling-off in natural gas, and a somewhat notable increase in petroleum, thus reversing the conditions prevailing in late years. The causes are touched on below.

Table II, which follows, illustrates the growth of the mineral industry of the Province during the last five years. It will be seen that the output of metals and metalliferous products has all but doubled in value within that period, while the increase in the non-metallic list has been about 9 per cent. The striking development of the metallic side of the mining industry in Ontario during the last fifteen years is shown by the fact that while in 1903 it produced a value of \$5,242,575, its products in 1918 were worth \$66,178,059. Ontario is now in fact pre-eminently the metal-yielding Province of the Dominion. Central Canada, which includes Ontario, is without coal mines, while the Atlantic and Pacific coasts as well as the flanks of the Rocky Mountains are rich in them. Notwithstanding this, the mineral production of Ontario per annum is now much more than double that of any of the other provinces, and in 1918 comprised 44.76 per cent. of the entire production of Canada. Of her whole output 82 per cent. is metallic in character, and 18 per cent. non-metallic.

There has been growth in the latter branch as well as the former, but on a smaller scale. In 1903 the non-metallic output of Ontario was valued at \$1,628,018, while in 1918 it had grown to \$14,130,913.

In Table III is given the value of the metals and metallic products produced in Ontario since mining began down to the end of 1918. Silver heads the list, nickel, pig iron, gold and copper following in this order. Since 1914 the Bureau's statistics credit pig iron only with the proportion made from Ontario ore, and only the iron ore which is exported is included. In this way duplication of the figures is avoided, and pig iron smelted from foreign ores cannot rightly be set down as a product of Ontario's mining industry. If all the pig iron turned out by the blast furnaces of the Province, regardless of the origin of the ore, and all domestic iron ore raised, whether smelted here or exported, were reckoned in, the figures for pig iron would be \$122,016,716, and for iron ore \$10,194,228 respectively, instead of those shown in the Table.

TABLE II.—VALUE OF MINERAL PRODUCTION, 1914 TO 1918.

Product.	1914	1915	1916	1917	1918
METALLIC:	\$	\$	\$	\$	\$
Gold	5,529,767	8,501,391	10,339,259	8,698,735	8,502,480
Silver	12,795,214	12,174,312	12,705,591	16,183,208	17,415,882
Cobalt	546,479 (a)	379,657 (a)	762,327 (a)	1,122,779 (a)	1,615,130
Copper	2,081,332	3,926,018	8,365,255	7,961,662	8,532,790
Nickel	5,136,804 (b)	17,042,230 (b)	20,685,564 (b)	21,041,956 (b)	27,840,422 (b)
Other Nickel and Cobalt compounds	45,189	9,227	60,956	42,026	73,347
Iron ore (exported)	169,427	171,345	342,700	483,690	624,364
Pig iron	7,041,079 (c)	1,891,400 (c)	1,646,010 (c)	1,016,699 (c)	1,364,736 (c)
Lead (pig)			70,863	172,601	149,841
Molybdenite		14,099	26,393	108,501	59,067
Metallic production	33,345,291	44,109,679	55,002,918	56,831,857	66,178,059
NON-METALLIC:					
Actinolite				1,320	2,508
Arsenic	116,624	148,379	200,103	608,483	566,332
Asbestos			100	2,150	
Barite					900
Brick, common and sand-lime	2,336,207	763,591	509,559	800,983	756,962
Brick, paving, fancy.....	237,440	158,515	318,942	474,614	396,698
" pressed	656,944	217,350			
Calcium carbide	142,883	(d)	(d)	(d)	(d)
Cement, Portland	2,931,190	2,534,537	2,242,433	2,934,271	1,910,839
Corundum	65,730	31,398	8,763	31,213	26,120
Feldspar	55,686	47,031	42,159	81,802	111,173
Fluorspar			10,146	66,474	153,190
Graphite	87,167	115,274	249,586	296,587	208,848
Gypsum	221,175	190,422	116,206	130,138	151,564
Iron pyrites	264,722	353,498	471,807	1,111,264	1,144,737
Lime	333,407	244,953	265,356	657,364	872,177
Mica	40,402	33,490	55,407	92,453	49,575
Mineral Water.....					133,808
Natural gas	2,346,687	2,622,838	2,404,499	3,220,123	2,498,769
Peat fuel	2,100				
Petroleum (crude)	337,867	300,219	387,846	475,000	781,097
Phosphate of lime	3,150				
Pottery	25,720	49,387	87,025	94,501	88,275
Quartz	82,544	142,354	223,514	358,674	452,711
Salt	498,383	585,022	700,515	1,047,707	1,287,039
Sand and gravel	151,909	178,288	470,963	431,597	553,638
Sewer pipe	571,756	361,283	216,749	378,923	362,536
Stone, building, crushed, etc.	1,088,862	651,593	755,313	939,052	869,239
Tale, crude and ground	74,583	85,325	111,489	179,554	246,691
Tile, drain	277,530	321,253	275,471	546,040	309,899
" building			(e) 176,953	(e) 301,688 (e)	195,588
Non-metallic production	12,950,668	10,136,000	10,300,904	15,261,975	14,130,913
Add metallic production	33,345,291	44,109,679	55,002,918	56,831,857	66,178,059
Total production	46,295,959	54,245,679	65,303,822	72,093,832	80,308,972

(a) Cobalt oxide and metallic cobalt.

(b) Nickel in matte, oxide and metallic nickel.

(c) Product of Ontario ore only.

(d) Raw materials not produced in Ontario.

(e) Included in former years with fancy and paving brick.

TABLE III.—TOTAL PRODUCTION OF METALS IN ONTARIO.

Metal or Product	Total Production to 31st December, 1918	
	Value, \$	
Gold	50,864,863	
Silver	185,027,590	
Platinum and Palladium	1,300,000	
Cobalt, including Cobalt oxide.....	5,918,899	
Nickel, including Nickel oxide.....	138,010,542	
Other Cobalt and Nickel Compounds.....	230,745	
Copper.....	49,947,080	
Iron Ore	9,301,935	
Pig Iron	78,925,917	
Lead	510,595	
Zinc Ore	92,410	
Molybdenite.....	209,735	
Total.....	520,340,311	

Present Situation and Outlook

The close of the war by the signing of the armistice in November came suddenly. One effect was the immediate cessation of the demand for war materials. Of these the most important from Ontario were nickel and copper. During the period of war, especially the latter part, the Sudbury mines were worked to their maximum capacity, and all former records of production were surpassed. Large stocks of nickel had accumulated in the hands of the allied governments and their contractors for war munitions. The use of nickel having been strictly controlled for military purposes, its employment for ordinary industrial uses had been reduced to a minimum. The profound and far-reaching disturbance of the economic and manufacturing life of the world wrought by the war—to say nothing of the political and social results—was not to be remedied in a day. Though the fighting was over, peace had not been signed, and the period of waiting until terms were arranged was necessarily one of uncertainty, during which readjustments could go on but slowly. The unprecedented labour troubles which followed the war, and which yet continue, have prolonged these conditions, and it is beyond human power to predict what further throes society may have to endure, or what will be the ultimate form which the whole process of industrial production will assume. If capital is to be dethroned, or even obliged to divide its authority with labour, the re-alignment of forces will not be accomplished without difficulty, or without a season of slackening in the production of the commodities required by mankind.

By the beginning of 1919 it became clear that until the existing stocks of nickel could be absorbed or materially lessened by peace industries, there could be no object in adding to them. Consequently, the nickel mining companies allowed a number of their furnaces to go out of blast, materially reduced the hoisting of ore, and cut down their operations generally. The output for 1918 touched high water mark, the interval between the German capitulation and the end of the year not being long enough to greatly curtail production, but it may be expected that the figures for 1919 will afford a decided contrast.

Ontario "War Minerals"

Nickel and copper were not the only mineral contributions of Ontario to the allied victory. "War minerals" are of two kinds, those required for direct use in fighting, such as steel, lead, copper and nickel, and those necessary for manufacturing munitions, though not themselves actually forming part of the same. The second class includes coal and other fuels, also materials like iron pyrites and cobalt. Sulphur was required in enormous quantities for sulphuric acid necessary in making explosives, and there was a decided scarcity on this continent, due to the cutting down of shipments from Sicily, especially after the United States entered the war. The sulphur deposits of Louisiana and Texas were freely drawn upon, and Ontario owners of pyrite deposits were asked for help in making good the deficiency. The pyrite resources of this Province are very extensive, eastern, northern and north-western Ontario containing many bodies, some of them of large size. In 1917 286,049 tons, and in 1918, 270,966 tons of iron pyrites were raised, some of which was utilized in making sulphuric acid in Ontario, but most of which was exported to the United States for the same purpose. The greatest previous production was 175,593 tons, in 1916.

Cobalt had also its war uses. The chief form in which cobalt was used until recently was the oxide, particularly in the ceramic manufacture of Europe, where it imparted the beautiful and characteristic tint known as cobalt blue. The large output of cobalt necessitated by the opening of the silver mines of Cobalt demanded new uses, and it was found that as an alloy with chromium and tungsten, called "stellite," cobalt formed a very serviceable material for tools required in cutting and machining steel. Practically all the cobalt utilized for this purpose was produced in Ontario, and an important market was supplied by the steel and munition factories of the United States and Canada. In 1917 the shipments of cobalt in the forms of oxide and metal and as stellite, from the silver refineries of the Province amounted in value to \$1,122,779 and in 1918 to \$1,615,130.

Another mineral called for by the exigencies of war was molybdenite, of which there are numerous occurrences¹ in Ontario. It is used as an ingredient of special tool steel, and before the war was supplied to the British steel-makers in the form of ferro-molybdenum by Germany. When this source was cut off the British authorities sent an urgent appeal to Canada, among other British countries, for molybdenite concentrates, and fixed a price per pound. Ontario responded by increasing her output of this mineral, which in 1916 amounted to 24,562 pounds, to 77,517 pounds in 1917, and 47,611 pounds in 1918. Most of this was exported to Great Britain either as concentrates or as ferro-molybdenum, the manufacture of which was undertaken at Orillia. Part of the exports went to France. It is said that the lining of the famous 75-millimetre guns so effectively used by the French in the war was of molybdenite steel.

Still another substance whose production was much stimulated by the demand arising out of war requirements was fluorspar. It has long been known that deposits of fluorspar or fluorite existed in the county of Hastings, near Madoc, but there was little production. The use of fluorspar in making steel increases the

¹ See Molybdenite Deposits of Ontario, by A. L. Parsons, Bur. Min. Rep., Vol. XXVI, 1917.

fluidity of the charge, and facilitates pouring of the furnace. The price rapidly rose and a number of the veins at Madoc were opened and worked. In 1916, the output was 1,283 tons, and in 1917, 4,327 tons. In 1918 it rose to 7,286 tons.

The mining of talc increased by reason of the war, the supplies of foreign material to the United States being cut off by the lack of shipping. Talc is used mainly as a filler in the manufacture of paper, also in rubber goods and as a cosmetic. In 1916 the production from Ontario deposits was 11,810 tons, in 1917 16,976 tons, and in 1918 17,465 tons.

On the other hand, the partial paralysis which attacked the building trade by reason of the war very greatly restricted the output of construction materials. Thus, bricks fell in number from 367,973 thousand in 1914 to 113,526 thousand in 1917, and to 80,816 thousand in 1918; Portland cement from 2,665,650 barrels in 1914 to 2,063,231 barrels in 1917 and 1,226,244 barrels in 1918; stone, for building and other purposes, from \$1,088,862 worth in 1914, to \$939,052 in 1917 and \$869,239 in 1918. The extent to which building fell off is illustrated by the fact that while in Toronto in the year 1913 permits were given for the construction of buildings amounting in value to \$27,038,000, the corresponding figures for 1916, 1917 and 1918 were only \$9,882,000, \$7,163,000 and \$8,535,000 respectively. The present high prices of building material of all kinds, and the prevailing idea that such prices will inevitably fall in the near future, are retarding the construction of buildings. In consequence, there is a lack of dwelling houses, especially those of moderate price, in all centres of population. This lack is all the more severely felt because of the return from overseas of our citizen army, nearly one-half of whom were recruited in Ontario. Rents have gone up greatly, and the difficulties of the situation are such that the Government has been impelled to come to the aid of the people by providing funds at a low rate of interest to assist in solving the housing problem.

Reference was made in last year's Report¹ to the large number of Ontario prospectors then fighting in Europe, and the inevitable effect the continued want of prospecting would have upon the welfare, and even the existence, of the mining industry. Many hardy prospectors from the north have succumbed to the hazards of war, and others have returned with constitutions so weakened as to unfit them for their calling. But many others are again at home, ready to begin anew the search for mineral riches. With the view of affording them practical assistance in their work, the Bureau had an examination made last year of the comparatively unexplored yet fairly accessible region south and southwest of Lake Abitibi, where gold discoveries have already been made. The results of this examination, along with a geological map of the territory have already been published as Part II of this Report under the title Abitibi-Night Hawk Gold Area. The authors are C. W. Knight, A. G. Burrows, P. E. Hopkins, Assistant Provincial Geologists, and Prof. A. L. Parsons of the University of Toronto. Included in the volume are some notes on Larder Lake gold area, by Mr. Hopkins.

As for the prospects of mining in Ontario, it is never safe to prophesy. Up to the present time, the only key to the future has been the past. If experience is

¹ Rep. Bur. Min., Vol. XXVII, 1918, Part I, p. 5.

henceforth to be discarded as a guide, and the conduct of mankind to be regulated by new principles, old standards are rendered useless, and we have no basis for prognostication. But under any conceivable order of society, minerals will be indispensable. Hence they must be sought for, extracted and made fit for use. Nickel will be needed to make bridges strong, locomotives light while powerful, for electroplating, and a hundred other uses, even if battleships requiring armour for their sides cease to be built. Copper, probably next to iron the most useful metal, will still be required for a thousand purposes, and we can look with confidence for a resumption of activity in the nickel-copper mines of Sudbury. Silver will continue to please the eye with its lustre, and will probably remain the currency of the hundreds of millions in India and China and other parts of Asia. There are special difficulties in the case of gold, and unless prices of labour and commodities fall, low grade deposits in which there is now no margin of profit will cease to be worked. But in the whole list of minerals produced in Ontario, long and varied as it is, there is not one which does not subserve some interest of mankind, and which therefore can pass out of use without loss. Man being as he is, the mining industry will go on; what changes time may see in the conditions of its existence or the distribution of the fruits of its production, it would be useless to conjecture.

Gold

In 1918 the output of gold was 411,878 ounces, or a little over 2 per cent. less than in 1917. In view of the severity with which the greatly increased cost of production bears on gold mining, it is matter for surprise that the falling-off was so slight. It is a tribute to the fundamentally strong position of the northern Ontario gold mines that they were able to maintain their production at so high a level, in spite of the fact that in the nature of things it was impossible for them to pass on to the users of gold any part of the enhanced cost of producing it. The increased cost was due not only to the higher prices of all kinds of supplies, but to the scarcity, greater cost and especially the inefficiency of labour. A large proportion of the best workmen, both underground and surface, had sprung to arms in the early stages of the war, and those who remained were in the main of inferior skill and calibre. So marked was this feature, that the manager of one of the largest gold mining companies, after making a careful computation based on the quantity of work passing a given point in the mine, estimated that as compared with pre-war times, his workmen were only 60 per cent. efficient.

Table IV which follows gives the record of the producing gold mines in 1918. It should perhaps be pointed out that as regards the smaller mines where little production is shown, it would be unfair to regard the yield as an indication of the capabilities of the mine, since in nearly all cases only odd lots of ore and material taken out during development work were treated.

TABLE IV.—GOLD PRODUCTION IN 1918.

Mine	Tons ore milled	Gold Product		Silver Product		Total Value	Extraction per ton
		Fine ounces	Value	Fine ounces	Value		
Poreupine—			\$ c.		\$ c.	\$ c.	\$ c.
Davidson.....	2,537	752.04	15,544 62	35.38	34 24	15,578 86	6 22
Dome Lake.....	11,929	4,894.00	100,799 06	495.00	484 25	101,283 31	8 41
Dome.....	*	3,948.24	81,617 68	576.25	508 96	82,126 64	.....
Hollinger.....	578,755	276,044.73	5,706,214 35	47,850.69	46,156 52	5,752,370 87	9 90
McIntyre Poreupine	176,976	75,555.62	1,561,734 70	16,960.90	16,708 97	1,578,443 67	8 92
Newray.....	401	72.93	1,507 64	8.66	8 59	1,516 23	3 78
Poreupine Crown.	10,907	5,978.91	123,563 42	941.28	910 90	124,474 32	11 41
Poreupine V.N.T.	15,134	3,976.94	82,203 27	687.09	664 91	82,868 18	5 48
Schumacher.....	19,098	4,463.40	92,260 07	660.50	581 88	92,841 95	4 86
West Dome.....	300	119.10	2,461 90	.....	.....	2,461 90	8 20
Total Poreupine ..	816,037	375,805.91	7,767,906 71	68,215.75	66,059 22	7,833,965 93	9 50
Kirkland Lake—							
Lake Shore.....	16,749	20,031.01	415,229 75	1,188.62	1,184 06	416,413 81	24 86
Teck-Hughes.....	14,774	3,869.29	79,949 48	669.52	620 73	80,570 21	5 45
Tough-Oakes.....	22,000	6,619.52	136,827 63	3,006.68	2,855 67	139,683 30	6 35
Total Kirkland Lake.....	53,523	30,519.82	632,006 86	4,864.82	4,660 46	636,667 32	11 81
Miscellaneous—							
Bourkes.....	3	54.53	1,090 60	22.08	22 08	1,112 68	.....
Cresus.....	692	3,123.90	64,555 00	254.18	224 77	64,779 77	93 61
Hill.....	25	30.23	635 00	.....	.....	635 00	.....
Miller Ind.....	.....	58.49	1,209 13	70.00	73 90	1,283 03	.....
Patricia.....	1,502	486.23	10,051 20	62.97	62 64	10,113 84	6 73
Pt. Colborne Ni-Cu Refinery.....	.....	57.60	1,152 00	.....	.....	1,152 00	.....
Redeemer.....	200	8.22	170 00	.....	.....	170 00	.....
Rognon.....	8	2.21	45 77	.52	51	46 28	.....
St. Anthony.....	3,603	1,460.39	18,076 61	263.04	263 04	18,339 65	5 09
U. S. Refineries treating Cobalt ore.....	.....	270.00	5,581 00	.....	.....	5,581 00	.....
Total Miscellaneous	6,033	5,551.80	102,566 31	672.79	646 94	103,213 25	.....
Total.....	875,593	411,878.00	8,502,480 00	73,753.36	71,366 62	8,573,846 62	.....

*Clean up of mill.

Hollinger Consolidated and McIntyre Poreupine, in the Poreupine camp, were the only mills in operation for the whole of the year. The Dome crushed no ore in 1918, but carried on development work. Schumacher shut down in May. Poreupine Crown in June. Poreupine V. N. T., Dome Lake and West Dome ran for only part of the time. At Kirkland Lake, Teck-Hughes stopped work from the middle of July to the end of October, and at the Tough-Oakes no milling was done after August. On the other hand, Lake Shore began grinding ore in March, and continued at work until the close of the year. The extraction at this mine for the entire run was at the rate of \$24.86 per ton.

The mines at Poreupine produced over 91 per cent. of the gold yield, those of Kirkland Lake over 7 per cent., and those in other parts of the Province over 1 per cent.

Other properties in the Porcupine area which were in operation included the Davidson in Tisdale township, owned by Davidson Gold Mines, Limited. No milling or hoisting of ore was done during the last three months of the year. Earlier 2,537 tons of ore were put through the mill, yielding 828 ounces of gold and 35 ounces of silver. A considerable amount of development work was accomplished. At the Newray, the McIntyre Porcupine Company did a small amount of work under option from the Newray Mines, Limited. Ore was raised and treated to the extent of 401 tons, which yielded about 13 ounces of gold and 8.66 ounces of silver. The Coniagas Mine, Limited, had the Maidens-McDonald and Ankerite properties under exploitation, and did a large amount of work upon them, but treated no ore.

Kirkland Lake is establishing itself as the most productive camp next to Porcupine, and the outlook for the industry there is good. At the end of the year there were five mines equipped with mills, and a sixth mill was in course of construction. Besides the properties already mentioned, the following were under active development during the year: Kirkland Lake Gold Mining Company, Limited, Burnside Gold Mines, Limited, Elliott-Kirkland Gold Mines, Limited, Kirkland-Porphry Gold Mines, Limited, Wright-Hargreaves Mines, Limited, Ontario-Kirkland Gold Mines, Limited.

Gold Camps being Developed

The Bourkes Mines, Limited, at Bourke's siding on the T. & N. O. railway, did some 625 feet of underground work and shipped some tons of high grade ore.

At Boston Creek, the Miller Independence Mines, Limited, continued to open up their mine, in which the occurrence of tellurides is a feature, and marketed bullion containing gold and silver to the value of \$1,209,13. The Patricia Syndicate carried on development operations, and also produced some 186 ounces of gold and 63 ounces of silver.

In the township of Munro the Croesus Gold Mines, Limited, ceased operations in April, after having milled 692 tons of ore and extracted therefrom 3,124 ounces of gold and 254 ounces of silver. They also shipped 13 tons of concentrate, estimated to contain 26 ounces of gold. A little farther to the east in the township of Beatty the Hill Gold Mining Company, Limited, carried on prospecting operations for six months of the year, and have a 18-ton Hardinge ball mill on the property. They milled 25 tons of ore and recovered 30 ounces of gold.

Fort Matachewan and Larder Lake are also being tested, the former by the Colorado-Ontario Development Company, Limited, and the latter by the Associated Goldfields of Ontario, Limited.

Gold having been found in 1917 near Lightning river, in the township of Holloway, the Bureau deemed it advisable to examine and map, so far as this could be done in one season, the area south and west of Lake Abitibi. Accordingly Messrs. C. W. Knight, A. G. Burrows, P. E. Hopkins and A. L. Parsons were placed in the field last year, and the result of their observations is contained in Part II of this Report and the geological map which accompanies it.

The area served by the Timiskaming and Northern Ontario railway and lying both to the west and east of the line, in the latter direction practically as far as the

Quebec boundary line, has already been shown to contain gold in many and widely scattered localities, and offers an excellent field for prospectors.

Gold was found at West Shining Tree lake in 1911, and more or less development work has been going on ever since. The Wasapika Gold Mines, Limited, are now exploring their property, and endeavouring to raise sufficient capital to carry on more extensive operations in 1919. Recently some rich gold ore was taken out of the Holding claims, Nos. T.R.S. 508 and 318, and interest in the area has been revived. Distance from railway facilities has had a tendency to retard operations in this camp, and it is hoped that this difficulty may be removed in the near future.

In the northwest part of the Province, not a great deal of work was done last year. On Contact bay, Lake Wabigoon, the workings of the Redeemer mine were unwatered and about 200 tons of ore were run through the mill as a test. In the same locality, the Rognon Gold Mines, Limited, did work of a similar kind, raising and milling about 40 tons from various parts of the mine and recovering some gold.

On Sturgeon lake, the Thunder Mining Company, Limited, operated the St. Anthony mill until August. Some 3,603 tons of ore were treated and 1,160 ounces of gold obtained, together with 263 ounces of silver.

In Eastern Ontario, a little work was done by the Ore Chimney Mining Company, Limited, at the mines of that name in the township of Barrie. No ore was raised or milled, the labour performed being in connection with the construction of an electric plant, etc. The Cobalt-Frontenac Mining Company, Limited, carried on some development work in the Golden Fleece mine, near Flinton, but treated no ore.

The list of producing gold mines is as follows:—

PRODUCING GOLD MINES, 1918.

Name of Company.	Name of Mine.	Locality.	P.O. Address of Manager, etc.
Bourkes Mines, Limited	Bourkes Mines	Benoit tp.	Bourkes.
Contact Bay Mines, Limited	Redeemer	Wabigoon Lake.	Dryden.
Croesus Gold Mines, Limited	Croesus	Munro tp.	Matheson.
Davidson Gold Mines, Limited	Davidson	Poreupine	South Poreupine.
Dome Lake Mining and Milling Company, Limited	Dome Lake	Poreupine	South Poreupine.
Dome Mines Company, Limited	Dome	Poreupine	South Poreupine.
Hill Gold Mining Company, Limited	Hill	Beatty tp.	Matheson.
Hollinger Consolidated Gold Mines, Limited	Hollinger	Poreupine	Timmins.
Lake Shore Mines, Limited	Lake Shore	Kirkland Lake.	Kirkland Lake.
McIntyre-Poreupine Mines, Limited	McIntyre	Poreupine	Schumacher.
Miller Independence Mines, Limited	Miller Independence	Boston Creek	Boston Creek.
Newray Mines, Limited	Newray	Poreupine	Timmins.
Patricia Syndicate	Patricia	Boston Creek	Boston Creek.
Poreupine Crown Mines, Limited	Poreupine Crown	Poreupine	Timmins.
Poreupine V. N. T. Gold Mines, Limited	Poreupine V. N. T.	Poreupine	Timmins.
Rognon Gold Mines, Limited	Rognon	Wabigoon Lake.	Dryden.
Schumacher Gold Mines, Limited	Schumacher	Poreupine	Schumacher.
Teek-Hughes Gold Mines, Limited	Teek-Hughes	Kirkland Lake.	Kirkland Lake.
Thunder Mining Company, Limited	St. Anthony	Sturgeon Lake.	St. Anthony Mine.
Tough-Oakes Gold Mines, Limited	Tough-Oakes	Kirkland Lake.	Kirkland Lake.
West Dome Consolidated	West Dome	Poreupine	South Poreupine.

The years of the war have borne heavily upon the gold mining industry. It is not surprising that the producers of gold, which remains the basis of our financial system, should protest against the conditions which discriminated against them. They could not evade any part of the increased cost of production, nor pass it on to the consumer. Gold miners felt that if their product was essential to carrying on the affairs of the public, the public should in some way come to their relief. Hence the gold mining companies of Great Britain and the United States appealed to their respective governments to pay them a bonus on all new gold produced. These governments appointed committees to study the question, but in the end the request was refused. The ground of the refusal was not that the gold miners had no reason for complaint, but that it seemed certain the gold mines for the most part would remain in operation without a bonus.

The world's production of gold in 1918 is estimated at between 370 and 380 million dollars' worth, being a reduction as compared with 1917 of 45 or 50 million dollars, and the tendency at present seems to be toward a still further lessening of the product.

Dividends

Up to the end of 1918, there had been paid out as dividends and bonuses by the gold mining companies of Ontario the sum of \$13,359,209.90, of which the amount paid out last year was \$1,873,042.45.

A list of the dividend-paying mines, and the amounts paid, will be found on the opposite page.

Silver

The production of silver in 1918 amounted to 17,738,153 fine ounces, valued at \$17,115,882. In quantity there was a decrease compared with 1917 of 1,741,539 ounces, or 9.7 per cent.; but in value there was an increase, owing to the higher price, of \$1,232,674, or 7.6 per cent. The average per fine ounce realized by the mining companies in 1918 was \$0.9818 per ounce, as compared with \$0.8307 in 1917, and \$0.6349 in 1916.

Financing the business of the world by ordinary peace-time methods became wholly impossible during the war, and the measures resorted to in international exchange governed the course of silver prices after the early months of 1918. The necessity of providing bullion to settle trade balances with India led to negotiations between the government of Great Britain and that of the United States, and the latter agreed to release as much of its stock of silver, amounting to \$350,000,000,¹ held in Washington against silver certificates, as was required to meet these balances. The Act of Congress authorizing this was passed April 23rd. The silver, which was in the form of one-dollar coins, was sold to the British authorities at \$1 per ounce and converted into bullion. Up to the end of 1918 about 160,000,000 coins had been so disposed of. By the terms of the Act the Director of the U. S. Mint was required to replace the silver by purchases at the rate of \$1 per ounce whenever convenient to do so. In August the maximum price was increased to \$1.015 per ounce. This action of the U. S. government saved the

¹The silver equivalent is about 271,000,000 fine ounces.

TABLE V.—DIVIDENDS AND BONUSES PAID BY GOLD MINING COMPANIES TO DECEMBER 31, 1918.

Name of Company.	Date of Incorporation.	Authorized Capital.	Capital Stock Issued.	Par value per share.	Amount of Dividends and Bonuses paid to end of 1917	Amount of Dividends and Bonuses paid during 1918.	Rate per cent.	Total of Dividends and Bonuses paid to Dec. 31st, 1918.	Date when last Dividend or Bonus paid.
		\$	\$	\$ c.	\$	\$	c.	\$	
Dome Mines Company, Ltd.	Mar. 23, 1910	5,000,000	4,000,000	10 00	1,500,000 00	.....	.....	1,500,000 00	May 7, 1917
Hollinger Consolidated Gold Mines Ltd ¹ ...	May 20, 1916	25,000,000	24,600,000	5 00	8,194,000 00	1,230,000 00	5	9,424,000 00	Dec. 31, 1918
Lake Shore Gold Mines, Ltd.	Feb. 25, 1914	2,000,000	2,000,000	1 00	.....	100,000 00	2½	100,000 00	Dec. 10, 1918
McIntyre-Poreupine Mines, Ltd.	Mar. 16, 1911	4,000,000	3,640,283	1 00	541,542 45	543,042 45	15	1,084,584 90	Nov. 30, 1918
Poreupine Crown Mines, Ltd.	May 26, 1913	2,000,000	2,000,000	1 00	840,000 00	.....	.....	840,000 00	July 15, 1917
Rea Consolidated Gold Mines	April 5, 1911	1,000,000	200,000	5 00	12,000 00	.....	.....	12,000 00	.....
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
Total					11,486,167 45	1,873,042 45		13,359,209 90	

¹ Hollinger Consolidated Gold Mines, Limited, is a consolidation of the Acme Gold Mines, Limited, Millerton Gold Mines, Limited, and Hollinger Gold Mines, Limited. Dividends include \$160,000 paid by Acme prior to amalgamation with Hollinger.

situation as between Britain and India, and prevented the serious complications which might otherwise have arisen by reason of the impossibility of exporting British manufactures to India in sufficient quantity while the war continued.

It is a striking fact that India exercises, in peace as well as in war, a powerful influence on the price of silver. Producing but little of this metal itself, the immense population of that country has during generations developed the habit of hoarding its savings in the form of silver ornaments and jewellery, and latterly of coined rupees. Gold, in the years preceding the war, was hoarded as well as silver; but under present conditions, gold for this or any other purpose will be difficult to obtain in India. When crops are good, India imports large quantities of silver, and the bars into which it is cast in the refineries of America and Europe are of the size, shape and weight demanded by the Indian bazaars. Comparatively little silver is exported from India, except when famine presses, as not infrequently happens. In addition to the supplies provided by the U. S. Congress, the Indian government made very large purchases of silver in London.

It seems likely that the political results of the war will lead to even an extended use of silver for currency purposes in those parts of the East which have been rescued from Turkish control. In Mesopotamia, Syria and Palestine as well as Egypt the rupee circulates freely, and it may be expected that under the improved conditions which will follow their emancipation the people of these lands will enjoy a degree of prosperity unknown before, and so will have a greater need for the medium of exchange.

The monsoon season of 1918 in India was an unfavourable one, and partial failure of crops followed. Exports of corn and wheat were prohibited, and at the close of the year the silver reserves in India, including shipments in transit, rose to 3,347 lacs (or 33,470,000) rupees as compared with 1,905 lacs (or 19,050,000) rupees at the beginning of the year. The total purchases of silver for coinage at the Indian mints during the financial year 1917-18 amounted to about 77,500,000 fine ounces.

In the early part of the year, the governments of the United States and Great Britain purchased considerable silver for coinage purposes, the latter to the extent of seven million pounds sterling, but in August the U. S. and Canadian governments prohibited all exports of silver except under license, so that no new silver was available for minting in Britain during the remainder of the year.

On 5th May, 1919, the U. S. Federal Reserve Board removed all restrictions on the export of silver, and this action was followed by a considerable increase in the price. The general expectation is that for some time to come silver will remain at a higher level than it has reached for many years.

The Ontario Output

The world's production of silver in 1918 is variously estimated at 160 million to 180 million fine ounces, of which the United States produced 67,740,000 ounces, Mexico about 40,000,000 ounces, and Canada 20,600,000 ounces.

Classified according to source, the Ontario output of 1918 was derived as follows:—

	Ounces.
Cobalt	16,807,407
Casey township	143,901
Gowganda	638,198
South Lorrain	72,188
Recovered from gold ores	73,755
Recovered from nickel-copper matte	2,704
Total.....	17,738,153

The largest shippers and those sending out over one million ounces were:—

	Ounces.
Nipissing	5,785,739
Kerr Lake	2,221,811
Mining Corporation of Canada	1,994,061
O'Brien	1,074,312
Coniagas	1,006,103

Mines shipping more than a quarter million but less than a million ounces were:—

	Ounces.
McKinley-Darragh-Savage	885,530
Buffalo.....	870,247
Miller-Lake O'Brien	631,671
Temiskaming.....	517,673
Beaver Consolidated	411,606
Crown Reserve	301,507
Trethewey	291,269
La Rose Consolidated	276,130

The producing mines were as given in the following list:—

PRODUCING SILVER MINES IN 1918.

Company or Owner.	Mine.	P.O. Address of Manager, etc.
Adanae Silver Mines, Limited.....	Adanae	Haileybury.
Aladdin Cobalt Company, Limited.....	Chambers-Ferland	Cobalt.
Angus, D. H.	Nipissing Reduction Mill clean-up	Cobalt.
Associated Goldfields of Western Australia, Ltd.	Keeley	Almonte.
Beaver Consolidated Mines, Limited	Beaver	Cobalt.
Buffalo Mines, Limited, The	Buffalo	Cobalt.
Casey Cobalt Silver Mining Company, Limited.	Casey-Cobalt	New Liskeard.
Cobalt Comet Mines, Limited	Drummond	Giroux Lake.
Cobalt Provincial Mining Co., Limited	Provincial	Cobalt.
Cobalt Silver Queen, Ltd.	Silver Queen	Cobalt.
Coniagas Mines, Limited	Coniagas	Cobalt.
Crews-McFarlan Mining Co.	Crews-McFarlan	Gowganda.
Crown Reserve Mining Company, Limited.....	Crown Reserve	Cobalt.
Dominion Reduction Co., Ltd.	Dominion	Cobalt.
Edwards & Wright, Ltd.	Green Meehan	North Cobalt.
Foster Lease (C. L. Campbell <i>et al</i>).....	Foster	Giroux Lake.
Hargrave Silver Mines, Limited	Hargrave	Cobalt.
Hudson Bay Mines, Limited	Hudson Bay	Cobalt.
Kerr Lake Mining Company, Limited	Kerr Lake	Cobalt.
La Rose Mines, Limited	La Rose	Cobalt.
Lumsden Mining Co., Ltd.	Lumsden	Cobalt.
McKinley-Darragh-Savage Mines of Cobalt, Limited	McKinley-Darragh- Savage	Cobalt.

PRODUCING SILVER MINES IN 1918.—Continued.

Company or Owner.	Mine.	P.O. Address or Manager, etc.
Mining Corporation of Canada, Limited, The..	Cobalt Lake, Townsite-	
	City	Cobalt.
National Mines, Limited	National	Cobalt.
Nipissing Mining Company, Limited	Nipissing	Cobalt.
O'Brien, M. J., Limited	O'Brien	Cobalt.
do	Miller-Lake O'Brien	Gowganda.
Penn-Canadian Mines, Limited.....	Penn-Canadian	Cobalt.
Peterson Lake Silver Cobalt Mining Co., Ltd....	Peterson Lake	Cobalt.
Pittsburg Lorrain Syndicate	H.R. 105, or Currie	Silver Centre.
Reliance Leasing Company	Reliance	Cobalt.
Right of Way Mines, Ltd.	Right of Way	Cobalt.
Silver Eagle Mining Co., Ltd.	Miller-Lake O'Brien	Silver Centre.
Temiskaming Mining Company, Limited	Temiskaming	Cobalt.
Trethewey Silver-Cobalt Mine, Limited	Trethewey	Cobalt.
Waldman Silver Mines, Ltd.	Waldman	Cobalt.

In Table VI is given the shipments of ore, concentrates and bullion from the mines of Cobalt since mining began in 1904. By "shipment" is meant consignment to outside points whether in Canada or the United States, but not movements within the camp itself, as for example, ore hauled or shipped by rail from a mine to a concentrating or sampling plant in Cobalt.

TABLE VI.—SILVER PRODUCTION, COBALT MINES, 1904 TO 1918.

Year.	No. of Producing Mines.	Shipments and Silver Contents.								
		Ore.			Concentrates and Residues.			Bullion.	Total.	
		Tons.	Oz.	Av. per ton. Oz.	Tons.	Oz.	Av. per ton. Oz.	Oz.	Ounces.	Value. \$
1904....	4	158	206,875	1,309	.....	.....	.....	.....	206,875	111,887
1905....	16	2,144	2,451,356	1,143	.....	.....	.....	.....	2,451,356	1,360,503
1906....	17	5,335	5,401,766	1,013	.....	.....	.....	.....	5,401,766	3,667,551
1907....	28	14,788	10,023,311	677	.....	.....	.....	.....	10,023,311	6,155,391
1908....	30	24,487	18,022,480	736	1,137	1,415,395	1,241	.....	19,437,875	9,133,378
1909....	31	27,729	22,426,355	809	2,948	3,461,470	1,174	.....	25,897,825	12,461,576
1910....	41	27,437	22,581,714	821	6,945	7,082,834	1,030	980,633	30,645,181	15,478,947
1911....	34	17,278	20,318,626	1,176	9,375	8,056,189	858	3,132,976	31,507,791	15,953,847
1912....	30	10,719	15,395,504	1,436	11,214	9,768,228	871	5,080,127	30,243,859	17,408,935
1913....	35	9,861	13,668,079	1,386	11,016	8,489,321	770	7,524,575	29,681,975	16,553,981
1914....	32	4,302	6,504,753	1,511	12,152	8,915,958	733	9,742,130	25,162,841	12,765,461
1915....	24	2,865	6,758,286	2,359	11,996	10,001,548	834	7,986,700	24,746,534	12,135,816
1916....	28	2,177	4,672,500	2,146	8,561	7,593,011	887	7,644,579	19,915,090	12,643,175
1917....	28	2,288	3,271,353	1,429	13,720	6,445,243	469	8,053,318	19,401,893	16,121,013
1918....	28	1,456	1,401,050	962	17,958	5,793,756	323	10,466,888	17,661,694	17,341,790
Total		153,924	153,114,008	1,000	106,922	77,027,953	720	60,611,926	392,385,866	169,292,351

Table VII shows the quantity and value of all the constituents of the ores mined at Cobalt from the time the mines were opened. Previous to 1914 an estimate was made of the nickel, cobalt and arsenic contents, exact figures not being obtainable, as few or no assays were made for these substances because of the mining companies not being paid for them. Since that time only the actual recoveries of these subsidiary elements are included.

TABLE VII.—TOTAL PRODUCTION, COBALT SILVER MINES, 1904 TO 1918.

Year.	Copper.		Nickel.		Cobalt.		Arsenic.		Silver.		Total Value.
	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.	Ounces.	Value.	
		\$		\$		\$		\$		\$	
1904..			14	3,167	16	19,960	72	903	206,875	111,887	136,217
1905..			75	10,000	118	100,090	519	2,693	2,451,356	1,360,503	1,473,196
1906..			169	.....	321	80,704	1,410	15,858	5,401,766	3,667,551	3,761,113
1907..			370	1,174	739	104,426	2,958	10,104	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	9,281,869
1909..			766	.....	1,533	91,965	4,294	61,039	25,897,825	12,461,576	12,617,580
1910..			501	.....	1,098	51,699	4,897	70,709	30,645,181	15,478,947	15,603,455
1911..			392	.....	852	170,890	3,806	74,609	31,507,791	15,953,847	16,199,316
1912..			429	11,220	931	311,381	1,166	80,546	30,213,859	17,408,935	17,818,082
1913..			377	13,326	821	420,366	3,663	64,146	29,681,975	16,553,981	17,051,839
1914..			(b) 90	28,978	(b) 351	590,466	2,030	116,624	25,162,811	12,765,461	13,501,469
1915..			(c) 35	28,353	(d) 296	383,261	2,490	118,379	21,746,534	12,135,816	12,695,809
1916..			(c) 79	59,380	(d) 400	805,014	2,160	200,103	19,915,090	12,643,175	13,707,672
1917..	(a) 53	28,840	(c) 155	125,071	(d) 327	1,138,190	2,592	608,483	19,401,893	16,121,013	18,028,595
1918..	(a) 72	35,712	186	158,893	380	1,640,319	2,545	560,332	17,661,694	17,341,790	19,741,037
Total.	125	64,552	4,244	440,862	9,320	6,028,710	41,331	2,090,901	292,385,866	169,292,351	177,917,37

(a) Copper is recovered from certain silver ores and concentrates shipped to United States refineries.
 (b) Metallic contents of Nickel and Cobalt oxides respectively.
 (c) Metals and metallic contents of all Nickel compounds.
 (d) Metals and metallic contents of all Cobalt compounds.

Treating and Refining the Ore

Facilities for refining the ore at Cobalt have been much increased, and most of the silver now leaves the camp as bullion, produced either at the mines themselves or at local reduction works. The reducing plants at Cobalt are those of the Cobalt Reduction Company, Limited, which operates as well a mill for concentrating low grade ore, and the Dominion Reduction Company, Limited. Northern Customs Concentrators, Limited, treats ores for the mines or purchased from them, but does not produce bullion. Campbell and Deyell, Limited, have operated for a number of years a sampling plant which serves a useful purpose in the sale of ores, especially those raised by the smaller operators.

The operations of these plants for 1918 is shown in the following table:—

CUSTOM ORE SAMPLING, CONCENTRATION AND REDUCTION WORKS, 1918.

Company	Ore Sampled	Ore Treated	Concentrates produced	Silver Bullion produced	Employees	Wages
	tons	tons	tons	ounces		\$
Campbell and Deyell, Ltd	2,253	.....	.....	98,317	11	14,786
Cobalt Reduction Company	.....	456	.....	1,091,570	75	256,314
Dominion Reduction Company	.....	58,836	3,468	238,802	79	120,604
Northern Customs Concentrators, Ltd	.....	55,823	1,509	.....	38	50,477
Total	2,253	115,115	4,977	1,428,689	203	442,181

In the southern part of Ontario there are four reduction works for the treatment of silver ore and concentrates from Cobalt. These are as set out in the following list, the fourth company in which treated only a small quantity of ore. The Deloro company handles mainly the product of the O'Brien and Miller-Lake O'Brien mines, the property of M. J. O'Brien, Limited, which also controls the refinery, while the Comiagas Reduction Company, Limited, refines for the most

part the ores and concentrates shipped from the Coniagas mine. Metals Chemical, Limited, ran last year mainly on residues from the Nipissing Mining Company's high grade ore refinery at Cobalt. This company aims primarily at the production of the compounds of cobalt and nickel and not at the recovery of silver. These refining companies may be listed as follows:—

REFINERS OF SILVER-COBALT ORES, 1918.

Name of Company.	Location of Works.	P.O. Address.
Deloro Smelting and Refining Co., Limited....	Deloro.....	Deloro.
Coniagas Reduction Co., Limited	Thorold.....	St. Catharines.
Metals Chemical, Limited	Welland.....	Welland.
Standard Smelting and Refining Co., Ltd.....	Chippawa.....	Niagara Falls.

The operations of the refining companies during 1918 are summarized in the figures given below. Apart from the silver recovered, the by-products of the Cobalt ores had a value of \$2,363,535.

OPERATION OF ONTARIO SILVER-COBALT REFINERIES, 1918.

Product	Quantity	Value
		\$
Ore, treated.....tons	1,327	.....
Concentrates, treated	4,288	.....
Residue, treated....."	2,751	.....
Silver recovered.....fine ounces	5,014,469	4,874,319
Arsenic, White, shipments.....lbs.	4,240,227	524,838
Arsenic, Crude, shipments....."	850,591	41,494
Cobalt Oxide, shipments....."	477,583	727,170
Cobalt Hydroxide and Sulphate, shipments....."	48,513	25,180
Cobalt, Metallic, shipments....."	404,248	887,960
Nickel Oxide, shipments....."	406	106
Nickel Sulphate and Carbonate, shipments....."	405,263	48,165
Nickel, Metallic, shipments....."	272,029	108,622
Total value of products.....	.....	7,237,854

The number of workmen employed in the refineries was 613, and the wages paid them amounted to \$750,237.

Re-treatment of Tailings

There is now little raw ore from Cobalt exported to other countries, but much of the concentrates produced and part of the residues from the treatment mills are sent to the United States for final manipulation. In the refining of concentrates obtained by oil or water flotation methods, more or less difficulty has been experienced. The flotation process has meant much for the Cobalt silver industry, since it has enabled a large percentage of the values contained in old dumps and low grade wall rock to be profitably recovered. The advance in the price of silver has also been a decided factor in lowering the minimum metallic content of material classifiable as ore. It is apparent that when

silver sells at 60 cents an ounce, rock containing on an average six ounces per ton might be on or below the profit line, while at one dollar or one dollar and ten cents an ounce, it might yield a handsome return. These two causes have combined to prolong the life of the Cobalt mines, and to enable a much larger proportion of silver to be recovered than at one time seemed possible. Several instances may be given in which old tailing piles have been worked over to advantage. The National Mines, Limited, ran from April 15 to November 6 on tailings recovered from the bed of Cross lake, on which they had been deposited by former operators of the King Edward and Silver Cliff mines situated on the shores of the lake. Of these tailings 13,244 tons were put through the flotation process and 216 tons of concentrates produced, the silver recovery from which was 59,963 ounces worth \$60,359. It is recalled that at the time of these operations permission had to be obtained from the owners of the lake bed for placing thereon what was then considered to be absolutely waste material. Similarly, mill sands from the Seneca-Superior mill were run into Peterson lake, the company holding a lease of part of the land under water from the Peterson Lake company. When the vein was worked out and the lease terminated, the land reverted to the latter company, who are now treating the sands by flotation at a good profit. At the east end of the same lake, the Nova Scotia company worked a deposit on the shore, and ran the tailings into the water. When these acquired value, a dispute arose as to their ownership, but the courts decided that they were the property of the company on whose lands they lay.

The following figures have been compiled showing the products of the Cobalt mines which were treated in United States plants in 1918, and the recoveries made therefrom:—

Ore treated, tons	42,89
Concentrates treated, tons	7,835.32
Residues or slag treated, tons	555.74
Silver recovered, ounces	2,930,114
Gold recovered, ounces	204
Copper recovered, lbs.	144,763
Lead recovered, lbs.	6,116

Dividends

In dividends and bonuses the silver mining companies distributed in 1918 the sum of \$4,821,513.65, making a total up to the end of that year of \$74,810,521.08. Particulars are given in the Table appended. Profits of privately owned mines or close corporations are not included. These have amounted to at least five or six million dollars during the life of the camp.

TABLE VIII.—DIVIDENDS AND BONUSES PAID BY SILVER MINING COMPANIES TO DECEMBER 31, 1918.

Name of Company.	Date of Incorporation	Authorized Capital	Capital Stock Issued	Par value per share	Amount of Dividends and Bonuses paid to end of 1917		Amount of Dividends and Bonuses paid during 1918	Rate per cent. to 31st Dec., 1918	Total of Dividends and Bonuses paid	Date when last Dividend or Bonus paid
					\$	¢				
Aladdin Cobalt Company, Limited	Aug. 23, 1912	500,000	500,000	5 00	.....	75,000 00	15	75,000 00	April 30, 1917
Beaver Consolidated Mines, Ltd.	Mar. 1, 1907	2,000,000	2,000,000	1 00	650,000 00	.....	.....	650,000 00	April 8, 1916
Buffalo Mines, Ltd., The ¹	April 27, 1906	500,000	500,000	50	2,787,000 00	.....	.....	2,787,000 00	May 28, 1914
Casey Cobalt Silver Mining Company, Ltd.	Dec. 19, 1906	100,000	100,000	1 00	203,249 33	.....	.....	203,249 33	April 22, 1914
Cobalt Comet Mines, Ltd. ²	April 16, 1913	1,000,000	1,000,000	1 00	230,000 00	.....	.....	230,000 00	April 1, 1915
Coniagas Mines, Limited, The	Nov. 24, 1906	4,000,000	4,000,000	5 00	8,740,000 00	500,000 00	12½	9,240,000 00	Nov. 1, 1918	
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
Kerr Lake Mining Company, Ltd.	Aug. 9, 1905	40,000	40,000	100 00	7,790,000 00	658,000 00	.....	8,448,000 00	Dec. 10, 1918
La Rose Mines, Ltd.	May 31, 1908	1,500,000	1,500,000	1 00	6,270,646 84	30,000 00	2	6,300,646 84	April 20, 1918	
McKinley-Darragh-Savage Mines of Cobalt Ltd.	April 17, 1906	2,500,000	2,247,692	1 00	5,146,222 74	269,723 04	12	5,415,945 78	Oct. 1, 1918	
Mining Corporation of Canada, Ltd. ³	Nov. 23, 1916	8,300,250	8,300,250	5 00	2,905,046 86	1,348,790 61	.....	4,253,837 47	Dec. 14, 1918
Nipissing Mining Company, Ltd. ⁴	Dec. 16, 1904	250,000	250,000	100 00	17,623,297 25	1,815,000 00	.....	19,438,297 25	Oct. 21, 1918
Penn-Canadian Mines, Ltd.	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	2,401,820	1 00	462,063 35	.....	.....	462,063 35	Jan. 2, 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
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
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	1,984,156 25	75,000 00	Jan.	18, 1918
Trethewey Silver Cobalt Mines, Ltd.	May June	30, 1906 { 1, 1911 {	2,000,000	1,000,000	1 00	1,111,988 50	50,000 00	Aug.	20, 1917
Wetlaufer Lorrain Silver Mines, Ltd.	Nov.	30, 1908	1,500,000	1,416,500	1 00	637,465 50	.....	Sept.	22, 1913
City of Cobalt Mining Co., Ltd. ¹	Oct. Jan.	5, 1906 { 7, 1909 {	500,000 1,500,000	1,500,000	1 00	145,000 00	.....	April	15, 1909
Cobalt Central Mines Co., Ltd.	Dec.	13, 1906	5,000,000	5,000,000	1 00	192,845 00	.....	Aug.	25, 1909
Cobalt Lake Mining Co., Ltd. ²	Dec.	22, 1906	3,000,000	3,000,000	1 00	465,000 00	.....	May	29, 1914
Cobalt Silver Queen, Ltd.	April	1, 1906	1,500,000	1,500,000	1 00	315,000 00	.....	Dec.	31, 1908
Cobalt Townsite Mining Co., Ltd. ³	May	8, 1906	100,000	45,011	1 00	1,042,259 61	.....	Nov.	11, 1914
Foster Cobalt Mining Co., Ltd.	Feb.	14, 1906	1,000,000	915,588	1 00	45,000 00	.....	Jan.	1, 1907
Temiskaming and Hudson Bay Mining Co. Ltd.	July	29, 1903	25,000	7,761	1 00	1,940,250 00	.....	Nov.	10, 1914
Hudson Bay Mines, Ltd.	July	16, 1909	3,500,000	3,200,050	5 00	778,909 42	.....	Aug.	31, 1913
Total						69,989,007 43	44,821,513 65		74,810,521 08

¹ In 1917 the capital stock of the company was reduced from \$1,000,000 to \$750,000 and in 1918 from \$750,000 to \$500,000 by returning to shareholders \$250,000 in each year, leaving 1,000,000 shares issued of 50 cents each.

² Cash assets amounting to \$30,000 paid on April 27, 1917.

³ Mining Corporation of Canada, Limited, owns and operates the City of Cobalt, Cobalt Lake and Cobalt Townsite mines.

⁴ Includes \$16,288,297.25 paid in dividends by the Niipissing Mines Co. (the holding company) to the end of 1916.

⁵ Now owned and operated by Mining Corporation of Canada, Limited.

Copper

The nickel-copper ores of the Sudbury area continue to be the source of practically all the copper produced in Ontario. These ores contain from 1 to 2.5 per cent. of copper, the recovery averaging year by year a little over 1.5 per cent. Copper ores not containing nickel are found in many parts of the Province, notably on the north shore of Lake Huron, where at Bruce Mines the first mine of northern Ontario was opened two generations ago. This deposit yielded in all about \$3,500,000 worth of copper. After its hey-day was over, it remained idle for many years, but recently passed into the possession of the Mond Nickel Company, by whom the ore is used because of its siliceous properties. In the process of smelting the small percentage of copper which it carries is also recovered. There was one small shipment of non-nickeliferous copper ore from the Havilah mine of the Hudson Copper Company. A recovery of 141,763 pounds of copper was made in U. S. refineries from ores received from the Cobalt silver mines. The total production of copper during the year was 23,557 tons, of which 1,211,922 pounds were obtained as blister copper by the International Nickel Company of Canada in the treatment of nickel-copper matte at the Port Colborne refinery.

Nickel

Under the stimulus of war, the production of nickel in Ontario reached the highest point yet recorded. There were turned out of the converters at Copper Cliff and Coniston 87,184 tons of matte, the nickel contents of which were 45,886 tons. Of the matte 5,334 tons were treated at the International Nickel Company of Canada's refinery at Port Colborne, which went into operation in July. As compared with 1917, the nickel output of Sudbury shows an increase of 2,410 tons. The value of the nickel in the matte form was \$26,578,200, an increase over 1917 of \$5,634,700. The quantity of ore smelted was 1,559,892 tons, and of ore raised from the mines 1,643,040. This production was from the following mines:—

International Nickel Company:—	Tons.	Tons.
Creighton	1,104,673	
Crean Hill	125,836	
	<hr/>	1,230,509
Mond Nickel Company:—		
Garson	143,016	
Victoria No. 1	33,498	
Worthington.....	69,793	
Levack.....	97,585	
Bruce.....	39,021	
	<hr/>	382,913
Alexo Mining Company:—		
Alexo.....		8,618
British America Nickel Corporation:—		
Murray.....		21,000
	<hr/>	
Total.....		1,643,040

The ore raised from the Alexo mine, an extra-Sudbury deposit, was shipped as usual to the Mond Nickel Company, and smelted at the latter's works, Coniston. None of the Murray mine ore extracted by the British America Nickel Corporation was treated, this company's works not yet having been completed.

For the first three months of the year the mines and works at Copper Cliff and vicinity continued to be operated by the Canadian Copper Company, the pioneer of the nickel industry¹ in Ontario which was organized under the laws of the State of Ohio in 1886 to take over the holdings of Samuel J. Ritchie. For the remainder of the year the properties were worked by the International Nickel Company of Canada, Limited, to whom they were transferred, and in whose name also the refinery at Port Colborne is conducted, thus effecting a new amalgamation of all the Canadian interests. To the perseverance shown by the Canadian Copper Company, and the high degree of ability and technical skill which has characterized its career, it may be justly said the nickel business of this Province owes not only its origin but to a large extent its successful development.

The mines and smelters of the two operating companies, namely, the Canadian Copper Company—now the International Nickel Company of Canada, Limited—and the Mond Nickel Company, Limited, have been so often described in the Bureau's reports, that there is no necessity for referring to them here at any length. For details, the reader is referred to the Report of the Royal Ontario Nickel Commission published in 1917, which gives a full history of the origin, growth and development of the nickel industry of Ontario up to the time of publication; also to the chapter of this Report entitled Mines of Ontario. A description of the Port Colborne refinery erected by the International Nickel Company of Canada will be found on later pages of this Report in the same chapter.

The British America Nickel Corporation, in which the British Government holds a controlling interest, was steadily at work during the year in developing the Murray mine, and in erecting a smelter there and a refinery at Deschenes, Quebec. This refinery will operate the electrolytic process of recovering the nickel and copper from the matte, as developed by V. N. Hybinette in Norway.

The number of men employed in the mining, smelting and refining of nickel in Ontario last year was 3,735, to whom were paid as wages \$7,233,289. The quantity of coke used at the furnaces was 197,010 tons, worth \$2,772,672, and of wood, chiefly for heap-roasting purposes, 35,296 cords valued at \$161,262.

From the silver ores of the Cobalt area there were recovered in the refineries at Thorold, Deloro and Welland the following nickel products, the figures being those of actual shipments:—

	Quantity.	Value.
	lbs.	\$
Nickel Oxide	406	106
“ Sulphate.....	329,669	28,772
“ Carbonate.....	75,594	19,393
“ Metal.....	270,029	108,622

Adding the metallic nickel equivalent of the above to the nickel contained in the Sudbury mattes, the total production of nickel last year was 46,072 tons.

The following list gives the names and addresses of the nickel-copper mining companies carrying on active work in 1918:—

¹See history of The Canadian Copper Company in Report of Royal Ontario Nickel Commission, pp. 60 *et seq.*; A. T. Wilgress, Printer to the King's Most Excellent Majesty, Toronto, 1917.

NICKEL-COPPER MINING COMPANIES, 1918.

Name of Company.	Name of Mine.	P.O. Address.
Alexo Mining Company, Ltd., The.....	Alexo.....	Porquis Junction.
British America Nickel Corp'n, Ltd., The.....	Murray.....	Nickelton.
Canadian Copper Company	Creighton, Crean Hill.....	Copper Cliff.
International Nickel Co'y of Can., Ltd.	Creighton, Crean Hill.....	Copper Cliff.
Mond Nickel Company, Limited, The	Garson, Levack, etc.....	Coniston.

Table IX which follows shows the large development of the nickel industry during the years of the war. It will be observed that the quantity of matte produced increased by 80 per cent., the nickel contents by 101 per cent., and the copper contents by 65 per cent. The greater relative increase in nickel than in copper is doubtless due to the heavier drafts on the Creighton mine, the ore of which is high in nickel and comparatively low in copper. It might be inferred from the much larger value placed upon the nickel and copper contents from 1915 on that there had been a great increase in the price of these metals. The fact is that while in copper there was a decided advance during the war, the price rising to more than double its former figure, there was a comparatively small rise in the selling value of nickel. The large advance in value of nickel in 1915 over 1914 is due not only to an increase in output of 50 per cent., but also to an increased valuation of the nickel in the matte.

TABLE IX.—NICKEL-COPPER MINING AND SMELTING, 1914-1918.

Schedule.	1914	1915	1916	1917	1918
Ore raised..... tons.	1,000,364	1,339,322	1,572,804	1,536,828	1,643,040
Ore smelted..... "	947,053	1,272,283	1,546,215	1,453,661	1,559,892
Bessemer matte produced.. "	46,396	67,703	80,010	78,897	87,184
Nickel contents of matte .. "	22,759	34,039	41,299	41,887	45,886
Copper contents of matte... "	14,448	19,608	22,450	21,197	23,843
Value of Nickel in matte... \$	5,108,997	17,019,500	20,649,279	20,943,500	27,531,600
Value of Copper in matte... \$	2,080,034	3,921,600	8,299,051	7,842,890	8,453,880
Wages paid..... \$	3,131,520	3,581,639	4,920,720	5,570,587	6,861,773
Men employed .....No..	3,464	4,178	4,730	3,356	3,145

Part of the Sudbury matte production for the first time was refined within the limits of the Province, at Port Colborne. The following figures summarize the operations:—

TABLE X.—NICKEL-COPPER REFINING, 1918.

Schedule	Quantity	Value
		\$
Matte refined in Ontario	tons 5,334	.....
Metallic Nickel recovered	" 1,589	1,153,494 00
Bliſter Copper	" 532	234,280 00
Gold	ounces 57.6	1,152 16
Silver	" 2,704.3	2,724 18
Total value of Products.....		1,391,650 34

New Nickel Areas in Ontario

The discovery of the nickel deposit known as the Alexo mine, situated in the township of Dundonald, in the Poreupine area, showed that there were nickel ores in Ontario outside of the great nickel ranges of Sudbury. The typical method of ore occurrence in the latter is at or near the contact between the norite and granite or other acid rock, geologists not being in agreement as to the manner in which the ore was deposited. The Alexo ore body is also a contact one, but the parent formation is serpentine, and that with which the contact is made is andesite. The Alexo mine has up to the end of 1918 produced about 49,132 tons of ore, which resembles the Sudbury ore in composition, being essentially a mixture of pyrrhotite and chalcopyrite, carrying nickel. Alexo ore as shipped is somewhat richer in nickel and poorer in copper than the average ores of Sudbury. Nickel ores have been found in other sections of Ontario, namely, in the township of McCart, in the township of Munro, and in the township of Strathy, Timagami Forest Reserve, and more recently it has been reported from near Lake Shebandowan in the district of Thunder Bay. Steps are being taken by the Bureau of Mines to investigate the extent of these deposits, but generally speaking, while it can be said that the ores do exist, no large and important bodies are as yet known to occur. C. W. Knight, Assistant Provincial Geologist, will be in the field during the season of 1919 in order to obtain data for a report on these extra-Sudbury deposits.

In the Sudbury area itself, a body of water known as Windy lake lies in the townships of Cascaden and Dowling, where the northern band of norite bears to the southwest. As mapped by Coleman, the norite-granite contact passes through Windy lake, and with the view of locating a possible ore body on its bed, a magnetometric survey was made on the ice last winter. The work was done by A. H. A. Robinson, of the Department of Mines, Ottawa, and C. W. Knight. The services of the former, along with the magnetometer, were courteously loaned the Bureau for the purpose by the Mines Department. At the same time a traverse and survey of the lake were made by McAuslan and Anderson, Ontario Land Surveyors; also a series of soundings to ascertain the depth of the lake. The magnetometer, however, gave no readings from which the existence of ore could be inferred.

The Ontario nickel ores are sulphides, and are undoubtedly the most important bodies of this type known to-day. In other countries, especially those which have escaped the action of glacial forces, ore bodies of the lateritic type¹ occur, some of which carry nickel. For example, Cuba, Madagascar and the island of Seboekoe, near Borneo, all tropical or sub-tropical countries with a humid climate, contain nickel ore deposits of lateritic origin, that is, ores formed by the residual decay of the parent rock, such as peridotite or serpentine, the leaching out of the non-metallic minerals, and the consequent concentration of those of a metallic character. The well-known nickel ores of New Caledonia are of this kind; so, too, are the cobalt ores of the same island.

¹See Lateritic Ore Deposits, by W. G. Miller, Rep. Bur. Min., Vol. XXVI, 1917, pp. 318-334.

New Sources of Nickel Elsewhere

A report recently issued in the Dutch language by the Mining department of the Dutch East India government gives particulars of large lateritic iron ore deposits recently discovered in the central portion of the island of Celebes, in the Borneo archipelago. These deposits are situated in the Verbeek mountains, and are compared in composition and occurrence with those of Seboekoe above mentioned, resembling the latter in containing nickel, of which assays show from 0.27 to 0.64 per cent. It is estimated that the Verbeek deposits contain as much as 1,000 million tons of iron ore.

The report proceeds to say that hand in hand with these iron ore deposits go deposits of nickel ore. Exploration in the Verbeek mountains shows that in their origin these two groups of ore are closely connected; both arise from the same source, namely, the peridotite and serpentine rocks of that locality. The nickel ores agree in character with those of New Caledonia, and like the latter fill fissures in the friable but still solid parent rock, and also occur as ore crusts some decimeters thick overlying the upper weathered strata. For the most part they belong to the garnierite group of hydrated magnesium nickel silicates; but the brown variety known as chocolate ore also occurs. The percentage of nickel runs as high as 10 per cent. in not a few cases, and specimens containing more than 25 per cent. have been found. In general, the nickel content of the unselected ore, owing to intermixture with quartz (chalcedony), etc., is considerably lower. Two experimental pits in a nickel deposit at Soroako on the southerly shore of lake Katano gave, throughout a depth of 9 and 12 metres respectively, an average content of 2.31 and 2.50 per cent. of nickel; on Boetoh hill near by, the average content from twenty-one pits and trenches was estimated to be over 5 per cent. The total quantity of ore in the region of these experimental workings was estimated at 50,000 to 60,000 tons. It must be remembered, the report adds, that to win the 60,000 tons of ore on Boetoh hill, more than one million cubic metres of material would have to be handled. Similar occurrences are noted at other points. Up to the present, exploration has been restricted to the ridges, though there is a possibility that the ore may be found in the valleys as well. The individual hill deposits seem not to be very extensive, containing not more than a few tens of thousands of tons each; but they are probably numerous.

Nickel occurs along with copper, lead and cobalt in ore bodies now being worked by the Missouri Cobalt Company at Frederickton, Mo. These deposits are found at the contact of sandstone and limestone and are in the form of flat beds, workable for a depth of two to eight feet. The ore contains 2 to 2.5 per cent. copper, 0.5 to 0.8 per cent. nickel, 0.5 per cent. cobalt, together with lead and a little silver. All the metals are present as sulphides, and are associated with considerable pyrites. A 300-ton mill has been erected by the company, in which the ore is concentrated, four or five parts into one, by gravity concentration aided by flotation, 85 to 95 per cent. of the metals being recovered in the concentrates. The concentrates are roasted and smelted in a blast furnace, and the resulting matte is leached after roasting, the residue being converted into anodes. The copper is recovered by electrolytic refining, and the cobalt and nickel by chemical precipita-

tion. The cobalt and nickel refineries began operation about the beginning of 1919. The nickel from these works is the first produced in the United States from native ore for a number of years.

In the island of Santo Domingo, a low grade nickel deposit called the Perseverancia mine has been opened up by Cuban capitalists. The work done in 1918 was principally in building houses and making roads.

At Insizwa,¹ South Africa, sulphides carrying nickel and copper have been found under geological conditions which have suggested to some observers a resemblance to those of the Sudbury field, but as yet there has not been development enough to prove the existence of any considerable bodies of ore.

More recently accounts have been printed describing the occurrence of sulphides containing nickel and copper at Vlakfontein, No. 902, in the Rustenburg district of the Transvaal, where the geology is also said to be suggestive of that of Sudbury. A huge laccolith of red granite is represented as being surrounded by a marginal fringe of norite and basic rocks, the norites being usually about 6 miles in width, but at points spreading out to a maximum of 70 miles. On or near the marginal zone, gossan outcrops show traces of ancient workings, evidently for copper. Where shafts have been sunk on these outcrops, the general experience has been that down to 40 feet the gossan is ill-defined, and carries nothing but traces of copper with occasional blocks of unaltered sulphide ore. From this depth nickel appears in conjunction with the copper as an irregular impregnation, becoming richer at 100 feet, the greatest depth yet reached. Assays of the ore at various openings and depths show 0.57 per cent. to 3.25 per cent. of nickel and 0.25 to 6 per cent. of copper. No large amount of work has so far been done, and no important bodies of ore located.

Iron and Sulphur

The present treatment of the nickel-copper ores of Sudbury has for their chief aim the recovery of the nickel and copper contents. For this object the methods are efficient, and are carried out with much technical skill. The metallurgical plants are models of their kind, and their equipment is of the most modern type. Nevertheless, there are important constituents of the ore which go to waste. As it comes from the ground a ton of the ore contains on the average about 40 per cent. or 800 lbs. of iron, and 30 per cent., or 600 lbs. of sulphur. All of this iron and sulphur are lost. That is to say, in the 1,559,892 tons of ore which passed through the furnaces in 1918, there were 623,957 tons of metallic iron which was cast away in the slag. This is not much short of the entire annual output of pig iron from the blast furnaces of Ontario, amounting in 1918 to 751,650 tons.

The case is similar with regard to sulphur. Part of the sulphur is driven off in acrid fumes by heap-roasting in the open air, part is expelled in the smelting furnaces and converters, and part in refining the matte. But all is wasted. The Royal Ontario Nickel Commission, assuming an average of only 25 per cent. of sulphur in the ore treated, states² that at "the present (1917) rate of

¹See Rep. Roy. Ont. Nickel Commission, 1917, p. R278.

²Report, p. 488.

production not less than 300,000 tons of sulphur, capable of producing nearly a million tons of ordinary sulphuric acid, is annually lost, and does damage through being allowed to escape."

It is not intended to suggest that these losses are intentional, or due to neglect. In the present state of metallurgy they are doubtless inevitable. If these subsidiary contents of the ore cannot be recovered at a profit, they cannot be recovered at all. Furthermore, the nickel mining companies have given much attention to the possibility of avoiding these losses, and it may be taken for granted that so far they have not found it practicable to do so. Freight charges play a large part in the problem of sulphuric acid manufacture, and the Sudbury smelters are at so great a distance from acid-consuming centres that the transportation charges would be insurmountably high, even if methods of trapping the sulphur fumes and converting them into acid were devised.

Yet it is evident that there is here an opportunity for the exercise of metallurgical skill and inventive genius. The need for thrift in the use of natural resources is becoming universally recognized, and we may hope that long ere the nickel-copper ores of Sudbury are worked out means to make use of both the iron and the sulphur will be found.

As a matter of fact the utilization of the iron contents of these ores has already made some progress. Attention was called in the Report of the Royal Ontario Nickel Commission¹ to the attempts which have been made to produce a nickel-copper steel by direct smelting. The presence of copper in steel has in the past been objected to as injurious, but this opinion is undergoing revision in the light of practical experience, since it has been shown that a small percentage of copper may not only with safety, but possibly with advantage, be carried along with nickel in a nickel-steel. Theoretically, at least, nickel-copper steel may be obtained either direct from the ore, or by re-treating the slag from nickel smelting. The latter process would not only make use of the iron, but also of the small percentages of nickel and copper remaining in the slag, and would besides avoid the waste of the precious metals entailed by smelting the ore as it comes from the mine. On the other hand the smelting of slag is more difficult in practice.

The manufacture of nickel-copper or "Ni-cu" steel has been begun by Electric Steel and Engineering at Welland, Ont. Experimental bars and sheets have been made of good quality, and even gun tubes for the British government.

The "Precious" and "Rare" Metals

Besides the two metals of principal quest, the Sudbury ores carry platinum, palladium and other metals of the platinum group, also gold and silver. The latter two, when spoken of collectively, are usually referred to as the "precious metals," and for clearness' sake, platinum, palladium, etc., may be called "rare metals." In point of value "rare metals" are at the present time worth per ounce six times as much as gold, and one hundred times as much as silver. Exact figures cannot be given for the precious and rare metal contents of the mattes produced at Sudbury, as these undoubtedly vary from year to year, being to some extent dependent upon the class of ores smelted. Certain deposits of the rocky type are richer in these

¹Report, pp. 413-422. See also Appendix.

constituents than the more massive ore bodies, and the whole subject of the association and method of occurrence of platinum and especially of palladium, in the Sudbury ores, is as yet not thoroughly understood.

For the three years, ending in 1915, the average contents of the precious and rare metals in the Canadian Copper Company's mattes were 0.10 ounces platinum per ton, 0.15 ounces palladium, 0.05 ounces gold, and 1.75 ounces silver.¹ At this rate, the mattes produced by the Company in 1916, amounting to 56,405 tons, are estimated to have contained 5,640 ounces of platinum, 8,460 ounces of palladium,² 2,820 ounces of gold, and 98,709 ounces of silver. Of the precious metals, a greater proportion is actually recovered than of the rare metals. For example, in 1916, as is shown in the table on page 30, the gold recovered amounted to 3,495 ounces and the silver to 110,285 ounces, in each case considerably more than the theoretical contents based on the average of the three preceding years, while of platinum the yield was 1,016 ounces, of palladium 1,345 ounces, and of rhodium metals 257 ounces.

In the Orford process of refining, the platinum and palladium pass into the nickel and Monel metal, and are thus lost, practically only those products which are treated electrolytically in the refinery, yielding their rare metal contents. The gold and silver follow the copper, and are obtained in refining the blister metal. Recent experiments suggest the possibility of adapting electrolytic methods to the refining of nickel at certain stages of the Orford process, and if this can be successfully done, the production of the platinum group of metals from the Sudbury ores should be decidedly increased.

The Mond process of refining affords opportunity for a full recovery of these metals, which are concentrated in the residues. These are periodically removed and have in the past been disposed of to the well-known firm of Johnson, Matthey & Company, of London, by whom it was refined. Recently the Mond Company have installed in their works at Clydach, Wales, a plant for treating the residues, and henceforward will be in a position to recover the precious and rare metals themselves. Analyses show this company's mattes to be richer in both the "precious" and "rare" groups than those of the International Nickel Company, but the quantities obtained have not been reported.

It should be stated that the known ore deposits which are specially rich in the rare elements, such as Victoria, Worthington and Vermilion, are few in number, and some of them small in size, and consequently cannot be depended on for continued large production. The outlook is that future mattes may not assay so high in the rare metals as they have done in the past.

The full recovery of precious and rare metals from the mattes of the Canadian Copper Company (now the International Nickel Company) for the twelve years 1907 to 1918 was as follows:

¹ Royal Ontario Nickel Commission Report, p. 484.

²Ibid. p. 484.

PRECIOUS AND RARE METALS FROM CAN. COPPER COMPANY'S MATTES.

Year.	Matte Treated.	Gold.	Silver.	Platinum.	Palladium.	Rhodium Metals.
	Tons.	Ounces.	Ounces.	Ounces.	Ounces.	Ounces.
1907.....	.....	993.572	63,400.70	226.800	607.300	.....
1908.....	.....	5,238.181	139,329.29	172.316	382.287	.....
1909.....	.....	2,113.669	63,138.66	546.627	1,270.598	.....
1910.....	.....	2,649.799	60,256.83	258.325	522.804	.....
1911.....	.....	2,203.052	70,954.38	665.552	753.363	.....
1912.....	.....	2,476.558	62,169.66	496.850	680.130	.....
1913.....	37,767	2,336.405	77,924.03	192.863	207.713	191.067
1914.....	29,615	2,695.957	75,928.18	748.440	756.360	515.801
1915.....	48,770	3,444.785	101,793.17	452.430	543.240	57.475
1916.....	58,559	3,495.123	110,285.21	1,016.581	1,344.915	257.070
1917.....	59,209	1,954.934	92,963.67	970.695	1,354.459	325.407
1918.....	62,250	1,968.703	107,076.78	649.737	786.654	472.579
		31,570.738	1,025,220.56	6,397.216	9,209.823	1,819.399

Improving Electrolytic Process of Refining

Improvements have been invented in the electrolytic refining of nickel by George A. Guess, professor of metallurgy at the University of Toronto.

Prof. Guess states it is found that if an anode of crude nickel, which may contain copper and iron, is electrolyzed in a bath of nickel sulphate in which is suspended finely divided calcium carbonate, there is deposited on the cathode, which is suspended in a sack diaphragm, metallic nickel practically free from copper and iron. The copper is precipitated as a double basic sulphate of copper and nickel, which is quite insoluble. The function of the diaphragm is to protect the cathode from mechanical pollution by contact with the insoluble copper salt. Since an equivalent quantity of nickel is combined with the copper in the insoluble basic sulphate, it is obvious that the copper content of the anodes should be as low as possible. Preliminary treatment of the converter matte to remove copper is necessary. Two methods at once suggest themselves for doing this. The first is by leaching the roasted matte with dilute sulphuric acid, as is done in the preliminary operation for the Mond process. The second method would be a fusion with coke and salt cake (Na_2SO_4), which is the preliminary step in the Orford process.

Experiments have been made with Prof. Guess' process at one of the Sudbury smelting plants, which are said to have been successful, and it is hoped that a more extended trial will be made. A three-fold advantage is claimed for the process; it saves time, it reduces the cost of refining, and it enables the gold, platinum, etc., to be recovered.

Iron Ore and Pig Iron

From the mines of the Province last year there were raised 251,367 tons of iron ore, of which 29,684 tons were hematite, 61,128 tons magnetite, and 160,555 tons siderite. The shipments were, to blast furnaces in Ontario, 91,609 tons, and to points in the United States, 107,273 tons, valued at \$621,364. In 1917 the quantity of ore exported was 136,343 tons. The exports of ore last year were for the most part of roasted and nodulized siderite from the Magpie mine, and briquettes from the concentration plant at Moose Mountain. These mines, with the Helen, were

the chief producing properties. Small quantities of hematite were shipped by the Canadian Union Iron Mines Corporation from the Playfair mine near Fallbrook in Lanark county, and by G. Wallbridge from the dumps of the old Wallbridge mine near Eldorado in Madoc township, the ore itself having been mined eighteen years ago. The Poe Mining Company marketed 345 tons of low phosphorus magnetite raised from the Ferguson mine in Palmerston township, county of Frontenac. The principal work of the last-named company was the erection of a one-unit coarse separation plant for concentrating the ore.

The Helen Mine

The year was marked by the passing of the well-known Helen mine, owned by the Algoma Steel Corporation, which was worked out and closed down April 16th. This deposit was discovered in the fall of 1898 by Alois Goetz, and was almost immediately acquired and opened up by the late E. V. Clergue, afterwards becoming the property of the Lake Superior Power Company, of which F. H. Clergue was manager. A railway was built from Michipicoten Harbour to the mine, and shipments began in July, 1900.

The deposit has been frequently described in the Reports of the Bureau of Mines¹ and furnished most of the native ore smelted in Ontario furnaces since the time it began to produce. The Helen product, which changed from limonite to hematite as the deposit was opened up, was in demand, being of good, though non-Bessemer quality, and working well in the furnace. A peculiar feature, and one doubtless connected with the origin of the ore body, was that it contained a considerable quantity of iron pyrites, quite granular in form, which on being broken into in mining, ran like water and in consequence had to be carefully shut off for fear of contaminating the shipping ore. There was also found in the mine a decomposed dike of diabase, and an area of Keewatin schist, both of which by their decay formed deposits of kaolin, which, however, were never worked.² From first to last the shipments from the Helen mine were as follows, in tons of 2,000 pounds:

Transportation	Hematite	Tailings	Pyrites	Total
Lake and rail shipments.....	2,532,903	41,275	32,910	2,607,088
Rail shipments	247,333	1,858	19,020	268,211
Total.....	2,780,236	43,133	51,930	2,875,299

Beneficiation of Low Grade Ore

The fact that most of the iron ore mined in Ontario requires beneficiation before smelting has undoubtedly retarded the development of iron mining in the Province. There are very large reserves of ore in the northern and northwestern regions, but so far as the character of the deposits has been revealed, they are in the main low in metallic contents, and in some cases carry an objectionable proportion of sulphur.

¹Vol. VIII, 1899, pp. 254-258; Vol. IX, 1900, pp. 154-164; Vol. X, 1901, pp. 191-198, etc.

²A. L. Parsons in Bur. Min. Rep., Vol. XXIV, 1915, pp. 192-194.

4 B. M. (i)

Many of these deposits are contained in ranges of banded ore, composed principally of magnetite, but frequently carrying hematite as well. In these layers iron ore alternates with layers of silica or jasper, such layers varying in thickness from that of leaves in a book to a foot or several feet. The intermixture of iron and silica being intimate, fine grinding is necessary before any method of magnetic concentration can be employed, and complete separation between the particles of ore and those of silica is difficult.

Siderite also occurs in large bodies, and by roasting and nodulizing can be converted into first-class furnace material. In eastern Ontario there are many deposits, chiefly of magnetic ore. A considerable number of these have been worked, but the production has never been large.

Government Aid Asked for

The conditions of iron mining in Ontario are such as to lead to a demand for some sort of government aid in order to bring about the establishment of a permanent industry, and representations have been made both at Ottawa and Toronto in favour of such assistance. The fact is that at the present time the proportion of native Canadian ores charged into the blast furnaces of the whole of Canada last year was only 4.3 per cent., practically all the ore used being imported from Newfoundland and the mines of the Lake Superior region south of the international boundary line. Undoubtedly, the iron ore deposits of Ontario will be called upon, and it may be at no distant date; but for the present it is difficult to induce iron masters to turn from the beaten path of imported ore and make experiments with what they regard as uncertain sources of supply both as to quantity and kind.

Following is a list of the iron mines from which ore was shipped in 1918:—

IRON ORE MINING COMPANIES, 1918.

Company or Firm.	Mine.	Location.	Kind of Ore.	P.O. Address of Company.
Algoma Steel Corporation, Ltd.	Helen.....	Michipicoten...	Hematite...	Sault Ste. Marie
Algoma Steel Corporation, Ltd.	Magpie.....	Algoma dist....	Siderite....	Sault Ste. Marie
Canadian Union Iron Mines Corporation, Ltd.	Playfair.....	Fallbrook, Lanark county...	Hematite...	Montreal, Que., 145 St. James St.
Moose Mountain, Ltd.	Moose Mountain.	Sudbury dist....	Magnetite..	Sellwood
Poe Mining Company	Ferguson.....	Palmerston tp..	Low-Phos. Magnetite	Clarendon Station
Wallbridge, G.	Wallbridge.....	Madoc tp.....	Hematite...	Madoc

The production of pig iron reached in 1918 the highest point yet recorded, the quantity being 751,650 tons, valued at \$20,522,356, as compared with 691,233 tons, worth \$14,201,695, in 1917. The increase in quantity produced was thus 8.7 per cent., while the value rose by over 44 per cent., the average price per ton increasing from \$20.54 to \$27.30. War requirements and the difficulty of procuring supplies of pig iron in the United States contributed to this enlarged production at home. Out

of a total of 1,400,085 tons of ore smelted, only 99,852 tons, or 6.65 per cent., were of Ontario origin, the remainder consisting of ore imported from the United States.

The producing companies are shown on the list given below. In all nine blast furnaces were in operation during the year. More than one-half the total quantity of pig iron was produced by the Algoma Steel Corporation at Sault Ste. Marie. The pig iron and steelmaking capacity of the Province is being added to by the plant of the Canadian Steel Corporation, Limited, now under construction at Ojibway, near Windsor.

IRON BLAST FURNACES IN OPERATION, 1918.

Name of Company.	No. of Furnaces operated.	Fuel used.	Location.
Algoma Steel Corporation, Limited.....	4	Coke.....	Sault Ste. Marie.
Canadian Furnace Company, Limited.....	1	Coke.....	Port Colborne.
Midland Iron and Steel Company, Limited.	1	Coke.....	Midland.
Standard Iron Company, Limited.....	1	Coke.....	Deseronto.
Steel Company of Canada, Limited.....	2	Coke.....	Hamilton.

The Standard Iron Company's furnace at Parry Sound was not operated during the year.

In the production of the Algoma Steel Corporation there is included 3,996 tons of spiegeleisen valued at \$165,683.46.

Table XI gives particulars of the iron and steel-making industry of the Province for the last five years.

TABLE XI.—PRODUCTION IRON AND STEEL, 1914 TO 1918.

Schedule.	1914	1915	1916	1917	1918
Ontario ore smelted .....tons	163,779	293,305	215,366	94,318	99,852
Foreign ore smelted "	752,560	623,094	1,056,810	1,221,881	1,400,085
Limestone for flux "	252,258	215,686	296,988	319,535	405,683
Coke "	590,902	486,022	708,273	723,657	869,729
Charcoal .....bush.	920,045	1,314,957	1,843,209	1,288,390	.....
Pig iron produced .....tons	556,112	493,400	699,202	691,233	751,650
Value of pig iron produced \$	7,041,079	5,910,625	9,739,704	14,201,695	20,522,356
Steel made .....tons	479,320	471,059	686,959	862,504	881,509
Value of steel made \$	7,786,303	7,618,272	12,847,309	22,179,982	28,792,361

As regards steel, it should be noted that the foregoing table includes only steel made by plants in which iron ore is reduced in the blast furnace and converted into steel, whether or not the process is a continuous one. No account is taken of what may be called secondary steel, namely, that made from scrap, turnings, etc. A large quantity of such material is charged into steel furnaces every year, and during the period of the war, the quantity of steel so produced in Canada was little less than that produced from pig iron. Much of this product was for the manufacture of shells, and a considerable proportion of it was made in the electric furnace. Nor does the production of pig iron include that made from scrap, on which process several plants were operated during the year.

It will be observed that no charcoal iron was made in 1918. Of the coke consumed 408,033 tons, or nearly that company's entire consumption, was made by the Algoma Steel Corporation at its own ovens at Sault Ste. Marie. The coking plant consists of 110 Koppers retort ovens and 25 Wilputte retorts; 25 additional ovens of the latter type are in course of construction. The Steel Company of Canada has also installed a coke-making battery of ovens which is being operated in 1919.

Lead

The Estate of James Robertson continued to operate the lead mine and smelter at Galetta. The quantity of pig lead produced at these works, together with a small quantity recovered from Cobalt silver ores treated at Denver, Colorado, was 1,670,251 pounds, valued at \$149,841.

The average number of men employed in the mine and works at Galetta was 37, and the wages paid for labour amounted to \$41,238.

Molybdenite

There was a considerable falling off in the quantity of molybdenite concentrates produced last year as compared with 1917, the output being 47,614 pounds valued at \$59,067, as against 77,517 pounds worth \$108,501. The market price of this material declined heavily during the year, falling from about \$2.25 per pound in January to 87 cents in December. This fact, and the practical cessation of demand even before the close of the war, had a discouraging effect upon production.

The concentrating plants in operation were as shown in the following list:—

MOLYBDENITE CONCENTRATING PLANTS, 1918.

Name.	Location.	Lbs. Concentrates produced.
Mines Branch, Department of Mines.....	Ottawa	8,533
Renfrew Molybdenum Mines, Ltd.	Brougham tp.	35,561
Steel Alloys Corporation	Daere	1,090
Spain, W. J.	Daere	2,430
Total		47,614

The largest producer of concentrates, the Renfrew Molybdenum Mines, Limited, whose deposit is situated on lots 8 and 9 in the eleventh concession of the township of Brougham, shipped its output to France.

Molybdenum Products Company, Limited, have erected a Callow flotation plant for the concentration of molybdenite on their property, lots 32 in the fifteenth and sixteenth concession, of Monmouth township, near Wilberforce station on the Irondale, Bancroft and Ottawa railway. The mill was completed about the end of the year, and no ore was mined or treated in 1918.

Steel Alloys Corporation have acquired the Spain mine, lots 30 to 33 in the fourth concession and 30 to 32 in the fifth concession of the township of Griffith, also the Sunset mine on lots 35 and 36 in the fourteenth concession of the township of Brougham, near Daere. There is a mill and concentration plant on the former

property with a treatment capacity of 50 tons of ore per day. The mill was overhauled during the latter part of the year and equipped with Callow flotation cells. The two properties are connected by a road about one mile long.

At the Chisholm mine, near Enterprise, in the township of East Camden, the Sheffield Molybdenite Mining Company was engaged from June to December in installing a flotation process for obtaining molybdenite concentrates, together with a Wilfley table apparatus for separating the associated pyrite as a by-product.

Following is a list of molybdenite producers in 1918:—

PRODUCERS OF MOLYBDENITE, 1918.

Name.	Location of Deposit.	P.O. Address.
Barton, Jas. W.	Near Timagami Stn.	318 Palmerston Bldg., Toronto
Bancroft Mining Company	Bancroft	304 University St., Montreal.
Cole, J. E.	Daere	Daere.
Day, James F.	Renfrew county	Box 540, Sudbury.
International Molybdenum Company.	Renfrew county	Ovillia.
Ontario Molybdenum Company	Tory Hill	305 Mail Bldg., Toronto.
Renfrew Molybdenum Mines, Ltd....	Brougham tp.	128 Bleury St., Montreal.
Spain, W. J.	Daere	Daere.
Steel Alloys Corporation	Daere	Wheeling, West Virginia, U.S.A.
Schreiner, J. C.	Daere	May Bldg., Pittsburgh, Pa.
Taylor, A. W.	Asbdod.....	123 Bay St., Toronto.

There were several other operators engaged in development work, whose properties had not reached the stage of production, either of ore or concentrates. Reference to these will be found under the heading Mines of Ontario.

A full statement regarding the Molybdenite Deposits of Ontario is given by A. L. Parsons in Vol. XXVI of the Bureau's Reports, 1917, pp. 275-313.

Materials of Construction

Clay Products

Statistics of production show a marked decrease in the output of building materials, including bricks and other articles manufactured from clay in whole or in part. This was an inevitable result of the terrible contest in which Canada as well as practically the whole of the civilized world was engaged. The energies of the people were devoted for the time being solely to the prosecution of the war, and until the liberties of the nations were placed beyond the challenge of Germany, the construction of buildings or public improvements was a matter to be left for a happier time.

Pressed and Fancy Brick.—The number of pressed and fancy brick manufactured last year was 25,377 M, worth at the factory \$396,698, as compared with 36,233 M, worth \$474,614 in 1917. As in the latter year, more than one-half the production was made by Milton Pressed Brick Company, Limited, which utilizes as raw material the banks of Medina shale which occur near the town of Milton in Halton county. Overlying the Medina shale is five or eight feet of a limy grayish red clay which is mixed with ground shale to ensure a good colour and is used in

the manufacture of wire-cut brick. The shale itself is ground and made into red pressed brick of good quality; there is also a band of bluish gray shale about two feet thick which is used for the manufacture of buff-coloured brick.

Common Brick, Drain and Building Tile.—There is abundance of clay suitable for brick and tile-making in most parts of older Ontario, where the great bulk of the Province's population resides. The consequent accessibility of good material for permanent and safe construction of dwelling houses and buildings generally is not one of the least advantages of life in Ontario. The cities and towns of this Province will compare favourably with those of many parts of the United States, for example, where buildings made of wood and consequently more subject to damage or destruction by fire, are more common than they are here.

The steadily advancing cost of labour, fuel and machinery has had the same effect upon the selling price of bricks and other building material as upon other commodities. In fact, it may be said that these are the only factors in the price of bricks, since the value of the raw material in the clay bank is practically negligible.

Extensive brickyards exist in the neighbourhood of most of our cities and large towns, since bricks being both bulky and heavy for transportation purposes, it is essential to keep freight charges down to the lowest possible point. In the outskirts of Toronto are many large brickyards equipped to meet the demand which it is hoped will follow the return of peace and the renewal of building operations. The scarcity of houses has become pressing. Rents, already high, have advanced, and it is evident the housing accommodation is insufficient. Some house construction is in progress, but builders anticipate a recession from the present cost of materials and labour, and meantime refrain from large scale operations.

The following table gives the figures of output, value, fuel consumption and price for common brick, drain tile and hollow building tile. As will be seen, common brick which in 1915 sold at \$7.96 per M have risen to \$13.44.

TABLE XII.—OUTPUT AND VALUE OF BRICK AND TILE, 1918.

Product	M.	Value \$	Value per M.
Common Brick.....	49,498	665,454	\$13 44
Drain Tile.....	13,087	309,899	.....
Hollow Building Tile.....		195,588	.....

In the matter of fuel used in firing the brick kilns, the figures indicate a decided decrease in the use of wood, and a corresponding increase in the use of coal. The quantity of natural gas also shows a considerable decline, but a marked advance in the price per thousand feet.

FUEL CONSUMPTION.

Wood			Coal or Coke			Natural Gas		
Cords	Value \$		Tons	Value \$		M. cu. ft.	Value \$	
	Total	per cord		Total	per ton		Total	per M.
13,378	70,845	5 29	27,791	195,322	7 03	112,678	28,917	0 25

The average period of operation for the brick and tile plants was 132 days in the year 1918. Many of the smaller plants operate in the summer months only. Employees numbered 1,027, and \$667,715 was paid in wages.

Following is a list of the brick and tile operators who reported an output in 1918:—

BRICK AND TILE PLANTS, 1918.

Name.	Address.	Product.
Alvinston Brick & Tile Co., Ltd.	Alvinston	Brick, Tile and Hollow Blocks.
Armstrong Bros.	Fletcher	Tile.
Baird & Son, H. C.	Parkhill	Brick and Tile.
Bond & Bird	Woodstock, R.R. No. 5.	Brick.
Broadwell & Son, B.	Kingsville	Tile.
Brown, J. W.	Vienna	Tile.
Brownscombe Bros.	Paisley, R.R. No. 2.	Brick and Tile.
Brownscombe & Sons, H.	Cargill	Brick and Tile.
Buek, J. L.	Port Rowan	Brick and Tile.
Butwell, Richard	Humber Bay	Brick.
Cabana, Jr., Oliver	Zurich	Brick and Tile.
Cairo Brick and Tile Works	Cairo	Brick and Tile.
Cawrse, J. W.	London	Brick and Tile.
Canadian Pressed Brick Co., Ltd.	Hamilton	Pressed Brick.
Clark, Walter	Corunna	Brick and Tile.
Cooper, W. C.		Brick.
Curtin, Frank	Lindsay	Brick.
Curtis Bros.	Peterboro', R.R. No. 9.	Brick and Tile.
Deller & Sons, Geo.	Norwich	Brick, Tile and Hollow Blocks.
Deller, Wm. H.	Thorndale, R.R. No. 4.	Tile.
Dochart Brick & Tile Works	Arnprior	Brick, Tile and Blocks.
Dolan, John	Watford, R.R. No. 2.	Tile.
Dominion Sewer Pipe Co., Ltd.	Aldershot	Brick and Tile.
Don Valley Brick Works	Todmorden	Common, Pressed and Fancy Brick.
Elliott & Sons, Jas.	Steelton	Brick.
Frank, E. D.	Strathroy, R.R. No. 6.	Brick and Tile.
Frid Bros.	Hamilton	Brick.
Gardiner, William	Blenheim	Brick and Tile.
Hallatt, H.	Comber	Brick and Tile.
Halton Brick Co., Ltd.	Terra Cotta	Pressed Brick.
Hamilton Pressed Brick Co., Limited.	Hamilton	Pressed Brick.
Hill, A. W.	Coatsworth, R.R. No. 1.	Brick and Tile.
Hill, W. J. and J. S.	Madoc	Brick.
Hiscock & Sons	Cobourg	Brick.

BRICK AND TILE PLANTS, 1918.—*Continued.*

Name.	Address.	Products.
Hitch, Mrs. Susan	Ridgetown	Brick, Tile and Hollow Blocks.
Hitch, Thos.	St. Thomas	Brick and Tile.
Hohl, John	Wellesley, R. R. No. 1.	Brick and Tile.
Holland & Son, William	Rusecomb	Tile.
Howlett, Fred	Petrolia	Tile.
Interprovincial Pressed Brick Co. of Canada,		
Ltd., The	Cheltenham	Pressed Brick.
Jackson Bros.	Brantford	Brick.
Janes, D. A.	Delaware	Brick and Tile.
Jasperson, B.	Kingsville	Brick, Tile and Hollow Blocks.
Jervis & Son, John	Dorchester Station	Brick and Tile.
Jordan, D.	Chatham	Brick and Tile.
Koebel, Joseph Z.	St. Clements	Brick and Tile.
Kruse Bros.	Egmondville	Brick and Tile.
Kuhu, Henry J.	Crediton	Tile.
LabeY & Son, Geo. A.	Foxboro'	Tile.
Lindsay, Stephen	Wallaceburg, R.R. No. 2.	Tile.
Lowe, Jos.	Meaford, R. R. No. 1.	Tile.
Lowes, Gordon	Kent Centre	Brick and Tile.
MaeKay Bros.	Dutton	Brick and Tile.
McCredie & Reid	Belmont, R.R. No. 3.	Brick and Tile.
Marshall, W. W.	Woodstock	Brick and Tile.
Martin, David	Thamesville	Brick and Tile.
Middleton, Chas.	Wyoming	Tile.
Milton Pressed Brick Co., Ltd.	Milton	Pressed and Fancy Brick.
Miner, J. T.	Kingsville, R.R. No. 2.	Brick and Tile.
National Fire Proofing Co. of Canada, Ltd.		
New, Edward	Aldershot	Hollow Blocks.
	Hamilton	Brick.
Odell & Sons, Wm.	Ingersoll	Brick, Tile and Blocks.
Ollman Bros.	Hamilton	Brick.
Ontario Paving Brick Co., Limited	West Toronto	Brick.
Ott Brick & Tile Mfg. Co., Limited	Kitchener	Brick.
Ottawa Brick Mfg. Co., Limited, The	Ottawa	Brick.
Owen Sound Brick Co., Limited	Owen Sound	Brick.
Parks, H. W.	Dresden	Tile and Hollow Blocks.
Paxton & Bray	St. Catharines	Brick.
Pears & Son, James	Toronto	Brick.
Pembroke Brick Co., The	Pembroke	Brick.
Petty, Chas.	Cherrywood	Tile.
Phillips & Son, Thos.	Lucknow, R.R. No. 1.	Tile.
Phinn, Geo. E.	Lucan	Brick, Tile and Hollow Blocks.
Port Credit Brick Co., Limited, The	Port Credit	Common and Pressed Brick.
Price Estate, John	Toronto	Brick.
Provincial Brick & Tile Plant	Mimico	Brick and Tile.
Richardson & Son, James	Kerwood	Brick and Tile.
Sadler, F. L.	Dublin	Brick and Tile.
Sipprell, J. H.	Wilkesport	Tile.
Smith & Son, Alex.	Dutton, R.R. No. 2.	Brick and Tile.
Snelgrove & Teer	Beaverton	Brick and Tile.
Standard Brick Co., Ltd.	Toronto	Brick.
Sudbury Brick Co., Limited	Sudbury	Brick.
Sun Brick Co., Limited	Toronto	Fancy Brick and Hollow Blocks.

BRICK AND TILE PLANTS, 1918.—Continued.

Name.	Address.	Products.
Thompson Bros.	Essex	Brick and Tile.
Thornton, John	Perth	Brick.
Wagstaff, Chas.	Lindsay	Brick and Tile.
Waite, J. E.	Forrester's Falls	Brick and Tile.
Wallace & Son, R.	North Bay	Brick.
Warwick Brick Works	London	Brick.
Woodslee Brick & Tile Co.	Woodslee	Brick and Tile.
Wright, J. C.	Proton	Brick and Tile.

Pottery.—The manufacture of pottery is not increasing in Ontario, our native clays so far employed not being suitable for the manufacture of fine goods. Particulars were given in the Bureau's last Report¹ of the discovery of what appears to be a deposit of good refractory clay adapted to the making of chinaware and porcelain, at the foot of Long Portage, on the banks of the Mattagami river. Similar clays have been found on the Missanaibi and Abitibi rivers. Exploration has not yet shown whether these are separate and isolated deposits, or whether they are in any way connected. In any event, when transportation facilities have been provided, these clay deposits, which seem to be of large size, may play an important part in the industrial development of that part of Ontario.

Pottery to the value of \$88,275 was made last year. The business employed 22 workmen, who were paid wages amounting to \$22,061.

Following is a list of the operators:—

POTTERY MANUFACTURERS, 1918.

Name.	Address.
R. Campbell's Sons	Lock St. South, Hamilton.
J. Cranston Estate	216 Dundurn St. South, Hamilton.
Davis & Son, John	601 Merton St., Toronto.
Foster Pottery Company	Main St. West, Hamilton.

Sewer Pipe.—Three sewer pipe manufacturing companies sold last year sewer pipe having a value at the works of \$362,536. The actual production was a little less, stocks having been carried over from 1917. The number of employees was 171, and the wages paid them \$139,775.

The raw material for sewer pipe manufacture is the red-burning Medina shale, which is quarried at Waterdown and brought to the several works by rail. A typical analysis² of this shale is silica 65.04, alumina 16.14, ferric oxide 6.37, lime .80, magnesia 2.17, soda .64, potash 3.21, sulphur .12, loss by heat 5.98.

The list of manufacturers follows:—

SEWER PIPE WORKS, 1918.

Name of Company.	Location of Plant.	P.O. Address of Manager, etc.
Dominion Sewer Pipe Co., Ltd.	Swansea	Swansea.
Hamilton & Toronto Sewer Pipe Co., Ltd.	Hamilton	Hamilton.
Ontario Sewer Pipe Co., Ltd.	Mimico	Mimico.

¹Vol. XXVII, 1918, pp. 36, 37.

²Rep. Bur. Min., Vol. XV, 1906, pp. 116, 14.

Brick, Tile, Sewer Pipe and Pottery

The following table shows the comparative value of the output of clay products since the outbreak of the war. As will be observed, the production for 1918 was worth a little less than half that of 1914.

TABLE XIII.—VALUE OF CLAY PRODUCTS, 1914-1918.

Year.	Brick.		Pottery.	Drain Tile.	Sewer Pipe.	Total.
	Common.	Pressed, Fancy, Hollow Tile, etc.				
1914	\$ 2,336,207	\$ 894,384	\$ 25,720	\$ 277,530	\$ 571,756	\$ 4,105,597
1915	763,591	375,865	49,387	321,253	361,283	1,871,379
1916	509,559	495,895	87,025	275,471	216,749	1,584,699
1917	713,824	776,302	94,501	546,040	379,923	2,509,590
1918	665,454	592,286	88,275	309,899	362,536	2,018,450

Sand-Lime Brick.—The manufacture of this variety of brick, made by compressing sand and lime, sprang up a few years ago, growing out of the effort to procure a building material which could be produced and sold more cheaply than brick made from clay or shale. The quantity manufactured last year was less than in 1917, being 7,941 M as compared with 9,079 M. In value there was an increase of \$4,349, the selling price of the bricks having risen from \$9.60 per M to \$11.52. In 1918 the average price in the United States for "common" sand-lime brick was \$8.94 per M, and for "front" brick \$11.35 per M; corresponding prices in 1917 were \$7.54 and \$9.36 per M. These figures, it will be seen, are slightly lower than those for Ontario.

The list of operating plants is as follows, several works being idle, owing mainly to the difficulty in procuring labour:—

SAND-LIME BRICK PRODUCERS, 1918.

Name.	Location of Plant.	Address.
Hepworth Silica Pressed Brick Co.....	Hepworth	Hepworth.
Silicate Brick Co. of Ottawa, Ltd.....	278 Echo Drive, Ottawa..	Ottawa.
The Canada Sand Lime Pressed Brick Co..	Symes Rd., West Toronto	Toronto, 915 Keele St.
Willeox Lake Brick Co., Ltd.	Whitehurch tp.	Richmond Hill.
York Sandstone Brick Co., Ltd.	Gerrard St. and Victoria Ave., Toronto.	Toronto, 431 St. Clarens Ave.

Lime.—The number of lime-producing establishments is steadily decreasing, but the quantity of lime produced is not greatly reduced. This means that the small kilns which formerly figured largely in the production of lime are giving place to plants of greater capacity, and that considerable lime is being used for other than building purposes. One of these is in the manufacture of compounds such as "cyanamide," a nitrogenous fertilizer made by the American Cyanamid Company

at Niagara Falls. Another use for lime is in the refining of sugar, but in cases where the limestone is bought from an outside quarry, the lime is not included in the figures of production, since the stone has already been taken to account under its own proper heading.

Lime was made in 1918 to the extent of 2,650,285 bushels, valued at \$872,177. The corresponding figures for 1917 were 2,820,507 bushels, worth \$657,364, so that the average price of lime has risen from 23.3 cents per bushel in 1917 to 32.9 cents per bushel in 1918. Prices varied, but those plants conveniently situated for marketing their product were able to sell to the best advantage.

The number of employees was 287, who received in wages \$300,746, or at the rate of \$1,047.89 each. Fuel was used in burning the lime of a total value of \$237,427. Of this \$3,704 was for natural gas, \$21,794 was for wood, \$79,643 for coal, and \$132,286 for wood and coal. The smaller plants used wood almost exclusively. About 212,000 bushels of lime were converted into the hydrated form. This is done by the addition of sufficient water to satisfy the chemical affinity of quick lime for water. Hydrated lime is used in the same way as quick lime for all the purposes to which the latter is applied. Being in the form of powder, it can be mixed dry with other materials and thus has some advantage over quick lime. It is easier to handle than the latter, as it can be shipped in bags like cement. The price for hydrated lime is about the same as for quick lime, the water taken up by the former during conversion about counter-balancing the greater cost of manufacture.

Below are given the names of producers and the location of plants in Ontario which operated in 1918:—

LIME PRODUCERS, 1918.

Name of Owner or Company.	Location.
American Cyanamid Co.	Niagara Falls.
Annis, George	Orillia.
Beachville White Lime Co., Limited	Beachville.
Bergin, Patrick	Napanee.
Cameron, W. M.	Carleton Place.
Chalmers & Campbell	Owen Sound.
Chestnut, W. D.	Duntroon.
Christie, Henderson & Co., Limited	Puslinch, Kelso and Hespeler.
Contractors' Supply Co., Limited	Melville Junction and Teeswater.
Delta Lime Co., Limited	Delta.
Elora White Lime Co., Limited	Elora.
Flielers, Edward	Clarendon tp.
Gallagher Lime & Stone Co., Limited	Hamilton.
Harvey, E., Limited	Rockwood.
Higginson & Stevens	Hawkesbury.
Jamieson, J. M.	Porroster's Falls.
McTernan, John	Forbolton.
Marshall Lime & Cement Works, Jas.	Hamilton.
Parks Bros.	Froy.
Robertson Co., D., Limited	Milton.
Smith, John S.	Inverhuron.
Standard Chemical Iron & Lumber Co., Limited.	Eganville.
Standard White Lime Co., Limited	Beachville, Guelph and St. Mary's.
Toronto Brick Co., Limited	Coboconk.
Toronto Lime Co., Limited	Limehouse and Dolly Varden.
Toronto Plaster Co.	Teeswater.
Weppeler, Henry	Priceville, R.R. No. 1.

Portland Cement.—The cement industry shared in the general depression under which the manufacture of building materials laboured last year, and in consequence production was on a considerably lower scale. The number of barrels of cement marketed was 1,226,244, as compared with 2,063,231 barrels in 1917. Actual production of cement was somewhat less, namely, 1,138,980 barrels. In value, cement sales represented \$1,910,839, there being a rise in price at the works from \$1.42 to \$1.56, or 14 cents per barrel.

Of the six Ontario plants owned by the Canada Cement Company, Limited, only one, namely, plant No. 5, near Belleville, was operated during the year in the manufacture of cement. The company was largely engaged in the making of war munitions.

The number of employees last year was 425, as compared with 589 in 1917, and the wages paid were \$423,580.

PORTLAND CEMENT PLANTS, 1918.

Name of Company.	Location of Plant.	P.O. Address of Manager, etc.
Canada Cement Company, Limited, Plant No. 5.	Thurlow tp., near Belleville.	Herald Bldg., Montreal.
The Hanover Portland Cement Co., Ltd....	Hanover	Hanover.
National Portland Cement Co., Ltd.	Durham	Durham.
St. Mary's Portland Cement Co., Ltd.....	St. Mary's	St. Mary's.

At the following works no cement was made during the year: Canada Cement Company, Limited, Plant No. 4, Point Anne, No. 6, Marlbank, No. 7, Lakesfield, No. 8, Port Colborne, No. 9, Shallow Lake; Union Cement Company, Limited, Owen Sound; Ontario Portland Cement Company, Limited, Brantford; The Maple Leaf Cement Company, Limited, Atwood, and the Kirkfield Portland Cement Company, Limited. The last-named company went into voluntary liquidation 15th August, 1918.

Cement Products.—Portland cement has come to be largely used for the manufacture of field and culvert tile, building blocks, heads and sills, etc., thus displacing clay and stone. Its adaptability for other uses was shown during the war period by the construction of cement ships. The manufacture of cement products was not active in 1918, the building trade being depressed and labour scarce. In the natural gas districts, makers were deprived of the use of gas for fuel. For these reasons many plants were idle or did very little. Nevertheless, the output was greater in value than in 1917, being \$124,003, as compared with \$100,318. The number of employees was 72, and the amount paid in wages was \$25,901. On an average the plants operated 122 days in the year, being mostly closed in winter.

A feature of the business is the use of portable plants which are taken to the site of the construction work, thus saving transportation charges on the finished product.

Returns received show the following output for 1918:—

MANUFACTURE OF CEMENT PRODUCTS, 1918.

Product.	Number	Value.
Cement Brick.....	92,124	\$ 1,290
Cement Blocks	211,354	41,362
Cement Tile and Sewer Pipe.....	1,423,652	81,351
Total Value		124,003

The following list gives the names and addresses of manufacturers of cement products reporting to the Bureau of Mines:—

MANUFACTURERS OF CEMENT PRODUCTS, 1918.

Name.	Address.	Products.
Andrews, S. J.	Clinton	Blocks and Tile.
Begg, J. B.	Lindsay	Blocks and Tile.
Campbell, Neil F.	West Lorne	Tile.
Corlett, A. S.	Leamington	Brick.
de Jersey, O. W.	Forest	Blocks.
Deveney & Campbell	St. Mary's	Blocks and Tile.
Dillon, John	Seeley's Bay	Tile.
Fletcher & Sons, J. H.	Fonthill	Blocks.
Gillies, A.	Galt	Brick and Blocks.
Granite Concrete Block Co., Ltd.	Mt. Dennis	Blocks.
Gree, G. C.	Wallaceburg	Blocks and Tile.
Hewitt & Son, A. B.	Princeton	Tile.
Hyndman, Jno.	Gorrie	Tile.
Iler Concrete Tile Co.	Arner	Tile.
Karr & Rose	Petrolia	Tile.
Kilgour, D. G.	Eganville	Tile.
McLenaghan, W. A.	Essex	Blocks and Tile.
McQueen, Alex.	Arthur	Tile.
Malcolm, Jno.	Fergus	Tile.
Moore, D. G.	Ailsa Craig	Blocks and Tile.
Oil Springs Tile & Cement Co.	Oil Springs	Tile.
Ord, John A.	Guelph, R.R. No. 3	Tile.
Pfaff, W. E.	Hensall	Blocks and Tile.
Schram, A. J.	Camlachie	Tile.
Smith, A. G. C.	Acton	Blocks and Tile.
Taylor & Hall	Peterboro	Blocks and Tile.
Watts, Alfred	Tillsonburg	Brick, Blocks and Tile.
Williams, E. J.	Wheatley	Blocks and Tile.
Wyatt, W. J.	Cottam	Blocks and Tile.

Sand and Gravel.—These useful construction materials are found in abundance in most parts of Ontario, being in large part the result of the glacial activity which is so marked a feature of the geological history of the Province. Both igneous and sedimentary rocks have contributed to the sands and gravels. In consequence there is a wide range of products, both in composition, size of particles and the uses for which they are suited. In the beds of the great lakes and connecting rivers

are found many deposits of sand and gravel, and large quantities of both have been recovered by dredging or sand-sucking vessels, principally in the neighbourhood of the larger towns and cities along the border. The building trade of Detroit and Cleveland especially has drawn heavily on the gravels from the St. Clair river and the sand bars of Pelee Island and Point Pelee, and much material for construction works on the Welland canal has come from the north shore of lake Erie and also the mouth of the Niagara river in lake Ontario.

Volume XXVII of the Bureau's Reports, Part II, contains an account of the Sand and Gravel Deposits of the Province, arranged by counties. The author, Prof. Auguste Ledoux, a gallant soldier in the Belgian army which so heroically withstood the onrush of the German hosts in 1914, had covered the older part of the Province, and was investigating the newer portions when his sudden death on 7th August, 1918, put an end to the work.

From the returns sent in by 107 operators in sand and gravel it appears that the total quantity raised and marketed was somewhat under that of 1917, being 1,023,497 cubic yards in all, valued at \$553,638, an average of \$0.54 per cubic yard. In 1917 the quantity was 1,187,973 cubic yards, valued at \$431,597. The average price per cubic yard in 1917 was \$0.363 and in 1916 \$0.372.

Following is a list of sand and gravel operators who removed 1,000 cubic yards or more during the year:—

SAND AND GRAVEL OPERATORS, 1918.

Name of Owner or Company.	Material.	Address.
Armstrong Supply Co., Ltd., The.....	Gravel	Hamilton, 106 Dunsmere Ave.
Ashton, Thos.	Sand	Toronto, 1354 Queen St. E.
Barton Sand & Gravel Co., The.....	Sand and gravel..	Bartonville.
Baxter, Jas.	Gravel	Brownsville, R.R. No. 1.
Bellyou, Norman E.	Sand and gravel..	Trenton, R.R. No. 4.
Brantford Lands, Ltd.	Gravel	Brantford, 45 Market St.
Campbell, A.	Gravel	Strathroy.
Chapman, Walter	Gravel	Uxbridge.
Chatham Sand & Gravel Co.	Sand and gravel..	Chatham.
City of Brantford	Gravel	Brantford.
City of Peterboro	Gravel	Peterborough.
Creepcr, John	Sand and gravel..	Belleville, R.R. No. 5.
Dean, Harry F.	Gravel	Tillsonburg, R.R. No. 4.
Department of Public Highways, Ont....	Gravel	Toronto, Parliament Bldgs.
Downey & Sons, I. J.	Gravel	Sault Ste. Marie, Ont.
Empire Limestone Co.	Sand	Buffalo, N.Y., 19 Hudson St.
Fonthill Gravel Co., Ltd.	Sand	Fonthill.
Gillespie Est., J. M.	Sand	Perth.
Hale, J. M.	Gravel	Aylmer, Box 6.
Hamilton Sand & Gravel, Ltd.	Sand and gravel..	Hamilton, 508 Spectator Bldg.
Hansen, H. C.	Sand and gravel..	Cleveland, Ohio, 7325 Clinton Ave.
Kerr, Estate Jno.	Sand and gravel..	Petrolia.
Kilbourne & Son, Harvey	Sand	London, 5 Cove Road.

SAND AND GRAVEL OPERATORS, 1918.—*Continued.*

Name of Owner or Company.	Material.	Address.
Larter, Chas.	Sand	Galt, 76 Chalmers St.
Lyons Fuel & Supply Co.	Gravel	Sault Ste. Marie, Ont.
Maple Sand, Gravel & Brick Co.	Sand and gravel..	Toronto, 79 Spadina Ave.
Marine Contracting Co.	Gravel	Port Huron, Mich.
Markus, Wm., Ltd.	Gravel	Pembroke.
McAuley, P. L.	Gravel	Trenton, R.R. No. 4.
McLean & Sons, A. B.	Gravel	Sault Ste. Marie.
McMurray, Geo.	Sand and gravel..	Tamblings Corners.
McPhail & Wright Construction Co.	Sand	Sault Ste. Marie.
Ollman Bros.	Sand	Hamilton, Macklin St.
Oneida Lime Co., Ltd.	Sand	Buffalo, N.Y., 406 Erie Co. Bank Bldg.
Ontario Gravel Freighting Co., Ltd.	Gravel	Windsor.
Ontario Malleable Iron Co., Ltd.	Sand	Oshawa.
Pelce Island Sand & Gravel Co.	Gravel	Cleveland, Ohio.
Ponsford, A. E.	Sand and gravel..	St. Thomas, 605 Talbot St.
Reid, C. F.	Sand and gravel..	Odessa, R.R. No. 1.
Rideau Canal Supply Co.	Sand and gravel..	Ottawa.
Roesand Company, Ltd.	Sand and gravel..	Toronto, 407 Lumsden Bldg.
Sand & Supplies, Ltd.	Sand and gravel..	Toronto, 19 Melinda St.
Sarjeant Co., Ltd., The	Sand and gravel..	Barrie.
Standard Gravel Co., Ltd.	Gravel	Niagara Falls, Ont.
Sleemon, Philip	Gravel	Port Hope.
Smith, J. W.	Sand and gravel..	Leamington.
Taylor Gravel Pit	Gravel	Rodney.
Twin City Tug Line	Sand	Port Arthur, Box 42.
United Fuel & Supply Co.	Sand and gravel..	Detroit, Mich., Free Press Bldg.
Whiting & Son, R.	Sand and gravel..	Copleston.
Windsor, Essex & Lake Shore Ry. Co.	Gravel	Kingsville.
Windsor Sand & Gravel Co., Ltd., The.	Sand and gravel..	Walkerville.
Wood, John T.	Sand and gravel..	Exeter.
York Sand & Gravel Co., Ltd.	Sand and gravel..	Toronto, 1327 Bloor St. W.

Stone.—Quarry operations last year were principally in limestone and quartz, the latter of which is dealt with separately. Trap and granite were also produced on a smaller scale, but sandstone was almost entirely neglected. The closing of the quarries at Credit Forks had no doubt much to do with the latter feature.

The limestone was for building purposes, either as dressed stone or crushed for use in concrete, or for flux, lime-burning, chemical manufacture, etc., while the trap and granite were mainly utilized in making roads.

The value of the stone raised last year was \$869,239, which is \$69,813 less than in 1917. Employees numbered 631 and \$478,070 was paid out in wages.

Classified according to variety, the quarry products of the Province for 1918, together with comparative values from 1915 to 1918 inclusive, were worth as follows:—

TABLE XIV.—STONE PRODUCTION, 1915-1918.

Year.	Limestone.	Sandstone.	Trap.	Granite.	Marble.	Quartz.
1915.....	\$ 587,000	\$ 5,500	\$ 32,100	\$ 15,500	\$ 10,600	\$ 142,354
1916.....	625,628	14,268	91,762	23,655	.....	223,514
1917.....	728,975	115,932	70,570	25,575	.....	358,674
1918.....	820,985	145	24,774	23,334	.....	452,711

Below are given the names of quarry operators reporting a production for 1918, classified according to product:—

LIMESTONE AND SANDSTONE QUARRIES, 1918.

Name of Owner, Firm or Company.	Location.	Kind of Stone.
Beachville White Lime Co., Limited.....	Beachville	Limestone.
Bergin, Patrick	Napanee	do
Bolender Bros.	Haliburton	Ground Limestone, Poultry grit.
Brunner, Mond Canada, Ltd.	Amherstburg	Limestone.
Canada Cement Co., Ltd.	Thurlow tp.	Limestone.
Canada Crushed Stone Corporation, Limited.	Dundas	Limestone and Sand- stone.
Contractors' Supply Co., Limited.....	Orangeville	Crushed Limestone.
Cook, J. S.	Warton	Limestone.
Crushed Stone, Limited	Kirkfield	Crushed Limestone.
Dept. of Public Highways	Toronto	Limestone.
Elmsley S. Twp.	Elmsley S. tp.	do
Farr, Mrs. C. C.	Haileybury	do
Hagersville Crushed Stone Co., Limited...	Hagersville	do
Hamilton, Corporation of	Hamilton	do, crushed.
Hildreth, Chas.	Barton tp.	do
Kingston, Corporation of	Kingston	do, crushed.
Longford Quarry Co., Limited	Longford Mills	do
Markus, Wm., Ltd.	Pembroke	do
Michigan Central Railway	Hagersville	do
Oliver-Rogers Stone Co., Limited, The....	Owen Sound	do
Ontario Stone Corporation, Limited	Ulthoff	do
Peters Coal Co.	Coldwater	do
Point Anne Quarries, Limited	Point Anne	do
Queenston Quarry Co., Limited	St. Davids	do
Quinlan & Robertson, Ltd.	Crookston	do
Reid, C. F.	Odessa	do
Renfrew, Town of	Renfrew	do
Robertson, D., & Company, Limited	Milton	Sandstone.
Robillard, H., & Son	Ottawa	Limestone.
Roddy & Monk	Kingston	do
St. Marys Horse Shoe Quarry, Limited....	St. Marys	do
Standard White Lime Co., Limited	Beachville, Guelph and St. Marys	do
Walker Bros.	Thorold	do
Wendland County Lime Works Co., Limited..	Port Colborne	do
Wentworth Quarry Co., Limited	Vinemount	do

GRANITE AND TRAP QUARRIES, 1918.

Name of Owner, Firm or Company.	Location.	Kind of Stone.
Brown, Robert	Lyndhurst	Granite.
Bruce Mines Trap Rock Co., Limited.....	Bruce Mines	Trap.
Horne, Wm.	Ignace and Butler	Granite Blocks and Monuments.
National Potash Corporation, Limited	Gravenhurst	Crushed Granite.
Ontario Rock Co., Limited	Prenevean	Trap.
Tillson Quarries	Nepean tp., Carleton co..	Granite.

Quartz

A very considerable quantity of silica or quartz was quarried in 1918, practically all of it for metallurgical use.

The Dominion Mines and Quarries, Limited, operated a deposit on East Neebish island near Sault Ste. Marie and shipped by boat during the season of navigation. The product of this quarry contains about 98 per cent. silica, and is used in the manufacture of ferro-silicon at Buffalo, N.Y.

Electro-Metals, Limited, Welland, also manufacture ferro-silicon, and got a like quality of quartz from their quarry near Killarney on the north shore of Georgian bay. This property was formerly owned and worked by Willmott and Company of Toronto.

The International Nickel Company of Canada require a large quantity of silica in their smelting plant at Copper Cliff, where the nickel-copper ores of Sudbury are reduced to the form of matte. Their supply is obtained from a quarry in the township of Dill owned and operated by the Company itself.

McPhail and Wright Construction Company, Limited, of Sault Ste. Marie, worked a silica deposit at Mile 21 on the Algoma Central railway, and shipped the product to the furnaces of the Algoma Steel Corporation at Sault Ste. Marie.

In the feldspar quarries near Verona on the Kingston and Pembroke railway dikes of nearly pure quartz are occasionally encountered. This quartz is extracted separately. A small quantity of the material was shipped last year from the stock piles of the Kingston Feldspar and Mining Company, Limited.

The Mond Nickel Company, Limited, obtain the necessary silica for their smelting operations at Coniston from the old Bruce mines, which is now owned by the company. The ore is exceedingly silicious, and has the advantage of carrying a small percentage of copper. Great piles of tailings, or "skimpings," as they were locally termed, formerly existed at these mines, the remains of by-gone mining and ore-dressing operations. These were used as a source of silica by the Mond company until they were exhausted. Parts of these "skimpings" heaps carried as much as two per cent. of copper.

The quantity of quartz raised and shipped to market in 1918 was 213,420 tons, valued at \$452,711. The number of men employed in the industry was 207, and the wages paid them \$187,635. In 1917 the quartz production amounted to 176,993 tons and the value was \$358,674. The average price at which the output of 1917 was appraised was \$2.02 per ton, and of 1918, \$2.12 per ton.

Appended is a list of the companies operating quartz quarries during 1918:—

QUARTZ QUARRIES, 1918.

Name of Owner, Firm or Company.	Location.	P.O. Address of Manager, etc.
Canadian Copper Company ¹	Dill tp.	Copper Cliff.
Dominion Mines and Quarries, Limited....	Port Neebish.....	Sault Ste. Marie, Mich.
Electro-Metals, Limited	Killarney	Welland.
International Nickel Company of Canada, Limited	Dill tp.	Copper Cliff.
Kingston Feldspar & Mining Company....	Verona	Kingston.
McPhail & Wrigat Construction Co., Ltd....	Mile 19¾ A. C. Ry.....	Sault Ste. Marie.

¹The Canadian Copper Company operated for the first three months of the year when it was taken over by the International Nickel Company of Canada, Limited.

Actinolite

There was no actual mining of actinolite in 1918, but the plant of the Actinolite Mining Company, Limited, at Actinolite, was operated for about two weeks, and a small quantity of material was ground and shipped to the United States. The product is used largely in making roofs, and also as an ingredient in certain forms of paint. For such purposes its fire-resisting qualities make it useful.

Barite

The only commercial production of barite last year was by Premier Langmuir Mines, Limited, from a deposit in the township of Langmuir, in the Porcupine area. This company has erected a mill for grinding and preparing for market the contents of a large barite vein which traverses the property. The mill was completed and equipped shortly before the close of navigation in 1918, and one shipment of about 60 tons of the product was made. The plant is distant about half a mile from the Night Hawk river, a barge on which conveys the material to the crossing of the river by the branch line of the Timiskaming and Northern Ontario railway at Connaught station.

Other deposits of barite in northern Ontario are in the townships of Yarrow, Cairo and Lawson. A vein of barium sulphate was discovered last year by Russell Cryderman, of Sudbury, in the township of Penhorwood, about 150 miles northwest of Sudbury, and two and one half miles west of Trompage station on the Canadian Northern railway. It lies close to the railway track.

Some development work was done by T. B. Caldwell on a barite prospect in the township of Levant, in the county of Lanark. In the township of Portland, on lot 5 in concessions eight and nine, during the working of a feldspar deposit, about 200 tons of inferior barite were extracted by Mica Products, Limited, but no shipments were made. Deposits are known to occur elsewhere in eastern Ontario, for instance in the townships of Bathurst (lot 25, concession one), Oso, and North Burgess (lot 20, concession ten). During May and June, 1918, H. C. Bellew, of Montreal, sank a number of pits on the last mentioned property and traced the vein a considerable distance. Analyses showed 98.9 to 99.27 per cent. of barium sulphate.

While not a mineral of first-class importance, barite has a large variety of uses, particularly in the manufacture of paper, paint and rubber goods.

Corundum

The quantity of crude corundum raised during the year was 1,029 tons, and the quantity of refined or grain corundum shipped to market was 137 tons. The only company operating was the Manufacturers Corundum Company, Limited, whose mines and works are situated at Jewelville. Work was discontinued during the year.

Feldspar

There was an increase in the output of feldspar last year over the year before of 1,450 tons and in value of \$30,071. The production of 1918 was 19,784 tons, worth at the quarry \$111,173, or \$5.61, while in 1917 the value was \$4.45 per ton, and in 1916, \$3.25. The quantity of feldspar raised was 24,691 tons, so that there was a considerable stock on hand at the close of the year.

The bulk of the production was from the quarries along the line of the Kingston and Pembroke railway, in the vicinity of the village of Verona. The product of these quarries is in demand by the large pottery makers of East Liverpool, Ohio, and Newark, New Jersey, and most of the output has been exported to these places. Feldspar is a very common mineral as a rock constituent, but the occurrence of large masses sufficiently large for quarrying operations is less common.

There has been an intermittent production in certain parts of Parry Sound district, and the National Potash Corporation has erected a plant at Muskoka Wharf, near Gravenhurst, for the production of crushed rock and the extraction of potash from a feldspar dike. The plant has not yet got into successful operation for the latter purpose. A little feldspar has also been taken out near Markstay, which is on the main line of the Canadian Pacific railway east of Sudbury.

The workmen engaged in the production of feldspar numbered 138, and their wages amounted to \$100,302.

The companies shipping feldspar in 1918 were as follows:—

FELDSPAR PRODUCERS, 1918.

Name.	Location of Deposit.	P.O. Address.
Canada Feldspar Corporation, Ltd.....	Verona	Toronto, 168 Madison Ave.
Crystal Products, Ltd.	Godfrey	Toronto, 319 Dominion Bank Bldg.
Dominion Mica Mining Company, Ltd...	McConkey tp.	Detroit, Mich., 1268 Penobscot Bldg.
Donnen Feldspar Company, Limited....	Markstay	Ottawa, P.O. Box 2.
Eureka Flint & Spar Co., The.....	Verona	Trenton, N.J.
Feldspars, Limited	Bedford tp.	Godfrey.
Feldspar Quarries, Limited	Portland tp.	Toronto, 15 Manning Arcade Annex.
Mendels, J. H.	Bathurst tp.	Perth.
National Potash Corporation, Limited..	Gravenhurst	Toronto, 178 Spadina Ave.
Richardson, H. W.	Verona	Kingston, 243 King St. East.

Fluorspar

There was a strong demand for fluorspar last year, and prices ruled high. The result was a decided increase in the production in comparison with 1917, the output being 7,286 tons, as against 4,327. There was also an increase in value, the total for 1918 being \$153,190, while for 1917 it was \$66,474. The average price per ton, which in 1916 was \$7.90, increased in 1917 to \$15.13 and in 1918 to \$21.02.

The main use of fluorspar is as a flux in the making of steel; a minor one is in hydrofluosilicic acid for electrolysis. All the production so far has been from the deposits in the townships of Huntingdon and Madoc in the county of Hastings, where there are numerous occurrences. A map showing the same will be found in Vol. XXVII of the Bureau's Reports, 1918, at page 137, and the several workings are described in this Report under Mines of Ontario. The greater part of the tonnage raised in 1918 was shipped to Hamilton, Welland, Toronto and other points in Ontario, but a portion was exported to the United States.

The number of men employed in the fluorspar mines was 129, and the wages paid them amounted to \$85,783.

Following is a list of the operators:—

FLUORSPAR PRODUCERS, 1918.

Name.	Location.	Address.
Canadian Fluorite, Ltd.	Madoc	Madoc.
Canadian Industrial Minerals, Ltd.	Huntingdon and Madoc tps.	Toronto, 1511 Bank of Hamilton Bldg.
Cross & Wellington	Lot 11, Con. XIII, Huntingdon.	Madoc.
Dwyer, P. J.	Wilberforce	Wilberforce.
Gillen & Henderson	Lot 7, Con. XIII, Huntingdon.	Madoc.
Mineral Products, Limited	Lot 2, Con. IV, Madoc	Madoc.
O'Reilly Company	Lot 6, Con. I, Madoc	Madoc.
Usborne, H. L.	Lots 1 and 4, Con. I, Madoc.	Toronto, 30 Sun Life Bldg.
Wallbridge, Mrs. Jane	Lot 4, Con. I, Madoc	Madoc.
Wellington & Munro	{ Lot 13, Con. XII, Huntingdon. Madoc.	
	{ Lot 1, Con. I, Madoc	Madoc.

Graphite

The production last year was 2,934 tons, of which 1,040 tons were shipped as crude, and the remainder after refining into flake and foundry grades. The combined value was \$208,848. Ontario graphite finds a market mostly in the United States.

Two companies only were mining and milling graphite last year, namely, Black Donald Graphite Company, Limited, whose mine is situated on the shores of Whitefish lake in the township of Brougham, and whose shipping point is Calabogie on the Kingston and Pembroke railway; and the Globe Graphite Mining and Refining Company, Limited, whose mine and refinery are at Port Elmsley, on the Rideau canal, and main office at Syracuse, N.Y.

A third company, the Timmins Graphite Mines, were engaged in developing a new property in the fifth and sixth concessions of the township of North Burgess.

A 200-ton mill was erected and the machinery installed in the early part of 1919. The Spearman process of refining will be adopted.

National Graphite, Limited, put up a mill at Orser siding, near Mumford station, Irondale, Baneroft and Ottawa railway. The Spearman refining process was installed, and the mill began operations in January, 1919. Further particulars will be found in this Report under Mines of Ontario.

The refining of graphite has offered a good many difficulties in the past, and methods adopted have in some cases given unsatisfactory results. The effort is to produce as large a percentage of "flake" as possible, this being the most valuable grade, largely used in the making of crucibles for steel smelting. At the same time, it is necessary to remove the impurities accompanying the ore, such as rock matter, pyrite, mica, etc., flake for crucible-making being required to contain 85 or 90 per cent. of carbon. The buhr stone, pneumatic jig, electrostatic separator, and other appliances have been used with greater or less success, and more recently the flotation process has been introduced. In the selection of a process regard must be had to the physical characteristics of the ore and the nature of the crude flake. It will probably be found that a combination of methods suited to the particular ore will give the best results.

Hitherto a large part of the best flake graphite has been supplied by Ceylon. Difficulties in transportation due to the war have lessened exports from that island, and in the meantime deposits in Madagascar have been developed on a considerable scale, so that the Madagascar product has become a strong competitor with that of Ceylon. The principal market for Ceylon graphite is the United States, but in 1918 the exports to that country were only 8,409 tons, as compared with 21,963 tons in 1917. Great Britain's imports, on the other hand, increased from 4,600 tons in 1917 to 6,386 tons in 1918. In the United States itself numerous deposits of graphite have been found in Alabama, and during the scarcity of foreign supplies, the graphite industry of that State made a rapid development.

The number of workmen employed in graphite mining and milling was 128, and the wages paid them were \$102,777.

Following is a list of graphite operators active during the year:—

GRAPHITE OPERATORS, 1918.

Company.	Location of Mine.	P.O. Address.
Black Donald Graphite Co., Limited	Brougham tp.	Calabogie.
National Graphite, Limited ¹	Monteagle tp.	Toronto, 1304 Royal Bank Building.
The Globe Graphite Mining and Refining Co., Limited	Port Elmsley	Syracuse, N.Y., U.S.A., 410 Dillaye Building.
The Timmins Graphite Mines	Stanleyville	Stanleyville.

¹200-ton refinery under construction.

Gypsum

From the gypsum deposits in the valley of the Grand river there were mined a total of 39,397 tons. Shipments of crushed, ground, calcined and manufactured

gypsum amounted in all to 38,214 tons, valued at \$151,564, the output being 10,729 tons less in quantity and \$21,426 more in value than in 1917. The market was in Ontario, Quebec and Nova Scotia.

The Ontario Gypsum Company, Limited, of Caledonia, was the only producer in 1918. This company's mines are at Caledonia and its manufactory at Paris. In the latter a large variety of products, such as wall plaster, kalsomine, bug finish, etc., are made.

The mines and works of Grand Gypsum, Limited, situated on lot 45 in the first concession of North Cayuga, were not in operation. The secretary-treasurer of this company is Walter Anderson, 445 King St. East, Hamilton.

Iron Pyrites

Eastern and northwestern Ontario deposits were in operation in 1918, the total shipments being 270,966 tons, valued at \$1,144,737. The output in 1917 was greater in quantity by 21,426 tons and less in value by \$33,473, the average value per ton being \$3.88 in 1917 and \$4.22 in 1918. Of the production 240,807 tons were exported to the United States, and 30,159 tons went to acid plants in Ontario. The number of employees was 621, to whom were paid wages amounting to \$707,020.

The principal use of iron pyrites is in the manufacture of sulphuric acid, which is indispensable in the chemical industry. After roasting off the sulphur the residue is practically iron ore, and can be used as such for the making of pig iron. In the huge manufacture of explosives for purposes of the war, immense quantities of sulphuric acid were required, both in the United States and Canada, and during the four years beginning in 1915, not less than 877,923 tons of iron pyrites were extracted in Ontario, most of which was exported to the United States.

The pyrite resources of Ontario are very large, and can easily supply any demand likely to be made upon them. The ore exported comes in the main from the mines of the northwestern part of the Province, where the principal producing company during the period of the war was the Nichols Chemical Company. This company's mines are at Northpines, Goudreau and Mokomon, the last-named not yet having begun production.

From the stock pile at Wawa there was shipped a considerable tonnage of the fine granular pyrite found in the Helen iron mine. The Rand Consolidated Mines, Limited, also operated a deposit at Goudreau near those of the Nichols Company.

In the eastern part of Ontario, the Nichols Company owns and operates the pyrite mine and acid plant at Sulphide.

The Grasselli Chemical Company also manufactures sulphuric acid at Hamilton, and supplied its requirements in part from its own newly opened Caldwell mine at Clyde Lake in the township of Blithfield, but chiefly from the deposits of the Canadian Sulphur Ore Company, Limited, and Rand Consolidated Mines, Limited, at Queensboro and Goudreau respectively.

At Trenton the British Chemical Company operated a plant for the manufacture of war munitions, and made on the premises the sulphuric acid required, the pyrite being obtained from Canadian Sulphur Ore Company.

The ore marketed last year varied a good deal in sulphur contents, the extremes being 29 and 49 per cent. On the average, it ran between 35 and 36 per

cent. Considerable free or elemental sulphur from the United States was used in the acid plants of the Province in addition to pyrite.

A possible use for native pyrite is in the pulp and paper mills of northern and other parts of Ontario, which now exclusively use imported elemental sulphur. On the other hand, part of the pyrite imported from Ontario by the United States is used in the pulp and paper plants of that country.

Below is the list of producers of iron pyrites in 1918:—

IRON PYRITES SHIPPERS, 1918.

Name of Owner, Firm or Company.	Location or Name of Mine.	P.O. Address of Manager, etc.
Algoma Steel Corporation, Limited.....	Helen	Sault Ste. Marie.
Canadian Sulphur Ore Company, Limited..	Queensboro	Toronto, Crown Office Building.
Bannockburn Pyrite Mining Co.	Mundie	Bannockburn.
Crownshield, A. H.	Craig	Toronto.
Grasselli Chemical Co.....	Caldwell	Flower Station.
Nichols Chemical Co., Limited, The.....	Goudreau	Goudreau.
	Sulphide	Sulphide.
	Vermilion Lake	Northpines.
Rand Consolidated Mines, Limited	Goudreau	Buffalo, N.Y., 853 Ellicott Square.
Stranahan Pyrites Co.	Fort Frances	65 Wall St., New York.
Sheffield Molybdenite Mining Co.	Chisholm	Enterprise.
Whalen, James	Lake Mimitaki.....	Port Arthur.

The acid manufacturing plants were:—

MANUFACTURERS OF SULPHURIC ACID, 1918.

Name.	Location of Plant.	Address.
British Chemical Company	Trenton	Trenton.
Grasselli Chemical Company	Hamilton	Hamilton.
Nichols Chemical Company	Sulphide	Montreal.

Mica

The characteristic mica of Ontario and Quebec is the amber variety, or phlogopite. Black mica, or biotite, and white mica or muscovite, are also found, but the deposits are comparatively of little commercial importance. Frontenac, Lanark and Leeds counties have produced most of the mica obtained in this Province, but merchantable mica has of late years been found and worked in Parry Sound and Nipissing districts.

There is more or less difficulty in collecting the statistics of mica production. When the demand is good, considerable mica is collected by farmers from their own lands, who dispose of it to local dealers, and of whose operations it is almost impossible to obtain a satisfactory report. Part of the mica obtained by regular mining is shipped to splitting works in the rough-cobbed form, and part is cleaned and trimmed on the spot.

The larger sizes of mica bring a much higher price per pound than the smaller sizes, but of late years the practice has come extensively into use of using the small sizes in building up so-called "micanite" sheets composed of mica and shellac, which can be cut and shaped to suit requirements. The chief use of mica is for insulation purposes in the manufacture of electrical machinery, mica being largely impervious to the electric current. Stains, cracks and inclusions reduce the value.

The amber variety is superior to the black, because of its greater resistance to the electric current, the iron content of biotite unfitting it for use in electrical apparatus. As compared with the white or muscovite variety, it is more flexible and not so hard, and consequently not liable to break or split when being bent or shaped. In thin-splitting quality it is the equal of either.

The production last year amounted to 275 tons, valued at \$49,575. Of this the larger portion was "rough-cobbed" mica, disposed of to trimming works, where it is reduced in weight and at the same time increased in value, by being freed from rock, and cut and graded according to size. The output in 1917 was 435 tons, valued at \$92,453.

The principal producers were the Loughborough Mining Company, Limited, owners of the well-known Lacey mine in Loughborough township, and Kent Bros. and Estate of J. M. Stoness, who worked deposits in the township of Bedford. The first-named company also purchased considerable "thumb-trimmed" mica from local producers and dealers.

Near Kearney, in the district of Parry Sound, Robert Elliott got out a quantity of amber mica, two crystals being of exceptional size. They measured 20 by 24 inches, and weighed 1,600 pounds.

The Finlan mine is situated on lot 7 in the first concession of Davis, Nipissing district. It was worked by D. Finlan and the firm of Clarke and Lounsbury, North Bay, in partnership, and a considerable quantity of mica obtained which was cut and sold for stove fronts. A little white mica was also won by Harry Kraft near Burk's Falls, Parry Sound.

The list of producers follows:—

MICA PRODUCERS, 1918.

Name of Owner or Producer.	Location or Name of Mine.	P.O. Address of Manager, etc.
Adams, J. H.	N. Burgess tp.	Perth.
Elliott, Stinson & Murphy	Kearney	Wilberforce.
Finlan, Clarke & Lounsbury	Davis tp.	North Bay.
Grierson & Sons, John K. ....	.....	Perth.
Hoffman, W. J.	Lount tp.	Sundridge.
Kent Bros. and Estate J. M. Stoness.....	Bedford tp.	Kingston.
Kraft, Harry N.	Burk's Falls.....	Perth.
Loughborough Mining Co., Ltd.	Lacey mine	Sydenham.
McLaren, W. L.	North Burgess tp.....	Perth.
Orser, S. H.	North Burgess tp.....	Perth.
Tory Hill Marble & Mica Co.	Glamorgan tp.	Tory Hill.
Winning & Boyd .....	.....	Ottawa, 90 Booth St.

Mineral Water

The only pure water is that which is distilled from the clouds and falls in the form of rain. Immediately upon reaching the ground it begins to take up, usually in minute quantity, the soluble substances with which it comes in contact. In consequence, all drinking water, whether procured from springs, wells, streams or lakes, contains more or less mineral matter. The presence of such ingredients distinguishes "hard" water from "soft," and renders it more agreeable to the taste. Waters more heavily charged with mineral substances and possessing medicinal or curative properties, are classed as mineral waters. The use of these is extensive and of long standing. Compounds of lime, magnesium, sodium and alkalies generally, also sulphur, carbonic acid and iron are common constituents in mineral waters, and the chemical composition largely determines the therapeutic or other use to which they are put. Heated waters rising from the ground generally contain a larger proportion of mineral matter than cold, and hence are frequently used for bathing purposes. Again, water only slightly mineralized may be used for drinking, with little or no reference to its medicinal properties, if any.

In some cases the waters are shipped from the spring in bulk and bottled elsewhere.

Owing to the war and the scarcity of labour, sales of mineral water in 1918 were much less than in pre-war times. The total quantity sold, as appears from the returns of those engaged in the business, was 298,498 imperial gallons, valued at \$133,808. One company complains: "The passing of the prohibition laws killed the mineral water trade."

Following is a list of firms and companies producing mineral water in 1918:—

SHIPPERS OF MINERAL WATERS, 1918.

Producer.	Location of Wells or Springs.	Brand of Water.	P.O. Address of Manager, etc.
Allan's, Limited	Caledonia Springs ..	Caledonia Water..	86 Dorchester St. W., Montreal.
Belanger, Arthur	North Plantagenet, George Lake.	St. George	Papineauville.
Borthwick, W.	Gloucester tp.	Borthwick	18 Fourth Ave., Ottawa.
Caledonia Springs Co., Ltd., The	Caledonia Springs and Bourget.	Magi, Duncan Adanae.	360 Craig St. E., Montreal.
Carlsbad, Limited, The	Carlsbad Springs ...	Magi, Carlsbad, Lithia.	Carlsbad Springs.
Gillan, W. J.	Pakenham	Dominion	Pakenham, R.R. No. 4.
Gurd & Co., Limited, Charles.....	Caledonia tp.	Gurd's Caledonia Water.	76 Bleury St., Montreal.
Lyall, Trenholme & Macdonnell...	Caledonia Springs ..	Beaver Brand Caledonia Water.	Montreal West.
Maple Leaf Aerated Water Co. ...	Caledonia Springs ..	Maple Leaf Water	Hawkesbury.
Sanitaris, Limited	Pakenham tp ..	Sanitaris	Amprior.

Natural Gas

The production of natural gas in 1918 was 13,075 million cubic feet,¹ valued at \$2,498,769, a heavy fall from the output of 1917, when it was 20,026 million cubic feet, worth \$3,220,123.

The gas fields of the Province are situated on the north and east shores of lake Erie, the oldest being the one in Welland county and adjacent territory, and the newest and most productive in the county of Kent. Natural gas is of much importance to the people of the southwestern peninsula, and has given rise to some unusual conditions in the social and economic life of that part of the Province. The questions involved are dealt with at greater length in following pages, and particularly in the Report of the Natural Gas Advisory Board.

The following figures show the work done and the results obtained in the gas fields during 1917 and 1918. The reasons for the much smaller output in the latter year are explained elsewhere.

TABLE XV.—NATURAL GAS STATISTICS, 1918.

	1917	1918
Gas wells drilled in year:		
Productive	121	66
Non-productive	52	31
Producing wells at end of year	1,905	1,849
Miles of pipe line	2,925 (a)	3,328 (a)
Workmen employed	780	872
Wages for labour	\$537,946	\$540,339
Gas production:		
Quantity (M. cu. ft.)	20,025,699	13,075,742
Value	\$3,220,123	\$2,498,769

(a) Including pipe lines of distributing companies.

The following producers of natural gas reported an output for 1918:—

NATURAL GAS PRODUCERS, 1918.

Name of Person or Company.	Producing Wells, Dec. 31, 1918.	Township.	P.O. Address of Manager, etc.
Aikins, W. J.	1	Onondaga	Dunville.
Aldrich Gas & Oil Co., Limited....	10	Rainham	Merchants Bank Bldg., Hamilton.
Azoff Natural Gas Co., Limited....	1	N. Cayuga	Canfield.
Battle Natural Gas Co.	8	Moulton	Sun Life Bldg., Hamilton.
Bertie Natural Gas Co., Limited....	8	Bertie	Ridgeway.
Brown, W. G.	1	.....	Cainsville.

¹ These figures are slightly greater than those given by G. R. Mickle on page 68. The reason for this is that there are numerous small producers whose output, not being taxable, is not included in the latter's returns.

NATURAL GAS PRODUCERS, 1918.—Continued.

Name of Person or Company.	Producing Wells, Dec. 31, 1918.	Township.	P.O. Address of Manager, etc.
Canadian Gas Co., Limited	43	Raleigh, Romney, Tilbury E.	1426 Dime Bank Bldg., Detroit, Mich.
Canadian Steel Foundries, Limited.	8	Crowland	Thorold.
Canfield Natural Gas Co., Limited..	3	N. Cayuga	Canfield.
Chippawa Development Co., Ltd. . .	8	Willoughby	Chippawa.
Chippawa Oil and Gas Co., Limited.	40	Caistor, Canboro and Cayuga	Tavistock.
Coleman, J. A.	4	Wainfleet	Wellandport.
Darling Road Co-operative Gas Co.	6	Canboro, N. Cayuga.	Canfield.
Dominion Natural Gas Co., Ltd....	776	Lincoln, Wentworth Elgin, Norfolk and Haldimand (counties)	838 Marine Trust Co. Bldg., Buffalo, N.Y.
Beaver Oil & Gas Co., Ltd. ¹	23	Romney & E. Tilbury	do
Glenwood Natural Gas Co., Ltd. ¹	78	Raleigh, Romney & E Tilbury	do
United Gas Companies, Ltd. ¹	44	Gainsboro, Moulton & Wainfleet	do
Dunegan Oil & Gas Co.	1	.....	Chatham.
Dunn Natural Gas Co., Limited....	19	Dunn	Dunnville.
Eastside Gas Co., Limited.....	6	Sherbrooke	Lowbanks.
Emerson, Troughton & Laidlaw....	4	Canboro	Attercliffe Station.
Empire Limestone Co.	4	Humberstone	19 Hudson Street, Buffalo, N.Y.
Fairbank, J. H., Estate of.....	1	Enniskillen	Petrolia.
Fletcher, J. I.	1	Binbrook	Hannon, R.R. No. 1.
Fisherville Gas Co., Nos. 1 & 3...	2	Rainham	Fisherville.
Gas & Oil Co. of Springvale, Ltd..	2	Walpole	Hagersville, R.R.No.4.
Hager, Ham	1	Onondaga	Middleport.
Hamilton Gas & Oil Co., Limited..	6	Seneca	Hamilton.
Hart & Harrington	2	.....	.....
Hendee Natural Gas Co.	6	S. Cayuga	Cayuga.
Hoover, D. E.	1	Rainham	Selkirk.
Industrial Natural Gas Co., Ltd...	29	Bertie, Crowland and Humberstone	Thorold.
Jones, James S.	3	Dunn	Port Maitland.
Jones, Nelson	2	Canboro, Moulton ..	Attercliffe Station.
Kindy Gas Co., Limited	6	Rainham	South Cayuga.
Kindy & Sons, D.	5	Rainham	Selkirk.
Kohler, May & Hoover	14	Canboro	Selkirk.
Lalor, F. R.	5	Moulton	Dunnville.
Lalor & Vokes	10	Walpole	Dunnville.
Lamb, Alfred	4	Walpole	Selkirk.
Liesinger-Lembke Co.	1	Humberstone	Buffalo, N.Y.
Marshall, Jas.	11	Glanford, Seneca ...	Hamilton.
Martin, Edward	2	Dunn	Dunnville.
May, A. G.	3	Walpole	75 Melrose Ave., Hamilton.

¹ Subsidiary Company controlled from the head office of the Dominion Natural Gas Company, Limited, 838 Marine Trust Co. Building, Buffalo, N.Y.

NATURAL GAS PRODUCERS, 1918.—Continued.

Name of Person or Company.	Producing Wells, Dec. 31, 1918.	Township.	P.O. Address of Manager, etc.
McKillop, Kohler, May & Hoover Syndicate	4	Canboro	Selkirk.
Medina Natural Gas Co., Limited..	24	Bayham	Chatham.
Mickle, Geo. T., & McKechnie, S...	5	Canboro	Ridgetown.
Midfield Natural Gas Co., Limited.	7	N. Cayuga	32 Stinson St., Ham- ilton.
National Gas Co., Limited	72	Rainham, Seneca ...	119 Carrick Ave., Hamilton.
Niagara National Gas & Fuel Co. Ltd.	3	Humberstone	Fenwick.
North Shore Gas Co., Limited	8	Rainham	Merchants Bank Bldg., Hamilton.
Oil Springs Oil & Gas Co., Ltd.	6	Emmiskillen	Oil Springs.
Ontario Gypsum Co., Ltd., The....	4	Seneca	Paris.
Pilkington Bros., Ltd.	4	Crowland	St. Catharines.
Port Colborne-Welland Natural Gas & Oil Co., Limited	27	Seneca, Onondaga, Onon- daga	Port Colborne.
Producers' Fuel & Light Co.	1	Euphemia	Sarnia.
Provincial Natural Gas & Fuel Co. of Ontario, Limited, The.....	215	Welland (county) ..	Niagara Falls.
Richardson, J. W.	1	Seneca	Caledonia.
Richmond Gas & Oil Co., Ltd.	4	Bayham	Chatham.
Robinson Road Gas Co.	4	Canboro and Moulton	Dunnville, R.R. No. 4.
Sparham, A. F.	6	Glanford	Caledonia.
Sterling Gas Co., Limited	65	Humberstone, Wain- fleet, Moulton and Sherbrooke	Port Colborne.
Stevensville Gas & Fuel Co.	3	Bertie	Stevensville.
Sundy Gas Well Co.	2	Canboro	Dunnville.
Union Natural Gas Co. of Ontario, Limited	125	Dover, Raleigh and Tilbury	Niagara Falls.
Vacuum Gas & Oil Co., Limited....	2	Middleton	608 Lumsden Bldg., Toronto.
Vansickle, A. W.	2	Onondaga	Onondaga.
Wainfleet & Moulton Gas Co.	3	Middleton	Lowbanks, R.R. No. 1.
Welland County Lime Works Co., Limited	29	Wainfleet	Port Colborne.
Wedrick, M.	2	Walpole	Nanticoke.
Wylie & Benjamin	4	Glanford	Glanford Station, R.R. No. 2.
Total.....	1,549		

Following is a list of companies which pipe natural gas from the wells to the points of consumption or which distribute it there, but which do not themselves produce gas:—

PIPE LINE COMPANIES OR DISTRIBUTORS OF NATURAL GAS.

Name of Company.	M. cu. ft distributed in 1918.	Miles of Pipe Line Dec. 31, 1918.	Head Office or Address.
Central Pipe Line Co., Limited.....	150,578	41.7	Chatham.
Chatham Gas Co., Limited.....	1,280,396	25.0	Chatham.
Dominion Natural Gas Co., Ltd....			838 Marine Trust Co. Bldg., Buffalo, N.Y.
Brantford Gas Co., Limited.....	336,211	58.9	
Ingersoll Gas Light Co., Limited..	256,732	24.2	do do do
Manufacturers Natural Gas Co., Limited.....	515,235	5.6	do do do
Southern Ontario Gas Co., Limited	330,254	211.1	do do do
Woodstock Gas Light Co., Limited	183,995	44.0	do do do
Lake Shore Natural Gas Co., Limited	7,209	7.0	294 Baynes St., Buffalo, N.Y.
Mehlenbacher, J. H.....	960	1.0	Nelles Corners.
Northern Pipe Line Co., Limited....	897,110	29.5	P. O. Box 66, Niagara Falls.
Petrolia Utilities Co., Limited.....	259,254	12.0	Petrolia.
Rosehill Natural Gas Co., Limited..	1,543	1.5	15 City Hall, Buffalo, N.Y.
Sarnia Gas Co., Limited.....	654,483	40.0	Sarnia.
Tilbury Town Gas Co., Limited....	100,268	12.5	P. O. Box 66, Niagara Falls.
United Gas & Fuel Co. of Hamilton, Limited.....	1,036,398	335.0	72 James St. N., Hamilton.
Wallaceburg Gas Company.....	20,610	18.0	Wallaceburg.
Windsor Gas Co., Limited.....	1,961,211	74.2	235 Onelette Ave., Windsor.
Total.....	7,992,447	941.2	

During the year 1918 the above mentioned companies employed 237 men and paid \$215,886 in wages.

A. E. Near, Inspector of gas wells for the Welland field, reports as follows, under date of January 14, 1919:—

Drilling operations in this district have not been as extensive as in former years. The Dominion Natural Gas Company of Hamilton, being the largest company in the district, drilled during the year 1918, 45 wells, of which 33 were producing and 12 non-producing, being an additional open flow production from the 33 wells of 3,465 M. cu. ft. They also purchased during the year the gas wells and pipe lines of the Kittinger Gas Company, and abandoned 65 exhausted wells, leaving them at the close of the year with 775 producing wells, from which they supply gas to upwards of 38,800 customers. This company is also at present drilling a well in the Selkirk gas field, and is now at a depth of 3,000 feet, in the hope of securing gas in the Trenton limestone.

The Provincial Natural Gas and Fuel Company of Niagara Falls, Ontario, during the past year drilled only 2 wells in the Welland county gas field, and at the close of the year had a total of 215 producing wells, from which they supply gas to about 7,400 customers, in the cities of Niagara Falls and Welland, town of Bridgeburg, and villages of Fort Erie, Stevensville and Crystal Beach. On account of a general decline in gas, this company refuse to supply any new customers, and have disconnected all furnaces and large heaters from their service line, in order, if possible, to ensure adequate supply for cooking and light-heating only. This company are also drilling a second deep well in the township of Bertie at Point Abino, and have it drilled to a depth of about 3,100 feet, or within about 200 feet of the Trenton.

The Sterling Gas Company of Port Colborne drilled during the year three wells, two of which are producing wells, having thus at the close of the year 68 wells, from which they supply upwards of 1,200 customers in the town of Port Colborne and the villages of Humberstone and Lowbanks. This company has been enabled to give a fairly good service of gas to its customers.

The Welland County Lime Works Company, Limited, of Port Colborne, during the year just closed, abandoned and plugged 27 exhausted gas wells, and have removed and disposed of all their pipe lines in the Wainfleet gas field.

J. W. Beno, Inspector for the Kent county field, summarizes the developments there for 1918 as follows:—

Owing to the unsettled condition of the gas question in Ontario, and the high cost of labour and well supplies, there have been fewer operations along development lines, and very little drilling has been done in this section during the year 1918. Only three oil wells and six gas wells were brought in, though ten dry holes were drilled in different parts of the area.¹

WELLS ABANDONED AND PLUGGED.

- 7 oil wells on Lot 2, Con. 8, Tilbury East, Kent Co.
- 6 oil wells on Lot 1, Con. 9, Tilbury East, Kent Co.
- 7 oil wells on Lot 1, Con. 5, Raleigh Tp., Kent Co.
- 2 oil wells on Lot 1, Con. 7, Raleigh Tp., Kent Co.
- 1 gas well on Lot 30, Con. 3, Romney Tp., Kent Co.
- 1 gas well on Lot 178, T.R.W., Romney Tp., Kent Co.
- 11 old oil wells in shallow field, Romney Tp., Kent Co.

There were two small pools struck which are outside of the former oil and gas fields:—

(1) A light well of both oil and gas, on Lot 20, Con. 7, Mersea tp., Essex county, which was struck at 1,223 ft. There were two other wells drilled on the same lot which came in dry holes.

(2) A well of 50,000 ft. of gas was struck on Lot 22, Con. 10, Raleigh tp., Kent county: a bed of dry salt 125 ft. thick was found below the gas sands.

(3) A 165-ft. bed of dry salt was found in the deep well on Rondeau Park, Harwich tp., Kent county.

SUMMARY.

The total number of gas wells being operated in the counties of Essex and Kent is 282, and the total number of oil wells, 14.

There are a number of oil wells which are not being operated, which will have to be abandoned and plugged if not put in operation soon.

The total length of gas lines of all sizes is about 900 miles.

There are 9 drilling rigs at work now in this section.

Natural Gas Legislation

Administration of the law and regulations regarding natural gas is now in charge of E. S. Estlin, Commissioner of Gas, whose office is in Chatham, the centre of the Kent gas field. Mr. Estlin supplies the following notes on the several steps taken by Provincial authority to ameliorate conditions there:—

Owing to the unusual severity of the winter of 1917-1918 the supply of natural gas drawn from the Kent county fields failed to meet the requirements, and in certain localities distress and suffering ensued. The government was appealed to in order that some prompt remedy might be found. As a result, certain restrictions were immediately placed upon the use of natural gas in industrial plants in localities where the shortage was most acute, as a temporary measure of relief. This relieved the situation, and the supply was increased for the homes.

THE NATURAL GAS ACT, 1918

Then followed the passing of the Natural Gas Act of 1918, on the 6th day of February, 1918, which placed the administration of natural gas matters in the hands of the Ontario Railway and Municipal Board with authority to act. The Board held several hearings which revealed the necessity of enquiring into further details, and the writer was called in on the 8th of April, 1918, by the Department of Lands, Forests and Mines, to make an examination of the conditions under which gas was being produced, transported, sold and consumed.

After due consultation with the Minister of Lands, Forests and Mines and G. R. Mickle, Mine Assessor, it was decided that Mr. Mickle and the writer should make a preliminary

¹ For details of drilling, see report of E. S. Estlin, Commissioner of Natural Gas, pp. 65, 66.



SKETCH MAP SHOWING DISTRIBUTION OF NATURAL GAS BY PIPE LINE FROM ONTARIO GAS FIELDS.

To accompany Vol. XXVIII, Part 1, Report of the Ontario Bureau of Mines, 1919.

Note: -The figures which appear along the several pipe lines represent the dimensions in inches. Two compressor stations are located in the Kent field, and three in the Eastern field at Blackheath, Casfield and Winger, respectively.

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review of the situation and go over the ground for a few days together for the purpose of outlining the method of the work.

The following towns and cities were visited and the conditions therein noted: Chatham, Sarnia, Windsor, Wallaceburg, and Walkerville. About a week was spent in looking over a few factories in each locality, and a plan was laid down for checking up all the particulars of industrial consumption of gas dependent upon the Kent county wells. Mr. Mickle then returned to Toronto, and the writer proceeded with the work.

INDUSTRIAL USE OF GAS FROM KENT FIELD

All the industries using gas from the Kent field in the following towns were visited and the data concerning processes, monthly consumption, price, supply, pressures, service, alternative fuel, etc., were obtained: Chatham, Blenheim, Windsor, Walkerville, Wallaceburg, Tupperville, Sarnia, Dresden, Ridgertown, Petrolia, Oil Springs, Merlin, Tilbury, Wheatley, Coatsworth, Tecumseh (and district), Hamilton, Brantford, Galt, Paris, Woodstock, Ingersoll, Leamington, Kingsville, Essex, Comber, Woodslee, Corunna and Bridgen. Besides these were numerous small places where gas was used industrially, bringing the number up to about forty.

During this inspection 444 factories were visited and particulars as to efficiency of burners, economy of appliances, operations served, price, consumption, etc., carefully checked up and noted. Principal among the industries using gas were found the following: milling, implement manufacturing, vehicle manufacturing, bakeries, meat packers, brick and tile manufacturing, woodworkers, public utilities, food products, machine shops, dairies, cigar manufacturing, greenhouses, printers, textile workers.

The total amount of gas consumed by all industries furnished from the Kent field in 1917 was 9,124,752,000 cubic feet, and the amount used for domestic service for the same period was 6,105,000,000 cubic feet, making a total delivery from the Kent wells of 15,229,752,000 cubic feet for 1917.

The industrial consumption was divided up as follows:—

INDUSTRIAL CONSUMPTION KENT COUNTY GAS IN 1917.

Town	Total Industries	Agriclt. Impls.	Vehicles	Bakeries	Packers	BrickandTileMfg.	Wood Workers	Public Utilities	Food Products	Machine Shops	Dairies	Cigar Mfgs.	Printers	Textiles	Gas Engines	Boilers	Average Rate	Total Consumption M. cu. ft.
Chatham	43	1	5	4	1	4	4	3	3	6	4	1	2	2	3	32	13.9	829,866
Blenheim	8	...	...	1	...	3	...	...	1	...	...	...	...	...	2	6	15.	31,309
Windsor	69	1	7	1	...	4	3	2	12	22	2	4	2	8	4	30	25.81	697,988
Walkerville	27	...	7	...	...	1	...	...	5	11	...	...	...	3	1	12	...	716,819
Wallaceburg	12	...	...	1	...	2	...	...	...	3	...	1	...	2	5	5	18.45	1,413,903
Tupperville	3	...	...	...	...	...	...	...	...	...	...	1	...	...	2	1	21.66	2,642
Sarnia	21	1	...	1	...	1	1	2	1	7	1	...	1	2	7	14	21.4	2,097,046
Dresden	12	...	...	1	...	3	...	1	1	3	...	...	...	...	4	6	18.84	47,904
Ridgertown	12	...	...	1	...	...	...	1	1	2	...	2	...	2	5	7	18.57	23,447
Petrolia	6	...	...	...	...	1	...	...	...	2	1	...	...	...	1	5	17.	214,341
Merlin	5	...	...	1	...	1	...	1	...	1	...	...	...	...	3	1	15.	30,665
Tilbury	8	...	...	...	...	1	1	...	1	2	...	...	...	...	3	4	16.8	80,250
Wheatley	7	...	...	1	...	1	...	1	...	1	...	...	1	...	7	...	25.	2,776
Coatsworth	2	...	...	...	...	1	...	...	...	...	...	...	...	...	1	1	12.5	43,037
Tecumseh and Dis.	22	...	...	...	...	7	...	1	4	1	...	1	...	1	9	11	17.3	363,113
Hamilton	19	3	...	1	...	...	...	2	...	9	1	...	...	3	...	7	25.47	1,940,489
Brantford	34	5	1	2	...	...	...	...	3	14	...	...	2	5	15	...	44.4	58,257
Galt	39	...	...	...	...	...	2	...	...	26	1	...	1	9	7	3	39.6	30,243
Paris	23	2	2	...	...	...	1	...	2	6	...	1	3	3	12	2	41.3	55,678
Woodstock	14	1	...	...	...	...	3	...	1	4	1	...	...	2	...	5	37.8	4,468
Ingersoll	4	...	...	1	...	...	...	...	1	2	...	...	...	...	...	...	425.	104,918
Leamington	20	...	...	...	...	2	1	2	3	1	...	9	...	1	...	20	17.2	161,229
Kingsville	10	...	...	2	...	...	...	2	1	...	...	2	...	1	1	7	23.5	100,677
Essex and Dist.	24	1	...	1	...	7	2	1	2	...	...	...	1	2	10	12	22.8	123,687
Total Industries	444	15	22	19	1	39	19	19	42	122	12	22	13	46	102	195	.....	9,124,752

Prominent among these consumers were the following large users, each with a consumption for the year of over 100,000,000 cubic feet:—

		cu. ft.	Price per M. cu. ft.
Chatam	Chatam, Wallaceburg & Lake Erie Railway...	162,000,000	12c.
	Chatam Gas Co.	125,681,000	7½c.
Courtright	Western Salt Co.	217,833,000	15c.
Hamilton	Dominion Glass Co.	406,000,000	25c.
	Steel Co. of Canada	1,402,701,000	21½-22½c.
Petrolia	Canadian Oil Co.	195,065,000	17c.
Sarnia	H. Mueller Co.	106,258,000	15c.-13½c.
	Imperial Oil Co.	1,880,273,000	12c.
Walkerville	Dominion Forge & Stamping Co.	263,000,000	12c.
	Hiram Walker & Sons	212,000,000	12c.
Wallaceburg	Dominion Sugar Co.	844,282,000	12c.
	Dominion Glass Co.	555,346,000	12c.
Windsor	Canadian Salt Co.	478,866,000	12c.
Total.....		6,443,305,000	

These thirteen corporations used more gas than all the homes put together, and the whole amount of gas used in the year for industrial purposes would have supplied 46,500 families for the same period.

The effect of price on gas as a fuel for steam boilers and gas engines is shown in the following schedule:—

Average price per M cu. ft.	No. of Boilers	No. Gas Engines
Cents.		
12.5	1	1
13.9	32	3
15.0	6	2
15.0	1	3
16.8	4	3
17.3	11	9
17.0	5	1
17.2	20	.....
18.45	5	9
18.57	7	5
18.84	6	4
21.4	14	7
21.66	1	2
22.8	12	10
23.5	7	1
25.0	4	.....
25.0	.....	.....
25.47	7	.....
25.81	30	4
37.8	5	.....
39.6	3	7
44.4	.....	15

It would seem that the use of gas under boilers declines as the price rises, and the number of gas engines increases.

A careful scrutiny of the operations carried on in the factories where gas was an important factor in heating, power supply, or in special manufacturing processes, revealed the fact that wasteful methods were being employed in many cases, and the full value of the heat units was not being utilized. Apart from unsuitable burners and inattention to same, the using of gas for steam boilers supplying power or heat is very extravagant, and is only made possible by the extremely low price.

The same may be said of such purposes where gas was used for metal furnaces, forges, cupolas, incinerators, glass melting, drying and evaporating plants, tobacco factories, greenhouse heating, lime-burning, brick and tile manufacturing, bakeries, etc. It was found that many primitive forms of burner were in use; in one case a large steam boiler was being fired by means of two two-inch pipes projected into the fire-box without any means of introducing

or mixing air or forming a proper combustion mixture. Some baking ovens were found using gas in a similar way. In only two cases were automatic regulating burners in use, where the proper amount of air was proportioned to the pressure and volume of gas used.

Amongst the smaller factories information regarding the amount of gas used monthly and the price paid was unreliable, not from any wish to mislead, but because the value of gas as a fuel was not fully appreciated, and in many cases the record was defective and the receipts lost or destroyed. It was found that many concerns had established themselves within reach of the gas lines so as to take advantage of this cheap and efficient fuel.

Many of the large users were procuring all the gas they required at fifteen cents per M cubic feet, which meant the equivalent of coal at \$3.60 per ton delivered at the fire door, if full application could be made of the heat units in the coal. This comparison is worked out as follows: In 1,000 cubic feet of natural gas there are approximately 990 British Thermal Units costing 15 cents, and in 24,000 cubic feet (the equivalent of one ton of coal), there are approximately 23,760,000 British Thermal Units costing \$3.60.

Throughout the summer of last year, 1918, the allotment of gas to industries was carefully watched, monthly permits were issued for limited amounts and these amounts reduced each month where possible, and the re-modelling of appliances went on as quickly as materials could be delivered and workmen procured. It was found that the work of administering the gas Act and supervising the operations generally over so large an area could not conveniently be carried on from Toronto, and the Office of Natural Gas Commissioner was created early in September, 1918, subject to the jurisdiction of the Ontario Railway and Municipal Board, with headquarters at Chatham. By concentrating the work in one office and by having the representative of the government stationed near the centre of the gas field, it has been possible to handle the various phases of the gas question to better advantage, and to learn more thoroughly the needs of those interested in the production and use of natural gas.

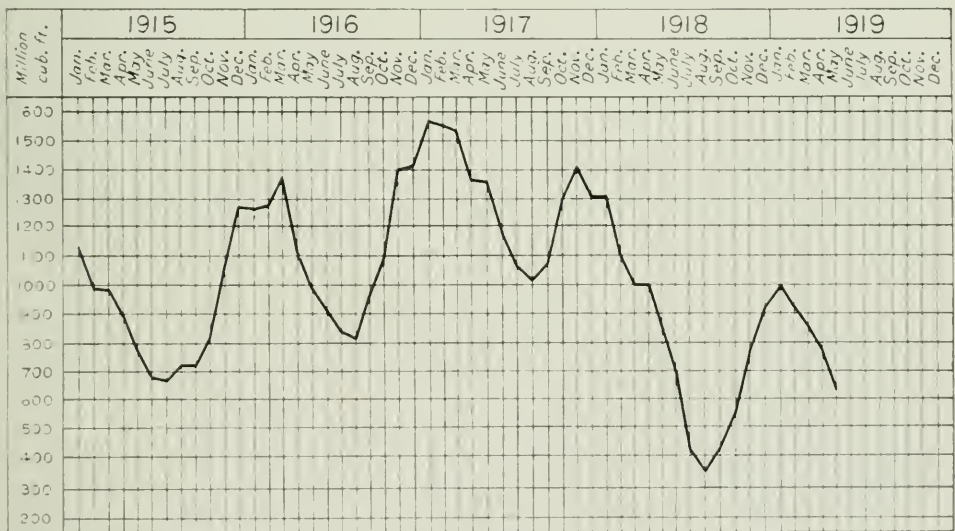


Diagram showing output in million cubic feet of Kent gas field.

APPOINTMENT OF NATURAL GAS ADVISORY BOARD

In working out solutions of the many problems presented by the gas question it became apparent that some changes in the Natural Gas Act of 1918 were desirable, and the Minister of Lands, Forests and Mines called a convention of those interested from the several points of view. This convention was held in Chatham on the 29th of November, 1918, and included representatives of the gas producers, gas distributors, and urban and rural consumers. These bodies held separate meetings, and selected delegates from whom the Minister might choose the personnel of a Natural Gas Advisory Board.

The result of the convention was that the following gentlemen were selected by the Minister to deliberate and make recommendations for meeting the problems connected with the natural gas question: Alex. McKee, Sandwich, Judge Stanworth, Chatham, W. S. West, Woodstock, T. J. Mahoney, Wentworth county, and E. R. Gray, Hamilton, representing the

rural and urban interests, and Perry A. Little, Buffalo, H. R. Davis, Buffalo, C. E. Steele, Port Colborne, P. S. Coate, Chatham, and T. P. Pinckard, of Windsor, representing the natural gas interests. Eight meetings of this Board were held and recommendations were embodied in a report¹ which was submitted to the Minister.

THE NATURAL GAS ACT, 1919

The Legislature being then in session, Hon. Mr. Ferguson submitted a measure which was in due course enacted under the title The Natural Gas Act, 1919. This repealed the Act of 1918; also subsections 2 to 5 of section 24 of the Mining Tax Act. The new Act places the control of natural gas affairs in the hands of the Minister of Lands, Forests and Mines, who is authorized to delegate his powers for administrative purposes to the Commissioner of Natural Gas.

Many interesting changes have taken place in the gas industry, chiefly in the Kent field, since the passing of legislation in the spring of 1918, the principal one being the readjustment of the market consequent upon restrictions made necessary by the declining supply; and it is significant to note from the accompanying diagram how the consumption of gas from the Kent field has varied during the years covered by the same.

CONDITIONS IN THE SEVERAL FIELDS

Tilbury Field.—In reviewing the conditions generally throughout all the gas fields, it is evident that two factors were responsible for the absence of any material gas shortage last winter (1918-19); first, the rationing process in force during the late summer under the permit system as applied to the industrial use of gas, and, secondly, the extremely mild winter. While the total consumption out of the Kent field was approximately six billion cubic feet less than in 1917 (or nearly equal to the whole domestic consumption for that year), there were times when it was extremely difficult to maintain a service pressure at Sarnia, Chatham, Petrolia, Wallaceburg, and Windsor. Several times it was necessary to resort to preferential service or the cutting off of certain large consumers, such as churches, etc., in order to build up pressures.

One great difficulty in restoring service pressure at the end of a long line is that when a heavy and sudden pull comes upon a pipe-line and the pressure at the delivery end is quickly reduced, the friction increases so rapidly, as the pressure lowers, that it takes a struggle to build it back and pack up the line again. There was enough evidence during these several drops in temperature to show that the field could barely carry the peak load in an unusually fine winter with six billion less of a load upon it. However, a fairly good service was maintained through the winter; but the protracted spring kept the domestic consumption up much later than usual.

The following table is interesting as showing the average pressures maintained at the high pressure service stations at the outskirts of the cities mentioned during January, February and March:—

	Average Pressures			Average Field Temperature
	Sarnia	Chatham	Windsor	
January	77	49	75	28
February	44	27	43	27
March	51	54	51	32

During the present summer everything possible is being done to augment the failing supply of gas. In the Tilbury field the writer took the open flow measurements on June 27th and 28th of 43 wells in the heart of the field. These wells, drilled in at different dates during the last eleven years (some of them as late as 1917), the total original production of which was 97,300,000 cubic feet per day, now only show 20,600,000 cubic feet, with the measurements taken at the most favourable time.

Water is encroaching rapidly upon the wells, trapping off the gas, and the aim of the Department is to co-operate with the field companies and maintain a system of uniform pumping, so that the water levels will be kept down to a minimum. A careful record is being kept of the water output and the pumping dates, and it is expected that the water conditions will be revealed and any defective casing or packing detected.

Since the passing of the Natural Gas Act, 1919, and for some time previous, the producing companies have been getting together in a highly commendable way, devising ways and means for bettering the service. They feel that precautions taken at the time of drilling will not only save many wells but whole fields.

¹ Printed on pp. 193-227 of this volume.

It is quite probable that in the Tilbury field careless methods may have resulted in the water passing into the gas sands in wells that have been drilled a few feet too deep, and while plugging may have been resorted to, it would be easy to spoil several wells by plugging too high in the well and yet low enough to protect the pay sand above the plug, forgetting the sand below the plug, which sand might reasonably communicate with other wells. These things are hard to locate, but time may bring some of them to light.

The treatment of gas wells in the Tilbury field is a continuing problem, and it will take all the care and nursing that is possible to bestow upon it to keep production up to the ideal.

Dover Field.—In the Dover field conditions are different—the wells are about a thousand feet deeper and drilling is very costly, so that the most modern engineering methods only are employed. These wells now cost nearly five dollars a foot for drilling alone.

Eastern Field.—In the eastern field (known as the Welland-Haldimand field), the wells have been drawn upon for thirty years; they are not so deep as the Tilbury wells, and water conditions are not so severe. The territory having been about all tested, and most of it drilled, the field has settled down to a uniform decline, and the methods of management are much the same over the field. This field has reached a point where restriction or control of consumption is practically automatic, and the gas is, and has been for some years, confined chiefly to domestic use.

THE LICENSING REGULATIONS

Under the provisions of the Act of 1919 the various operations in gas transactions are put under license. The prospector procures a license and makes returns showing where his leases and locations are. This protects him, because the records show whether the ground is worth his while or not, and it also protects any producer near whose wells he wishes to locate.

The driller takes out a license, and provides proper records by keeping correct logs and measurements and samples of rock cuttings; the advantage of this is obvious, for no reliable records have been kept covering the areas drilled, and many a man has thrown his money away which could have been saved if rock conditions had been better understood.

The producer takes a license, and is protected by the conditions imposed upon the former, and the distributor takes a license as well as the pipe-line company. So the whole industry is classified and recorded, and no outside interference can take place without very good cause. Highways through which the gas line must pass receive their share of protection, and altogether the system of licensing should work out to the benefit of all concerned, and bring about better conditions in the gas fields.

GENERAL NOTES

The purchase of the Canadian Gas Company's field by the Union Natural Gas Company is one indication of the concentration of effort, and the bringing of these two important sections of the Tilbury field under the same method of treatment will make for increased production.

In the eastern fields, not many changes of this kind have taken place. A few small producers whose arrangements for disposing of their output were not satisfactory, or whose contracts with larger companies have run out, are being assisted in finding a market by this office.

One incident worthy of record in the events of the past year, and one of great interest to the consumers of Tilbury gas, is the persistent effort on the part of the Glenwood Natural Gas Company in treating their gas for the reduction of the sulphur content. This work is being carried on at the company's plant at Glenwood in the Kent gas field, which was put into regular commission on October 16th, 1918, after four years of research work had been carried on at great expense. The advantage was felt by the consumers in the abatement of the odour. The purifiers have been almost constantly in service since started, with the exception of a short interruption during June, when repairs had to be made to one of the heaters which had become corroded.

WELL-DRILLING IN 1918 AND 1919

During the year 1918 the following development work was carried out in spite of the difficulties experienced in obtaining well materials and labour:—

Owner	Lot	Con.	Township	County	Per Diem		Depth	Date
					Oil	Gas		
Union Natural Gas Co.	2	13	Raleigh...	Kent	.....	$\frac{1}{2}$ Mill	1376	Jan. 21
	1	13	"	"	.....	"	1395	Apr. 18 water
	2	3	Dover W..	"	.....	200 $3\frac{1}{2}$ Mill	3277	May 20
	12	10	Tilbury E.	"	.....	$1\frac{1}{2}$ Mill	1386	June. 6
	3	2	Dover W..	"	.....	Show	3332	Aug. 9 dry
	6	2	Tilbury E.	"	.....	"	3372	" 30
	3	3	Dover W..	"	.....	Good Show	3560	Oct. 8 shot
	3	3	"	"	.....	Show Small	3346	" 26
Glenwood Nat. Gas Co.....	2	3	"	"	.....	"	3315	" 28 shot
	Gore	3	Romney ..	"	.....	$1\frac{1}{2}$ Mill	1320	Feb. 9
	3	13	Raleigh...	"	.....	$\frac{1}{2}$ "	1364	Apr. 26
	30	3	Romney ..	"	.....	"	1378	May 18
	20	10	Raleigh...	"	.....	$\frac{1}{10}$ Mill	1590	" 30 125' salt
	22	7	Mersea ...	Essex ..	Show	$\frac{1}{10}$ "	1223	" 30
	Govt. Pk.		Harwich..	Kent	.....	"	4010	Aug. 26 165' salt
	20	7	Mersea ...	Essex ..	Show	Show	1322	Sept. 2
Symmes & Co.....	20	7	"	"	.....	"	1604	" 25
	1	5	Dover W..	Kent	.....	"	3209	Apr. 24
Canadian Gas Co.....	13	3	Tilbury E.	"	.....	"	3204	" 30
Dally & Co.....	4	3	Romney ..	"	.....	"	1307	May 28
Northern Gas & Gasoline Co., Ltd.....	2	10	Amabel ..	Bruce ..	.....	$\frac{1}{2}$ Mill	1440	July 1
	3	10	"	"	.....	"	started	

Up to the time of writing the completed development work for 1919 consists of the following:—

Owner	Lot	Con.	Township	County	Per Diem		Depth	Date
					Oil	Gas		
Union Natural Gas Co.	2	3	Dover W..	Kent	.....	$7\frac{1}{2}$ Mill	3060	May 18
	3	3	"	"	.....	8 "	2972	" 31
	13	13	Tilbury E.	"	.....	$\frac{1}{5}$ "	1378	June 3
	11	13	"	"	.....	$\frac{1}{5}$ "	1383	" 14
Glenwood Natural Gas Co.	236	TRS	Mersea ...	Essex ..	.....	"	1080	Jan. 7
	19	11	Raleigh ..	Kent	.....	"	1545	Feb. 9 130' salt
	1	12	"	"	.....	$1\frac{1}{2}$ "	1368	Mar. 21
	13	2	Mersea ...	Essex ..	.....	$\frac{1}{8}$ "	968	Apr. 10
	15	2	"	"	.....	$\frac{1}{10}$ "	967	June 18
United Develop. Co.....	1	5	Dover E ..	Kent	.....	"	3709	Mar. 28
Vacuum Oil and Gas Co....	24	1	Chatham..	"	.....	"	412	June 3
Castle Oil and Gas Co.....	.....	.....	Euphemia	Lambton	.....	"	1712	No. 2
	.....	.....	"	"	.....	"	1611	No. 3

Dominion Natural Gas Company drilled 15 wells, of which 33 are producing and 12 dry. The open flow production of the 33 new wells is 3,465,000 cu. ft. This company abandoned 65 exhausted wells.

Provincial Natural Gas Company drilled 2 wells in Welland county.

Welland County Lime Works abandoned and plugged 27 exhausted wells.

Benjamin Canby drilled one producing well in the township of Wainfleet.

Port Colborne-Welland Natural Gas Co. drilled 3 producing wells in the Seneca field.

Sterling Natural Gas Company drilled 3 wells, 2 producing and 1 dry.

Matt. Hoover and Elder drilled 5 light producing wells.

Work in progress throughout the different gas fields has reached the following stage:—

PRESENT DRILLING OPERATIONS, 1919

Owner	Lot	Con.	Township	County	Per Diem		Depth	Date
					Oil	Gas		
Union Natural Gas Co.			Dover W.	Kent			2900	July
.. .. .							2100	
.. .. .			Tilbury	..		336	1385	
.. .. .			Dawn	Lambton				Derrick up
.. .. .			Tilbury	Kent				2 rigs cleaning out
Glenwood			Harwich	..			1200	
.. .. .	28	2	Romney	..		350		
.. .. .			Leamington	Essex				Just starting
Medina Natural Gas Co.			Procur-	Vienna				
.. .. .			ier Farm	Bayham	Field		1340	
Imperial Oil	1	8	Mersea	Essex				
.. .. .	13	3	Tilbury E.	Kent				
Vacuum Oil and Gas Co.	1	2	Dover W.	..				
Glen. Halley Co.	12	1	Romney	..				
Castle Oil Co.			Euphemia	Lambton				Rig on location
Oil Springs Oil and Gas Co.								
Dominion Nat. Gas Co.			Long Point				3100	
.. .. .							445	
.. .. .			Seneca					Just started
.. .. .			Canboro				300	
.. .. .			Melinda				500	
.. .. .			Binbrook				500	
.. .. .			N. Wal-					
.. .. .			singham				1000	
.. .. .			Woodhouse				1000	

That all the efforts to improve conditions in the gas fields so as to prolong the production of natural gas to the utmost, and at the same time encourage search and development work, are fully warranted there can be no question, for the records show that approximately 80,000 homes depend upon it for household comfort.

It is hoped that some further new production may be looked for this year from the Dover field where the Union Natural Gas Co. brought in two wells recently of seven and a half million and two and a half million cubic feet respectively (open flow measurement).

In Euphemia the Castle Oil Company have secured indications in their two wells recently drilled in with 300 and 500 thousand respectively.

The Provincial Natural Gas Company are drilling a deep test well in the Welland-Haldimand field, with the hope that more pay may underlie the shallow drilling in that field.

Two wells have been drilled in near Hepworth in Grey county, but particulars are too meagre for forming an opinion.

Apart from the fuel value of natural gas to the communities within reach of the wells, there should always be borne in mind the direct benefit to those who own the land carrying the gas wells. As an indication of this the following table shows what four producing companies pay out per annum in rentals:—

Land rentals	178,586 acres.	\$68,217 12
Well rentals	102,438 "	71,067 25
	281,024 "	\$139,284 37

There should be added to this the advantage of gas "without charge" enjoyed by most of the owners of the land, which collectively runs into a large sum each year.

LIST OF CITIES, TOWNS AND VILLAGES IN THE PROVINCE OF ONTARIO
SUPPLIED WITH NATURAL GAS.

Attercliffe	Delli	Mandarin	Selkirk
Ancaster	Dorchester	Merlin	Springvale
Aeacia	Dutton	Maidstone	Simcoe
Aylmer	Elfrida	Marshville	Straffordville
Bridgeburg	Essex	Mount Salem	Shedden
Binbrook	Eden	Niagara Falls	St. Catharines
Blackheath	Elmstead	N. Ridge	St. George
Blenheim	Fonthill	Nelles Corners	St. Jacobs
Brigden	Fletcher	Nantioke	St. Williams
Baldoon	Ford	North Oxford	Thorold
North Buxton	Fisherville	Onvry	Tilbury
South Buxton	Frome	Olinda	Teecumseh
Belle River	Fingal	Oil Springs	Tupperville
Brantford	Fenwick	Oil City	Tillsonburg
Belmont	Port Erie	Onondaga	Talbotville
Bartonville	Galt	Oldeastle	Valetta
Chippewa	Guilds	Palmyra	Vittoria
Crowland	Humberstone	Petrolia	Vienna
Crystal Beach	Hamilton	Paris	Welland
Caledonia	Hannon	Putnam	Wellandport
Caisterville	Highgate	Power Glen	Woodburn
Cedar Springs	Hagersville	N. Pelham	Wilkesport
Coppleston	Ingersoll	Point Abino	Wallaceburg
Coruma	Iona	Point Edward	Wheatley
Courtright	Jeannette's Creek	Ridgeway	Woodslee
Chatham	Jarvis	Ryckmans	S. Woodslee
Charing Cross	Kingsville	Rodney	Windsor
Coatsworth	Kohler	Ridgetown	Walkerville
Comber	Lythmore	Rondeau	Willow Grove
Cottam	Logierait	Romney	Woodstock
Clanbrassill	Leamington	Ruscomb	Wilton Grove
Cayuga	Lyme Valley	Ruthven	Wallacetown
S. Cayuga	Lynedoch	Rainham Centre	West Lorne
Cainsville	London	Rosehill	Winger
Cheapside	Lambeth	Stevensville	Port Purwell
Chedoke	Low Banks	Sherkston	Port Colborne
Dunnville	Merritton	Stroniness	Port Maitland
Dundas	Muirkirk	Sinclairville	Port Lambton
Dover	Mall	Shetland	Port Ryerse
Dealtown	Morpeth	Sarnia	Port Dover
Dresden		Sombra	Port Royal
Decewsville		Sandwich	Port Rowan

Natural Gas Industry in 1918

Since the year 1907, when a tax was first placed on natural gas, the collection of the same has been under the charge of G. R. Mickle, Mine Assessor. Mr. Mickle has also had supervision of the inspection of gas and oil wells carried on for the purpose of enforcing the law for the protection of gas and oil fields from abandoned and improperly plugged wells, etc. His duties have brought Mr. Mickle into close contact with the natural gas situation, and the following analysis of the same as it was in 1918 will be found of interest:—

The total production of natural gas in Ontario in 1918 was 13,067.4 million cubic feet. The output of the respective fields was as follows:—

	Mill. cu. ft.	
Welland-Haldimand-Norfolk field	3,375.0	or 25.8 per cent.
Kent field (old)	8,965.0	or 68.7 "
Kent field (new), Dover Tp.	351.6	or 2.7 "
Elgin field	338.8	or 2.6 "
Lambton field	37.0	or 0.2 "
Total.....	13,067.4	or 100. "

This marks a decline of about one-third of the production of the previous year, due mainly to the breakdown of the supply from the Kent field, and the consequent curtailment of the output. This matter was fully dealt with in the last report of the Bureau of Mines. In the other fields there was also a decline in the yield of natural gas.

The old field in Welland, Haldimand, Norfolk and Brant counties has now produced 64,807 million cubic feet. The output shown above includes an estimated amount from a number of very small producers who make no returns. This field is showing a continuous decline in rock pressures and output.

From the Kent field the production is about 41 per cent, less than in 1917. The total production from this area to the end of 1918 is 89,995 million cubic feet. It still remains the most important known supply of natural gas in Ontario. According to the calculation given in the last Report of the Bureau, the total gas which might be obtained from this field was originally about 173,000 million cubic feet; there would thus be left 83,000 million cubic feet. This cannot, however, be drawn off at any rate of production that seems desirable, owing to the danger from salt water, as fully explained in the Bureau's last Report. This danger is not merely threatening but is actually being realized, and in some parts of the field has shut off the production entirely. Nothing but drastic restriction of the output can prevent a repetition of the disastrous experience in the Essex field.

ANALYSIS OF THE DOMESTIC CONSUMPTION OF NATURAL GAS

The whole question of the regulation of the production and consumption of natural gas is under discussion and consideration everywhere. The regulation is difficult owing to the peculiar nature of the substance, the outstanding features being that there is no way of preventing by any physical means the owner of a gas lease drawing off his neighbour's gas, and that natural gas is so easily destroyed, and is not capable of reproduction. All these circumstances make the case for public control stronger than with any other commodity. Any information as to mode of use is accordingly of value. Since natural gas is used for two separate purposes in the home, viz., cooking and heating, it seemed desirable to estimate what proportion of the total yearly consumption in the average household is for cooking and heating respectively. Where natural gas is not available these two purposes are very often served by totally different sources of heat, varying greatly in price.

The table given below is made from information furnished by the gas companies supplying the places mentioned. It applies to the year 1917.

Place	Average No. of meters in use	July and August consumption per meter	Total consumption per meter per year	Estimated per cent. used for cooking	Rate paid per M.	Total paid per meter per year	Total domestic consumption
Windsor.....	7,320	10.5 M	200 M.	45	30c.	\$60	1,464,000 M.
Sarnia.....	3,268	7.5	166	38	30	50	542,488
Chatham.....	3,122	8.1	176	39	25	44	549,472
Blenheim.....	473	7.7	185	35	(av.) 23	43	87,505
Ingersoll.....	1,186	5.02	129	33	(av.) 38	49	152,994
Ridgetown.....	1,471	7.12	157	38	(av.) 27.7	43	230,947
Highgate.....							
Dutton, etc.....							
Kingsville.....	481	7.0	166	36	25	41	79,846
Kent Co. farm houses.....	145	11.7	200	49	15	30	29,000
	(portion only)						
Leamington (flat rate), average number of consumers...	768	16.2	342	40		24	262,656
Total consumers.....	18,234			304		per house	3,398,908
Deduct flat rate.....	768					Deduct flat rate. ...	262,656
Total meters.....	17,466			304 8 percent		Total by meter =	3,136,252

To estimate the quantity of gas used for cooking throughout the year, the consumption for July and August is taken as a basis, it being assumed that no one will use any gas for heating in these months, and that, moreover, for the sake of comfort, as little gas as possible will be used for any purpose. An arbitrary addition of fifty per cent. to the consumption for July and August has been made in the estimate for the other ten months of the year, to make allowance for the extra amount of cooking in the colder months, due to the nature of the food being somewhat different in the very hot weather and requiring less cooking. For example, taking the first city on the list (Windsor), we have:—

Consumption per meter in July and August....	10.5 M. (5.25 M. per month)
Estimated consumption in other 10 months....	78.7 M.
Total estimated	89.2 M.

As the total consumption per year is 200 M, this means that 45 per cent. is used for cooking. If it were assumed that exactly the same amount was used for cooking in the other ten months of the year as in July and August, which certainly would not be correct, we would have a consumption of 5.25 M. per month throughout the year, or a total of 63 M. per year, consequently, the percentage used for cooking would be 32 instead of 45, or 13 per cent. less, and this is the difference for the city showing the highest percentage used for cooking. If the calculation is made for Ingersoll, which shows the lowest percentage used for cooking, making no allowance for extra use of gas for cooking outside the very hot months, the percentage is 23 instead of 33 as shown in the table, or a difference of 10 per cent. The arbitrary addition therefore makes a difference of 10 to 13 per cent. and is, it seems reasonable to assume, nearer the actual fact than if the figures for July and August were taken as truly representing the whole year. It will be noticed that if the high percentage shown as used for cooking in Kent county farm houses is excluded—as it is only represented by a relatively insignificant number of meters—and an equal weight is assigned to the average obtained in each place regardless of the number of meters, the average is 38 per cent. used for cooking. If the number of meters in each city or town were taken into consideration, the average would be somewhat higher. The estimate of 38 per cent. as the amount used for cooking in the average household may therefore reasonably be taken as within a very few per cent. of the actual truth.

It is of course obvious that it is the same to the householder whether he pays a certain uniform moderately high rate for gas regardless of the purpose for which it is used, or a high rate for gas used for cooking and a lower one for the heating gas. If for instance gas¹ used for cooking is computed at 90 cents per M., that being the lowest price at which artificial gas is sold anywhere in Ontario at the present time, and if moreover the gas for heating were sold at 20 cents per M., or the equivalent of less than half the price of coal at the present time, the result to the householder would be just the same as paying the uniform rate calculated below, viz., 46.6c. per thousand.

38 per cent. at 90 cents =	3,420
62 per cent. at 20 cents =	1,240
<hr/>	<hr/>
100	4,660

or 46.6 cents per thousand is the equivalent uniform rate.

While it is exactly the same to the householder who consumes the *average* amount of gas, the smaller householder undoubtedly uses a higher percentage of his gas for cooking than the larger householder does; consequently the equivalent moderately high uniform rate is more advantageous to the smaller consumer, and moreover must tend to enforce careful use and prolong the life of the field. In the table given above it can be seen that there are 17,466 domestic meters and the amount of gas passed through these is 3,136,252 M. The average amount of gas used per householder is therefore 179 M.

INFLUENCE OF VARIATIONS IN TEMPERATURE ON DOMESTIC CONSUMPTION

As we have had two winter seasons in succession showing great departures from the normal, that of 1917-18 being unusually severe and 1918-19 very mild, the question of the influence of temperature on the domestic consumption of gas naturally arises, especially as we have seen that 100—38 or 62 per cent. of the gas used in the average household is for heating. Some interesting information is given on this point in Bulletin 102, United States National Museum, p. 48. The statement is made there that the demands for heating service "are practically proportional to the number of degrees that the atmospheric temperature is below 70." It is further stated that the demand for gas for heating in Louisville was

¹This artificial gas moreover contains less than 500 B.T.U's. efficiency per cubic foot, compared with about 1,000 for the natural gas under consideration.

5,500,000 cubic feet per month for each degree of the mean monthly temperature below 70 F. The detailed information given shows that in all 2,594 million cubic feet were delivered to Louisville in one year, of which 1,674 million was independent of the temperature, and 920 million was used for heating. That is, the percentages used for cooking and heating were respectively 65 and 35. Comparing this with 38 and 62 in the districts served by Kent gas, we notice that the percentage used for heating is almost twice as great, and as this is the demand that fluctuates so immensely, all the difficulties due to the peak load described in this bulletin are accentuated in Ontario. Taking the figures for 1917 as a basis, the estimated domestic use of Kent gas is 4,372 million cubic feet. Of this we have seen 38 per cent., or 1,661 million, is used for cooking, and the balance, or 2,711 million, for heating. In addition to this 1,310 million feet were used in heating offices, stores, public buildings, etc., where the consumption is also governed by the temperature, making 4,021 million cubic feet in all used for heating. The ratio of gas used for heating in the district supplied by Kent gas and in Louisville is accordingly 4,021 to 920, or 4.4 to 1 approximately. The ratio of gas used for cooking, on the other hand, is 1,661 to 1,674, or practically the same. This is probably directly proportional to the population served, assuming the same mode of living.

To show the difference in consumption of gas caused by temperature, on the basis of the Louisville experience, and applying the same to Kent and surrounding district, we may take three sets of figures into consideration, viz., (1) the normal temperature or average monthly temperature for a considerable number of years, taking only the colder months, (2) the mean monthly temperature for the same months in the mild season of 1918-19 and (3) for the severe winter of 1917-18. These are given by the Meteorological Office for Chatham, which may be taken to represent the average of the district served by Kent natural gas, as follows:—

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Normal season	52	39	27	25	22	34
Season 1918-19	55	44	36	31	30	37
Season 1917-18	45	37	26	12	22	38

It is seen that in the season 1918-19 every month shows a mean monthly temperature higher than the normal, thus:—

October	3 degrees above normal
November	5 " "
December	9 " "
January	6 " "
February	8 " "
March	3 " "
Total.....	34 " "

This is equivalent to 34 degrees for one month as far as the effect on gas consumption is concerned. If the consumption is governed by the temperature in the same way as shown by the table giving the consumption in Louisville, then the saving in the season of 1918-19 due to the mild weather, as compared with a normal season, would be $5.5 \times 34 \times 4.4 = 823$ million cubic feet. Comparing the mild season 1918-19 with 1917-18, it can be seen that the equivalent difference for one month in the mean monthly temperature would be 59 degrees, corresponding to a difference in gas consumption of $5.5 \times 59 \times 4.4$ or 1,428 million cubic feet. This is the equivalent of 70,000 tons of coal in heating power, and is a measure of the difference between a mild season and a severe one.

In order to establish the relation between temperature and gas consumption from experience gained in Ontario, the following table was supplied through the kindness of the Dominion Natural Gas Company.

RELATION BETWEEN TEMPERATURE AND GAS CONSUMPTION
Simcoe Area, Winters of 1917=18 and 1918=19

	1917			1918			1919					
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Domestic Consumption	23,576 M	37,915 M	53,297 M	59,527 M	62,908 M	43,936 M	21,105 M	29,863 M	41,022 M	49,174 M	48,972 M	43,868 M
Number of Consumers	2,774	2,768	2,763	2,752	2,797	2,751	2,754	2,732	2,704	2,716	2,717	2,715
Consumption per meter	8.50	13.66	19.29	21.63	22.49	15.97	7.66	10.93	15.17	18.11	18.02	16.15
Used regardless of Temperature, per meter.	3.46	3.46	3.46	3.46	3.46	3.46	3.46	3.46	3.46	3.46	3.46	3.46
Used for heating	5.04	10.20	15.83	18.17	19.03	12.51	4.20	7.47	11.71	14.65	14.56	12.69
Mean Temperature of month	47	38	23	13	18	33	51	47	34	28	28	33
Mean Temperature subtracted from 65 degrees.....	18	27	42	52	47	32	14	18	31	37	37	32
Consumption per meter per degree difference in M.....	.28	.38	.38	.35	.40	.39	.31	.42	.38	.40	.39	.40

Average consumption per meter per month per degree below 65 F. = 373 cubic feet.

Simecoe district was taken in preference to places supplied by Kent gas, as the supply was satisfactory there, whereas there was a serious shortage in towns supplied by Kent gas during part of the time covered by the table. An inspection of the analyses of the natural gas from Haldimand and Norfolk, which is supplied to Simecoe, given in the Twenty-third Report of the Bureau, shows that the heating power of this gas is almost exactly the same as that of the Kent gas. The mean monthly temperatures given are supplied by the Meteorological Office from the Welland station, this being the one that was considered to represent the Simecoe district best.¹ In compiling this table from the observation and experience of the Dominion Natural Gas Company, 65 degrees was fixed as the mean monthly temperature above which no gas is used for heating, instead of 70° F., as was done in the Bulletin referred to above. It will be observed that there is a marked agreement in the average monthly consumption per meter per degree below 65° F., and that the average of all these is 373 cubic feet. If then the total number of domestic meters through which the Kent gas passes were known, the difference caused by a mild season can be calculated from our own experience.

The first table given above in which the percentage used for cooking is estimated, accounts for 3,399 million cubic feet which is passed through 18,234 meters, including for this purpose Leamington. Taking the figures for 1917 as a basis, with a total non-industrial consumption of 5,829 million cubic feet, we have 3,399 million accounted for by the meters shown in the table; to this add 1,310 million for the amount estimated as used in public buildings, etc., making 4,709 million in all; the difference between this amount and 5,829, or the total non-industrial consumption, is 1,120 million, which is passed through or might be passed through domestic meters in places not mentioned in that table. Most of these are in towns east of Kent county where the rates are higher, consequently it would be reasonable to assume 150 M. as the average annual consumption per meter; this would account for 7,466 more meters. To arrive at the influence of the temperature on the consumption of gas in offices and public buildings where it is used for heat only, a correction must be made for the amount of gas ordinarily used in cooking. This was found to be 38 per cent., consequently if we assume as before an average consumption of 150 M. per meter and deduct 38 per cent., this leaves 93 M. per meter for the equivalent number of meters that would be required for this amount of gas for heating; accordingly the 1,310 million feet should supply 14,086 meters.

We have then as follows:—

Number of domestic meters shown in table	18,234
Number of domestic meters estimated, not shown	7,466
Estimated equivalent number of domestic meters	14,086
Total.....	39,786

or approximately 40,000 meters. It has been seen already that the difference in temperature between the season 1918-19 and the normal in the Chatham district is equivalent to 34 degrees for one month, that the average consumption per meter per month varies 373 cubic feet for each degree below 65° F., and the total number of meters is estimated at 40,000. The saving in gas consumption for 1918-19 over the normal year was therefore $40,000 \times 373 \times 34 = 507$ million cubic feet.

A reference to the table above giving the total domestic consumption in a number of cities shows that this amount is about nine-tenths the domestic consumption of Sarnia or Chatham in a whole year, and this saving was effected in the six colder months, when probably two-thirds or more of the total domestic consumption of the year takes place, so that the effect of the mild season as a relief to the gas supply was equivalent to cutting a city with a population of twenty thousand or so off the lines for the winter or time of gas shortage. In like manner, as seen above, the influence of a severe season such as 1917-18 would be almost equal in the opposite direction, and would be similar in influence on the gas supply to extending the lines to another Chatham or Sarnia. A consideration of these facts will show the precarious nature of the gas supply.

INFLUENCE OF WIND ON CONSUMPTION OF NATURAL GAS

It is evident of course that more fuel would be required to heat a house when a strong wind is blowing than would be needed if there were no wind and the same atmospheric temperature. Just what influence the wind has in this respect we have no means of determining, but as there never is a windless month, it is only departures from the normal that need be considered. The table given is supplied by the Meteorological Office from the wind measuring station at the Eastern Gap, Toronto. It is the nearest one to Simecoe, and is known to represent the Simecoe conditions closely. This is a continuous wind measuring station, and the table

¹As the figures for the monthly consumption are obtained from meter readings made some days before the end of the month, the mean monthly temperatures given are not for the calendar month, but for a month ending on the 24th, in each case.

gives all possible information about the wind during the months in question. It will be noticed that the average hourly velocity of the wind for the month does not differ much from the normal, the greatest variation from the normal in any month in the twelve months given being 3.9 miles per hour. Possibly gales have more influence on the gas consumption than slight variations in the monthly velocity, but they never last long enough to affect the consumption of gas for the month seriously.¹ Thus taking the greatest velocity for 24 hours in the record of the two seasons given, viz., 1,002 miles or the equivalent of a gale of 42 miles per hour for the whole 24 hours, and even supposing this doubles the gas consumption for that day, it would only add about 3 per cent. to the monthly consumption or make the figure for the average consumption per meter per degree difference .35 for instance instead of .34. Comparing the various months in the two seasons with reference to the wind as can easily be seen from the charts, we see that:—

- (1) October, 1917, should show higher gas consumption than October, 1918.
- (2) November, 1917, should show lower gas consumption than November, 1918.
- (3) December, 1917, should show higher gas consumption than December, 1918.
- (4) January, 1918, should show higher gas consumption than January, 1919.
- (5) February, 1918, should show about the same gas consumption as February, 1919.
- (6) March, 1918, should show lower gas consumption than March, 1919.

Of all these actually the last is the only one that shows an agreement between the relative amount of wind and gas consumption. We must conclude therefore that whatever influence the wind has on individual days, the variations in the average monthly velocities from the normal are not sufficiently great, or the gales do not last long enough, to appreciably affect the monthly consumption.

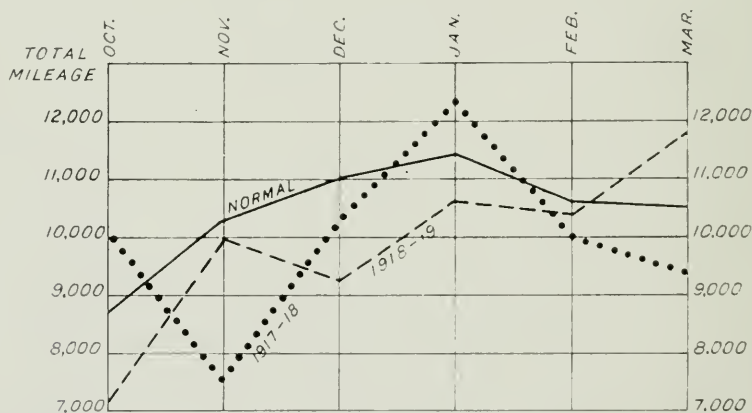


Chart showing total mileage of wind with departure from normal.

¹It will be noticed that the mileage of 1,002 in 24 hours registered in January, 1918, is the greatest on record at this wind-measuring station, which has been established for ten years.

SUMMARY OF WIND VELOCITY AT EASTERN GAP, TORONTO

Months	Total mileage for month	Difference from average	Average hourly velocity	Difference from average	Greatest mileage in 24 hours	Difference from average	Highest on record	Maximum hourly velocity	Highest on record
1917. October	10,114	1,395	13.6	1.6	674	102	674	41	55
November	7,543	-2,755	10.5	-3.9	477	-201	817	30	50
December	10,316	-697	13.9	-1.2	831	143	831	47	47
1918. January	12,344	914	16.6	1.3	1,002	223	1,002	54	57
February	10,017	-568	14.9	-0.7	809	41	976	54	59
March	9,384	-1,158	12.6	-1.5	659	-26	953	56	60
October	7,110	-1,609	9.5	-2.5	380	-192	674	29	55
November	9,957	-341	13.8	-0.6	657	-21	817	43	50
December	9,231	-1,782	12.4	-2.7	750	62	831	47	47
1919. January	10,664	-766	14.3	-1.0	614	-165	1,002	47	57
February	10,462	-141	15.6	0.0	664	-104	976	45	59
March	11,790	1,248	15.9	1.8	749	64	953	40	60

Petroleum

There was a notable increase in the output of crude petroleum in 1918 as compared with the previous year, the yield being 10,106,615 Imperial gallons as against 7,104,700, an excess of 42 per cent. As will be seen from the figures given below, showing production in the several pools or areas, the new field in Mosa township was responsible for most of the increase. Thamesville fell away considerably, and there were decreases in Dutton and Bothwell, also in the old field of Lambton county, the decline in the last-named being a little over 9 per cent.

Charles Jenkins, a veteran oil operator of Petrolia, points out in a letter to the Deputy Minister of Mines that the winter of 1917-18 was an exceptionally cold one, beginning early and lasting well into March. In consequence pumping was stopped in the majority of wells for a long time, and to this cause was due the greater part of the loss in Lambton. In Tilbury the increase was due to drilling in the district proper and by deliveries from the wells drilled in Dover township for gas, which subsequently yielded some oil as well.

The Mosa yield, 3,814,591 Imperial gallons, was equal to 90 per cent. of that of Lambton, and constituted over 37 per cent. of the entire production. Mr. Jenkins remarks that the Mosa field is a peculiar one, being in shape very narrow—what in the language of oil operators is called a “sucker-rod” belt. Deep drilling was undertaken in Mosa, and shortly after the end of the year, a well begun by F. J. Carman had reached a depth of 1,600 feet. Some 38 wells in all were put down during the year, 41 wells were abandoned, and 37 were still in operation.

One set of tools was working in the old Petrolia field, one fairly good well having been brought in, and another being under way.

The production of the several fields for the years 1917 and 1918 was as follows:—

PETROLEUM PRODUCTION BY FIELDS, 1917 AND 1918.

Field.	1917	1918	Increase	Decrease
	Bbls.	Bbls.	Bbls.	Bbls.
Petrolia and Enniskillen.....	74,267	65,467	.....	8,800
Oil Springs	46,902	44,671	.....	2,231
Moore township	6,282	6,367	85	.....
Sarnia	4,494	3,438	.....	1,056
Plympton	579	412	.....	167
Bothwell	29,682	29,116	.....	566
Tilbury	10,041	25,228	15,187	.....
Dutton	2,941	1,875	.....	1,066
Onondaga township.....	383	1,186	803	.....
Belle River .....	.....	447	447	.....
Mosa township	20,999	108,988	87,989	.....
Thamesville.....	6,420	1,565	.....	4,855
Total	202,990	288,760	104,511	18,741

John Scott, Inspector of oil wells, reports the following data regarding these wells as at December 31, 1918:—

OIL WELLS IN ONTARIO, 1918

Municipality.	In Operation		Not operated	Abandoned
	Pumped.	Baled.		
Sarnia Township.....	158	.....	36	.....
Plympton	29	.....	26	30
Moore	140	.....	67	71
Enniskillen	1,957	310	898	283
Oil Springs and vicinity.....	1,496	.....	90	3
Bothwell	278	.....	.....	.....
Thamesville	15	.....	29	.....
Dawn .. .. .	.....	.....	53	10
Euphemia.....	56	.....	.....	.....
Brooke	10	.....	.....	.....
Dutton	151	.....	19	33
Mosa	37	.....	.....	41
Indian Reservation.....	.....	.....	11	.....
Middlesex.....	.....	.....	.....	7
Total.....	4,327	310	1,229	478

At Flesherton in the county of Grey drilling into the Trenton limestone was carried on, and both oil and gas were shown to be there, but not in paying quantities. Some years ago there was a similar experience at Milton in the county of Halton. It is by no means impossible that somewhere in old Ontario, north of the present fields, an important reserve of petroleum may yet be found in the Trenton limestone.

Still further north, in the Silurian and Devonian limestones which succeed the Archean rocks in the coastal plain of James Bay, and which from what is known of them appear to correspond to the oil-bearing formations of the southwestern peninsula, there is reason for believing that the existence of oil and gas, also salt, is a possibility. Indian stories of the occurrence of oil, and the escape of gas in the beds of some of the north-running rivers are scarcely proofs, but a comparison of the fossiliferous evidence so far as it has been collected affords stronger grounds for entertaining a hope that these valuable substances may yet be located in that area.

Dr. W. A. Parks, of the University of Toronto, and a well-known paleontologist, a number of years ago examined the fossil-bearing limestones at points on the Abitibi, Moose, French and Kwataboahegan rivers, and regarded it as probable that a fringe of Silurian deposits "lies on the flank of the upland, at least in places, while the major portion of the Paleozoic area is composed of rocks comparable with the Upper Helderberg."¹ After a brief investigation of fossiliferous strata on the Kwataboahegan river, a tributary entering the Moose river near its mouth from the west, Dr. Parks without question referred these rocks to the Devonian series, and regarded them as probably equivalent to the bottom of the Upper Helderberg, while in some cases the assemblage would denote the Oriskany. As bearing on the possible presence of oil and gas, Dr. Parks remarks:—

¹Bar. Min. Rep., Vol. XIII, 1903, p. 180.

Oil and gas are known to occur in the rocks of this age in southern Ontario, and there is no reason to doubt that similar deposits may be met with north of the height of land. The rocks are very rich in organic remains. . . . The decay of such enormous numbers of organisms must have given rise to large quantities of petroleum. Whether this product is entirely dissipated, remains for future explorations to reveal.¹

When Dr. Parks wrote these words, the Kwataboahagan river was a long way indeed from older Ontario so far as transportation facilities were concerned. It is still a distant region, but the construction of the Temiskaming and Northern Ontario and Transcontinental railways has brought it a good deal nearer. It would be decidedly in the public interest to continue the study of these limestone formations in order that more light may be obtained on their age and extent and their degree of correspondence with the oil and gas-bearing rocks of southwestern Ontario, also on the most favourable localities for use of the drill.

The price of crude oil advanced during the year by successive raises from \$2.18 to \$2.78 per barrel, the average for the year being about \$2.705. This is without the bounty paid by the Dominion Government on crude oil produced in Canada, which is at the rate of 1½ cents per Imperial gallon or 52½ cents per barrel. In 1917 the average price per barrel was \$2.34.

Less than 7 per cent. of the crude oil distilled in Ontario is of domestic origin, the great bulk of it being imported from the United States. In compiling the figures for workmen employed and wages paid, only the proper proportion of each can be credited to Ontario oil. On this basis, the number of employees engaged in the oil refining industry last year was 84, and the wages paid \$93,810.

Salt

The quantity of salt made in Ontario has not varied greatly during the last three years. In 1916 the output was 128,935 tons, in 1917 138,909 tons, and in 1918 131,726 tons. The product of last year consisted of land salt 2,041 tons, coarse salt 24,930 tons, fine salt 53,908 tons, table and dairy salt 34,044 tons. To this should be added 16,221 tons the salt equivalent of the brine used in the chemical works of the Canadian Salt Company at Sandwich in making caustic soda and bleaching powder. The number of employees in the salt works was 302, who were paid wages amounting to \$275,842. The value of the salt produced was \$1,287,039.

The vast beds of limestone and salt which occur in proximity to one another on the Canadian as well as on the U. S. side of the St. Clair and Detroit rivers present an opportunity for the establishment of large industries for the manufacture of chemicals. An almost endless series of products can be produced from these substances, many of them of first-class importance in the arts. Other basic re-agents are sulphuric acid and ammonia; for the former there is abundance of pyrite in Ontario, and the latter can be had wherever cheap electric power, such as that from Niagara Falls, can be applied to the atmosphere. Caustic soda, bleaching powder, chlorine, sodium carbonate, etc., are essential for manufacturing purposes. Soda ash is used in glass, soap and paper making, in the refining of oils, the manufacture of cleansing materials and in numerous other ways. Salt cake is employed in the refining of nickel matte. Niagara electric power is used by the Canadian Salt Company in its chemical plant. Brunner, Mond Canada Limited has also recently completed

¹ Bur. Min. Rep., Vol. XIII, 1903, p. 191.

extensive works at Amberstburg to operate the Solvay system in the production of soda ash and related chemicals.

Last year a gas well was drilled on lot 22 in the tenth concession of Raleigh township, in the county of Kent, a light flow of gas being struck. Below the gas sand, a bed of dry salt 110 feet thick was penetrated. The well had a total depth of 1,800 feet, and the salt was found at about 1,200 feet. A dry hole was also sunk on Rondeau Park in the same county, a sandy peninsula jutting out into lake Erie about 5,000 acres in extent which contains a remnant of the rich hardwood forest that once covered this part of Ontario. The hole was put down to a depth of 4,010 feet, and at about 1,200 feet a bed of dry salt 125 feet in thickness was passed through. The existence of these salt beds shows that the limit of the salt area lies considerably to the east of its former supposed location, or at any rate that extensive deposits of salt can be found a long distance from the shores of lakes St. Clair and Huron.

The list of companies producing salt in 1918 is as follows:—

SALT COMPANIES, 1918.

Name of Owner, Firm or Company.	Location of Wells or Works.	P.O. Address of Manager, etc.
Canadian Salt Company, Limited.....	Windsor	Windsor.
	Sandwich	
Dominion Salt Company, Limited.....	Sarnia	Sarnia.
Elarton Salt Works Company, Limited.....	South of Egremont Road, Warwick tp.	Hyde Park.
Exeter Salt Works Company, Limited.....	Exeter	Exeter.
North American Chemical Co., Ltd.	Goderich	Clinton.
Ontario People's Salt and Soda Co., Limited..	Kincardine	Kincardine.
Western Canada Flour Mills Company, Limited	Goderich	Goderich.
Western Salt Company, Limited	Courtright	Courtright.
Wingham Salt Works (Young Estate)	Wingham	Wingham.

Strontium

J. E. Wilder of Montreal began to develop a deposit of celestite on lot 7 in the tenth concession of the township of Bagot by making an open cut and sinking a shaft about 20 feet in depth. He placed about 200 tons of the mineral on the dump. Finding it difficult to obtain a market for the product, Mr. Wilder discontinued operations. None of the celestite was shipped away.

Talc

Last year's output of talc, crude and ground, amounted to 17,465 tons, worth \$246,691. Of this 1,044 tons were shipped as crude, the remainder, 16,421 tons, being ground and refined into a variety of commercial grades. The crude talc was exported to the United States, and the ground products also found their chief market in that country. Part was marketed in Canada and part also in Cuba. The production was in excess of that of 1917, when 2,398 tons of crude were exported and 13,678 tons were ground. In the mining and milling of talc 43 men were employed who received \$41,936 in wages.

Madoc, in the county of Hastings, is the seat of the talc industry. The deposits are in the vicinity of the town, and there are two mills for grinding it there. One of these is owned and operated by Geo. H. Gillespie and Company, Limited, and the other by the Anglo-American Talc Corporation. The capacity of the former is 40 tons in 24 hours, and of the latter 28 tons. The progress of the industry may be deduced from the following figures showing the shipments during the last five years:—

TABLE XVI.—PRODUCTION OF TALC, 1914-1918.

Year	Shipments			Value
	Crude	Ground	Total	
	tons	tons	tons	\$
1914.....	1,269	8,866	10,560	74,583
1915.....	1,720	9,285	11,005	85,325
1916.....	3,665	8,145	11,810	111,489
1917.....	2,398	13,678	16,076	179,554
1918.....	1,044	16,421	17,465	246,691

Talc occurs in three forms, namely, foliated, fibrous and massive. There are deposits of all three varieties in Ontario, but only the massive is worked, this being the most desirable kind and most amenable to fine reduction. Massive talc is often known as soapstone, and from early ages has been a favourite material for the carver. It occurs in large beds and lenses in rocks of the older crystalline formations, and is also often associated with igneous rocks rich in magnesia.

The talc production of the world is placed at about 300,000 tons per annum, the bulk of it being of the inferior qualities. Chlorite, quartz, dolomite, pyrite, magnetite and other impurities reduce the value of talc, quartz being particularly objectionable for some of the finer uses. High grade talc indeed is of rare occurrence, and the output is comparatively insignificant in quantity. Italian talc enjoys a high reputation for its purity, and is used extensively in toilet and medicinal preparations.

The largest producer of talc is the United States, New York State containing important deposits at Gouverneur. It is also obtained in France, Bavaria, Norway, Brazil, India, and other countries.

The uses of talc are numerous. It is carved and sawn into slabs; it resists heat and ordinary acids or chemicals, and possesses much dielectric strength. It is used for lining fireplaces and stoves, for sanitary and electric appliances and for sinks, tanks and table-tops. As "French" or "Spanish" chalk it is employed by tailors and engineers for marking purposes, and is also used for gas tips. On being heated it becomes hard and durable, and will take on a good polish.

As ground material, talc finds its greatest use. Both the massive and fibrous varieties are extensively employed as a filler in the manufacture of paper. The rubber industry also affords a large outlet for ground talc. The fine-grained qualities, free from grit, are used in the preparation of face powders and cosmetics and in the making of soap. Ground very fine, it is used as a lubricant, either alone or mixed with graphite. Talc is employed in dressing skins and leather, for foundry

facings, for sizing and bleaching cotton cloth, in the manufacture of paints and wallpaper, for insulating electric wires, as a base for dynamite, as a body for medicines used in tablet form, for making imitation stone, for conserving fruits and vegetables, as a protection against the chafing of pneumatic tubes in automobile and bicycle tires, and for a hundred other purposes. In fact, it is doubtful whether any other single mineral finds so many applications in the arts and industries.

The following companies and firms were engaged in the raising and preparing of tale last year:—

TALC OPERATORS, 1918.

Firm or Company.	Location of Mine or Works.	Address of Manager, etc.
Anglo-American Talc Corporation, Ltd.....	Madoe	Madoe.
Cross and Wellington	Huntingdon tp.	Madoe.
Henderson Mines, Limited ¹	Huntingdon tp.	Madoe.
Geo. H. Gillespie and Company, Limited...	Madoe (grinding mill)	Madoe.

¹The Henderson mine was operated under lease by Cross and Wellington until April 27, 1918, when they sold the lease to Henderson Mines, Limited.

Mining Divisions

Below is given a statement summarizing the business done in the offices of the several Mining Recorders, nine in number. There are twelve Mining Divisions, but in three cases two Divisions are at present in charge of a single Recorder. These are Temiskaming and Coleman, N. J. McAulay acting as Recorder for both; Port Arthur and Kowkash, under the care of J. W. Morgan; and Gowganda and Montreal River, of which H. E. Sheppard had charge at the close of 1918, but in which he has since been succeeded by M. R. Morgan, formerly Recorder for the Kowkash Division. Mr. Sheppard returned from active military service overseas, and resumed his former position on the death of Arthur J. Browning in April, 1918.

Since the opening of the prospecting season of 1919, a branch office has been established at Swastika for the southern part of Larder Lake Division. H. G. Ginn, assistant to Recorder Hough, is in charge.

T. A. McArthur, North Bay, is Inspector of Mining Recorders' Offices, also of Crown Land Agencies.

TABLE XVII—RECEIPTS FROM MINING DIVISIONS, 1917-18.

Mining Division.	Name and Address of Recorder	Receipts, 1917-18.				
		Purchase Price.	Permits.	Miner's Licenses.	Recording Fees.	Total.
		\$ c.	\$ c.	\$ c.	\$ c.	\$ c.
Kenora	W. L. Spry, Kenora	1,184 10	.....	483 00	575 50	2,242 60
Port Arthur	J. W. Morgan, Port Arthur	3,415 56	10 00	2,069 00	1,405 75	6,900 31
Kowkash ¹	W. N. Miller, S.S. Marie... N. J. McAulay, Haileybury}	241 50	.....	1,300 00	2,569 00	4,110 50
Sault Ste. Marie		4,623 11	170 00	3,771 50	3,547 50	12,112 11
Timiskaming ...	J. A. Hough, Matheson.... H. E. Sheppard, ² Elk Lake}	12,782 92	.....	1,776 00	6,940 75	21,499 67
Coleman Special.		2,921 84	410 00	1,209 00	5,486 75	10,027 59
Larder Lake	G. H. Gauthier, S. Porcupine H. F. McQuire, Parry Sound	3,699 66	90 00	1,687 00	1,558 51	7,035 17
Porcupine .....		.....	.....	203 00	124 00	327 00
Parry Sound	C. A. Campbell, Sudbury...	6,109 02	170 00	2,069 00	2,300 25	10,648 27
Sudbury		Total	34,977 71	850 00	14,567 50	24,508 01	74,903 22

¹The head office of Kowkash Division was removed to Port Arthur, January 28th, 1918, up to which date Mining Recorder was M. R. Morgan.

²Succeeded A. J. Browning, who died April 30th, 1918. Mr. Sheppard was transferred to other duties, and was succeeded by M. R. Morgan, 19th May, 1919.

Reports from Mining Recorders

Kenora.—Mining claims recorded 48, cancelled 31; miner's licenses issued 54, renewed 46; letters received 1449, written 1353.

Port Arthur.—Mining claims recorded 66, claims cancelled 30; miner's licenses issued 102, renewed 242; letters received 2335, written 2099. Recorder J. W. Morgan remarks:—

The year 1918 has been a slack year. No new discoveries of importance have been made in this division. A large amount of assessment work has been done, but owing to the high wages paid for workmen in the cities, very little prospecting has been carried on. With the return of the soldiers from Europe I have no doubt many of them who were formerly prospectors will again take up that employment.

Sault Ste. Marie.—Claims recorded 199, cancelled 25; miner's licenses issued 162, renewed 102; letters received 515, written 385. Recorder W. N. Miller reports that there was much activity in his Division during the year, due principally to the vigorous working of pyrite deposits by the Nichols Chemical Company at Goudreau on the Algoma Central Railway; the Algoma Pyrite Company were also developing their pyrite deposit, northwest of and adjoining the Goudreau properties. Two miles northeast of Goudreau the Algoma Steel Corporation own a large body of pyrite; between these two deposits about 200 claims were staked for gold. A molybdenite claim was staked in township 51, range 28 on the main line of the Canadian Pacific railway at mileage 76.

Sudbury.—Claims recorded 168, cancelled 69; licenses issued 133, renewed 287, letters received 1016; written 889. C. A. Campbell, Mining Recorder, remarks that labour during the year was high in cost and almost unobtainable, also that as all the prospectors who were physically fit had enlisted, a few only were left to carry

on the work. Such prospecting as had been done was mostly on the old ground west of Shining Tree, and on the nickel range. On the Wasapika gold mine in MacMurchy township, and the Holding and Buckingham claims in Asquith township work was done and machinery installed. Russell Cryderman discovered a barite vein in the township of Penhorwood alongside the Canadian Northern railway track.

Temiskaming; Coleman Special.—Claims recorded 184, cancelled 97, licenses issued 245, renewed 853; letters received 1300, written 1159. N. J. McAulay, Recorder, reports that there was considerable activity in the townships of Eby and Catharine, where a number of claims were staked for gold; also that a good deal of development work was going on in the township of Paeaud for gold, apparently with good results.

Larder Lake.—Claims recorded 423, licenses issued 106; renewed 292. The activities of the year centred in three areas, namely, Lightning River, Kirkland Lake and Boston Creek. In Lightning River about 250 claims were recorded, but two-thirds of them were allowed to lapse, and little or no work was done there during the winter of 1918-19. The staking at Kirkland Lake was due to the fact that all development at depth in that area had proved satisfactory. Some discoveries of merit were made at Boston Creek during the year, and the indications were that prospecting would extend through to Larder Lake, where the first gold rush took place.

Gowganda.—Claims recorded 52, cancelled 30; licenses issued 11, renewed 68; letters received 394, written 397. Recorder H. E. Sheppard reports very little prospecting during 1918, but a good deal of development work, particularly on the following properties, Castle Mining Coy., Walsh claims, T. C. 177 Mining Coy., Collins claims, Crews-McFarlane Mining Coy., Reeve-Dobie.

Montreal River.—Claims recorded 293, cancelled 45; licenses issued 75, renewed 44; letters received 1778, written 1802. H. E. Sheppard, Mining Recorder, remarks that the most active area was the Matachewan gold field comprising the townships of Powell, Baden, Cairo and Alma. A good deal of development went on in this field until the freeze-up, and he understood, with very satisfactory results.

Porcupine.—Claims recorded 48, cancelled 37; licenses issued 54, renewed 46; letters received 1419, written 1353.

Parry Sound.—Claims recorded 12, cancelled 1; licenses issued 13, renewed 24.

Koochichewong.—Claims recorded 2, cancelled 0; licenses issued 58, renewed 2; letters received 477, written 401.

Mining Companies

In 1918 there were 59 mining companies incorporated under the laws of Ontario with an authorized capital of \$49,809,000; seven extra-Provincial mining corporations were licensed to do business here and employ an aggregate capital of \$15,000,000. Four mining companies surrendered their charters. The list of incorporations is unusually short, the number in 1917 being 100 and the nominal capital \$117,183,000.

MINING COMPANIES INCORPORATED IN 1918.

Name of Company.	Head Office.	Date of Incorporation.	Capital.
Aeme Engineering Company, Limited.....	Toronto	Jan. 30.....	\$ 125,000
Aetna Gold Mines Limited	"	Mar. 8.....	1,000,000
Allied Gold Mines, Limited	"	Nov. 23.....	2,000,000
Alloy Steel Works, Limited	"	Oct. 17.....	1,500,000
Attie Lake Mines, Limited	"	Aug. 19.....	40,000
Auto Oil Company, Limited	"	Feb. 22.....	250,000
Belle River Oil Company, Limited	Walkerville	May 20.....	40,000
Bothwell Oil Company, Limited	Toronto	Nov. 22.....	400,000
British American Feldspar, Limited	"	Oct. 1.....	100,000
Burlington Steel Company, Limited.....	Hamilton	Dec. 16.....	1 000,000
Cadwell Brick Company, Limited	Windsor	Feb. 7.....	200,000
Canadian Fluorite, Limited	Toronto	Apr. 2.....	500,000
Canadian Industrial Minerals, Limited....	"	Feb. 14.....	500,000
Castle Oil & Gas Company, Limited.....	"	Aug. 19.....	1,500,000
Churchill Mining & Milling Co., Ltd.....	"	Mar. 22.....	1,000,000
Cobalt Smelting & Mining Co., Ltd.....	"	Jan. 17.....	40,000
Colorado-Ontario Development Co., Ltd....	"	Apr. 12.....	40,000
Contact Bay Mines, Limited	"	July 10.....	200,000
Detroit-Glencoe Oil Company, Limited.....	Glencoe	May 18.....	650,000
Dominion Mineral Resources, Limited.....	Toronto	Apr. 3.....	40,000
Dover Oil Company, Limited	"	July 22.....	1,000,000
Dundas Oil & Gas Company, Limited.....	"	Sept. 11.....	500,000
Edwards & Wright, Limited	"	Jan. 30.....	100,000
Eldorado Mining & Milling Company, Ltd..	"	Aug. 14.....	500,000
Galt Foundry Company, Limited	Galt	Feb. 13.....	40,000
General Research & Development Co., Ltd..	Toronto	July 27.....	100,000
Goderich Salt Company, Limited	Goderich	Dec. 6.....	100,000
Golden Gate Mining Company, Limited....	Toronto	Jan. 4.....	40,000
Gold Lake Mining Company, Limited	"	Sept. 10.....	1,000,000
Great Lakes Oil Refining Co., Ltd.....	"	Mar. 14.....	1,750,000
Harmak Mining Company, Limited	"	June 15.....	300,000
Hastings Land Company, Limited	"	May 17.....	40,000
Hattie Gold Mines, Limited	"	Apr. 24.....	2,000,000
Henderson Farmers' Lime, Limited	"	Feb. 19.....	40,000
Henderson Mines, Limited	"	Nov. 21.....	25,000
Hill Gold Mining Company, Limited	"	May 13.....	3,000,000
Indian Peninsula Mining Company, Ltd....	Cobalt	Apr. 25.....	1,000,000
John Price, Limited	Toronto	Mar. 9.....	200,000
Kirkland-Munroe Gold Mines, Limited	"	May 14.....	2,000,000
Kowkash Gold Mines, Limited	"	Dec. 5.....	2,000,000
London Oil Company, Limited	London	Aug. 6.....	40,000
Lookout Mines, Limited	Toronto	May 6.....	40,000
Matachewan Gold Mines, Limited	"	Oct. 17.....	4,000,000
Metals Chemical Development Co., Ltd....	Welland	Feb. 8.....	40,000
Metals Chemical, Limited	"	Jan. 3.....	1,000,000
Molybdenum Alloys, Limited	Toronto	Jan. 7.....	500,000
Molybdenum Products Co., Ltd.	Wilberforce	July 12.....	1,075,000
Montreal-Kirkland Gold Mines, Ltd.	Kirkland Lake...	Mar. 2.....	1,000,000
National Iron Corporation, Ltd.	Toronto	Apr. 27.....	3,000,000
National Peat, Limited	"	Apr. 20.....	100,000
Nepigon Reserve Iron Co., Ltd.	"	Feb. 21.....	375,000
Northern Gas & Gasoline Co., Ltd.	Hepworth	Jan. 22.....	60,000
Ontario Peat Products, Limited	Chatham	Oct. 29.....	40,000
Parry Sound Iron Company, Limited	Owen Sound	July 30.....	2,000,000
San Patrieio Mining & Milling Co., Ltd....	Toronto	Nov. 7.....	1,500,000
Stanton Oil Producing Company, Ltd.	"	Oct. 28.....	300,000
Sudbury Diamond Drilling Co., Ltd.	Sudbury	June 25.....	100,000
Superior Mines, Limited	Toronto	June 10.....	500,000
The Algoma Pyrites Company, Ltd.	Sault Ste. Marie..	Oct. 10.....	1,500,000
The Bancroft Marble Quarries, Ltd.	Toronto	Aug. 7.....	300,000
The Buckingham Mines, Limited.....	"	Mar. 26.....	1,000,000

MINING COMPANIES INCORPORATED IN 1918.—*Continued.*

Name of Company.	Head Office.	Date of Incorporation.	Capital.
The Donnen Feldspar Co., Ltd.	Ottawa	Apr. 10.....	100,000
The Excelsior Gas & Oil Co., Ltd.	Hamilton	Sept. 24.....	40,000
The Mica-Products, Limited	Toronto	May 28.....	40,000
The New Extension Mines, Limited	"	Oct. 23.....	150,000
The Petrolia Oil and Refining Co., Ltd. ...	Petrolia	Nov. 27.....	40,000
Universal Coal Company, Limited	Toronto	Apr. 2.....	100,000
Victory Gold Mines, Limited	"	Jan. 12.....	1,000,000
Victory Oil & Gas Company, Ltd.	"	Nov. 20.....	1,000,000
Vindicator Gold Mines, Limited	"	Feb. 8.....	1,000,000
Western Ontario Oil Company, Limited...	"	Sept 28.....	1,000,000

MINING COMPANIES LICENSED IN 1918.

Name of Company.	Head Office for Ontario.	Date of License.	Capital for use in Ontario.
Canadian National Carbon Company, Ltd....	Toronto	Mar. 15.....	\$1,200,000
Dillon Crucible Alloys, Limited	Welland	June 4.....	110,000
Falconbridge Mines, Limited	Sudbury	Sept. 12.....	10,000
General Mining & Exploration Co., Ltd....	Toronto	Jan. 17.....	40,000
M. J. O'Brien, Limited	Ottawa	Jan. 17.....	12,000,000
The A. A. Robins Mining Co.,	Toronto	Apr. 4.....	40,000
The Shale Brick Co., of Canada, Ltd.....	"	Sept. 20.....	1,600,000

MINING COMPANY CHARTERS SURRENDERED IN 1918.

Name of Company.	Date of Dissolution.
New Extension Mines, Limited	Dec. 30
New York & Ontario Oil & Gas Co., Ltd.	June 24
The Crown Gypsum Company, Ltd.	Sept. 16
The Holmes Gas Company, Limited	Oct. 7

Mining Revenue

Mining revenue is derived mainly from three sources, (1) Crown lands, (2) fees for miner's licenses, etc., (3) taxation. Large sums were in former years received from royalties reserved to the Crown on the proceeds of minerals obtained from particular parcels of land or under agreement with certain purchasers, but in most cases the mines have been exhausted, and the payments have ceased.

From Crown lands the receipts comprise moneys paid for purchases or leases of mining lands, the price being fixed by statute or regulation, or as royalties on sand and gravel removed from the beds of lakes or rivers owned by the Crown, chiefly the great lakes and connecting streams.

The schedule attached to the Mining Act provides for certain fees, such as those for miner's licenses, forest reserve permits, recording claims, etc. A large part of this source of revenue comes to the Department through the offices of the Mining Re-

corders, and rises or falls according to the activity of prospecting and speculation in mining claims.

Under the Mining Tax Act, an impost of 3 per cent. is levied on the annual net profits of mining companies in excess of \$10,000. If such profits exceed a million dollars the rate rises to 5 per cent. on the excess. In the case of nickel-copper companies the rate is graded from 5 per cent. upward, and is based on the selling price of the refined products less the cost of production.

For the fiscal year ending October 31, 1918, the mining revenue was as follows:—

Sales of mining land	\$33,535 58
Mining leases	14,009 15
Sand and gravel royalties	29,464 21
Sand and gravel rentals	3,469 66
Miner's Licenses, etc.	52,271 86
Mining Tax Act	919,208 80
Provincial Assay Office	722 35
Provincial mine	1,384 53
Total.....	\$1,054,066 14

Sales and Rentals.—Mining lands are sold at \$2.50 per acre if in the unsurveyed territory, the purchaser procuring a survey of the same at his own expense, or at \$3 per acre where the lands have been surveyed by the Crown. In the following table are given particulars regarding the mining lands sold and leased during the year. There is some difference between the footings of this table and the figures given above, since the latter comprises all moneys received, while the former represents only completed transactions.

TABLE XVIII.—MINING LANDS SOLD AND LEASED DURING 1917-18.

District.	Sales.			Leases.			Total.		
	No.	Acres.	Amount.	No.	Acres.	Amount.	No.	Acres.	Amount.
			\$ c.			\$ c.			\$ c.
Timiskaming ...	222	8,138.98	22,012 76	46	1,801.22	1,721 80	268	9,940.20	23,734 56
Thunder Bay	33	1,238.17	3,195 31	.....	.....	.....	33	1,238.17	3,195 31
Algoma	2	80.50	241 50	.....	.....	.....	2	80.50	241 50
Sudbury	51	2,117.70	5,580 45	26	1,297.81	1,297 81	77	3,415.51	6,878 26
Nipissing .....	.....	.....	.....	1	20.43	20 43	1	20.43	20 43
Kenora	19	550.29	1,150 65	.....	.....	.....	19	550.29	1,150 65
Total	327	12,125.64	32,180 67	73	3,119.46	3,040 04	400	15,245 10	35,220 71

Miner's Licenses, etc.—The fee for a miner's license is \$5 per annum, and it gives the holder the right to stake out mining claims on Crown lands, to the number of three in any or every Mining Division during the year of its currency. Other fees paid to Mining Recorders are included under this heading, for instance the fee for recording a claim \$10, etc.

Sand and Gravel Royalties.—Annual licenses to dredge for sand and gravel mainly in the beds of the great lakes and the rivers connecting them are issued under the Public Lands Act. The fee for a license is \$100, and a royalty varying from three to 12 cents per cubic yard is levied on the quantity of material removed.

Mining Tax Act.—Revenue under this Act classifies itself under three headings, as follows:—

Acreage tax	\$29,301 62
Profit tax	863,547 75
Natural gas tax	26,359 43
Total.....	<u>\$919,208 80</u>

The acreage tax is at the rate of five cents per acre and now applies to all mining lands, instead of those only in unorganized territory, as was the case until 1917. Mineral rights severed from the surface are also liable to the tax.

The statement given below shows the sums paid as profit tax by the mining companies in 1917-1918, classified according to the minerals worked:—

Gold:	
Hollinger Consolidated, Ltd.	\$70,473 07
Tough-Oakes.....	6,472 97
Poreupine Crown	1,697 80
McIntyre-Poreupine.....	8,937 03
	<u>\$87,580 87</u>
Silver:	
Aladdin.....	\$65 89
Buffalo.....	1,001 34
Penn-Canadian.....	37 43
Trethewey.....	1,090 03
McKinley-Darragh-Savage.....	3,265 29
Kerr Lake	34,460 16
Crown Reserve	1,150 42
Temiskaming.....	6,661 71
Coniagas.....	6,505 55
Nipissing.....	64,927 56
Mining Corporation of Canada	872 44
Beaver Consolidated	895 96
Miller-Lake O'Brien	5,781 77
	<u>129,715 55</u>
Graphite:	
Blaek Donald	356 78
Mica:	
Loughborough Mining Company	125 43
Nickel-Copper:	
International Nickel Company	\$600,000 00
Mond Nickel Company	45,769 12
	<u>645,769 12</u>
Total.....	<u>\$863,547 75</u>

The collection of the revenue arising under the Mining Tax Act is under the charge of G. R. Mickle, Mine Assessor, who remarks as follows:—

The profit tax is levied on the profits in excess of \$10,000, and is determined in the manner explained minutely in the Act. The rate of taxation in all cases except for nickel mines is 3 per cent., with provision for a levy of 5 per cent. on profits exceeding \$1,000,000. There is, moreover, a deduction for municipal income tax paid the municipalities in which the various mines may be situated, amounting to one and a half per cent. of the taxable profits, with a certain maximum. With nickel mines the minimum rate is 5 per cent., with an increasing percentage on a sliding scale for profits over \$5,000,000.

The revenue called profit tax is obtained from four different kinds of mines, namely, (1) gold, (2) silver, (3) nickel-copper, (4) all other kinds or miscellaneous. The relative proportions of the total tax accruing due from these four kinds were approximately:—

(1) From gold mines	3 per cent.
(2) From silver mines	16 “
(3) From nickel-copper mines	80 “
(4) From miscellaneous mines	0.5 “

The amount obtained from silver mines was more than that collected during the previous year, due to an average increase in the price of silver of nearly seventeen cents per ounce in 1917 over 1916, the tax being calculated in every case on the operations of the preceding year.

Gold mines on the other hand show a serious decrease in profits in the same period. The increased operating costs with no compensating increase in the price obtained for gold had a tendency to curtail operations in addition to reducing profits on the gold actually extracted.

For the immediate future the most serious change will be a decided drop in the revenue obtained from nickel mines due to decreased output and lower price prevailing for copper.

The natural gas tax is levied as a uniform rate per thousand cubic feet, and about 80 per cent. of the natural gas produced in Ontario in the last few years has been drawn from the Kent gas field. The output having been restricted, as a measure of conservation, while the production from the other fields has remained stationary, there will be a marked decline in revenue from this source unless new discoveries are made.

The sum collected as average tax is slightly below the amount that may be expected annually from this source.

Provincial Assay Office

W. K. O'Neill, Provincial Assayer, reports as follows for the year 1918:—

During the year 1918 the work of the Provincial Assay Office was greater in volume and more diversified in character than in former years, because of the increased demand for non-metallie minerals, and the Assay Office has been called upon by a number of those engaged in the mining industry to assist in solving the problems with which they were confronted.

In general the scope of the work may be described as follows:—

1. Examination and assaying of samples for prospectors, mining engineers, geologists, and the public generally. For this work the Department charges the regular fee.
2. Analyses of samples of rock, etc., for the geologists of the Bureau of Mines.
3. The sampling of car lots of Cobalt silver ores shipped from the mines, upon which the government collects a royalty. This work is in charge of Mr. T. E. Rothwell, Assistant Assayer.
4. The assaying and valuation of these car lots.
5. Special research work.

In addition to the above programme of activities, I had charge of the mineral exhibit made by the Bureau at the Canadian National Exhibition, Toronto, and also the display of Ontario minerals and metallurgical products at the National Exposition of Chemical Industries held in New York, and I wish to thank those who loaned samples for exhibition purposes, and in other ways helped to make this department a success.

The following list will show the work done in the laboratory:—

Gold ores:—521 samples were assayed for gold and reports issued.

Silver ores:—77 samples of silver were assayed. Car lots are reckoned as one sample.

Platinum minerals:—A greater activity was noticed in connection with platinum assaying, and altogether 22 samples were assayed and reports issued.

Copper ore:—24 samples were analyzed.

Nickel and Cobalt ores:—18 samples of nickel and 13 samples of cobalt were submitted for analysis.

Iron ores:—71 samples of iron ore were submitted. These in many cases were assayed for silica, sulphur and phosphorus as well as titanium and vanadium.

Chrome ores:—10 samples of chrome ore were analyzed for chromium.

Zinc and Lead ores:—8 samples were assayed for their zinc and lead content.

Feldspar:—9 samples of feldspar were assayed for potash and soda; in some cases a complete analysis was made.

Sands:—Complete analyses were made of 8 samples of sand, submitted by the geologists of the Bureau of Mines.

Rocks:—36 samples were analyzed for the geologists of the Bureau of Mines.

Radium:—8 samples were submitted by mail for the radium test; also a number were brought in directly to the laboratory. No charge is made for this work.

Identification:—77 samples were sent by mail for identification. Some hundreds of samples were brought directly to the office and identified. No record was kept of these, and no charge is made for this class of work.

Miscellaneous:—63 other samples were submitted for assay, including barite, limestone, fluorspar, magnesite, etc.

The work of this Department was carried on with the assistance of Mr. T. E. Rothwell, Assistant Assayer, as well as Mr. A. T. Leat, who is employed as a sampler and general assistant.

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 whence they were taken.

Crushed samples representing large quantities or samples less than five pounds weight may be sent by mail as third class matter. The name and address of sender should be written plainly on each parcel. Instructions, with money in payment of fees, should be contained 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.

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 insure prompt return of certificate, as no examination is commenced until the regulation fee is paid.

Samples should be addressed as follows: Provincial Assay Office, 5 Queen's Park, Toronto, Ont.

TARIFF OF FEES FOR ANALYSES AND ASSAYS.

1. Assays:

Gold	\$1 50
Silver.....	1 50
Gold and Silver in one sample	2 50
Platinum Minerals	5 00
Gold and Platinum Minerals in one sample	7 00
Separation of Platinum Minerals.....	Prices on application

2. Iron Ores:

Iron (metallie)	\$1 50
Silica	1 50
Iron and insoluble residue	2 50
Ferrous Oxide	2 00
Phosphorus	3 00
Sulphur.....	2 50
Iron, Sulphur, Phosphorus and insoluble	8 00
Manganese	3 00
Titanium	4 00
Complete analysis.....	Price on application.

3. Limestones, Dolomites, Marls, Clays, Shales:

Determination of:

Insolubles	\$1 50
Silica	1 50
Ferrie Iron	3 00
Ferrous Iron	2 00
Alumina	3 00
Lime	2 00
Magnesia	2 50
Potash	5 00
Soda	5 00
Alkalies (on one sample)	6 00
Water (combined)	2 00
Moisture	1 00
Carbon Dioxide	2 00
Sulphur	2 50
Phosphorus Anhydride	3 00

4. Examination of Clay, Shale, or Cement Rock for Cement Manufacture:

Determination of:

Silica, Iron Oxide, Alumina, Lime, Magnesia, Sulphur, and Volatile matter	Prices on application.
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5. *Coal, Coke, Peat, etc.:*

Determination of:

Moisture	5¢	00
Volatile Combustible	1	50
Fixed Carbon	1	50
Ash	1	50
Sulphur	2	50
Phosphorus	3	00
Calorific value (B.T.U.)	5	00
Ultimate analysis	Price on application.	

6. *Mineral Waters*Price on application.7. *Ores and Minerals:*

Determination of:

Alumina	\$3	00
Antimony	4	00
Arsenic	4	00
Bismuth	4	00
Cadmium	4	00
Chromium.....	5	00
Cobalt	5	00
Nickel	5	00
Cobalt and Nickel on same sample	6	00
Copper	2	00
Fluorite.....	4	00
Lead	3	00
Molybdenum	4	00
Manganese	3	00
Tin	4	00
Zinc	3	00

8. *Rocks, Complete Analysis*Price on application.9. *Slags, Sand, etc.*Price on application.10. *Identification of Minerals and Rocks not Requiring Chemical Analysis*..Free.11. *Test for Radio-Activity*Free.

Any analytical work not specified in this circular will be undertaken on application to the Provincial Assayer.

The pulp of each sample is retained for future reference.

Minerals new to Ontario

Three minerals not heretofore recognized as occurring in Ontario, have been identified by members of the geological staff of the Bureau of Mines. One of these is elaterite, a species of hydro-carbon found sparingly in a vein of fluorspar near Madoc worked by Canadian Industrial Minerals Limited. It was brought by R. C. Bryden, the company's manager, to the attention of C. W. Knight, Assistant Provincial Geologist. Following is Mr. Knight's description of the mineral:—

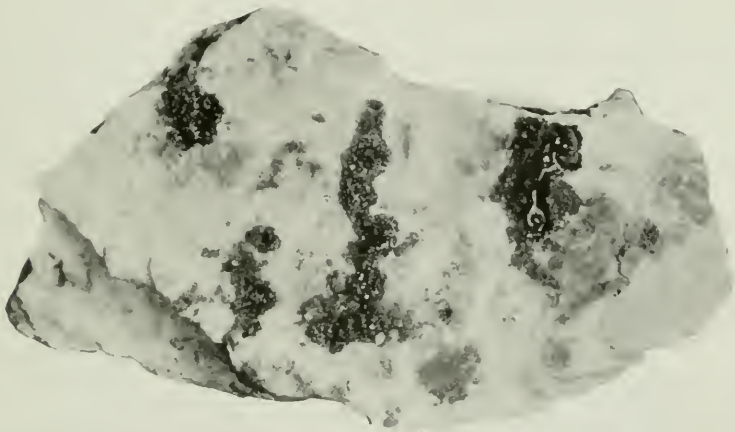
Elaterite or Elastic Bitumen

The attention of the Ontario Bureau of Mines having been called to the occurrence of a peculiar bituminous substance in the fluorite vein of the Canadian Industrial Minerals, Limited, at Madoc, Hastings County, Ontario, the writer spent a short time in the early part of May, 1919, examining the deposit. R. C. Bryden, manager of the company, very kindly took the writer through the mine, and pointed out the location of the material. Specimens were collected and forwarded to Ledoux and Company of New York, and the material was determined to be "elastic bitumen," or

"elaterite." Elaterite has not previously been found in the Province of Ontario, and its occurrence is not mentioned in Johnston's "List of Canadian Mineral Occurrences" published by the Geological Survey of Canada.

The fluorite veins at Madoc have been known for many years. They contain, in addition to fluorite, the minerals barite and calcite. It was only during the Great War that they were worked to any large extent. T. F. Sutherland describes sixteen properties round Madoc in which fluorite is found.¹ The deposits are also described in the Twenty-Second Report of the Ontario Bureau of Mines, Part II.

The veins intersect granites, schists, crystalline limestones and other rocks of pre-Cambrian age, and also fossiliferous limestones of Black River (Paleozoic) age. The deposit owned by the Canadian Industrial Minerals, Limited, occurs in a red and grey granite and has been worked to a depth of 200 feet. The elaterite was found on the 200-foot level, and was seen at the time of examination to occur spar-



The dark parts of the illustration represent "elaterite" or elastic bitumen.

ingly — less than half a pound altogether—for several feet along the vein where the latter is two or three feet wide. It is not found in economic quantities. It has a dark brown color and occurs in vugs in the vein material. In the specimens collected these vugs are from a fraction of an inch to one or two inches in length, and fractions of an inch in width. It was reported by Mr. Bryden that larger masses of the material had been found.

The description of the identification of elaterite by Ledoux and Company is given below:

After superficial examination of the sample of bituminous substance associated with fluorite, barite, calcite minerals referred to in your favour of May 10th, 1919, especially with regard to the manner in which it melts and burns and the action of organic solvents upon it, we have little hesitation in expressing the opinion that it is elaterite, known also as mineral enouthone or elastic bitumen.

Elaterite and similar bitumens are subject to change in composition due, in part, to more or less oxidation. There are a number of closely related compounds which have been given different names by different observers. The original mineral appears to be an unoxxygenated hydrocarbon containing 86 per cent. of carbon and 13 to 14 hydrogen.

The only way to positively identify the compound would be by ultimate analysis, but the sample submitted is insufficient for this purpose; at least, it is impossible to separate enough

¹ Ont. Bur. Min., Vol. XXVII, 1918, pp. 136-138.

of the hydrocarbon perfectly free from the associated inorganic minerals to obtain an accurate analysis.¹ We do not believe it is necessary to go to the considerable expense of ultimate analysis for the purpose of classification, since, if the mineral is not elaterite, it is at least something very close to it, and, furthermore, such authorities as there are on these minerals differ as to the composition.

We would also call your attention to the fact that the bitumen in the sample is not uniform, part of it being more or less sticky and fluid, while the rest is of the consistency of crude rubber. This variation in consistency (and also in composition) is noted in Dana's Mineralogy.

It may be added that Mr. Bryden told the writer that he considered the material to be elaterite. This was before the sample was forwarded by the Ontario Bureau of Mines to Ledoux and Company for definite identification.

The origin of the elaterite in the fluorite vein is obscure. It may have been deposited at the same time as the fluorite, calcite, and barite which now compose the deposit. If this is true, then possibly the elaterite may have had a volcanic origin.



Fluorite concentrating mill on property of Industrial Minerals, Ltd., Madoc.

since fluorite is often considered to have been deposited from gases and vapours given off by igneous rocks. There are, however, no known igneous rocks cutting the Palaeozoic beds between Madoc and Lake Ontario.

Another suggestion as to the origin of the elaterite is that the material descended into the vein from pools of oil which might have been present at some time prior to erosion in the overlying beds of Palaeozoic limestones.

Whatever may be the origin of the material it is interesting to speculate as to the possible occurrence of a large vein of the material in the Madoc area, hidden somewhere in a valley or other depression. Southeastern Ontario has produced an amazing variety of minerals, some of them in paying quantities, such as talc, fluorspar, feldspar, graphite, mica, iron pyrites and other minerals. Perhaps the region has in store another surprise in the form of workable deposits of elaterite, or some other closely related hydrocarbon.

It is worth while recalling in this connection the deposit of the hydrocarbon known as albertite, which was found in New Brunswick many years ago. The occur-

¹ See so-called anthraxolite and other carbonaceous minerals occurring in Ontario described in Ont. Bur. Mines, Vol. VI, 1896, p. 162.

rence is described by Frederick G. Clapp in a publication (No. 291, Vol. 2, page 59) of the Department of Mines, Ottawa, as follows:

In 1849 Dr. A. Gesner discovered on Frederick brook near the present site of the Albert mines, a vein or bed of a bright, jet-black, shiny material, afterwards identified as mineral pitch or bitumen, and called albertite. This mineral proved on investigation to be of great value and was mined for nearly thirty years at great profit. The records of production were destroyed, but it was known that in each of the years 1865 and 1866 the output of albertite was 20,500 tons, while the total from 1863 to 1874 amounted to 154,800 tons, and during the entire period of working it was probably not far from 230,000 tons. The price ranged from \$15 to \$20 per ton.

Albertite is a solid bitumen representing the residuum of petroliferous seepages. It occurs in veins in the Albert shales at several points in Albert and Westmoreland counties. While in itself an indication of petroleum in past times rather than at present, it is generally associated with petroliferous shales, and in the Albert mine liquid petroleum was actually collected in buckets from seepages from sandy beds included in the shales associated with the albertite. Albertite is not a coal, notwithstanding the opinions of certain interested parties or legal decisions, but is a petroliferous residuum and therefore to be classed among the indications of oil, at least to the extent indicated above.

Kalgoorlite ; Coloradoite

In studying the geological relationships and petrography of the gold mines at Kirkland Lake, particularly the Tough-Oakes mine, A. G. Burrows, Assistant Provincial geologist, recognized in samples of ore given him by C. A. O'Connell, manager of the mine, two tellurides hitherto unknown to Ontario mineralogy. Mr. Burrows thus describes them:

The Ontario Bureau of Mines has added to its equipment at the Provincial Assay Office a grinding and polishing machine and microscope for examining metallic minerals by reflected light. By means of this equipment, aided by qualitative and quantitative analyses, some minerals have been recognized in ore from the Tough-Oakes mines not hitherto known to occur there or, in fact, in Canada.

Some time ago rich specimens of gold ore from the Tough-Oakes mine were obtained from Mr. C. A. O'Connell. These showed native gold, calaverite, altaite, and some black metallic minerals. These latter minerals were determined to be a telluride of gold, silver and mercury, and telluride of mercury, homogeneous minerals under the microscope. The former telluride was analyzed by W. K. McNeill and found to contain 20.40 per cent. au., 31.1 per cent. ag. and 1.02 per cent. hg., which corresponds closely to the formula for kalgoorlite, a precious telluride, first recognized in gold ore at Kalgoorlie in West Australia. The mercury telluride gave strong reactions for mercury and tellurium, but contains no gold or silver, and is the mineral "coloradoite." The presence of this group of tellurides associated with gold is of scientific interest in relation to the genesis of the ore deposit, temperature and pressure of formation of deposit, etc.

While the precious tellurides are probably rare in Kirkland lake ore, there is always the possibility of obtaining them in rich bunches in the veins. The precious tellurides in the material examined are in appreciable quantities. Tellurides of gold, without preliminary roasting, would pass into the tailing in the ordinary cyanide treatment.

Tellurides occur over considerable area along the line of the T. & N. O. railway, there having been recognized, in addition to those mentioned above—tetradymite (bismuth telluride) in Beatty township, calaverite and tetradymite at Boston Creek, petzite in Maisonville and Benoit townships, and hessite in Deloro township.

A New Discovery of Pitchblende¹

The European supply of radium is in the main obtained from pitchblende. The following note by C. W. Knight on a discovery of this mineral in Nipissing district will therefore be of interest:—

It having been reported to the Ontario Bureau of Mines that pitchblende, extraordinarily rich in radium, had been discovered in Butt township, east of the Georgian Bay, in the Province of Ontario, the writer was instructed to visit the area and make a preliminary examination. Accordingly, two days early in October, 1919, were spent in this township, and one or two ounces of pitchblende were collected.

The mineral was identified and found to be pitchblende by W. K. McNeill, Provincial Assayer for the Province of Ontario. He also found that it was strongly radio-active.

Butt township is entered by way of Kearney, a town on the Grand Trunk railway, 167 miles by rail north of Toronto, and 6 miles east of Scotia Junction. The deposit of pitchblende is 22 miles north-eastward from Kearney. A wagon road leads to within 4 miles of the occurrence, and the last 4 miles must be travelled on foot. It may be added that teams, wagons and supplies are obtainable at Kearney for those who desire to visit the area. Hotel accommodation is available at Scotia Junction and Kearney.

The country along the wagon road into the deposit is for the most part rugged, particularly in Butt township. The hills rise two or three hundred feet or more above the valleys, the latter being filled with sand and gravel. In that part of the township in which the pitchblende occurs the rocks are largely covered with drift, making prospecting difficult. Mica has been mined in a small way in this part of the country, on and off, for years.

The pitchblende occurs sparingly in a coarse, granite pegmatite dike, striking north 25 degrees east, and dipping at about 60 degrees to the northwest. The dike has been worked by an open cut about 40 feet long, and 7 or 8 feet deep. It occurs at the edge of a small lake, locally known as Mica lake, on lot 13 in the sixth and seventh concessions of Butt township. The lake has been partly drained in order to prevent the pit being flooded during mining operations.

The width of the dike is not known, since only the footwall has been exposed by the pit, but it appears to be at least 3 or 4 feet wide. The length of the dike is also not known, the surface being covered with drift; the open cut shows it to have a length of at least 40 feet.

The dike consists of white feldspar, red feldspar, white quartz, smoky quartz, white mica, black mica, a little tourmaline, pitchblende, and other minerals in small quantity, which have not as yet been identified, but which are being investigated by the Ontario Bureau of Mines.

¹The only regions of the world that have as yet produced any large amounts of radium and uranium on a commercial scale are Colorado and Utah in the United States, and Bohemia in Austria. The principal radium mineral in Colorado and Utah is carnotite, a hydrous potassium uranium vanadate with the composition: $K_2O \cdot 2UO_3 \cdot V_2O_5 (?) \cdot H_2O$. In Bohemia the ore is uraninite, a mineral with a somewhat indefinite formula, but essentially a combination of the two uranium oxides UO_2 and UO_3 . Pitchblende is the impure, amorphous form of uraninite. Radium occurs in these ores in the proportion of 1 part of radium element to about 3,000,000 parts of uranium. Some radium was extracted from the pitchblende ores of Cornwall, according to the *Mineral Industry*, one mine alone producing 18,000 mg. of radium bromide in 4 years.—R. A. F. Penrose, Jr., 14 Report, N.Y. State Museum, 1917.

MINING ACCIDENTS IN 1918

Chief Inspector of Mines, T. F. Sutherland, Toronto; Inspectors, E. A. Collins, Cobalt; J. H. Stovel, Sudbury; A. R. Webster, Toronto

During the year 1918 at the mines, metallurgical works, quarries, clay and gravel pits regulated by the Mining Act of Ontario there were 27 fatal accidents causing the death of 32 men, as compared with 36 deaths in 1917. Of these, 10 accidents resulting in 11 deaths occurred underground. Four men were killed above ground at the mines, 12 at the metallurgical works and five at the quarries.

Seventeen companies had fatal accidents during the year.

Table of Fatalities

	1914	1915	1916	1917	1918
Mines, underground	29	17	30	19	11
Mines, surface	9	4	7	7	4
Metallurgical works	5	1	8	6	12
Quarries	15	0	6	4	5
Totals	58	22	51	36	32

The fatalities at the mines were divided amongst the several areas as follows:

	1914	1915	1916	1917	1918
Gold mines	12	3	14	8	3
Silver mines	11	6	8	9	0
Nickel-copper mines	9	11	13	9	7
Iron mines	4	0	2	0	2
Western Ontario	1	0	0	0	1
Eastern Ontario	1	1	0	0	2
Totals	38	21	37	26	15

By months, the fatalities occurred as follows:—

	1914	1915	1916	1917	1918
January	6	0	7	8	3
February	5	3	4	3	5
March	7	0	1	2	4
April	7	4	2	3	3
May	5	0	7	2	2
June	8	1	5	0	1
July	4	2	1	5	1
August	5	3	2	6	2
September	2	3	3	1	2
October	3	3	1	3	4
November	4	1	10	0	5
December	2	2	8	3	0
Totals	58	22	51	36	32

Analysis of Fatalities at Mines

	1914	1915	1916	1917	1918
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Falls of ground	7.9	4.8	24.3	15.4	20.0
Shaft accidents	26.3	23.8	27.0	15.4	0.0
Explosives	26.3	33.3	21.6	15.4	40.0
Miscellaneous underground.	15.8	23.8	8.1	26.9	26.6
Surface	23.7	14.3	18.9	26.9	13.3

Table of Fatal Accidents in Mines, Metallurgical Works and Quarries, 1901 to 1918

	Persons killed at metallurgical works and mines.	Persons employed at metallurgical works and producing mines	Personsemployed at non-producing mines (estimated).	Total persons employed.	Fatalaccidents per 1000 employed.
1901.....	13	4,135	550	4,685	2.77
1902.....	10	4,426	450	4,876	2.05
1903.....	7	3,499	400	3,899	1.79
1904.....	7	3,475	400	3,875	1.80
1905.....	9	4,415	500	4,915	1.83
1906.....	11	5,017	750	5,767	1.90
1907.....	22	6,305	1,140	7,445	2.93
1908.....	47	7,435	1,750	9,185	5.11
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	3.60
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	2.10
Total.....	578	171,634	22,440	194,074	2.98

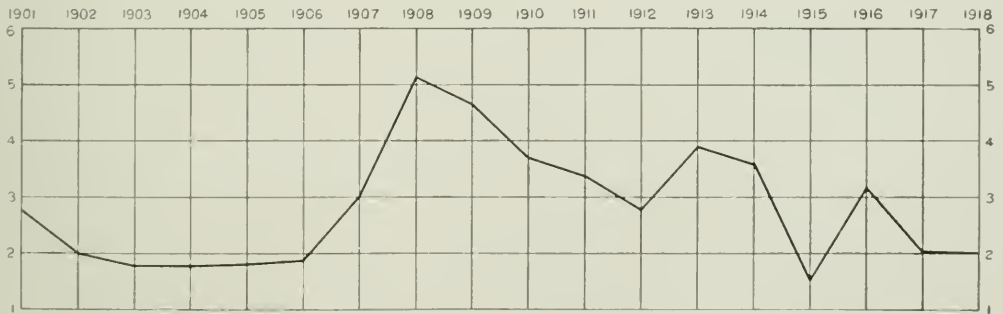


Diagram showing Mining Fatalities per thousand men employed between the years 1901-18.

Table of Fatal Accidents in

No.	Date 1918	Name of Mine.	Name of Owner.	Name of Deceased.	Occupation of Deceased.
1	Feb. 14	Magpie	Algoma Steel Corp'n...	G. Delzotti.....	Machine-runner
2	Mar. 26	Hollinger	Hollinger Consolidated Gold Mines, Ltd.	A. Mustafa	Trammer.....
3	Mar. 27	do	do do	J. Alta	Machine-runner
4	Feb. 7	Crean Hill	International Nickel Co. of Canada	M. Yogodo	Trammer.....
6	April 25	Creighton	do do	W. Hodorobar ..	Blaster.....
5	May 2	Crean Hill	do do	P. Silbojoun	Trammer.....
7	Aug. 3	Creighton	do do	A. Yurdicki	Blaster.....
7	do	do	do do	J. Rakaunen	Blaster.....
8	Oct. 30	do	do do	W. McClean	Machine-runner
9	Jan. 17	Garson	Mond Nickel Co.	J. Drogowski ...	Scaler.....
10	Feb. 3	Moose Mountain.	Moose Mountain, Ltd.	L. Meliar	Labourer.....
11	Jan. 26	Northern Pyrites	Nichols Chemical Co., Ltd.	A. Salo	Machine-runner
12	Mar. 13	Porcupine Crown	Porcupine Crown Mines Ltd.	E. Komula	Machine-runner
13	April 22	Mt. St. Patrick....	Renfrew Molybdenum Mines, Ltd.	J. Cloutier	Lineman.....
14	May 16	Prospect	Tory Hill Marble & Mica Company	R. S. Hunt	Prospector....

or about the Mines, 1918.

Nationality of Deceased.	Age.	Married or single	Below ground	Above ground	Cause of Accident.
Italian	32	M	1	.....	Crushed by rock while scaling in drift.
Greek	24	S	1	.....	Picked into explosives while loading car.
Finn	19	S	1	.....	Caught by fall of rock in stope.
Russian	27	M	1	.....	Struck by rock from chute.
Roumanian	23	S	1	.....	Caught by run of ore in chute.
Austrian	33	M	1	.....	Fell down ore pass.
German	28	M	1	.....	Premature explosion while blasting.
Austrian	32	M	1	.....	Premature explosion while blasting.
English-speaking...	32	M	.....	1	Premature explosion while loading hole.
Austrian	32	M	1	.....	Foot crushed by falling rock. Died Jan. 20.
Galician	45	M	.....	1	Crushed between two cars in briquetting plant.
Finn	24	M	1	.....	Walked into chute blast.
Finn	39	S	1	.....	Buried by run of ore in stope.
English-speaking...	26	S	.....	1	Fell from power pole.
English-speaking...	31	M	.....	1	Premature explosion while loading hole.

Table of Fatal Accidents at

No.	Date 1918	Name of Works.	Name of Owner.	Name of Deceased.	Occupation of Deceased.
15	April 6	Pig cast house...	Algoma Steel Corp. ...	G. Cavicholo ...	Labourer.....
16	Jan. 22	Smelter	British America Nickel Corporation	J. Graham	Mechanic.....
17	Feb. 25	Blast furnace ..	Canadian Furnace Co..	C. Dancies	Scrapper.....
18	Mar. 26	Smelter	Coniagas Reduction Co	G. Simionki ...	Labourer.....
19	Feb. 24	do	Deloro Smelting & Re- fining Co.	H. Thornton ...	Mechanic.....
20	Sept. 12	Refinery	International Nicke Co. of Canada	J. P. Kennedy ..	Crane operator
21	Oct. 25	Slag dump	do do	J. Armsrong ...	Brakesman....
21	do	do	do do	S. Marco	Truckman....
22	Nov. 16	Smelter	Mond Nickel Co.	P. Mazato	Baleman.....
22	do	do	do do	W. Maluga	Baleman.....
22	do	do	do do	S. Modrok	Labourer.....
22	do	do	do do	A. Zacoruski ..	do

Table of Fatal Accidents

23	Nov. 5	Quarry	Canada Crushed Stone Corp.	R. Keival	Driller.....
24	June 26	Crushing plant .	Dominion Mines and Quarries, Ltd.	W. Joseph	Labourer.....
25	Sept. 25	Quarry	do do	J. Jones	Blaster.....
26	July 12	do	National Potash Corp.	C. Price	Driller.....
27	Oct. 18	Yard	Queenston Quarry Co.	T. Bond	Labourer.....

Metallurgical Works, 1918.

Nationality of Deceased.	Age.	Married or Single	Cause of Accident.
Italian	29	S	Burned by molten slag and iron.
English-speaking...	35	S	Fell from staging.
Austrian	53	S	Fell from east floor to railroad track.
Roumanian	32	M	Scalded in slag pit.
English-speaking..	46	M	Struck by whirling belt.
English-speaking...	28	M	Fell with crane 32 feet.
English-speaking...	33	M	Section of slag dump settled 15 feet.
Austrian	34	M	Section of slag dump settled 15 feet.
Italian	45	S	} Crane broke while lifting ladle of matte. Crane broke while lifting ladle of matte. Crane broke while lifting ladle of matte. Died November 23.
Austrian	32	M	
Ruthenian	24	S	
Russian	37	M		Crane broke while lifting ladle of matte. Died November 21.

at Quarries, 1918.

English-speaking..	50	M	Struck by block of wood which fell from tower of drill.
English-speaking..	33	S	Caught between belt and tail pulley of conveyer.
English-speaking..	35	M	Struck by flying rock.
English-speaking..	53	M	Struck by rock rolling down slope.
English-speaking..	38	M	Slab fell while being loaded on railway car.

The occupation and nationality of the men killed are set out in the following table:

Occupation.	English Speaking	Austrian	Finn	Italian	Russian	Romanian.	Greek	German	Galician	Ruthenian	Total
Machine runner...	3		3	1							7
Labourer	2			1	1	1				1	7
Blaster	1	1				1		1	1		4
Tramner		1			1		1				3
Mechanic	2										2
Baleman		1		1							2
Truckman		1									1
Brakesman	1										1
Crane operator ...	1										1
Scraper		1									1
Lineman	1										1
Scaler		1									1
Prospector	1										1
Total.....	12	6	3	3	2	2	1	1	1	1	32

The ages of the men killed were as follows:

Age	17-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	Total.
No. killed ...	1	4	5	13	3	2	2	2	32

Cause and Place of Fatalities in Mines

Below Ground:—

Falls of ground	3
Explosive Accidents:—	
Walked into blast	1
Premature explosion while lighting holes	4
Picked into explosive	1
Miscellaneous Accidents:—	
Run of ore in chute	1
Falling down ore pass	1
Buried in stope	1
Ore falling from chute	1

Above Ground:—

Crushed between two cars	1
Fall from power pole	1
Metallurgical Plants:—	
Burned by molten material	5
Scalded in slag pit	1
Falls	3
Struck by belt	1
Buried in slag dump	2

Quarries:—

Falling objects	3
Caught in conveyor belt	1
Fall of rock from face	1

Prosecutions

On February 2nd, W. Pohribny, an Austrian trammer, employed at the Northern Pyrites mine, was charged with negligence under subsection 98, section 164, Part IX, of the Mining Act before Magistrate Vaughan of Sioux Lookout, and sentenced to one month in jail with hard labour and fined \$25 and costs or an additional month in jail.

Before Magistrate Atkinson, at Timmins, on February 14th, Peter Kulyk, a trammer of the Hollinger Consolidated Gold Mines, Ltd., was charged with an infringement of subsection 97, section 164, Part IX, of the Mining Act, in that he reported for work in an intoxicated condition on February 4th. A fine of \$100 and costs was imposed.

John Osmak, an Austrian employee of the Garson mine of the Mond Nickel Company, was sentenced to three months in jail by Magistrate Stoddart of Sudbury, for tampering with the bell signals in the Garson main shaft. See subsection 46, section 164, Part IX, of the Mining Act of Ontario.

B. Longycz, an Austrian cage-tender at the Mond mine of the Mond Nickel Company, was sentenced by Magistrate Stoddart at Sudbury, on May 6th, to three months in jail and a fine of \$50 or an additional one month in jail, for negligence in failing to pull the chairs at the 2,300-foot level of the Mond shaft. The information was laid under subsection 5, section 179, Part IX, of the Mining Act of Ontario.

The Gifford Cobalt Silver Mining Company on November 18th were fined \$100 and costs by Magistrate Atkinson, at Cobalt, for failure to provide the man-cage on their property with proper safety appliances as required by subsection 31, section 164, Part IX, of the Mining Act of Ontario.

MINES OF ONTARIO

Chief Inspector of Mines, T. F. Sutherland, Toronto; Inspectors, E. A. Collins, Cobalt; J. H. Stovel, Sudbury; A. R. Webster, Toronto.

I.—NORTHWESTERN ONTARIO

Iron Pyrites

Northern Pyrites Mine.—Shipments from this property of the Nichols Chemical Company, Limited, at Northpines, during the season of 1918, amounted to 103,337 tons of pyrites.

Ore is shipped during the navigation season only, and is sent from Northpines by rail to Fort William, thence by boat to the several manufacturing plants of the General Chemical Company in the United States.

Mining operations are continuous throughout the year. In the winter months the excess ore broken in the stopes is stockpiled at the rail-shipping point of the Canadian National railway. All development work, such as shaft-sinking, etc., is also done during the winter while shipments are suspended.

The entire production of 1918 was obtained from the third level east and west stopes and from the fourth level east stopes. Development stopes were continued east and west on the fourth level, new stopes opened and ventilation raises completed. No further shaft-sinking was done during 1918.

J. A. Battle was superintendent during the shipping season, employing from 200 to 250 men.

Mokomon.—The pyrite property of the Nichols Chemical Company, Limited, at Mokomon, in Conmee township, was not operated during 1918. Diamond-drilling was completed in 1917, and it is expected that operations will be commenced during 1920.

Gold

St. Anthony.—After lying idle since the autumn of 1917, the St. Anthony gold mine was unwatered and stoping carried on from May to September, 1918, by the Thunder Mining Company, Limited. The mill was run during part of the summer. The late H. H. Lavery was in charge of the work.

II.—SUDBURY, NORTH SHORE AND MICHIPICOTEN

Michipicoten Area

In this district the Helen iron mine, which for the past fifteen years has been the sole producer of hematite in Ontario, ceased operations in May, with the result that there is not now in Ontario any production of iron ore which does not require beneficiation before smelting.

Development work on the siderite deposit at the Helen mine was stopped in the autumn of 1918 owing to the high cost of labour and supplies, which have now reached a stage at which the siderite ores of this district cannot be mined, hoisted, transported and sold in competition with the natural ores to the south.

The Magpie siderite deposits continued in operation throughout the year.

The Goudreau pyrite mine of the Nichols Chemical Company operated continuously with good results. The Bear deposit was stripped and drilled, as well as one or two other showings owned by this company.

Many gold claims were staked in the vicinity of the Goudreau mine in the spring of 1918, but none of them was largely developed.

Iron

Dreany.—In 1918, some diamond-drilling was done on the Dreany iron claims, situated about four miles north of Goudreau station, Algoma Central Railway.

Helen.—Operations at this mine, owned by the Algoma Steel Corporation, consisted in drawing off the balance of the caved hematite ore, up to April 16th, 1918. At that time all recoverable straight sulphur and merchantable ore had been hoisted. Operations were stopped, the plant was dismantled and closed down permanently.

All ore hoisted was shipped to the Magpie mine, where it is roasted to eliminate the sulphur content. During 1918 4,729 tons of pyrites were shipped from the stockpile to the acid plant at Sault Ste. Marie, and 27,594 tons of hematite were shipped to Magpie mine.

At the large siderite deposit near this mine, which was diamond-drilled in 1916 and 1917, work on the adit, on the north side of the hill, or the deposit which is farthest from the mine buildings, was continued.

This tunnel will tap the ore body about 300 feet below the top of the hill, and a large tonnage will be available above the adit. It is planned to mine this portion of the ore body by open-pit method. Electric haulage to the roast plant, which will be erected not far from the tunnel entrance, will be used. On account of shortage of labour work on all tunnels was stopped on October 4th, 1918. All the equipment was stored with the expectation that work would be resumed early in the spring of 1919. At the time of the shut-down the mine tunnel had been driven 890 feet; No. 1, east branch, 285 feet; No. 2, east branch, 263 feet; and the west branch 244 feet, or a total of 1,690 feet.

G. R. McLaren, Helen Mine, Ont., is superintendent; about 70 men were employed.

Magpie.—The Magpie mine of the Algoma Steel Corporation produced 160,555 tons of roasted ore during 1918, and shipped 168,906 tons. Scarcity of labour prevented the mine being operated to full capacity. The ore produced came from the second, third and fourth level stopes.

A. Hasselbring, general superintendent of mines for the company, was in charge. From 200 to 230 men were employed.

Pyrite

Holdsworth.—A pyrite claim belonging to John Holdsworth and situated half a mile east of Hawk Junction, and about half a mile north of the Michipicoten branch of the Algoma Central railway, was diamond-drilled for the Algoma Steel Corporation. Twenty-two holes were put down. It is understood that over 900,000 tons of pyrite was proven by this work.

Rand.—The Rand Consolidated Mines, Limited, shipped about 3,000 tons of pyrite from their claims a short distance east of Goudreau station on the Algoma Central railway. Two steam shovels were used in stripping. A. W. Jackson, Goudreau, Ont., was in charge. About 20 men were employed.

Nickel and Copper

British-America Nickel Corporation

The development of the Murray mine and the construction work at both mine and smelter were continued in 1918. The furnaces will probably be ready to operate in the autumn of 1919.

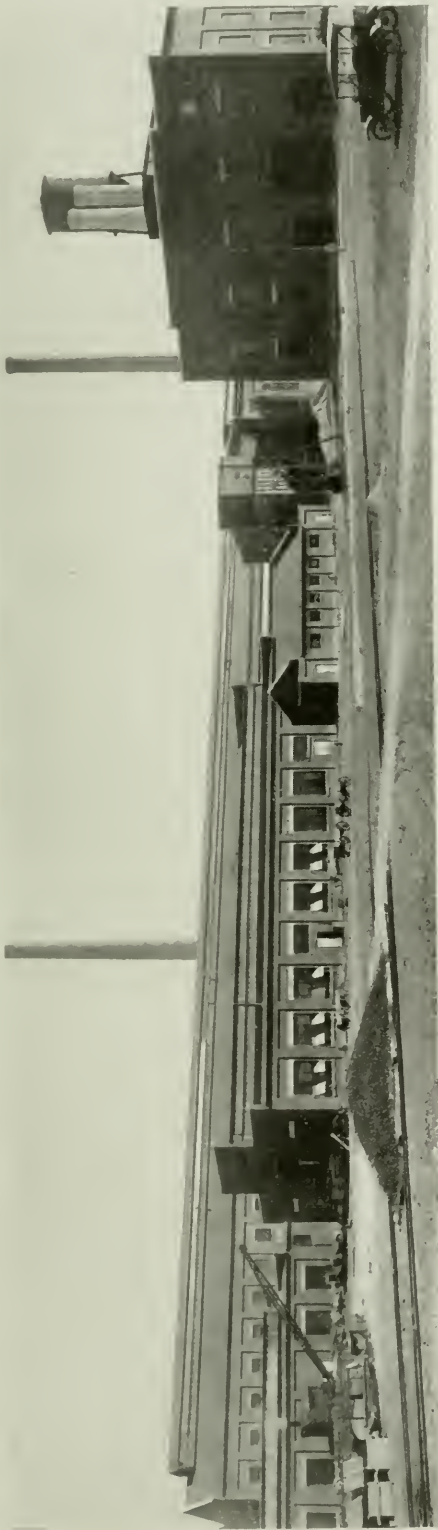
The officers of the company are: president, J. H. Dunn, New York; vice-president and managing director, W. A. Carlyle, Ottawa; acting-treasurer, S. H. Brown, Ottawa; head office, Citizen Building, Ottawa.

The authorized capital stock of the corporation is \$20,000,000, divided into 200,000 shares of common stock of a par value of \$100.

Murray.—The inclined shaft of the Murray mine in April, 1919, was 1,032 feet deep, measured on the slope, and the seventh and eighth-level stations are being cut at 800 and 900 feet respectively. From the shaft, which is sunk at an angle of 36 degrees and is in the footwall, the station cross-cut is driven to the footwall. Drifting is then carried on in ore along the footwall in both directions, and chutes are put in at 35-foot intervals. Untimbered raises 20 feet by 10 feet have been completed between the fourth and third levels, the third and second levels, and from the second level to the workings of the old mine. Between the sixth and fourth levels raising is in progress. About 350 feet of drifting has been done on each of the first six levels. Ore hoisted during 1918 amounted to 21,000 tons.

The shaft house and rock house are being built, and the brick power house, smokestack, and the blacksmith and machine shop building are completed. Three 500-h.p. Babcock and Wilcox boilers have been set up, as has the primary crusher, which is 36 in. by 48 in. and is of the Buchanan jaw type.

The new steam hoisting engine is now in position. This was made by the Canadian Allis-Chalmers Company, and is a duplex, direct-acting, double-drum Corliss, designed for 160-lbs. steam pressure. The cylinders are 22-inch by 48-inch. The drums are 7 ft. in diameter and 5 ft. 6 in. face between flanges, with grooves for 2,180 feet of 1¼-inch rope in two layers. One drum is keyed to the shaft and the other is loose, being driven by means of a double-disc, multiple-arm, friction clutch. The brake is of a parallel motion post type, with a brake wheel 101 in. in diameter and 13 in. face. An overwinding device entirely closes the throttle in case of an overwind, and applies the brake. This device also makes it necessary to reverse the engine after each trip before the throttle valve can be reopened. By means of a Reeves variable-speed changing device, the speed of the engine can be varied from that required for hoisting ore to that for hoisting men, while the speed of the governor remains practically constant. Hoisting will normally be in balance, but the engines are large enough to handle the total load out of balance in case of emergency. The maximum load on one rope will be 19,550 lbs. effective rope pull, and with balanced hoisting 12,450 lbs. effective rope pull.



International Nickel Company of Canada, Limited—General view of the Port Colborne plant.



Bird's-eye view of the Port Colborne plant from the southwest.

The officers of the company are: mine superintendent, Ernest Hibbert; assistant superintendent, H. L. Roscoe; mine foreman, J. H. Jones. Eighty-eight men were employed at the mine, exclusive of those on construction work.

Smelting Plant.—At the end of April, 1919, the work at the smelter at Nickelton had reached the following stage: office, warehouse, machine and boiler shop, and transformer house were completed and equipped; carpenter shop completed, power house completed and machinery being installed. Four Babcock and Wilcox boilers of 1,000 h.p. each have been set up with superheaters, mechanical stokers and coal-crushing and conveying plant; two more of these boilers are to be added. The steel work and roof of the main smelter building are completed. Two blast furnaces, 30 ft. long by 50 in. wide at the tuyeres are being erected. The main flue is completed and consists of brick and steel on a concrete foundation. The converter flue of similar construction is now being built. The ore bin foundations are being poured, and work has been commenced on the smelter stack, which is to be 25 feet inside diameter and 300 feet high.

The staff consists of: smelter superintendent, R. J. Carlyle; superintendent of construction, J. H. Gillis; electrical engineer, R. Howard; master mechanic, Walter Turner.

International Nickel Company of Canada

The International Nickel Company of Canada, Limited, was incorporated in the Dominion of Canada in July, 1916, with an authorized capital of \$5,000,000, which in March, 1918, was increased to \$50,000,000. In August, 1918, the Canadian Copper Company was absorbed by the International Nickel Company of Canada, Limited, and is now known as the Mining and Smelting Division of that company, the organization at the Port Colborne refinery being known as the Refining Division. A description of the plant and process will be found in another part of this report under the heading "Refineries." In November, 1918, the International Company opened its head office in the Harbour Commission Building, Toronto.

The officers of the company at Toronto are: President, A. D. Miles; vice-president, J. L. Agnew (Copper Cliff); assistant to president, G. E. Silvester; secretary, Britton Osler; assistant auditor, F. P. Bernhard; assistant treasurer, Wm. Dennett. The Mining and Smelting Division, Copper Cliff, comprises the following: General manager, J. L. Agnew (vice-president); general superintendent, J. C. Nichols; assistant general superintendent, E. H. Jones; superintendent of mines, E. T. Corkill; smelter superintendent, W. Kent; safety engineer, E. A. Collins. The Refining Division at Port Colborne is composed of John More, general manager; Jas. T. Kemp, assistant general manager.

During 1918, the Creighton and Crean Hill mines and the Dill quartz quarry were worked continuously, while the smelter at Copper Cliff was worked at full capacity. The new refinery at Port Colborne, Ont., began operating in June, and turned out the first run of refined nickel on September 15th. Owing to the lack of demand for nickel and copper after the signing of the armistice, production was greatly reduced in the latter part of January, 1919.

Copper Cliff Smelter.—Full production was maintained at the Copper Cliff smelter in 1918, where there are eight blast furnaces and six converters. An additional silica dryer was added in the converter building.

In January, 1919, production was curtailed, three furnaces and three converters being left in operation.

The Garred-Cavers process of firing with powdered coal is being tried in one of the blast furnaces.

Creighton.—The shipments from the Creighton mine during 1918 amounted to 1,104,674 tons of nickel-copper ore. The greater part of this ore came from between the 14th level and the surface. The main shaft, No. 3, was sunk to the 22nd level, a distance of 1,700 feet measured along the slope. Levels 16, 18, and 20 were opened during the year, and on the 20th level a 30-in. by 42-in. Farrell jaw crusher is being placed in position.

On the sixteenth level a new pump is in use. This is a Gould's Pattern L.A., vertical, single-acting, triplex, plunger pump, size 6¼ in. by 16 in. It has a capacity of 235 gallons of cold water per minute under a total head of 1,525 feet, including the friction head. This pump operates at 38 r.p.m. with an efficiency of 84 per cent. Under the conditions outlined above it requires 108 b.h.p. delivered to the pump shaft. When operating at a reduced head of approximately 1,055 feet, 80 horsepower is required, and the pump has an efficiency of 78 per cent. The gear is 59 1-3-in. outside diameter and 11-in. face. The pump is driven by a 100-h.p. squirrel-cage Canadian Crocker-Wheeler motor, 550-volt, 3-phase, 25-cycle, 500 r.p.m.

G. A. Morrison is superintendent; about 1,100 men were employed during the year.

Crean Hill.—The Crean Hill mine was worked continuously in 1918, but was closed down in January, 1919, and allowed to flood. During 1918, 125,036 tons of ore were shipped, most of which came from above the sixth level.

Charles Collins was superintendent.

Dill Quarry.—The Dill quartz quarry was worked during 1918, but was closed down at the end of January, 1919. The shipments of quartz during 1918 amounted to 96,021 tons.

W. H. Roach was superintendent, employing 45 men.

Mond Nickel Company

The Mond Nickel Company, Limited, employed an average of 1,522 men in its Ontario mines and smelter during 1918. Of this number, 942 were employed on the surface and 580 underground.

The company has a capitalization of £2,400,000 as follows: 500,000 7 per cent. £1 cumulative preference shares; 1,000,000 7 per cent. £1 non-cumulative preference shares; 900,000 ordinary shares, £1 each.

David Owen Evans, 39 Victoria St., London, S.W., is secretary. The head office of the company in Canada is at Coniston. The officials are C. V. Corless, manager, who is also a director of the company; J. F. Robertson, superintendent of

reduction works; O. Hall, mines superintendent; W. L. Dethloff, chief engineer; W. H. Soule, electrical superintendent.

Coniston Smelter.—Two units at the Coniston smelter were in operation until June, 1918, when a fourth furnace and converter were blown in. From June to November three units were in blast, one furnace and one converter being used as standbys. From November until the end of 1918 two furnaces and two converters were operated.

An innovation at this plant is the use of Garr silica guns to insert silica flux into the converters. The quartz does not require to be dried and is forced in by means of compressed air.

Bruce.—The Bruce copper mine at Bruce Mines was worked during all of 1918 by the Mond Nickel Company, and 39,021 tons of siliceous copper ore was shipped to Coniston smelter.

On the 155-foot level of the Tayler shaft, 97 feet of drifting has been done to the west and 860 feet to the east of the shaft. This work has exposed considerable ore, none of which has yet been stoped. Work on this ore body was stopped in July, 1918.

On the 427-foot level of the No. 4 shaft, the drifting done to date (April, 1919) amounts to 1,533 feet to the northwest and 200 feet to the southeast of the shaft. At a point 600 feet northwest of this shaft, a winze has been sunk from the 427-foot to the 527-foot level. On the latter level the drifting consists of 88 feet to the northwest and 166 feet to the southeast.

A. D. Carmichael, Bruce Mines, Ont., is superintendent; 65 men are employed.

Garson.—Shipments from the Garson mine in 1918 amounted to 143,016 tons. Most of the output was obtained from between the fourth and sixth levels. Extensive development work was done on the eighth and tenth levels with gratifying results, as the ore body has proved much larger than on the upper levels. No shaft-sinking was done.

J. R. Thoenen was superintendent until November, when V. P. Row succeeded him.

Levack.—The shaft at the Levack mine is now 700 feet deep (650 feet vertical depth) and the seventh level is being developed. Much development work was done on the fifth level in 1918, most of the ore produced during the year coming from this level and the levels above.

The ore shipped in 1918 amounted to 91,585 tons. The average number of men employed was about 210. F. J. Eager, Levack, Ont., is superintendent.

The following description of the Levack ore body and workings is abstracted from a paper written by O. Hall and read before the Canadian Mining Institute, March 7th, 1919:—

Conditions.—The Levack orebody has a maximum length of 1,200 feet and a thickness of from 20 to 200 feet. The dip varies from 30 to 70 degrees, the footwall being irregular. The walls are of greenstone and gneiss, chiefly the latter. The ore is tough and the walls stand well. As the orebody dips under a muskeg through which flows a creek draining a

large water basin, caving might result in flooding. Ample pillars must, therefore, be left.

Method of Mining:—The method of mining resembles that used at the Alaska Treadwell. The mine is divided into 40-foot pillars and 100-foot rooms. The pillars and rooms are approximately at right angles to the strike. The pillars are rib pillars, continuous on the dip. The rooms are completely mined out, no floors being left. Shrinkage stopes are started above each main level, and are carried through the floor of the level above. Above the 800-foot level where a pinch occurs, the pillars are being left until the remainder of the orebody has been removed. The final removal of these pillars may necessitate partial filling.

Development:—A central five-compartment shaft has been sunk at an angle of 65 degrees in the footwall. Main levels have been driven at vertical intervals of 120 feet. Where the orebody has a low dip, intermediate stations are cut and sub-levels driven 60 feet above the main levels. The main levels are developed by drifting to the ends of the orebody, and cross-cutting to the foot and hanging walls. Two cross-cuts, 50 feet apart, are driven under each stope. Where the dip is less than 60 degrees, the cross-cuts extend about 20 feet into the footwall and the ends of these cross-cuts are then joined by a drift in the footwall. Short raises are run from the sides of the cross-cuts and from the footwall drift. These are spaced at 35-foot centres and are shaped to take chutes of the Creighton type or steel-plated platforms sloping at 10 degrees. The latter are used only where much blockholing or sand-blasting is expected. When these raises are completed, a slice of ore is removed over the whole extent of the stope at a height of 20 feet above the main level. This operation is known as "cutting the section." The mill holes are then funnelled. Ventilation and man-ways are provided by running raises up the centre of each stope along the footwall and also in alternate pillars. When the dip is less than 50 degrees, short cross-cuts are run 60 feet above the main level from the raises to determine the position of the footwall. A footwall drift is then run from the sub-level station. The stopes can thus be entered from the sub-level, the level above, or through short drifts driven into the pillar raise. Steel and tools may be lowered into the stope through the stope raise, and removed by lowering them through the pillar raise. The direction of the ventilation is up the pillar raise and out by the stope raise. A system of ore pockets has been cut in the shaft pillar.

The footwall drifts facilitate tramming, as empty cars may be handled in one drift and loaded ones in another. Where the latter factor is not important, mill-holes are placed at the footwall end of cross-cuts and the footwall drifts omitted.

Stoping:—The stopes in the wider portion of the orebody have fairly large dimensions, 100 feet from pillar to pillar and up to 200 feet from footwall to hangingwall. All the larger stopes are mined by carrying breasts from foot to hanging. Starting at the footwall raise, a slice is cut out of the roof from pillar to pillar. The machines then face the hangingwall and carry a 10-foot breast towards it, drilling three horizontal rows of holes. The horizontal spacing between holes is about 7 feet, the vertical 3 feet. The breast is usually blasted in three stages, the lowest row of holes being fired first, followed by the second and third. After each stage of blasting, the large pieces are block-holed. The roof often breaks ahead of the holes, producing irregular faces, but an attempt to drill symmetrically always pays. Stoping is continued past the sub-level and through the floor and back of the level above. The stopes farthest from the shaft are mined first.

Victoria.—The Victoria Mine shaft, at Mond, which is now completed to a depth of 3,012 feet, is the deepest shaft in Ontario, and probably in Canada. Stations have been cut at the 17th level, 2,578 feet, and at the 18th level, 3,000 feet. On the former level the western ore body is developed, and a winze sunk in ore for 380 feet below the level at an angle of 67 degrees.

Shipments in 1918 totalled 33,198 tons, the ore being obtained from the 1th level down.

W. J. Mumford, Mond, Ont., is superintendent.

Worthington.—In 1918, the Worthington mine shaft was completed to 750 feet vertical depth. The fourth and fifth levels (at 600 and 750 feet) have been developed, and stoping has been begun above the fourth. Shipments for the year amounted to 69,793 tons, and 220 men were employed. J. G. Harris, Worthington, Ont., is superintendent.

The following description of the mining methods at the Worthington is summarized from a paper presented by O. Hall at the Canadian Mining Institute, March 7th, 1919:—

Conditions:—The orebody has a length of about 700 feet and a thickness of 20 to 60 feet. The dip, which is about 70 at the surface, increases with depth and is nearly vertical at 1,000 feet.

Mining Method:—Shrinkage stoping is used. A pillar near the shaft divides the orebody, the ore east and west of this point being mined in separate stopes. In the upper levels a dike further divides the deposit east of the shaft.

Development:—The shaft has been sunk in the footwall and a pillar 60 feet long left opposite. Down to 750 feet the levels have been cut at approximately 150-foot intervals; below this at 250-foot intervals. The stations have been cut in the shaft pillar and a main drift run east and west to the ends of the orebody. Short mill-holes are driven upward from the cross-cuts, and platforms are built three feet higher than the ears. The chutes are in the centre of the platforms and are covered by three 80-pound rails, 18 inches apart. This arrangement combines the advantages of a blockholing chamber and a chute. Where the orebody is less than 50 feet wide, a main drift is run 15 feet away from the footwall. The mill-holes are driven on either side of this at 35-foot centres. This arrangement is found to be more convenient than the cross-cut system, but cross-cuts are sometimes necessary to determine the position of the walls and to place the mill-holes advantageously. After the mill-holes are driven, a slice of the orebody is removed at a height of 20 feet above the level ("section-cutting"); this work is started at the shaft pillar and thence advances to the ends of the orebody.

Stoping:—The shaft pillar and the dike in the eastern part divide the deposit into three stopes. Raises are driven in the shaft pillar and along the dike. At each end of a stope a cribbed manway is provided. The ventilating current travels up one manway and out by the raise. Stoping starts at the raise, a slice being removed from the foot to the hangingwall, the first round of holes being drilled from a cross-bar in the raise. The drills are then pointed away from the shaft pillar, and a breast is carried to the end of the orebody. Up to 1916, piston drills were used, the earlier types of water drill being too light for this ground. With piston drills the back was carried with a downward slope to permit the use of wet holes. With water drills the back is kept level. The drilling face is about 9 feet high, and in it three horizontal rows of holes are carried. The holes are spaced 3 feet vertically and 6 feet horizontally, and are drilled parallel to the walls. The three rows of holes are blasted in succession, large pieces being blockholed after each blast. If rapid extraction is required, two or three benches are carried. With water drills about 30 feet is drilled per shift and 30 tons broken per stope shift or 50 tons per drilling shift. Where conditions permit, the machine men are paid by the yardage broken. This orebody is fairly regular, and the stoping has therefore been systematically done.

Miscellaneous Mines

Goudreau Pyrite.—During the season of 1918 shipments from the Goudreau mine of the Nichols Chemical Company amounted to 90,613 tons.

Ore was shipped during the navigation season by rail from Goudreau to Michipicoten Harbor, thence by boat to U.S. plants of the General Chemical Company.

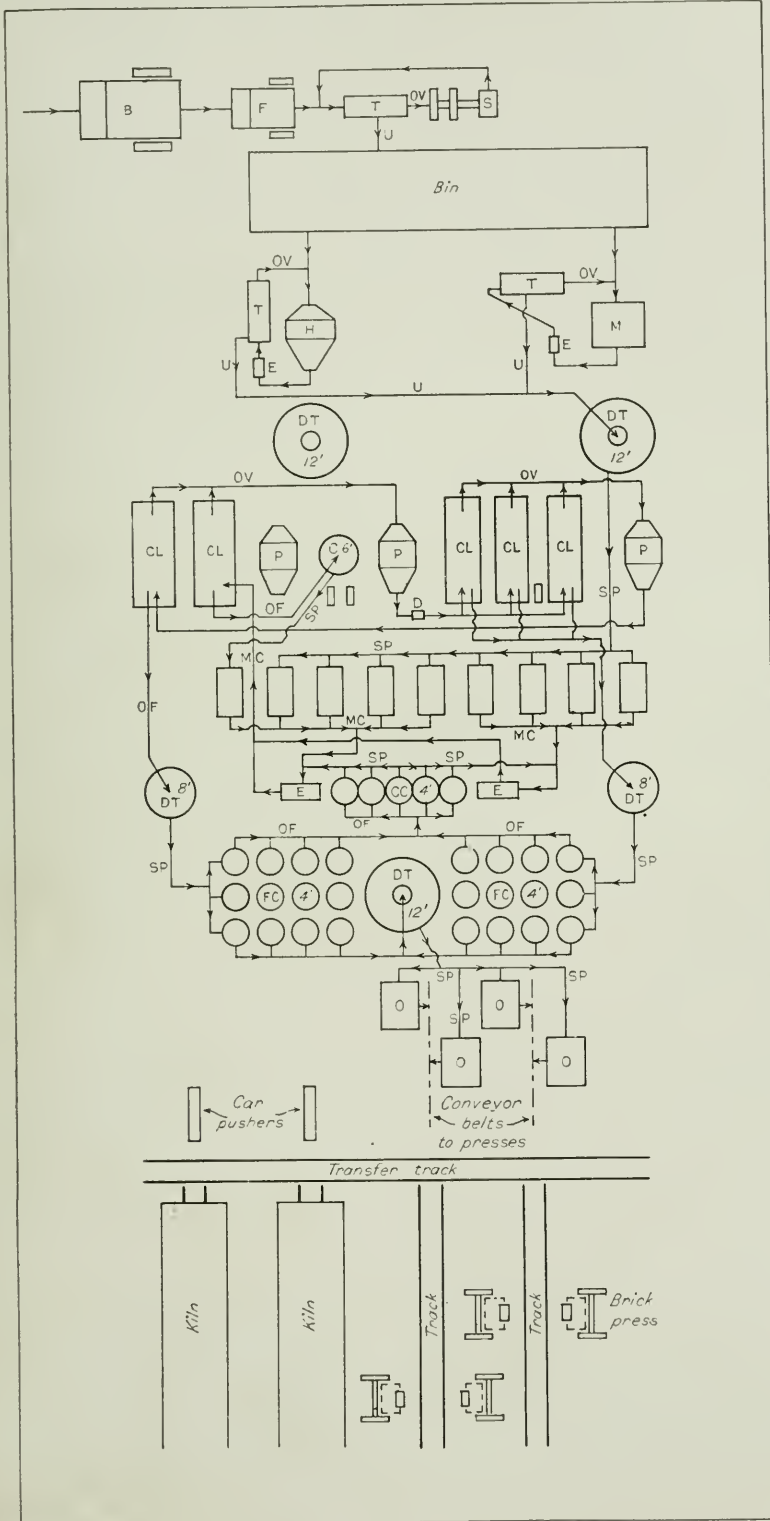
The ore shipped in 1918 was obtained from "C" deposit, which is situated about 1,000 feet from the mill. During 1918, a second deposit, known as the "Bear," was prepared for production. This deposit is situated one mile from the crushing plant, and the ore from it will be handled to the mill over a narrow-gauge track.

The crushing plant was entirely changed, the new installation including a No. 12 Gates gyratory crusher, which has greatly increased the production.

Diamond-drilling operations were pushed during 1918 on a property adjoining the Bear Deposit known as the Morrison No. 3. At the time of writing this report prospecting work on this property has not been completed, so that no accurate description of it is available.

Gerald G. Dobbs was superintendent at Goudreau for the season of 1918, employing about 200 men.

Moose Mountain Iron.—In 1918 work was continued at the mine and mill of the Moose Mountain, Limited, at Sellwood. The ore raised amounted to



FLOW SHEET OF THE MOOSE MOUNTAIN CONCENTRATING PLANT.

- B—Buchanan crusher.
- F—Farrell crusher.
- S—Symons disc crusher.
- M—Marey mill.
- H—Hardinge mill.
- I—Undersize.
- SP—Spigot.
- D—Demagnetizer.
- MC—Magnetic concentrates.
- CC—Cleaner cones.
- FC—Finishing cones.
- O—Oliver filter.
- OF—Overflow.
- OV—Oversize.
- T—Trommel.
- E—Elevator.
- DT—Dorr thickener.
- CL—Dorr classifier.
- P—Pebble mill.

54,271 tons, and the briquettes made and shipped to 26,385 tons. One hundred and forty men were employed.

The deposit at present being worked is developed by means of an adit 350 feet long and measuring 10 feet wide by 11 feet high. From the face of this adit two galleries branch, of the same size as the tunnel, "A" drift to the left 590 feet long, and "B" drift to the right, 514 feet long. Stoping is being carried on above each of these drifts. Chutes are put in the main drifts at 20-foot centres and sub-levels driven 14 feet above and parallel to these drifts.

In the mill and briquetting plant are the following: two jaw crushers, a 36-inch by 48-inch Buchanan, and a 20-inch by 30-inch Farrell; a No. 86 Macey mill, and an 8-ft. Hardinge mill; five duplex Dorr classifiers, two 6-ft. by 20-ft. and three 6-ft. by 12-ft.; three 6-ft. Hardinge mills; nine Gröndal electro-magnetic separators; five Dorr thickeners, two 8-ft and three 12-ft.; 24 classifying cones; three demagnetizers; two vacuum and two low-pressure pumps; four Oliver filters 6 ft. by 6 ft.; four American Clay Manufacturing Co. No. 7010 four-mould brick presses; two roasting kilns, each 220 feet long. The moulds now used in making the briquettes are 8 in. by 2 $\frac{1}{8}$ in. by 4 in.

The officers of the company are: president, Charles E. Herrman, New York; directors: L. B. Biller, Cleveland, O.; J. J. Mitchell and J. C. Hutchins, of Chicago; D. D. Mann and Wm. Mackenzie, of Toronto; Chas. H. Smith, John B. Dennis, Augustine L. Humes, David Dows, John F. Harris, all of New York; secretary, G. C. Lott, 17 Battery Place, New York. The head office is at Sellwood, Ont. The resident officers are: manager, A. J. Anderson; assistant manager, A. R. Globe; mill foreman, R. Sturgeon; mine foreman, J. G. Barron.

Quarries

East Neebish Island.—This quartzite quarry, owned and operated by the Dominion Mines and Quarries, Limited, was in continuous operation during the season of navigation in 1918.

L. Appleton, McLennan, Ont., is general manager, employing about 60 men.

Electro-Metals.—Electro-Metals, Limited, worked their quartzite quarry on the north shore of Georgian bay from May until October, 1918. The following machinery was added during the year—a 40 by 42-inch Power and Mining Machinery Co. crusher, a No. 6-D Gates crusher, a 200-h.p. Robb-Armstrong engine, a 150-h.p. r.f. boiler, and an electric light plant for lighting the quarry. Forty men in two shifts worked in the quarry, and 20 men were employed on the alterations to the plant. C. H. Rayner, Killarney, Ont., was in charge.

McPhail and Wright.—During the summer of 1918, the McPhail and Wright Construction Company, Limited, worked the quartzite quarry situated in the south-east quarter of the south half, Lot 42, Concession II, Deroche township, about a mile and a half north of Bellevue station, Algoma Central railway. The quartzite is shipped to the Algoma Steel Corporation, Sault Ste. Marie, Ont., for the manufacture of silica brick. The drilling was done by hand. Sixteen men were employed.

III.—DISTRICT OF TIMISKAMING

Gold

Boston Creek and Munro

Allied.—The Allied Gold Mines, Limited, has an authorized capital of 2,000,000 shares of a par value of \$1.00.

The company owns what were formerly known as the Renaud and Cullen claims, being the north half of lot 1 in the sixth concession of Pacaud township, adjoining the Miller Independence on the northeast.

A shaft has been sunk to a depth of 100 feet. The equipment consists of a 25-h.p. upright boiler and a 5 by 5 hoist.

R. W. Norrington is manager.

Baldwin.—The shaft on this property was sunk to a depth of 200 feet, with 75 feet of drifting on the 100-ft. level and 90 feet of drifting on the 200-ft. level.

The mine is situated on lot 2 in the sixth concession of Eby township, at mileage 167½ on the Timiskaming and Northern Ontario Railway.

C. P. Charlebois is manager, employing about 20 men.

Bourkes Mines.—This property comprises the south half of lot 9 in the second concession of Benoit township, and is operated by Bourkes Mines, Limited.

The company has a capitalization of 2,500,000 shares of a par value of \$1.00. The officials of the company are: Chas. Miller, president; Chas. Gentles, vice-president; A. Hunter, Secretary; J. J. Byrne, manager.

A vertical shaft has been sunk to a depth of 100 feet, and 594 feet of drifting and 150 feet of cross-cutting done on this level. From this level a winze has been sunk to the 200-ft. level, where 400 feet of drifting was done.

Buildings for the accommodation of 50 men have been erected, and plans are now being prepared for a mill; additional machinery is also being installed. The present plant includes two 40-h.p. locomotive boilers, a 210-cu. ft. compressor and two Jenckes hoists, one 7 by 10 and one 5 by 5.

Burton-Munro.—Operations at this property, on the north half of lot 11 in the first concession of Munro township, were suspended in February, 1918, and work was not resumed until the spring of 1919.

Croesus.—The Croesus mine in Munro township, owned by the Croesus Gold Mines, Limited, has been idle since February, 1918.

Kennedy.—On the Kennedy claims, seven in number, situated in the southeast corner of Boston township, the Mining Corporation of Canada did some surface prospecting under option in 1918.

Millistone.—The Millistone Mining Company is operating the south part of the north half of lot 1 in the sixth concession of Catharine township, formerly known as the Cotter Syndicate. This claim lies due east of the Miller Independence.

Trenching and diamond-drilling have been done under the supervision of J. Murphy.

Miller-Independence.—The Miller-Independence Mines, Limited, has an authorized capital of 700,000 shares of a par value of \$1.00. The officers and directors of the company are: Geo. J. Miller, president, Dayton; William Stroup, vice-president, Dayton; Edward Rettich, treasurer, Germantown; John C. Schaeffer, secretary, Germantown; O. B. Brown, Geo. W. Ozias, J. A. Read, J. A. Beagard, of Dayton; Frank Grotech, Cobalt. Frank Grotech and W. E. Simpson, of Cobalt, are consulting engineers.

“A” shaft, vertical, 2 compartment, has been sunk to a depth of 200 feet; “B” shaft is sunk to a depth of 100 feet at an inclination of 25°; “C” shaft is 110 feet deep; “D” shaft is 210 feet in depth on a 45° incline. From “D” shaft on the 100-ft. level drifting has been done 70 feet to the west and 50 feet to the east, and on the 200-ft. level 200 feet of drifting has been done. The vein in this shaft averages from one to five feet in width, strikes east and west and dips to the south at an angle of 40°.

The equipment includes half of a 10-drill Rand compressor; 2 small hoists; 3 boilers, locomotive-type, 50-, 60-, 80-h.p., and a 25-h.p. upright boiler. A small mill for testing purposes was in operation during part of the year, the equipment including a 5-ft. Hardinge ball mill and one unit of the Grotech flotation machine.

Patricia Syndicate.—This property, formerly known as the Boston Hollinger, consists of two 40-acre claims in the north half of lot 3 in the sixth concession of Pacand township, one mile southeast of Boston Creek station on the Temiskaming and Northern Ontario railway.

The mill, which is described in the Twenty-seventh Report of the Ontario Bureau of Mines, commenced crushing ore in June, 1918. In October milling operations were suspended and during the winter of 1918-19 the syndicate allowed the property to revert to the original owners.

In July, 1919, a forest fire destroyed the mill and all the surface equipment.

Kirkland Lake

Burnside.—The Burnside property adjoining the Tough-Oakes mine at Kirkland lake was operated in 1918 by the Aladdin Cobalt Mining Company.

The Burnside comprises 89.7 acres, being claims L. 1823 and L. 1822 in the township of Teck and L. 1821 in the township of Lebel. The head office of the company is at Finsbury Pavement House, London, England.

No. 2 shaft was sunk to a depth of 255 feet. On the 90-ft. level 113 feet of drifting and 122 feet of cross-cutting was done, while on the 152-ft. level there is 144 feet of drifting and 176 feet of cross-cutting. No. 3 shaft is now 337 feet deep with 56 feet of drifting and 60 feet of cross-cutting on the 120-ft. level, 35 feet of drifting and 155 feet of cross-cutting on the 220-ft. level, and 92 feet of cross-cutting on the 320-ft. level. At No. 3 shaft a 9 by 12 Ingersoll-Rand hoist was installed.

A mill 26 ft. by 68 ft. was built during 1918-1919. The equipment includes a 9 by 15 in. jaw crusher, a 6-ft. Hardinge mill, two 4 by 10 ft. amalgamating tables, two No. 6 Wilfleys, a 10-ft. Dorr thickener and a 75-ft.h.p. 2,200-volt motor.

Forty men were employed. Chas. Richardson is resident manager.

Canadian Kirkland.—The Canadian Kirkland Gold Mining Company, Limited, continued work on the four Killoran claims in Teek township until February, 1918. Two shafts were sunk, one 60 feet and one 30 feet deep. There are two small boilers and two small hoisting engines on the property.

The directors are: president, A. A. Amos, Cobalt; vice-president, George Tough, Haileybury; secretary-treasurer, G. G. T. Ware, Haileybury; D. H. Angus, Cobalt; R. W. Brigstocke, Kingston, Ont.

In May, 1919, the Crown Reserve Mining Company began work on these claims under an option and are deepening the 30-ft. shaft.

Elliott-Kirkland.—The Elliott-Kirkland Gold Mines, Limited, has an authorized capital of 2,000,000 shares of a par value of \$1.00. The officers and directors are: S. Harry Worth, Philadelphia, president and treasurer; W. A. Gordon, Haileybury, secretary; J. W. Wood, Haileybury; R. H. Lyman, Cobalt; E. W. Kearney, Haileybury.

The company owns claims 1616, 1617 and 3044 in Teek township. During 1918 the shaft was sunk from 333 feet to 537 feet, and on the fourth level 75 feet of drifting and 70 feet of cross-cutting done. On the fifth level 193 feet of cross-cutting and 369 feet of drifting were completed during the year.

The equipment includes a 60-h.p. boiler, locomotive-type, a 9 by 12 hoist and a 300-cu. ft. compressor.

J. W. Morrison is consulting engineer, employing 18 men.

Hohenaur.—After sinking a shaft to a depth of 40 feet, the Temiskaming Mining Company, Limited, ceased work in February, 1918, and dropped the option on the Hohenaur claim in Teek township.

Kirkland Lake.—The Kirkland Lake Gold Mining Company, Limited, has an authorized capital of 2,000,000 shares of a par value of \$1.00. The company owns 362 acres. The Beaver Consolidated Mines, Limited, has control of this company's stock.

The officials of the company are: F. L. Culver, president and general manager; F. C. Finkenstaedt, vice-president; H. E. Tremain, secretary-treasurer. The directors are: F. C. Finkenstaedt, F. L. Culver, F. L. Lovelace, J. H. Black, Wm. Thos. Mason, Wm. E. Stevenson, H. E. Tremain, Howard L. Churchill. The head office of the company is in the Lumsden Building, Toronto.

The main shaft was continued to the 500-ft. level with large working stations on the 300-, 400- and 500-ft. levels, which are connected with corresponding levels from No. 2 shaft, 700 feet in depth.

The following is a summary of the development work: drifting, 2,450 feet; cross-cutting, 1,553 feet; sinking, 1,207 feet; station-cutting, 893 cubic yards.

The new shaft house over the main shaft has been completed, and the machinery installed to give the ore its preliminary crushing. Raising the ore direct from the mine, it is dropped over a grizzly into an ore bin of 500 tons capacity. From this bin the ore is fed into a Buchanan jaw crusher, passed over a magnetic pulley, and through a trommel or screen, the undersize from this screen passing direct to a

travelling belt which conveys it to a large bin in the new mill. The oversize is crushed again by a Tellsmith crusher, the product dropping on to the travelling belt, thence to the mill bin. The mill, which has been erected during the year, has a capacity for treating 150 tons of ore per day, and is fully equipped for recovering the gold by the counter-current decantation system. The installation includes an eight-foot Hardinge ball mill, Dorr classifier, large tube mill, fifteen solution tanks, pumps, presses and compressor.

A water system for fire protection has been put in and a new refinery completed.

The mining plant consists of: three boilers, 30-, 40- and 60-h.p.; a single drum hoist electrically driven; a 10-drill Sullivan steam-driven compressor and a 4-drill Sullivan steam-driven compressor; also water tanks; all at the old power station. A new power house has been built containing a 12-drill electrically driven compressor; a large double drum electrically driven hoist and equipment for machine shop; transformer house and blacksmith shop.



Lake Shore mine, Kirkland Lake, June, 1919.

Kirkland Porphyry.—The Kirkland Porphyry Gold Mines, Limited, were not operating between June and October, 1918. In October, J. Houston was appointed manager and active development was resumed. At the end of the year the main shaft was 400 feet deep, with levels at 117, 238, 280 and 400 feet.

On the first level 52 feet of cross-cutting has been done, and on the second level 27 feet. Drifts have been extended to the west 65 feet, and to the east 58 feet on the vein. On the third level 28 feet of cross-cutting and on the fourth level 10 feet of cross-cutting were driven to the vein, but no drifting had been done on the vein on these levels at the close of 1918.

The equipment comprises a 60-h.p. boiler, a 4-drill electrically driven compressor, and an 8 by 12 Ingersoll-Rand hoist. An average of 20 men is employed.

Lake Shore.—The Lake Shore Mines, Limited, at Kirkland Lake, have an authorized capital of \$2,000,000 in shares of a par value of \$1.00, all of which have been issued. The officials of the company are Harry Oakes, president and managing director; Arthur G. Slaght, vice-president; Conrad E. Wettlaufer, treasurer;

Kirkland Securities, Limited, secretary. In addition to the above, the directors include Dr. W. P. St. Charles, Toronto, and A. E. Wende, Buffalo, N.Y. R. C. Coffey, Kirkland Lake, is mine manager, and the head office is at Kirkland Lake.

The following information is taken from the fourth annual report of the company, which covers the fiscal year ending November 30th, 1918.

The mill was completed and operations commenced on March 8th. From that time to the end of November, 14,948 tons of ore were treated, from which were recovered \$370,124.41, or a recovery of \$24.76 per ton.

The following table shows the sources from which the ore was taken:

	Tons.
Surface (stock dump)	227
100-ft. level	1,343
200-ft. level	3,558
300-ft. level	329
400-ft. level	9,738
	15,175

An analysis of the above, distinguishing ore from development and ore from mining, may be of interest:

	Tons.	Per cent.
From stopes	4,280	28.20
From raises	72	.47
Surface dump	207	1.37
Drifting	10,616	69.95
Total ore hoisted	15,175	99.99
Ore in bins	227	
Ore milled	14,948	

The following table shows the underground development. The annual report further states that approximately 80 per cent. of all drifting has been in ore of milling grade.

SYNOPSIS OF DEVELOPMENT.

	Drifting	Cross-cutting	Raising	
On No. 1 Vein—				
100-Foot Level		27 feet		
200-Foot "	167 feet	190 "	101 feet	
300-Foot "			94 "	
400-Foot "	543 feet	19 feet		
	710 feet	236 feet	195 feet	
On No. 2 Vein—			Total...	1,141 feet
200-Foot Level	589 feet	179 feet		
400-Foot "	612 "	390 "	50 feet	
	1,201 feet	569 feet	50 feet	
			Total...	1,820 feet
			Grand Total.	2,961 feet

A dividend of $2\frac{1}{2}$ per cent., amounting to \$50,000, was paid on August 20th, 1918, and another dividend of $2\frac{1}{2}$ per cent. was declared payable on December 10th, 1918. In addition, \$50,000 was invested in Canadian Victory Loan bonds.

Minaker Kirkland.—The Minaker Kirkland Gold Mines, Limited, has an authorized capital of 1,500,000 shares of a par value of \$1.00. The directors and officers of the company are: Fred. A. Day, president; George A. Bagshaw, secretary-treasurer; W. A. Gordon, A. E. Cranstoun, M. B. Boissonnault. The head office is at Haileybury.

The company owns claims 16634, 16633, 16726 and 3468 in Teek township, lying to the south of the Lake Shore property.

At the end of the year 1918 No. 1 shaft was 83 feet in depth and No. 2 shaft 25 feet.

The equipment includes a 50-h.p. boiler, a 6 by 8 hoist, and a 2-drill compressor.

T. J. Flynn was manager.



Teek-Hughes mine, June, 1919. The two buildings with verandahs in the foreground on the left belong to the Kirkland-Porphyr.

Montreal Kirkland.—The Montreal Kirkland Gold Mines, Limited, during 1918 sank a 100-foot shaft on the Killoran claims, L 6679, 6680, 6681 and 6682.

Ontario Kirkland.—The Ontario Kirkland Gold Mines, Limited, are operating L 2678 and L 2679, formerly known as the Hurd claims, in Kirkland lake. A two-compartment shaft was sunk to the 100-ft. level, and 20 feet of cross-cutting and 25 feet of drifting done. Early in 1919 sinking was resumed, it being the intention to continue the shaft to a depth of 300 feet. An electrically driven hoist and compressor are installed.

Ralph Hurd is manager, employing 12 men.

Teek-Hughes.—The Teek-Hughes Gold Mines, Limited, has an authorized capital of 2,500,000 shares of a par value of \$1.00, of which 2,134,000 shares have been issued. The officers and directors of the company are: Chas. L. Denison, president; Robert W. Pomeroy, vice-president; A. D. Crooks, secretary; H. C. Clarke, treasurer. In addition to the above Albert W. Johnston and J. F. Thomp-

son, of New York City, are directors. The head office of the company is at 14 Wall Street, New York.

The following information regarding operations at the mine is taken from the fifth annual report of the company.

The most important development work carried on was the further opening of the No. 3 vein on the 4th and 5th levels. On the 4th level, not only was the vein drifted on to the westward, but considerable raising and cross-cutting were done. The winze from the 4th level was continued to the 6th level, and the 5th level was started from it, drifts being run east and west on the No. 3 vein and a cross-cut being made to the north connecting with the No. 1 shaft by raising the latter from the 5th to the 4th level. The vein as far as developed on the 5th level was found to yield quite as good ore as on the 4th level, with the ore bodies located at corresponding places. Raises and stopes from the 4th level were carried up in ore, but this work was not advanced far enough to enable complete estimates of blocked ore to be obtained.

SUMMARY OF DEVELOPMENT

—	Drifting Feet	Cross- cutting Feet	Shaft sinking Feet	Station cutting Feet	Winzing Feet	Raising Feet	Stoping and side slicing Tons
At Sept. 1, 1917...	3,247	1,647	716	64	170	.....	3,400
Year's Performance	1,413	652	100	25	130	220	13,500
At Sept. 1, 1918...	4,660	2,299	816	89	300	220	16,900

Seventeen thousand six hundred and eighty-six tons of ore and 6,576 tons of waste were hoisted from the mine. One thousand eight hundred and eighty-four tons of ore were sent to the low-grade stock-pile, and 15,802 tons went to the mill. Of the ore hoisted 8,891 tons came from development, and 8,795 tons from stoping and side slicing.

From August 31st, 1917, to July 2nd, 1918, the mill treated 15,879 tons of an average value of \$7.87 per ton.

In May, 1918, D. L. H. Forbes was appointed general superintendent. In July, owing to scarcity of labour and high cost of materials, both mine and mill were shut down. Operations at this property were resumed in the autumn.

Tough-Oakes.—The Tough-Oakes Gold Mines, Limited, stopped mining and milling operations July 31st, 1918. The mine was kept pumped out and work underground was resumed March 15th, 1919.

In 1918 there was 2,528 feet of drifting and 537 feet of crosscutting done; 22,000 tons of ore was milled.

An amalgamation of the properties of the Tough-Oakes, Burnside and Sylvanite mining companies is being worked out.

Wright-Hargreaves.—The Wright-Hargreaves Mines, Limited, has an authorized capital of 2,500,000 shares, of a par value of \$1.00. The officers and directors are: Oliver Cabana, Jr., president; Gerard F. Miller, secretary; Clara B. McCallum, treasurer; Edwin Langmiller, Albert Wende, Oliver Donaldson, Ralph Hochstetter, all of Buffalo, N.Y.; Wm. H. Wright, Haileybury, W. C. Young, Toronto.

In July, 1918, the mine was shut down, and preparations for the erection of a headframe and a 150-ton mill were made under the direction of James Grant.

Prior to the shut-down No. 3 shaft was sunk to a depth of 425 feet, and on the fourth level 600 feet of cross-cutting done towards No. 1 shaft. On the 300-ft. level of No. 2 shaft 400 feet of drifting was done.

Larder Lake

Associated Goldfields.—The Associated Goldfields Mining Company, Limited, has an authorized capital of 5,000,000 shares of a par value of \$1.00 each, of which 2,500,000 shares have been issued.

The directors of the company are: Geo. A. MacKay, Toronto, president and managing director; A. A. McFall, Toronto, vice-president; R. W. MacKay, Toronto, secretary-treasurer; D. H. McCartney, Milton; J. Dinwoody, Toronto; Albert Singer, Toronto. In view of the extensive development policy planned for 1919 an advisory board was appointed. This advisory board is composed of 32 stockholders. The head office of the company is at 306 C.P.R. Building, Toronto.



Wright-Hargreaves mine, June, 1919.

On the Harris-Maxwell mine 100 feet of drifting was done on the 500-foot level.

At the Reddick mine 700 feet of cross-cutting and drifting was done on the 100-ft. level.

At this property a 2,500-cu. ft. Blaisdell air compressor, electrically driven by a 325-h.p. motor with the necessary transformers and electrical equipment, was installed.

C. G. Daimpré is general manager, employing an average of 40 men.

Porcupine

Davidson.—The Davidson Gold Mines, Limited, worked continuously during 1918 on lot 2, concession 5, township of Tisdale. On the 300-ft. level, 407 feet north of No. 1 shaft, a winze was sunk 220 feet, cutting an ore body previously located by diamond drilling. Early in 1919 electric power was supplied to the

mine by the Northern Canada Power Co. The ten-stamp mill is crushing about 30 tons per day. The officers of the company are G. C. Crean, president; vice-president, H. B. Sutherland; managing director, H. H. Sutherland; director, W. C. Lacey; secretary-treasurer, L. C. Platt, Toronto. In December, 1918, N. J. Evered succeeded D. Sloan as manager. F. D. Henderson is mine superintendent.

Dome.—The Dome Mines Company, Limited, has an authorized capital of \$5,000,000, of which \$4,000,000 has been issued.

The officers of the company are: president and treasurer, J. S. Bache; first vice-president, W. S. Edwards; second vice-president, C. D. Kaeding; third vice-president, H. P. De Pencier; secretary, Alex. Fasken; treasurer and assistant secretary, Alfred H. Curtis; assistant treasurer, Sol. Wexler. The directors are: J. S. Bache, W. S. Edwards, Alex. Fasken, G. C. Miller, T. R. Finucane, A. H. Curtis, C. Hoyt, C. D. Kaeding. The last-named is general manager. The head office is at 36 Toronto St., Toronto.

The following information is taken from the eighth annual report of the company, being for the fiscal year ending March 31st, 1919:

On account of the continuance of the conditions which caused the cessation of milling operations in December, 1917, the milling plant was not operated, and hence no ore was mined and hoisted. Following out the policies laid down at the last annual meeting, and from time to time since, a considerable amount of work has been done in the mine, and the plant has been carefully cared for in the interim.

The completion of the ore and waste handling systems in connection with No. 3 shaft (the magnitude and scope of which is not generally understood) is undoubtedly one of the most important events we have been able to report, and a resumé of this work is given for your information. The work started in 1915 (which has been interrupted and delayed from so many causes) consists of a large square type shaft sunk on the footwall side of the ore-bearing zone, stations at the 3rd, 5th, 6th, 7th, 8th, 9th, and 10th levels and loading pockets for ore and waste at the 6th, 7th, 8th and 10th levels. The 8th level, which is 850 feet vertically below the surface, has been made the main haulage and loading level, and the large 36 x 54-inch jaw crusher, which was installed temporarily on the 5th level at No. 2 shaft, has been permanently set below the 8th level and ore passes have been driven in such a manner that the entire ore tonnage (now estimated at nearly two million) above the 8th level will be handled only once by manual labour, when it is drawn from the stopes into the ore cars. After this it will flow into and through the large crusher, and is never again touched except by mechanical means in its flow out of the mine, through the secondary crushing plant and through the mill where the values are extracted. The same arrangement has been provided for the waste rock, utilizing old No. 2 shaft, now obsolete, as the main pass from the upper levels down as far as the 8th level, with the exception that the waste rock does not pass through the crusher, as it is always broken up small from the nature of the shot firing in development work. Loading pockets for waste are at the 8th and 10th levels. This section will insure the maximum quantity of unpayable material being kept out of the ore stream. During the progress of this work every level of the new shaft had to be connected with the existing workings of the mine, and temporary measures had to be taken in many instances to insure the continuance of the output during 1916 and 1917. These conditions are now all behind us, and the mine has a thoroughly modern and adequate plant and system serving it to a depth of 1,150 feet with which, if necessary, upwards of 3,000 tons of ore and waste can be flowed out in two shifts of eight hours each, and men and materials sent in to the workings. Thirty men can be accommodated at each trip on the man-eage, or the electric locomotives can be moved from level to level or to surface for repairs. The skips working in balance haul four tons per trip at a speed of 1,100 feet per minute. The entire system is served with electrically operated signal bells, lights and telephones.

With regard to the ore reserve there has been no change in the estimates since the last statement, the tonnage being sufficient to insure the maximum capacity operation of the milling plant for a period of four years.

The development is shown in the following table:

SUMMARY OF DEVELOPMENT WORK FOR YEAR 1918-19

Level	Drifts	Cross Cuts	Raises	Box Holes	Shafts	Stations	Pockets	Total	Diamond Drilling	Total	Excavation Cu. Ft.	Dome Ext. Drift
5th.....	5							5		5		
6th.....		8	171					179	751.75	930.75		92
7th.....			106					106		106	3,600	
8th.....	71	55	138.5					264.5	646.5	911	22,000	
9th.....												
10th.....	1,267	65.5				41	56	1429.5	1418.5	2848.0		
Shaft.....					199			199.0		199.0		
Total...	1,343	128.5	415.5		199	41	56	2183.0	2816.75	4999.75	25,600	92

Waste hoisted—22,165 tons.

Regarding the acquisition of the Dome Extension, President Bache of the Dome Mines Company gives the following information in the report to the directors:

Under an agreement entered into between the Dome Extension Mines Company, Limited, and this company, we have the option to purchase the property and assets of that company for 76,666 fully paid shares of the capital stock of this company. Under this agreement your company has no obligation, but if it desires to keep the option in force an average sum of \$3,000 per month in exploration and development must be expended. The option expires the 15th day of March, 1920. Your directors will, so long as conditions justify, continue exploration and development work on the Dome Extension property and if, in their opinion, results justify the completion of the purchase, a special meeting of the shareholders will be called and thereat all the available information will be laid before them. The programme of exploration now being pursued consists of cross-cutting on the sixth level in the Dome Extension property to the ore zone previously located by diamond-drilling. This work has now progressed to the extent that the zone has been penetrated by a cross-cut which discloses ore of about #4 grade.

Dome Lake.—The following particulars regarding the Dome Lake Mining and Milling Company, Limited, are abstracted from the company's annual report for the year ending December 31, 1918:

The mine was worked continuously. Development was confined to the No. 3 vein to the west of the shaft on the 300-, 400-, 500-, and 600-ft. levels. Ore hoisted amounted to 11,517 tons, of which 1,258 tons came from development. The summary of development work is as follows:

	In 1918 Feet	Previous to 1918 Feet	Total to Jan. 1, 1919 Feet
Drifting.....	644	9,032.6	9,676.6
Crosscutting.....	459	3,604.6	4,063.6
Raising.....	103	1,617.0	1,720.0
Winze-sinking.....	100	277.9	377.9
Shaft-sinking.....	80	935.5	1,015.5
Total.....	1,386	15,467.6	16,853.6

The mill was run until the middle of November, when it was closed down for the annual clean-up and to make certain changes. In March, 1918, the new cyanide plant was put in

operation, and since that time the average extraction has been over 87 per cent., whereas it was 66 per cent. the preceding year when amalgamation only was used.

Ore reserves are estimated to be: broken ore, 250 tons, worth \$2,800, and ore in place, 2,000 tons, worth \$23,200. Additional ore is being developed on the 600-ft. level.

The directors are: president, F. L. Bapst; vice-president, A. A. McKelvie; secretary-treasurer, F. L. Hutchinson; general manager, C. L. Sherrill; T. McCamus, W. H. Kinch, S. J. Dark. The head office is at New Liskeard, Ont. C. A. Randall, South Porcupine, Ont., is resident manager.

Hollinger Consolidated.—The following information regarding the operations of the Hollinger Consolidated Gold Mines, Limited, is taken from the eighth annual report of the company, for the year ending December 31, 1918:

The progress made in the mine during the year is summarized as follows:

Level	Shafts	Drifts	Cross-cuts	Raises	Diamond Drilling	Timbering		Excavation
						Shafts and Winzes	Stopes	
	feet	feet	feet	feet	feet	feet	feet	tons
100 feet		354	139	82				50
200 feet		1,620	1,016	452	2,246		1,641	164
300 feet		1,317	1,370	275	1,783		1,633	75
425 feet		2,223	2,016	536	1,329		974	957
550 feet		1,346	3,170	47	2,601		29	1,477
675 feet		1,813	1,953	330	730			4,319
800 feet	268	307	3,059	474	1,118	194		1,693
950 feet	8	7	9	196	299	20		1,304
1,100 feet			356					1,161
1,250 feet		41	827					
Total.....	276	9,028	13,915	2,392	10,106	214	4,277	11,200

Total sinking, drifting, cross-cutting and raising, 25,611 feet.

The ore hoisted in 1918 amounted to 580,062 tons, of which 12.9 per cent. came from development; 318,237 tons of broken ore remained in the stopes at the end of the year.

The ore reserves are now estimated as follows:—

	Tons	Gross value
Above the 425-ft. level.....	2,190,270	\$20,311,230
Between the 425-ft. and 800-ft. levels	1,860,370	16,751,510
Below the 800-ft. level	224,930	1,912,792
Veins not developed underground but calculated on a basis of 100-ft. depth	212,020	2,091,065
Surface dumps.....	1,490	13,410
Total.....	4,489,080	\$41,080,005

The value of ore reserves at the end of 1917 was estimated at \$40,231,435. No effort was made to increase the tonnage of ore reserves, owing to adverse labour conditions and the high price of supplies. Work below the 800-ft. level was practically suspended for the same reasons.

The milling results were: 578,755 tons milled with an average value per ton of \$10.24; net values recovered, \$5,752,370.87; average tons milled per day, 1,590 tons; per cent. of possible time run, 64.1; tons milled per 24 hours' running time, 2,480; stamp duty per 24 hours' running time, 15.5 tons; solution precipitated per ton of ore, 2.38 tons; value per ton in tailings, \$0.30; cyanide consumed per ton of ore, 0.447 lbs.; zinc consumed per ton of ore, 0.427 lbs.; zinc consumed per ton of solution, 0.180 lbs.; lime consumed per ton of ore, 2.41 lbs.; lead acetate consumed per ton of ore, .028 lbs.; average value of pregnant solution, \$4.153.

The "Plant and Development" accounts are as follows:—

Year	Plant		Development	
	Expended	Written off	Expended	Written off
	\$ c.	\$ c.	\$ c.	\$ c.
1910—1915	1,839,910 05	529,480 89	1,155,644 67	379,346 37
1916	599,417 16	150,000 00	125,593 32	.....
1917	673,237 52	100,000 00	131,224 23	.....
1918	118,379 14	375,000 00	5,006 54	.....
Total.....	3,230,943 87	1,154,480 89	1,417,468 76	379,346 37

The present valuation of \$2,076,462.98 for plant is 64 per cent. of the total cost of same. The following table shows the production and dividends of these mines:—

—	Year	Tons of Ore Milled	Values Recovered		Dividends Paid
			\$	c.	\$
Hollinger Gold Mines, Ltd., and Acme Gold Mines, Ltd.	1911	1,000	46,082	52	.....
	1912	45,195	933,682	00	270,000
	1913	140,131	2,488,022	58	1,170,000
Hollinger Consolidated Gold Mines, Ltd.	1914	211,846	2,719,354	47	1,170,000
	1915	441,236	4,205,901	69	1,720,000
Hollinger Consolidated Gold Mines, Ltd.	1916	601,854	5,073,401	05	3,126,000
	1917	508,139	4,261,938	72	738,000
	1918	578,755	5,752,370	87	1,230,000
		2,528,876	25,480,753	90	9,424,000

The average number of men employed during the year was 1,061, distributed as follows: mine, 698; mechanics, 154; mill and refinery, 121; staff and miscellaneous, 88.

The officers of the company are: president, N. A. Timmins, Montreal; vice-president and secretary-treasurer, D. A. Dunlap, Toronto; directors: L. H. Timmins, Montreal; J. B. Holden, Toronto; P. A. Robbins, Timmins; J. R. Timmins, Timmins; Dr. W. L. McDougald, Montreal.

P. A. Robbins resigned as general manager in 1918, and was succeeded by A. F. Brigham, formerly manager of the Jagersfontein Diamond Mines, South Africa. The other resident officials are: general superintendent, Chas. G. Williams; mill superintendent, E. L. Longmore; mechanical superintendent, R. W. Robbins; production superintendent, A. W. Young; development, superintendent, R. T. Regnell; mine inspector, Benjamin Richards.

McIntyre.—A Nordberg hoisting engine is now in operation at the No. 5 shaft. It has a double cylindrical drum keyed to the shaft, 6 ft. diameter by 44-in. face grooved for 1-in. cable to carry the cage, and 5 ft. diameter by 40-in. face grooved for 7/8-in. cable to carry the counterweight. The double-deck cage, which is on order, will weigh 3,500 lbs.; the counterweight weighs 3,750 lbs. The maximum hoisting speed is 750 feet per minute. The gear is Wuest, single-reduction, of 2 1/2 diametral pitch and 9-in. face with 16 teeth on the pinion and 193 on the gear. The engine is equipped with an oil-operated post brake, a liquid controller, a Francke coupling, a dial indicator and a Welch safety device. It is driven by a 125-h.p. motor, 485 r.p.m., 500 volts, and 25 cycles.

During the year ending June 30, 1919, there were milled 159,875 tons of ore of an average grade of \$9.73, with a gold production of \$1,670,956.41. The underground work was as follows:

Level	Drifts	Cross-cuts	Raises	Winzes	Shafts	Stations	Sumps	Pockets	D.H. Holes	Total
ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.
200	.....	.....	.....	42.5	.....	.....	.....	.....	1,414	42.5
300	.....	.....	.....	.....	.....	6	.....	.....	.....	6.0
400	72	.....	23	.....	.....	.....	.....	.....	.....	95.0
500	210	.....	.....	.....	.....	.....	.....	.....	.....	210.0
600	751	77	.....	.....	.....	.....	.....	.....	313	828.0
700	.....	.....	.....	.....	.....	.....	.....	.....	936	.....
800	955	35	217	.....	.....	.....	.....	.....	669	1,207.0
900	329	19	.....	.....	.....	.....	.....	.....	909	348.0
1,000	1,194	298	.....	81.0	.....	55	139	.....	4,400.4	1,767.0
1,125	1,308	363	329	.....	132	96	.....	121	769	2,349.0
1,250	.....	20	.....	.....	.....	25	.....	.....	.....	45.0
.....	4,819	812	569	123.5	132	182	139	121	9,410.4	6,897.5

The officers of the company are: president, J. P. Bickell; vice-president, Henry M. Pellatt; secretary-treasurer, M. P. Van der Voort, all of Toronto; directors, W. J. Sheppard, Waubashene; J. B. Tudhope, Orillia; E. F. Johnston, Toronto; H. D. Symmes, Niagara Falls; general manager, R. J. Emms; mine superintendent, J. E. McAllister; mill superintendent, A. Dorfman.

North Davidson.—Work on this property on Lot 3, Concession six, township of Tisdale, was confined to 1,000 feet of diamond drilling. The president of the company is R. T. Jeffrey, and the managing director L. G. Harris, Royal Bank Building, Toronto.

Porcupine-Crown.—On the Porcupine-Crown gold mine, near Timmins, the development work done in 1918 amounted to 700 feet. The ore milled amounted to 10,907 tons, yielding \$105,246.52, or \$9.64 per ton milled. The extraction was 97.09 per cent. In July, work was stopped on account of the abnormal costs of labour and supplies.

In February, 1919, when an inspection of this mine was made, ten men were employed timbering the stope above the first level east of the shaft.

The mine is owned by Porcupine-Crown Mines, Limited, of which the officers and directors are the same as for the Crown Reserve Mining Company, Limited. The head offices of the company are at 145 St. James Street, Montreal, and 18 Toronto Street, Toronto. H. J. Stewart, Cobalt, Ont., is acting manager, and A. S. Crowe, Timmins, Ont., mine foreman.

Porcupine V. N. T.—During 1918, the Porcupine V. N. T. Gold Mines, Limited, continued work from the beginning of the year up to July 17th. The mill was run on ore from the North Thompson and a small amount from the dump, 15,131 tons being treated.

A drift 200 feet long was run from the North Thompson shaft on the 100-ft. level to the Krist property, and exploratory work done on the Krist under contract.

The officers of the company are: H. W. Ward, president, New York; F. H. Hamilton, vice-president, London, England; E. G. Holloway, secretary, New York. The head office of the company is at 50 East 42nd Street, New York.

M. J. Ebered was manager up to November; about 110 men were employed.

Schumacher.—The underground work at the property of the Schumacher Gold Mines, Limited, up to May 15th, 1918, consisted of cleaning out old stopes. The mill was operated up to July 15th, 1918, when all broken ore had been treated. About 100 men were employed.

The officers of the company are: F. W. Schumacher, president; F. L. Culver, vice-president; James T. Murdoch, secretary-treasurer, 85 Bay Street, Toronto; T. J. Harwood is manager.

Whelpdale.—The Porcupine Whelpdale Mines, Limited, has an authorized capital of 2,500,000 shares of a par value of \$1.00. The officers and directors of the company are: J. A. Kilpatrick, president; B. J. Simons, secretary-treasurer; F. P. Jones, Montreal; R. M. Gray, S. B. Dawson, R. L. Marks, J. O. Gadsby, G. Tamblyn, C. M. Dineen, all of Toronto. The head office of the company is 911 Royal Bank Building, Toronto.

The property of the company comprises the north half of lot eleven in the third concession of Tisdale township.

A shaft has been sunk to a depth of 114 feet, and on the 100-ft. level drifts extend east 80 feet and west 26 feet.

The equipment includes a 4-drill compressor, a 5 by 7 hoist and two boilers, 30-h.p. and 70-h.p. respectively.



Otisse gold mine, Matachewan, operated by the Colorado-Ontario Development Company.

Matachewan

Colorado-Ontario (gold).—The Colorado-Ontario Development Company continued prospecting work on the Otisse and Robb gold claims in Powell township during 1918. A large amount of trenching was done, and 13 diamond-drill holes, averaging about 400 feet in depth, were put down.

Early in 1919 the company was reorganized under the name of the Matachewan Gold Mines, Limited, the officers of which are: W. J. Boland, 2 Toronto Street, Toronto, secretary; E. T. Boland, Toronto, president. T. J. Flynn is manager.

Wallace (gold).—The Crown Reserve Mining Company did some surface work in 1918 under option on the six Wallace mining claims situated north of the Otisse property in the Matachewan gold area.

West Shiningtree

Claims were first staked for gold in West Shiningtree in 1911, and more or less prospecting has been going on since that time. The area is connected by a 20-mile wagon road with Westree, a station on the Canadian National railway, 80 miles north of Sudbury. The gold occurs in quartz veins of various sizes, and in a variety of rocks, viz., pillow lava, rusty carbonate, hornblende schist, conglomerate, greywacké and porphyry, mainly of Keewatin age. Not enough work has been done yet to place a property beyond the prospect stage, but some small ore-shoots have been developed. The working properties in September, 1919, lie in the northern part of the area, i.e., 5 miles northeast of West Shiningtree lake, and are described in the following paragraphs.

NORTHERN SECTION.

Atlas.—The Atlas Gold Mines, Limited, is prospecting one claim, No 2504, which lies one-half mile southeast of the Westree, and is on the south end of Wasapika lake, in MacMurchy township. A few test pits have been sunk on different veins, and an adit was commenced in September, 1919, into the hillside to prospect an east-west gold-bearing quartz vein which outcrops about 60 feet above on the hill top.

Mr. Hershman is in charge of prospecting, and five men are employed.

The company has an authorized capitalization of \$2,000,000, divided into shares of a par value of \$1.00. The officials of the company are: Mark Workman, president; A. M. Bilsky, vice-president; Isaac Friedman, secretary; Jacob A. Jacobs, director, all of Montreal; Israel Singer, Toronto. The head office is in the Confederation Life Building, Toronto.

Herrick.—The holdings of the Herrick Gold Mines, Limited, comprise mining claims S. 4096, 4097, 4098, 4105, 4106, 4107, in the township of Churchill, formerly known as the Knox claims. The authorized capitalization is \$1,000,000, divided into shares of a par value of \$1.00.

The provisional directors of the company are: Russell Evans, Daniel Sherriff, Fannie Cox, Elsie White and May Stern, all of Toronto.

A vein, varying from a few inches to a few feet in width and enclosed by conglomerate, greywacké and mica-porphyry, has been traced in a north and south direction for 1,000 feet. Development work consists of a 50-ft. shaft and considerable diamond-drilling. One drill hole tapped the vein at 400 feet, and a second drill hole is now being put down.

George R. Rogers is in charge of operations and about 15 men are employed.

West Tree.—The holdings of the West Tree Mines, Limited, comprise mining claims W.D. 1418, 1419, 1420 and 1421. The authorized capitalization of the company is \$3,000,000, divided into shares of a par value of \$1.00.

The directors of the company are: Wm. David McKay, Ottawa; Clayton Smith Corson, Gideon Grant, Geo. R. Rogers, W. Jos. Butler, Arthur E. Way, Lina Rogers, all of Toronto; secretary, Gideon Grant. The head office is in the Bank of Hamilton Building, Toronto.

There are two shafts on the property, about 400 feet apart and separated by a narrow portion of Michiwakenda lake. The easterly shaft is 40 feet deep and

produced some spectacular gold specimens. The westerly shaft is 67 feet deep (September, 1919), having been sunk on a number of parallel quartz stringers, some of which carry gold. The sinking was done by hand, and the broken material hoisted by a small steam hoist.

Alex. Mitchell is in charge of prospecting work, about 12 men being employed.

There are numerous other properties in this northern section on which gold has been found and considerable work done, but these are now more or less idle. They include the following: Wood, Bennett, McIntyre, Saville, Foisey, Adair, Churchill, Queen of Sheba and Cochrane.

Wasapika.—The Wasapika Gold Mines, Limited, operates claims T.R.S. 2529 and 2530 in the township of MacMurchy. The authorized capitalization of the company is \$1,000,000, divided into shares of a par value of \$1.00.

The officers of the company are: president, George R. Rogers; vice-president, F. M. Connell; secretary-treasurer, J. A. M. Alley; directors: L. J. Lahay, George A. Young, J. A. M. Alley, all of Toronto. The head office is at 905 Bank of Hamilton Building, Toronto.

A 100-ft. vertical shaft has been sunk and 50 feet of cross-cutting, done to prospect the "Ribble" vein, which has been traced on the surface for over 1,000 feet in a north-south direction, the dip being approximately 60° to the west. The cross-cut on the 100-ft. level passed through 25 feet of quartz and schist, some of which carried visible gold. The shaft is being continued to the 200-ft. level.

The plant comprises a 6-drill compressor, smithy, portable saw-mill and camp buildings.

George R. Rogers is manager, employing about 10 men.

SOUTHERN SECTION.

In the southern section, viz., in the vicinity of the West Shiningtree lake and eastwardly, there are several properties upon which little work is being done at present.

Buckingham.—(Claim 2161, Asquith township). An incline shaft 85 feet deep has been sunk on a 5-ft. quartz vein carrying considerable gold: the vein dips to the south at an angle of 60° from the horizontal. The plant consists of a locomotive boiler, a 2-drill compressor and a steam hoist.

Underground work was suspended in May, 1919.

Burke.—(Claims 3786 and 3767). Where Papoose creek enters Granite lake, Fawcett township, a shaft has been sunk 35 feet and a cross-cut driven 78 feet west to tap a large vein which occurs in the creek bottom.

Gosselin.—(W.D. 1151, 1156, 1157). Work consists of several hundred feet of trenching, numerous test pits and one inclined shaft 50 feet in depth on veins varying from 5 to 100 feet wide.

Holding.—(Claims 3508 and 3118, Asquith township). A shaft 47 feet deep has been sunk on the vein which dips to the southeast at an angle of 70° from the horizontal. A 10-ft. drift has been driven on the 30-ft. level. Some rich specimens came from this property. The shaft pump is operated by a gasoline engine.

Steep.—On the Steep property (Claim No. 2434) a shaft 100 feet deep and dipping to the south at an angle of 85° from the horizontal was sunk in 1911 on an east-west shear zone carrying visible gold. The broken rock is hoisted by dog teams.

Other properties in this section are: Kubick, Clark, Thompson, Speed, Gibson, Moore and McDonald, Moore, McRae and Maguire.

Miscellaneous Mines

Alexo Nickel.—The Alexo Nickel Company continued the shaft at their property to a further depth of 60 feet, drifting in a westerly direction for 80 feet on the 265-ft. level. During the year, 8,761 tons of ore were shipped to the Coniston Smelter of the Mond Nickel Company, the ore being taken from the stopes on the 120 and 75-ft. levels.

The officers of the company are: president, G. F. Hanning, Toronto; vice-president, Major E. F. Pullen; treasurer, H. N. Roberts; director, Capt. F. Pullen; manager, William Anderson.

An average of 19 men are employed.

Cedar Lake Nickel Prospect.—The National Mines, Limited, did some trenching and 400 feet of diamond-drilling from January to March, 1919, on mining claims T.R. 1623 and 3448. These claims are situated in the township of Strathy, Timagami Forest Reserve, about one mile south of Cedar lake. The deposits tested are said to contain chalcopyrite, pyrrhotite and a little pentlandite and gold. One of the claims is owned by Fallahay and Walters, and the other by Cook.

Premier-Langmuir (barite).—Work on the barite property of the Premier-Langmuir Mines, Limited, in Langmuir township, was continued during the year. The adit level is now in 110 feet. The shaft has been sunk to a depth of 130 feet, and 80 feet of drifting has been done at the 60-ft. level.

In the power house is a 125-h.p. boiler, locomotive-type, and a 150-h.p. engine.

A mill with a capacity of 30 tons daily was completed during the year, and milling operations started in October; about 100 tons of barite were treated.

The mine-run of ore, after crushing and screening, is jigged to remove waste; after drying it is ground in Stouff pulverizers to between 200 and 300-mesh.

The officers of the company are: president, J. A. McIntosh, 454 Markham St., Toronto; secretary-treasurer, J. B. Aikenhead, London, Ont. E. H. Low succeeded Charles W. Dalby as mine manager. An average of 20 men was employed during the year. The post-office address of the mine is Connaught.

Cobalt Silver Area

Following are notes of the working silver mines in the Cobalt area, where production was carried on under the stimulus of the prevailing high prices for silver—prices much higher than any previously realized.

Adanac.—Work on the Pan-Silver claims in southeast Coleman was continued by the Adanac Silver Mines, Limited, in 1918.

The shaft is, as before, 420 feet deep, with levels at 100, 200, 321 and 400 feet.

The east winze extends from 200 to 321 feet, and the west winze from 200 to 310 feet. On the 310-ft. winze level a cross-cut extends north from the south boundary of the Pan-Silver north claim to within about 250 feet of the Prince claim's south boundary. The work done in 1918 was confined to prospecting this level and stopping several ore shoots encountered.

The officers of the company are: president, R. A. Cartwright, Ridgeway, Pa.; vice-president, Alex. Fasken, Toronto; directors, E. M. Campbell, Ridgeway, Pa.; C. L. Sherrill, Buffalo, N.Y.; treasurer and managing director, M. R. Cartwright, Haileybury, Ont.

Aladdin.—The following information is taken from the annual report of the Aladdin Cobalt Company, Limited, for the period May 1st, 1918, to December 31st, 1918, and deals with operations at the Chambers-Ferland mine, Cobalt.

A total of 3,175 tons of ore averaging 18.3 ounces of silver per ton were milled at the Northern Customs concentrator and at the Dominion Reduction Company's mill. This yielded 50,812 ounces. While the average mill heads (18.3 ounces) were slightly lower than for the previous year (19.6 ounces), the recovery was 86.98 per cent., as compared with 82.57 per cent. in 1917.

Shipments to the smelters were as follows:

	Tons	Gross Ounces	Gross Value
Concentrates.....	182.10	62,200.59	\$63,924.92
Screenings.....	19.14	2,192.49	2,217.16
High grade.....	20.83	43,051.59	44,014.84
Cobalt ore.....	3.58	.....	868.12
Total.....	225.65	107,444.67	\$111,025.04

Development work consisted of 52 feet of raising and 1,240 feet of cross-cutting and drifting. A cross-cut has been started on the 275-ft. level to tap a vein being mined on the Nipissing. On the 425-ft. level, cross-cut No. 42, running northeast towards the Genesee has been continued a distance of 885 feet from No. 4 shaft. This cross-cut is in conglomerate for the entire distance.

The officers of the company are: president, Capt. C. R. E. Jorgenson; directors, F. F. Fuller, H. B. Sedgwick, Dennis Herbert, all of London, England. The Canadian board is as follows: vice-president, Chas. A. Richardson; directors, R. T. Shillington, A. Ferland, all of Haileybury, Ont. Col. H. H. Johnson is consulting engineer, and John Matheson is mine foreman.

Beaver.—The Beaver Consolidated Mines, Limited, has an authorized capital of 2,000,000 shares of a par value of \$1.00. The officers of the company are: F. L. Culver, president and general manager; F. C. Finkenstaedt, vice-president; H. E. Tremain, secretary-treasurer; the directors are F. C. Finkenstaedt, F. L. Culver, F. L. Lovelace, J. H. Black, Wm. Thos. Mason, Wm. E. Stevenson, H. E. Tremain, Howard L. Churchill. The head office is in the Lumsden Building, Toronto. The company's mines are at Cobalt, Kirkland lake and Elk lake.

During the year, 385,042 ounces of silver was produced from the Beaver mine, Cobalt. The twelfth annual report of the company states that, although no high-grade ore bodies were discovered during the year, yet large bodies of milling ore were opened up. Prevailing conditions made it advisable to cease operations on the lower levels of the mine till recently. A cross-cut is being driven on the 1,400-ft. level to prove up the vein discovered on the 1,600-ft. level which carried excellent values. A new campaign of development work in virgin ground on the 200-ft. level is planned.

The development work during the year was as follows: drifting, 498 feet; raising, 290 feet; cross-cutting, 653 feet. At the close of the company's year, February 28th, 1919, there were 19,763 tons of broken ore underground.

Buffalo.—The Buffalo Mines, Limited, operated continuously during 1918.

The following information is taken from the thirteenth annual report of the company and covers the period from May 1st, 1918, to April 30th, 1919.

Underground operations were as follows:

Level	Raising	Drifting	Stoping
1st	45 ft.	215 ft.	57,000 cu. ft.
2nd .....	.....	245 ft.	186,000 cu. ft.
3rd .....	.....	510 ft.	93,600 cu. ft.
Total	45 ft.	970 ft.	336,600 cu. ft.

During the year the tonnage broken was as follows: in raising, 190 tons; in drifting, 2,400 tons; and in stoping, 30,600 tons, a total of 33,190 tons broken, of which 1,000 tons was waste rock, used for filling. Of the balance, 28,572 tons was hoisted to the mill, and 3,618 tons added to reserves of broken ore in the mine.

During the year the mill treated 28,572 tons of ore from the mine, and 2,000 tons of ore from stock piles on surface, a total of 30,572 tons. The mill also treated 77,239 tons of sand tailings, making a total of 107,811 tons treated in the mill.

The total production of silver for the year, including ore and bullion on hand and at smelters, amounted to 625,786.06 ounces.

The officers of the company are: Charles L. Denison, New York, president; Robert W. Pomeroy, Buffalo, vice-president; Albert W. Johnston, New York, second vice-president; George C. Miller, Buffalo, secretary-treasurer; T. R. Jones, general superintendent.

Casey-Cobalt.—The new mill of the Casey-Cobalt Silver Mining Company, Limited, was completed in the early part of 1918 and operated continuously to the end of the year. Ore from the mine was treated up to October 31st, and afterwards from the ore dumps. The ore from underground was all taken from old stopes on the third level at No. 6 shaft; 4,065 tons were broken in stopes; 9,232 tons were treated in the mill.

On July 15th work was commenced on a shaft on the adjoining property to the west. This was a contract taken by the company to develop the property for the Harmak Mining Company. A hoist and shaft equipment were installed and

the shaft sunk to a depth of 315 feet. Drifting was done for 19 feet on the 100-ft. level. The air for drilling was supplied by the Casey-Cobalt compressor.

The officers of the company are: president, W. R. P. Parker; vice-president, J. P. Watson; secretary, W. W. Perry, all of Toronto. Head office, 1,514 Traders' Bank Building, Toronto. J. W. Shaw, New Liskeard, is manager, employing 50 men.

Casey-Mountain.—The Casey-Mountain Mining Company, Limited, operated from March to October 30th, 1918, on lot 6 in the second concession of Casey township. A winze was sunk on the 315-ft. level to a depth of 69 feet, about 65 feet from the shaft on the southwest drift. A hoist was installed at this winze. Ten men were employed.

The officers of the company are: Robt. G. Williamson, president, Toronto; W. A. Staples, secretary-treasurer, Toronto; R. G. Williamson, manager, Judge P.O., Ont. The head office is at 115 Stair Building, Toronto.

Coniagas.—For the year ending October 31st, 1918, the Coniagas Mines, Limited, produced from their mine at Cobalt 974,264 ounces of silver. The shipments of silver from this mine now total over 26,000,000 ounces. The average price realized for the silver sold during the year was 94.14 cents per ounce, as compared with 79.89 cents per ounce in 1917 and 63.11 cents in 1916.

The ore was mined and concentrated during the year at a net cost of 33.87 cents per ounce, as compared with 21.36 cents per ounce during the previous year. This cost includes all overhead expenses, royalties, other general expenses, and a War Profits tax estimated at \$25,332,51, but excludes cost of smelting, refining, shipping and marketing, which amounts to 7.98 cents per ounce, as compared with 4.31 cents per ounce for the preceding year.

During the year dividends amounting to 7½ per cent., or \$300,000 were paid.

The tonnage of ore milled was 68,597 tons, or an average of 3.38 tons per stamp per 24 hours. Concentrates shipped were: high-grade concentrates, 529.51 tons, averaging 1,161.10 ounces per ton, and low-grade slime concentrates, 866.77 tons, averaging 244.81 ounces per ton. Mill heads for the year averaged 15.91 ounces per ton as compared with 18.56 ounces for the previous year.

The cyanide plant, which had been operating on canvas table concentrates and primary mill slime, was shut down on November 20th, 1917, as the canvas tables were discarded when the Callow flotation process was adopted. The Callow flotation plant was increased by another unit and treated all tailings from the concentrating mill. The assay of final tailing was 1.75 ounces per ton compared with 2.98 ounces for the previous year.

The underground work done to date is as follows:

	Total to Oct. 31, 1917	Total to Oct. 31, 1918	Work done during 1917-1918
Shaft-sinking, feet.....	879	879	.....
Winze-sinking, feet.....	632	721	89
Crosscutting, feet.....	10,295	10,678	383
Drifting, feet.....	18,834	19,909	1,075
Raising, feet.....	1,396	1,538	142
Total.....	32,036	33,725	1,689

Assuming a continuation of present market conditions, it is estimated that a three years' supply of ore is still available.

The officers of the company are: president and general manager, Col. R. W. Leonard, St. Catharines; vice-president, Alex. Longwell, Toronto; directors, Major R. P. Rogers, France; F. J. Bishop, Brantford; W. D. Woodruff and R. L. Peek, both of St. Catharines; director and superintendent, F. D. Reid, Cobalt; secretary-treasurer, J. J. Mackan, St. Catharines.

An average of 108 men (calculating on a six-day per week basis) was employed under superintendent F. D. Reid.

Crown Reserve.—The following information regarding operations at Cobalt is abstracted from the annual report of the Crown Reserve Mining Company, Limited, for the year ending December 31st, 1918:

Total development in 1918	2,560 feet
Total ore production in 1918 gave a net return of	\$198,011.35

In the autumn a promising vein was cut in the eastern part of the property. By the end of the year, 150 feet of drifting had shown the vein to be two to five inches wide, with an average silver content of over 2,500 ounces per ton. Stoping has been begun on this ore body.

The Silver Leaf claim, which is being worked by the Crown Reserve under lease, yielded during 1918 one ton of high-grade and 2,216 tons of milling ore.

The officers of the company are: president and managing director, John W. Carson; 1st vice-president, Wm. I. Gear; 2nd vice-president, James G. Ross; directors, the above-mentioned and Chas. C. Dickson, Z. Gallagher, A. G. Gardner, F. S. Meighen, R. W. Reford, J. W. Ross, Chas. A. Smart; secretary and treasurer, James Cooper; manager, H. J. Stewart, Cobalt; consulting engineer, S. W. Cohen. Offices, 605 Dominion Express Bldg., 145 St. James Street, Montreal, and 18 Toronto Street, Toronto.

Dickson Creek.—The Dickson Creek Mining Company, Limited, owns lots 9 and 10, concession V, Bucke township, and is prospecting the northeast quarter of the north half of lot 9. Here a shaft has been sunk at 78 degrees for 175 feet on a vein which strikes N. 35 degrees E. and dips to the southeast. A level has been opened at 150 feet, and on March 21st, 1919, 69 feet of drifting and cross-cutting had been done to the northeast and 62 feet to the southwest. Cross-cutting was still in progress, the drilling being done by hand. All the work has been done in conglomerate. The hoist is a 6-inch by 8-inch Jenckes, driven by a 22-h.p. motor. Five men are employed, with H. Hollands-Hurst, Box 479, Haileybury, Ont., in charge.

The officers of the company are: chairman, W. F. H. Blandford; directors, Walter Eveling, Phillip Hurst and Anthony E. Smith; all of London, England.

Dominion.—The Dominion Reduction Company, Limited, continued stoping from No. 3 shaft of the Dominion mine (better known as the "Nova Scotia") until August, 1918, when work was suspended. H. R. Bischoff, Cobalt, was in charge of the work.

Dominion Reduction Mill.—The custom mill of the Dominion Reduction Company, Limited, at Cobalt was operated during all of 1918. The ore treated came from the Kerr Lake and Crown Reserve mines, with a little from the Green-Meehan, Reliance, Cobalt Comet, Silver Queen and Chambers-Ferland mines. Some tailings from the old Nipissing Reduction Company mill were also treated. About sixty men were employed.

The officers are: president, D. M. Steindler, New York; vice-president, Mortimer Davis, Montreal; secretary-treasurer, H. M. Thompson, New York; director, L. L. Steindler, Cobalt; manager, G. W. Perram, Cobalt; mill superintendent, Albert Wood, Cobalt.

Foster.—L. Campbell, of Montreal, and W. H. Fairburn, of Toronto, are now operating this property under lease. Work was at first confined to shipping mill ore from the surface dumps, and about 2,500 tons were treated by the Northern Customs Concentrator at North Cobalt.

An examination of some of the old workings was so encouraging that underground work was commenced with good results. Two ore shoots were disclosed, one of which was exceptionally rich.

H. G. Carmichael is manager, employing about 20 men.

Green-Meehan.—Edwards and Wright, Limited, worked the Green-Meehan mine, near North Cobalt, from February, 1918, until February, 1919, when the work was stopped until spring, owing to shortage of water for the boilers. The main shaft is 200 feet deep, with levels at 100 and 200 feet. A winze extends from the 200-ft. to the 300-ft. level. The work done in 1918 consisted of about 250 feet of drifting and cross-cutting on the 245-ft. winze level, with some stoping above the level.

John Edwards, North Cobalt, is manager, and Ewen J. McMillan, mine foreman.

Genesee.—The Genesee Mining Company, Limited, continued work on the southwest quarter of the south half of lot 9, concession I, township of Bucke, until February 28th, 1919. On that date the prospecting done underground consisted of the following: The vertical shaft was 572 feet deep, with levels at 350, 450, 495 and 550 feet. On the 495-ft. level 1,374 feet of cross-cutting and drifting and 78 feet of raising had been completed. In doing this work, four veins are reported to have been cut, two of which gave encouraging assays. On each of the other levels 30 feet of cross-cutting was done on each side of the shaft.

The manager of the company stated that in sinking the shaft the following rocks were passed through: from surface to 526 feet, slate greywacké and conglomerate; 526 to 530, Timiskaming conglomerate; 530 to 560, lamprophyre; 560 to 572, Timiskaming conglomerate.

The officers of the company are: president, W. H. Wray; vice-president, C. H. Crandall; secretary-treasurer, Alex. Russell; managing director, A. H. Dewey; directors, C. F. Van Zandt, R. H. Gorsline, G. H. Welch, J. C. Comerford, all of Rochester, N.Y.; manager, Leonard F. Steenman, Cobalt.

Gifford.—The Gifford Cobalt Silver Mining Company resumed mining operations early in the year, employing from six to eight men continuously. Three hundred feet of cross-cutting and 108 feet of drifting was done on the bottom level. Several short drifts were put in on veins cut by the cross-cuts.

Frank B. Mosure, of Toronto, was manager, and John Bedford mine foreman.

Hargrave.—The Hargrave Silver Mines, Limited, operated during 1918 from January 1st to September 15th. The underground work during that period consisted in: drifting, 253 feet; cross-cutting, 38 feet; raising, 279 feet; sinking, 27 feet. Ore shipments amounted to 20.8 tons, yielding 15,694.01 oz. of silver, of a gross value of \$13,343.36.

The officers of the company are: president, James A. Aitchison; secretary-treasurer, Geo. H. Sedgewick; manager, J. T. Shaw; head office, Excelsior Life Building, Toronto.

Hudson Bay.—The Hudson Bay Mines, Limited, continued to work their No. 1 mine at Cobalt during 1918, practically all the ore being obtained from the old workings.

The following summary of the operations is abstracted from the annual report and covers the fiscal year ending August 31st, 1918:

Development work done amounted to 546 feet. The stamp mill crushed 20,540 tons of ore, from which the recovery was 140,732 ounces of silver, or 72.02 per cent. High-grade ore bagged contained 6,769 ounces additional. The ore milled averaged 9.5 ounces per ton, and the tailing loss was 2.38 ounces per ton. The net smelter value of the ore and concentrates was \$124,838.93. Silver was produced at a cost of 62.57 cents per ounce, including selling costs, and an average price of 86.33 cents per ounce of silver was received for it. The profit on the year's work amounted to \$32,402.47.

Ore reserves on Aug. 31st, 1918, were estimated to amount to 12,224 tons containing 60,149 ounces of silver.

The officials of the company are: president, F. L. Bapst; vice-president, A. A. McKelvie; secretary-treasurer, F. L. Hutchinson, New Liskeard, Ont.; general manager, C. L. Sherrill; directors, H. P. Burgard; T. McCamus; W. H. Kinch. A. H. Brown was superintendent until December, 1918, when he resigned.

Kerr Lake.—By a reorganization in November, 1917, the Kerr Lake Mining Company of New York was absorbed by Kerr Lake Mines, Limited, of Ontario. The capitalization remains as before, viz., \$3,000,000 divided into 600,000 shares of \$5.00 par value.

The following particulars are taken from the annual report of the combined companies for the year ending August 31st, 1918:

The gross production from all ores for the year amounted to 2,582,993 ounces of silver, 199,331 pounds of cobalt and 545 pounds of mercury. These figures include 54,523 ounces of silver from low-grade ore milled by the Dominion Reduction Company at Cobalt.

During the year, 3,088 feet of development work was done in the more favourable portions of the property. This work failed to encounter new veins of importance, although extensions of ore shoots containing commercial values in known

veins were exposed. The development work consisted of 1,091 feet of drifting, 968 feet of cross-cutting, 989 feet of raising and 40 feet of sinking. The total development to date amounts to 54,539 feet.

Material hoisted amounted to 48,542 tons at a mining cost of \$5.11 per ton. This consisted of 5,413 tons of waste and 43,129 tons of ore. The ore yielded 1,017 tons of sacking ore, 27,835 tons of mill ore and 14,277 tons of waste from the bumping table. Silver was produced at a total cost of 24.70 cents per ounce. This cost was made up as follows: mining and development, 9.60 cents; shipment and treatment, 14.20 cents; administration and general expense, 00.94 cents.

Ore reserves were estimated on September 1st, 1918, to consist of 34,730 tons, containing 1,631,300 ounces of silver.

The officers of the company are: president, Adolph Lewisohn; vice-president, S. A. Lewisohn; secretary and treasurer, E. H. Westlake; directors, the above-mentioned and J. H. Susmann, J. Parke Channing, S. S. Rosenstamm, D. M. Steindler, J. J. Steindler and W. B. Joyce; mine manager, H. A. Kee. The offices are at Cobalt, Ont., and 61 Broadway, New York.

La Rose.—La Rose Mines, Limited, has an authorized capital of 1,500,000 shares of a par value of \$1.00. The officers of the company are: D. Lorne McGibbon, president; Shirley Ogilvie, vice-president; Stephen J. LeHuray, secretary and treasurer; G. C. Bateman, general manager. The directors are: D. Lorne McGibbon, Edwin Hanson, Victor E. Mitchell, Shirley Ogilvie, W. A. Black and S. J. LeHuray, of Montreal; W. M. Dobell, Quebec; E. W. Nesbitt, Woodstock; David Fasken, Toronto; the head office of the company is at 260 St. James St., Montreal.

The following information is taken from the twelfth annual report of the company:

The silver produced during the year ending December 31st, 1918, amounted to 288,556 ounces, the net value of which was \$268,524.76. The net profit on production was \$15,544.21. The average price received for silver was 99.83 cents, and the cost of production was 87.17 cents. A dividend of 2 per cent. was paid on April 20th. The total production of the mine to the end of 1918 was 24,484,052 ounces.

The development during the year is shown in the following table:

SUMMARY OF DEVELOPMENT WORK DONE DURING 1918.

Property	Shafts	Drifts	Cross-cuts	Raises	Stopes	Stations
	ft.	ft.	ft.	ft.	cu. yds.	cu. yds.
La Rose.....	14	61.5	295	67	1,442	.....
Lawson.....	.....	.....	.....	.....	65	.....
Princess.....	.....	.....	86	12	45	.....
Violet.....	116	632.	601.5	82	121	453
Total.....	130	693.5	982.5	161	1,673	453

The tonnage of mill rock supplied by each mine was:

La Rose	12,485 tons
Lawson.....	13,280 "
Princess.....	8,811 "
Violet.....	2,035 "
Total.....	36,611 tons

At the La Rose mine 438 feet of development work was done, but no new ore was discovered. The output of the mine was obtained from veins 6-A and 8-A, discovered late in 1917, and from the cleaning up of old stopes and pillars in the main vein and veins Nos. 3, 9, 10 and 13. A small surface dump adjacent to the main shaft was milled, and this completed the exhaustion of the surface dumps on this claim.

The concentrator treated 36,611 tons of ore, the average grade of which was 7.71 ounces per ton, as compared with 8.75 ounces per ton in 1917. The concentrates amounted to 842.4 tons, averaging 267.88 ounces per ton, or an aggregate of 225,665.21 ounces.

The total output of silver, from concentrates, high-grade ore and cobalt ore, was 288,556 ounces. Payment was also received for 10 tons of cobalt, contained in the shipments.

No underground work was done at the Lawson mine during the year. The dumps supplied 13,280 tons of ore for the concentrator, and there is still a limited tonnage remaining. Thirty-nine tons of low-silver high-cobalt ore was also produced.

No work was done on the Fisher-Eplett and University properties.

An inspection of old workings on the first level of the Princess mine disclosed some ore in the walls of the stopes and in pillars. This ore is being broken, and the results have been sufficiently satisfactory to justify further investigation. Preparations are being made to unwater the second level for this purpose.

There was shipped to the concentrator 8,810 tons of ore from the surface dumps, but these have now been exhausted.

From the 410-ft. level of the Violet a cross-cut was driven south and intercepted several veins, carrying low values in silver. Drifting was begun, and a short distance to the east, at the diabase-Keewatin contact, high-grade ore was encountered. It was, however, limited in quantity, and although other small pockets were encountered in this drift, nothing of much value was found.

A winze, 70 feet deep, was sunk from the level, and drifting started at a point 60 feet below the level. The vein in the drift carries some silver, and the indications are favourable.

A new level was opened at a depth of 330 feet in the shaft and cross-cuts driven north and south. In the south cross-cut the same vein was cut as on the 410-ft. level. In the drifts on the vein a shoot of ore 60 feet long has been proven. As is usually the case with ore near the diabase-Keewatin contact, the distribution of silver is very erratic, but there is a certain amount of high-grade, and the adjoining rock carries milling values. The north cross-cut was driven for the purpose of exploring an area of conglomerate believed to lie under the diabase, and was found to be at the contact between this conglomerate and the underlying Keewatin. One hundred and fifty feet from the shaft a vein was cut in this cross-cut.

In the drifts and raises, on this vein, a small quantity of high-grade was encountered, but it is believed that the upper portions of the conglomerate offer the best possibilities. The indications point to a thickness of over 100 feet of conglomerate, in which only a small amount of work has yet been done.

There was shipped to the concentrator 2,034 tons of mine ore, and the production of silver from mill ore and high-grade ore was 30,000 ounces.

The company's engineers examined a number of promising properties during the year and took an option on a silver prospect in the Kamloops district, B.C. This option was allowed to lapse early in 1919.

McKinley-Darragh.—The McKinley-Darragh-Savage Mines of Cobalt, Limited, has an authorized capital of 2,500,000 shares of a par value of \$1.00, of which 2,247,692 shares have been issued. The officers and directors of the company are: J. R. L. Starr, Toronto, president; Thos. W. Finucane, Rochester, vice-president; Harper Sibley, Rochester, treasurer; A. G. Beckwith, Rochester, assistant-treasurer; J. H. Spence, Toronto, secretary; Hiram W. Sibley, James S. Watson, G. L. Thompson, T. R. Finucane, all of Rochester; T. R. Finucane, general manager. The head office is in the Trusts and Guarantee Building, Toronto.

During the year, 904,543 ounces of silver were recovered, bringing the total recovery of this company to 18,227,645 ounces of silver.

The estimated ore reserves on January 1, 1919, are given as 852,754 ounces of silver. This does not include the large tonnage of tailings from previous operations. A mill has been built for the re-treatment of these tailings; its operation is confined to the summer months.

The development work amounted to over 8,200 feet, as follows: 3,433 feet of cross-cutting; 4,370 feet of drifting; 441 feet of raising and 18 feet of sinking; 34,255 tons of ore were broken in the stopes.

The mill ran 97.2 per cent. of the possible running time, treating 67,020 tons of ore of an average assay of 12.923 ounces per ton, and recovering 755,502 ounces of silver, or an extraction of 87.23 per cent.

Dividends Nos. 38, 39 and 40, each for \$67,430.76, were paid during 1918. and dividend No. 41, for the same amount, was declared on November 18th for payment on January 1st, 1919.

Mining Corporation of Canada.—The Mining Corporation of Canada, Limited, owns the Cobalt Townsite, Cobalt Lake, City of Cobalt, Townsite Extension, and Little Nipissing mines. The Cobalt Reduction Company is also controlled by the Corporation, which is capitalized at 1,660,050 shares of \$5.00 each, all issued. The officers and directors are: Henry M. Pellatt, president; J. P. Watson, first vice-president; W. R. P. Parker, second vice-president; G. M. Clark, J. G. Watson, D'Arcy Weatherbe, R. E. G. Van Cutsem; D'Arcy Weatherbe, consulting engineer; M. F. Fairlie, resident manager. The head office is at 1512-1520 Traders' Bank Building, Toronto.

The following information is taken from the fifth annual report of the company:

The production for the year was 1,708,252.41 ounces of silver, and there is in ore reserves 1,240,550 ounces. In addition, the re-treatment of tailings is expected to give a large production of silver.

The net profits, after allowing for depreciation and special expenditure, amounted to \$925,760.38. Four dividends, one of \$415,012.50 and three of \$311,259.37 each, were paid.

UNDERGROUND WORK

	Lineal feet of working place advanced					Cubic feet Stopping
	Driven	Cross-cut	Sunk	Raised	Total	
Ore Extraction						251,199
Development.....	173			34	207	.....
Exploration.....		6,002	10	321	6,333	.....
Total.....	173	6,002	10	355	6,540	251,199

The total footage of drifts, cross-cuts, raises, winzes and shafts in the workings of the Mining Corporation amounted to an aggregate of over 22 miles at the end of 1918.

Of the total ore tonnage hoisted from the mines 125.9 tons of high-grade were treated in the high-grade plant of the Cobalt Reduction Company, and 42,355.88 tons were concentrated. In addition, 17,632.72 tons of tailings were treated by the Cobalt Reduction Company.

The last-named company's concentrating mill ran 93.18 per cent. of possible running time. The number of stamps dropping at January 2nd was 70; this was decreased to 40 on February 5th, increased to 45 on April 12th, and decreased to 25 on July 2nd. The cyanide plant operated continuously throughout the year.

No diamond-drilling was done during the year, and the programme of exploration at the Cobalt Lake mine being completed, this mine closed down at the end of 1918. Further exploration is to be carried on at the City mine, but it is not intended to do any further work of this nature at the Townsite mine.

Development on the Thompson claim at North Cobalt is still being carried on, as well as on the Nels Nelson in the Casey area.

After six months' work on the Raty gold claim in Riekard township the option was allowed to lapse.

The Noyes fluorspar mine at Madoc was acquired, and a separate company formed called the Canadian Industrial Minerals, Limited.

The Mining Corporation did 467 feet of cross-cutting in the conglomerate on the 300-ft. level of the Alexandra claim, Coleman township. This work was done between November, 1917, and May 1, 1918, under an option to purchase.

In December, 1918, the Corporation also began work on the Waldman claim in Coleman township which lies immediately west of the Savage mine. Cross-cutting to the extent of 1,810 ft. was done in conglomerate on the 100-ft. level of the Waldman No. 3 shaft. Most of this work was done in the north-eastern part of the claim. This shaft is 105 feet deep, but no lateral work had previously been done from it. The option was subsequently abandoned.

National.—The National Mines, Limited, did no work in the King Edward mine in 1918, but treated King Edward and Silver Cliff tailings from April 15th to November 1st, 1918.

The officers of the company are: president, H. E. Jackman, Rochester, N.Y.; secretary-treasurer, Ernest C. Whitbeck, 17 Ellwood Building, Rochester, N.Y.

Nipissing.—The Nipissing Mines Company, Limited, has an authorized and issued capital of 1,200,000 shares of a par value of \$5.00. The officers of the company are: E. P. Earle, president; Alexander Fasken, secretary; P. E. Pfeiffer, treasurer. The directors are: W. H. Brouse, John H. Black and David Fasken, of Toronto; Richard T. Greene, E. P. Earle, August Heckscher and R. B. Watson, of New York. The head and corporate office is in the Excelsior Life Building, Toronto, and the New York office is at 165 Broadway.

The operating Company is the Nipissing Mining Company, Limited, with an authorized and issued capital of 2,500 shares of a par value of \$100. The officers are: David Fasken, president; E. P. Earle, vice-president; Alexander Fasken, secretary; P. C. Pfeiffer, treasurer. The directors are: John H. Black and David Fasken, of Toronto; E. P. Earle, Richard T. Greene and R. B. Watson, of New York. The operating officials are: R. B. Watson, general manager; Hugh Park, manager; James Johnston, mill manager; James J. Denny, manager research department. The head office is at the Excelsior Life Building, Toronto.

The following information is taken from the fourteenth annual report of the company:

SUMMARY OF UNDERGROUND WORK, 1918

Shaft No.	Drifting	Cross-cutting	Raising	Sinking	Total	Stoping
	ft.	ft.	ft.	ft.	ft.	cu. yds.
63.....	81.0	1,274.5	67.5	.....	1,423.0	646
73.....	1,153.5	3,850.5	279.5	81.0	5,364.5	13,525
80.....	.....	.....	.....	.....	.....	129
96.....	154.5	711.5	71.0	.....	937.0	832
128.....	.....	.....	.....	90.5	90.5	.....
Total	1,389.0	5,836.5	418.0	171.5	7,815.0	15,132

Diamond-drilling, 4,077.6 feet, all surface, on locations R.L. 401, 402, 407.

DEVELOPMENT.

The total advance in 89 faces worked during the year amounted to 7,815 feet. This is the smallest advance made in recent years, and was due to the fact that no large veins were discovered, and the few small veins encountered were opened up with comparatively little drifting. On the other hand, a large amount of exploration work was done, cross-cutting likely territory in search of new ore. This comprised fully 85 per cent. of the total footage driven.

Most of this work was barren of favourable results, although two new veins, 73-511 and 102-100, were found in new territory and may prove of some importance after development. In the vicinity of 98 shaft a number of small veins opened up well and furnished considerable new ore.

The usual amount of stoping was done, most of the veins fully coming up to expectations. The high price of silver has enabled a much lower grade of ore to be treated, so that a considerable additional tonnage was obtained by slabbing off the sides of old stopes, and new stopes were carried wider than heretofore.

This inclusion of low-grade rock sent to the mill resulted in a drop of about 7 ounces per ton in the mill heads.

Shaft 63 was pumped out early in the year, and work was resumed on the Little Silver veins. Much new ore was taken from the old stope near the surface, by breaking down the walls.

Over 700 feet of cross-cutting was done from the workings connected with this shaft in exploring the ground to the east and north: this work will be continued, as it is all in likely conglomerate territory.

The new vein 544 in shaft 73 was cut on the fifth level near vein 190. A winze has been sunk on it to a depth of 145 feet, where the Keewatin contact was reached. The vein is two inches wide and strong throughout, but the values are not high except in spots. It is probable that pockets of good ore will be found on further development.

The best new vein found was 4067, near 98 shaft: the ore shoot on the fourth level is 125 feet long.

Although this shaft produced 62,000 tons during the year, or over three-quarters of all the ore going to the mill, the reserves of mill rock were only reduced 8,000 tons. This is largely due to the extension of the stopes on vein 490 beyond previous estimates: this is now the best vein on the property and contains one-third of the total ore reserves. The vein itself is wide, but assays only about 1,000 ounces per ton. The country rock is good, the average width of the stopes being over ten feet.

In tunnel 96 stoping was completed on veins 96 and 102, and all the broken ore was sent to the mill. A large amount of exploration was done from these workings in the territory to the south, and between the railroad and Cart lake.

Two new veins were cut showing fair values: one of them gives promise of producing at greater depth.

Shaft 128 is located on the east shore of Cobalt lake, some distance north of shaft 81. At this point there is a basin of conglomerate 125 feet deep, around the edges of which a number of veins have been opened up on the surface. It is hoped that some of these veins will make ore in the conglomerate. The shaft has been sunk to the contact, and cross-cutting has been begun.

No work was done in the workings of shaft 64 during the year. Over 4,000 feet of diamond-drilling was completed, most of it on R.L. 102, north of the O'Brien mine. Nothing of interest was found.

ORE RESERVES

Reserves of developed and partly developed ore at December 31st, 1918, are estimated as follows:—

Shaft No.	High Grade Ore		Mill Ore		
	Tons	Ounces	Tons	Assay, Oz.	Ounces
63.....	172	423,300	6,811	25	170,275
64.....	159	121,653	3,710	20	74,200
73.....	1,080	1,621,690	38,475	20	769,500
80.....	73	148,700	2,392	25	59,800
96.....			149	25	3,725
490.....	1,304	1,157,841	34,054	20	681,080
	2,788	3,473,184	85,591	20.5	1,758,580
Dumps			35,458	21.8	773,371
			121,049	20.9	2,531,951

The following is a summary of the above table:—

—	Tons	Assay. Oz.	Ounces
High Grade Ore	2,788	1245.	3,473,184
Mill Ore.....	121,049	20.9	2,531,951
Total.....	123,837	48.5	6,005,135

HIGH-GRADE MILL.

The process which has heretofore been used in the treatment of the high-grade ores and which gave satisfactory results for seven years, is an amalgamation process, using a large quantity of mercury. The price of mercury before the war was \$33 to \$39 per flask of 75 lbs. Demand for war purposes raised the price to \$130 per flask.

This so increased the cost of the process that it was decided to discontinue amalgamation and rely on cyaniding alone, after giving the ore a preliminary treatment with bleaching powder in the tube mill.

The necessary apparatus for this process was installed in the low-grade mill at a small cost, and in August last the old high-grade mill was shut down. The new process is working smoothly, and will be used as long as it shows a saving over amalgamation.

The two plants treated during the year 430 tons of custom ore and bullion containing 1,668,350 ounces; 983 tons of Nipissing ore assaying 1,713 ounces per ton, and 513 tons of Nipissing concentrate of an assay value of 1,609 ounces per ton, making a total of 1,926 tons containing 4,178,510 ounces.

Of this the old high-grade mill treated 1,102 tons, containing 2,733,467 ounces, and the new plant 824 tons, containing 1,445,043 ounces.

The refinery also handled precipitate from the low-grade mill containing 846,737 ounces. The bullion shipped averaged 998 fine and amounted to 190 tons containing 5,532,881 ounces.

Residue shipments were 2,157 tons, assaying 9.03 per cent. cobalt. The demand for this material is good, at much higher prices than ever received before.

LOW-GRADE MILL.

—	Tons	Assay	Ounces
Ore treated	80,274	23.81	1,911,198
By-products treated.....	43	.....	116,066
	80,317	25.24	2,027,264
Recovered from the above:			
Precipitate	35	24,166	846,737
Coarse Concentrate.....	544	1,611	876,471
Fine Concentrate.....	92	800	73,715
Total Recovery.....			1,796,923

Average tailing, 2.84 ounces. Recovery, 87.95 per cent.

In February, 1918, thirteen roughing tables were installed over the tube mills, and in April, sixteen fine sand tables were added.

The ore is crushed by stamps in cyanide solution and goes to the roughing tables without classification. The tailing is classified; the sand is re-crushed in tube mills; the overflow from the classifier goes to the fine sand tables. The tube mill discharge is returned to the classifier; the tailing from the fine sand tables is cyanided.

By this method 48 per cent. of the silver in the ore is recovered in the form of concentrate, 40 per cent. as precipitate from the cyanide plant, and 12 per cent. goes to waste.

The concentrate is re-treated with the high-grade ore in the high grade mill and the precipitate from both treatments is sent to the refinery where it is converted into bullion.

This process gives a better extraction and at less cost than can be obtained by cyanide alone on the quality of ore now being produced; due consideration must be given for the value of the cobalt in the concentrate.

Forty stamps ran 323 days, or 88.49 per cent. of the possible running time; they crushed 248 tons per day or 6.98 tons per stamp per day.

SHIPMENTS IN 1918

—	Dry Tons	Fine Ounces Silver	Net Value		Per cent. of Total Net Value
			\$	c.	
Silver Bullion.....	190.1065	5,532,880.87	5,485,427	24	131.67
Residue and Concentrates.....	2,292.6948	252,858.54	352,099	20	8.45
Total Shipments.....	2,482.8013	5,785,739.41	5,837,526	44	140.12
Less Custom Ore included in above.	406.9095	1,668,350.23	1,671,462	17	40.12
Shipments of Nipissing Product	2,075.8918	4,117,389.18	4,166,064	27	100.00

PRODUCTION IN 1918

—	Ounces Silver	Gross Value		Net Value	
		\$	c.	\$	c.
Shipments in 1918	4,117,389.18	4,239,173	85	4,166,064	27
On hand at Mine Dec. 31, 1918.....	806,161.22	838,780	92	826,315	25
On hand at Mine, Dec. 31, 1917.....	4,923,550.40	5,077,954	77	4,992,379	52
Difference between estimated shipments in 1917 and actual returns.....	1,222,051.38	1,038,744	08	1,020,413	30
Nipissing Production	3,701,498.52	4,039,210	69	3,971,966	22
	-82.14	1,235	41	1,230	41
Nipissing Production	3,701,416.38	4,040,446	10	3,973,196	63

Dividends amounting to \$1,800,000 were paid during 1918, and a dividend of \$600,000 declared in December, 1918, bringing the total amount paid in dividends to \$19,400,000.

Northern Customs.—The Northern Customs Concentrators, Limited, at Mileage 104, T. & N. O. railway, operated continuously during the year on ore from the following mines:

La Rose	36,324 tons; silver content, 280,782 oz.
Right of Way	5,543 “ “ 33,329 “
Aladdin Cobalt	7,557 “ “ 122,512 “
Edwards & Wright	3,708 “ “ 50,941 “
Campbell lease on Foster mine..	2,587 “ “ 17,639 “

The officers of the company are: president, A. J. Young; vice-president, C. J. Booth; general manager, J. F. Bourne, Cobalt; directors, C. W. Haentschel, H. J. Jessop; superintendent, C. J. B. Armstrong; secretary, L. O. Walton, 720 Excelsior Life Building, Toronto.

O'Brien.—This mine is now operated by M. J. O'Brien, Limited.
The work done during the year was as follows:

Drifting	4,385 ft.
Cross-cutting	2,570 ft.
Raising.....	75 ft.
Sinking.....	256 ft.
Stoping.....	36,658 tons.
Tonnage hoisted	73,800 tons.

It may be noted that of the ore broken 3,484 tons came from the conglomerate, 18,980 tons were in the diabase, and 26,800 tons were mined in the Keewatin below the diabase sill.

The officers of the company are: president, M. J. O'Brien, Renfrew; vice-president, J. A. O'Brien, Renfrew; manager, J. G. Dickenson, Cobalt; mining engineer, Angus Campbell; mine secretary, A. E. McKee.

Ophir.—The Ophir-Cobalt Silver Mines, Limited, of which company W. Murray Alexander, 608 Lumsden Building, Toronto, is president, continued to prospect their claim in 1918 until August 26th, when the Mining Corporation of Canada began work under option.

The Ophir company did 533 feet of cross-cutting near the Keewatin-diabase contact on the Ophir claim from the 408-ft. level of the People's Mining Company's shaft. A winze was sunk to a depth of 40 feet below this level near the centre of the claim and a little south of the Ophir No. 1 shaft.

The Mining Corporation continued the work until December 15, 1918, and sank the above mentioned winze to a depth of 110 feet, when the diabase contact was encountered. At the bottom of this winze, 48 feet of cross-cutting was done to the west when the Keewatin was entered. Fifteen feet of drifting to the north was also done from this cross-cut.

The Nipissing Mining Company, Limited, took over the claim under an option, and began to cross-cut the Keewatin above the contact on January 18, 1919.

People's.—The People's Silver Mines, Limited, did no work in 1918 on their claim in southeast Coleman, but the People's shaft was used in prospecting the adjoining claim of the Ophir Cobalt Mines, Limited.

Penn-Canadian.—The Penn-Canadian Mines, Limited, worked continuously in 1918, but did little development work: 29,910 tons of ore were treated in the mill.

The officers are: president, Wm. J. Haines, Philadelphia, Pa.; secretary-treasurer, R. B. Haines, Jr., Philadelphia, Pa.; directors, Spencer D. Wright, Philadelphia, Pa.; Jansen D. Haines, Des Moines, Ia.; E. C. P. Laidlaw, New York; manager, B. Neilly, Cobalt. The mine foreman is R. Sandoe, and the mill foreman is W. Kelly. The head office is at 1011 Chestnut St., Philadelphia, Pa.

Peterson Lake.—The Peterson Lake Silver Cobalt Mining Company, Limited, did no mining in 1918, but ran the Seneca-Superior mill from June to November, treating tailings from the latter property. The mill was started again on May 1st, 1919.

The officers of the company are: president, W. M. Lamport, Toronto; vice-president, S. G. Forst, Toronto; directors, Irving L. Ernst, New York; Max B. Borg, New York; Charles M. Nickel, Toronto; secretary-treasurer, P. M. Goff, Toronto; manager, Charles A. Filteau, Cobalt, Ont. The head office is at 909 Excelsior Life Building, Toronto.

Provincial.—The Cobalt Provincial Mining Company, Limited, worked the Provincial mine during eight months of 1918. Development work was confined

to 350 feet of cross-cutting on the 115-ft. level. The mill ran only two weeks during the year. One Callow flotation unit has been added. Shipments consisted of seven tons of concentrates and two tons of high-grade ore.

The officers of the company are: president, F. G. Logan, Chicago; vice-president and manager, John Reddington, Cobalt; secretary, C. L. Painter, St. Louis, Mo.; head office, 121 Chamber of Commerce, St. Louis, Mo.

Reliance.—On the Reliance claim, situated near the Nova Scotia mine and owned by Moorehead and Tough, the Reliance Leasing Company has been working under lease since November, 1918. The main shaft is 50 feet deep. About 150 feet east of it a second shaft, 40 feet deep, was sunk to the 50-ft. level and continued as a winze to a depth of 112 feet. When inspected, on May 29th, 1919, the two shafts were connected on the 50-ft. level and a total of 250 feet of drifting and cross-cutting had been done to the east of the main shaft and 200 feet to the west of the same. Some ore had been stoped above and below this level to the east of the main shaft. On the 112-ft. winze-level drifts extended 20 feet east and 10 feet west.

John T. Shaw, Cobalt, was in charge of the work, employing 8 men.

Silver Queen.—This property was under lease to George A. Irwin, Cobalt, during 1918.

From the surface dumps 450 tons of milling ore was shipped to the Dominion Reduction Company. No ore was hoisted from the underground workings.

Right-of-Way.—The following particulars are extracted from the annual report of the Right-of-Way Mines, Limited, covering the year ending December 31, 1918:

Work was carried on continuously during the year at No. 2 shaft, situated near the north end of Cobalt lake. Development work done consisted of: winze-sinking, 54 feet; raising, 96 feet; drifting, 431 feet; cross-cutting, 60 feet. The net value of the ore produced during the year was \$42,993.55. This amount was calculated as follows:

	Dry weight pounds	Silver contents ounces	Gross Value	Net Value
Shipments—			\$ c.	\$ c.
High grade and concentrates.....	305,008	45,733.25	45,901 19	38,798 20
Metallies	613.4	3,989.97	3,823 20	3,535 35
Ore on hand, Dec. 31, 1918.....	21,000	2,100.00	2,100 00	2,100 00
	326,621.4	51,823.22	51,824 39	44,433 55
Less ore on hand, Dec. 31, 1917.....	4,000	1,800.00	1,440 00	1,440 00
Production, 1918	322,621.4	50,023.22	50,384 39	42,993 55

The officers of the company are: president, C. Jackson Booth; vice-president, A. E. Larmonth; secretary, Jas. Cunningham; all of Ottawa; manager, D. H. Angus, Cobalt. The head office of the company is in Central Chambers, 46 Elgin Street, Ottawa, Ont.

Temiskaming.—The Temiskaming Mining Company, Limited, has an authorized and issued capital of 2,500,000 shares of a par value of \$1.00 each. The directors are: president, J. P. Bickell, Toronto; vice-president, W. J. Shepard, Wanbushene, Ont.; Geo. E. Drummond, Montreal; W. Linton, Toronto; George N. Miller, New York; H. D. Symmes, Niagara Falls, Ont.; J. B. Tudhope, Orillia, Ont. M. P. Van der Voort is secretary, and P. W. Cashman, treasurer. The head office is in the Standard Bank Building, Toronto, and the mine office is at Cobalt, Ont.

The mill was shut down on May 10th, 1918, and was not started again until November 18th, 1918. From January 1st, 1918, to June 30th, 1918, 11,759 tons of ore were treated in the mill and yielded 391,367 ounces of silver.

In a report on the Temiskaming mine, dated July 3rd, 1918, R. J. Ennis, consulting engineer for the company, says in part:

The operation of the mine may be divided into two periods. First, from the beginning of production in 1908 to the end of 1913, when veins Nos. 1 to 16 were worked and reached their maximum production, yielding 142,818 tons of ore, from which 7,163,360 ounces of silver were recovered, or 50.2 ounces per ton, including both high grade and mill rock. To make this production possible 21,851 feet of development work was done, or one foot for every 328 ounces of silver obtained. In the second period, from 1914 to the end of 1917, veins Nos. 19 to 21 were opened up and together with a small tonnage from the ends of veins Nos. 1 to 16, produced 91,595 tons of ore yielding 3,664,559 ounces of silver, or 40 ounces per ton of ore mined. Seventeen thousand six hundred and fifty-two feet of development work was performed in this period, or one foot for every 207½ ounces of silver obtained.

All the productive veins on the property have been found in about eight acres of ground in the west half of the Temiskaming lot. On the levels of the mine within this area above the diabase sill and on the 575-, 650- and 725-ft. levels in the diabase 38,000 feet of cross-cuts, drifts, raises and winzes have been driven.

The following statements are taken from mine manager McReavy's report dated July 3rd, 1918.

The total footage done on the property previous to 1918 amounted to 39,535 feet. Of this work 38,035 feet were on the Temiskaming lot and 1,500 feet on the Gans lot. The work on the Temiskaming developed the vein system from which 10,837,921 ounces of silver were recovered. Vein No. 2 produced some ore beyond the Temiskaming line, in the Gans lot; but with this exception the Gans has been unproductive.

The development and exploration work on the Temiskaming lot had been so extensive as to leave but small possibilities of finding any new veins of importance above the sill. Future production from this section must depend upon finding good ore in the extension of the known veins which, owing to the large amount of development work already done on them would, necessarily, be of limited extent.

Future possibilities of the property, therefore, depend on finding ore in the Gans lot above the sill or in the Temiskaming and Gans lots below the sill. From the geological report and from long sections of the mine workings, it is apparent that the productive portions of the veins in the Temiskaming lot were directly over a synclinal trough in the diabase, dipping to the east. The workings in the Gans lot show that a similar trough exists in the central portion of the lot, and it was recommended that a cross-cut be driven to the east from the north-south drift on the 500-foot level. This cross-cut has been driven 270 feet, and four strong veins passed through. No silver values were found in any of them, but they all contained niccolite and cobalt. The first vein encountered is being driven on to the south and the second to the north. No silver values have as yet been encountered, but the work continues to be most encouraging, the veins becoming more heavily mineralized and of greater width.

From the shaft a cross-cut had been driven (on the 1,600-ft. level in the Keewatin), 470 feet to a point directly under the productive vein system above the sill and a calcite vein 6 inches wide, but containing no silver, was passed through.

Since it is believed a synclinal trough above the sill is responsible for the favourable structural conditions in which productive veins occur, it is to be expected that the reverse would be true below the sill and favourable structural conditions found below anticlines in the diabase.

Drifting was started southeast on the calcite vein above mentioned and continued 192 feet without showing improvement. From this point a cross-cut is now being driven due east through the Keewatin under an anticlinal area to prove or disprove the existence of commercial veins.

The ore reserves, exclusive of tailings impounded, were estimated on June 30th, 1918, to be 3,468 tons containing 101,498 ounces of silver.

I. S. McReavy who was mine manager during 1918, resigned early in 1919, and was succeeded by Wm. Cooper.

Three Stars.—The Three Stars Silver Mines, Limited, worked at intervals in 1918 on the Airgiod, or Cyril lake claim. The work done consisted in drifting and cross-cutting on the 90-ft. level in both Keewatin and diabase. Ten men were employed.

H. A. Oswald, Cobalt, is president and manager, and John S. Clark, mine foreman.

Thompson.—The Mining Corporation of Canada worked under option for several months on the southwest quarter of the north half of lot 11 in the second concession of Bucke township. This claim was originally recorded in the name of Arthur Thompson. An old shaft, 100 feet deep, was straightened by the Corporation and continued to 300 feet. From the bottom a cross-cut was driven 275 feet to the southeast, and at 160 feet southeast of the shaft a drift was run to the west on a vein for 70 feet. This drift extends beneath some old workings. Near the face of the cross-cut a diamond-drill hole, pointed about due east, was put down for 426 feet at an angle of 70 degrees. Diabase is said to have been the only rock encountered in all of this work.

On the north half of the northwest quarter of the south half of lot 11 in the second concession of Bucke township the Corporation drilled a second hole in a southwesterly direction at 72 degrees. This hole was stopped at 394 feet and was also in diabase.

The work was discontinued on May 24th, 1919.

Trethewey.—The Trethewey Silver-Cobalt Mine, Limited, has an authorized capital of 2,000,000 shares of a par value of \$1.00, of which 1,000,000 shares have been issued. The directors are: S. R. Wickett, president, Toronto; J. B. Tudhope, vice-president, Orillia; W. J. Sheppard, Waubaushene; Gordon Taylor, Toronto; J. P. Bickell, Toronto; L. J. Pashler, Standard Bank Building, Toronto, secretary-treasurer.

The mine and mill were in continuous operation during 1918. There was no development work done, as it is considered that the productive area of the property has been thoroughly explored; 24,514 tons of ore were broken from the walls of old stopes. The mill treated 34,546 tons of 10.2-oz. ore. The net value of the production for the year was \$250,534.94.

Machinery was installed for the re-treatment of the old tailings, and a recovery of 3.6 ounces of silver per ton is expected.

One dividend of 5 per cent. was paid during the year.

I. S. McReavy is manager.

Miscellaneous

Farr Quarry.—The Farr limestone quarry, situated in the north half of lot 10 in the third concession of Bucke township, was worked during part of 1918. The limestone was shipped to the Abitibi Pulp and Power Company at Iroquois Falls. The quarry is owned by Mrs. C. C. Farr, of Haileybury, and in 1919 was being worked under lease by John Berry of that place. The face carried is from 5 to 10 feet high, and the overburden of soil averages about two feet in thickness.

Lang Quarry.—The George Taylor Hardware Company, Limited, operated a limestone quarry west of the town of New Liskeard during 1917 and for a short time in 1918. The rock was used for the manufacture of lime. The quarry is situated on the north half of lot 6 in the second concession of Dymond township, and is on the farm of Henry Lang, New Liskeard, Ont.

Prospecting for Oil, Bucke Township.—In May, 1919, a diamond-drill hole was put down in search of oil in limestone on the Farr Estate about a quarter of a mile southwest of Haileybury station. It is reported that the work, which proved unsuccessful, was done for a syndicate of Haileybury people.

D. D. Chisholm, Toronto, is in charge of the work, and George Jamieson, Haileybury, is secretary-treasurer of the syndicate.

Elk Lake and Gowganda Silver Area

Bonsall.—The Bonsall group of claims, comprising R.S.C. 82, 83, 84, and 85, are situated in the Miller lake section of the Gowganda area. M. J. O'Brien, Limited, which has an interest in this group, did some work on R.S.C. 82 in the summer of 1918. On this claim the main shaft was 118 feet deep, with some drifting done to the southwest on the 110-ft. level. The work done in 1918 consisted of about 100 feet of cross-cutting and drifting on this level to the northeast of the shaft.

Castle.—In January, 1918, the Trothewey Silver-Cobalt Mine, Limited, began work under option on the property of the Castle Mining Company, Limited, east of the Miller-Lake O'Brien mine, comprising twelve claims and 120 acres under the bed of Miller lake.

On the northwest corner of R.S.C. 106 a shaft was sunk to a depth of 315 feet. This was begun in Keewatin rock, but from a depth of 100 feet to the bottom of the shaft the rock encountered was diabase. When inspected in May, 1919, the work done was as follows: on the 200-ft. level, 210 feet of drifting west from the shaft; on the 300-ft. level, 1,100 feet of drifting and cross-cutting, 30 feet of raising, and a winze being sunk had reached a depth of 25 feet. The Keewatin formation has been encountered at one point on the 300-ft. level.

The plant consists of two r.t. boilers of 80- and 100-h.p.; an Ingersoll Sergeant Company of Canada compressor of 760-c.f. capacity; an 8 by 10-in. Jenckes hoist for the main shaft, and a 6 by 8-in. Jenckes hoist for the winze.

I. S. McReavy, of Cobalt, is manager, and J. C. Lively, Haileybury, is superintendent. Forty men are employed.

Crews-McFarlan.—The Crews-McFarlan Mining Company, Limited, continued work in No. 2 vertical shaft on claim J.S. 280 near Hewitt lake. This shaft was sunk to a depth of 140 feet. On the 125-ft. level the following was approximately the amount of work done: cross-cutting, 125 feet to the north and 125 feet to the south; drifting, 325 feet to the east and west. All of the work done from this shaft was in diabase.

This company has been working the Bartlett mine in Milner township since July, 1917. In May, 1919, No. 1 shaft was 300 feet deep, with levels at 100, 200 and 300 feet; and No. 2 shaft was 110 feet deep, with a level at 100 feet. The drifting and cross-cutting done since the new owners began work was as follows: No. 1 shaft, 100-ft. level, 500 feet; 200-ft. level, 250 feet; 300-ft. level, 100 feet; No. 2 shaft, 100-ft. level, 250 feet. A raise was also driven from the 100-ft. level of No. 1 shaft to the bottom of an open pit. Twenty-two men were employed.

The officers of the company are: president, C. H. Streit, Nutley, N.J.; vice-president, Walter Little, Nutley, N.J.; secretary, Henry R. Crews, Paterson, N.J.; treasurer, W. J. McFarlan, Paterson, N.J.; N. O. Lindstrom, Albert E. Howe, Robert S. Parsons, W. P. Wells, of Nutley, N.J.; H. Bornemann, Jr., A. J. Hedges, of Newark, N.J.; Chas. Simon, T. F. Malloy, F. W. Ball, of Paterson, N.J.; Alfred Bicknell, of Toronto. Isaac G. Wheaton, Gowganda, is manager.

Hitchcock.—In August, 1918, the Paragon-Hitchcock Mines, Limited, commenced work on the Hitchcock mine, which was formerly worked by the Westmount Mining Company, Limited. This mine is situated on lot 10 in the first concession of Tudhope township. On May 13th, 1919, the shaft, which is vertical, was 162 feet deep, with sinking in progress. There is a level at 100 feet, and here the total work done consists of 260 feet of drifting and cross-cutting and 30 feet of raising. All the work is done in diabase.

The plant consists of a 60-h.p. Jenckes boiler, locomotive type; a six-drill Canadian Rand compressor and a 6 by 8-in. Jenekes hoist.

The capitalization of the company is \$2,000,000, divided into shares of \$1.00 par value each. The officers are: president, Dr. Donald McKay, Collingwood, Ont.; vice-president, W. R. Hitchcock, Cornwall; secretary, David Melville, Collingwood; directors, E. R. Hitchcock, Wabun, Ont.; Reginald Gilpin, R. Feighan, Wm. T. Herrington, Chas. Pitt, W. A. Hamilton, all of Collingwood; J. P. Welsh, Wabun.

Fourteen men are employed, with J. P. Welsh in charge.

Kell Bros. and Perriault.—Some very rich ore is reported to have been found in a vein in the diabase in Corkill township, near the south boundary and about three miles southwest of Beauty lake. The claim belongs to Kell Bros., Perriault and others.

Mapes-Johnston.—The Brant Mines, Limited, which reopened the Mapes-Johnston mine in October, 1917, ceased work in January, 1918. All work at this mine had been in diabase until, at a depth of 400 feet in the bottom of a winze, the slate-conglomerate formation was encountered. On the 400-ft. level a drift

is reported to have been carried north about 150 feet in slate, but nothing of value was found.

Neil Morrison, of Elk Lake, was in charge of the work.

Miller-Lake O'Brien.—This mine was a regular shipper of silver during 1918. The main shaft, No. 2, is, as before, 450 feet deep, with levels at 60, 90, 140, 200, 240, 300, 350 and 450 feet. No. 4 winze has been sunk from the 350-ft. to the 525-ft. level, and levels opened at 400, 460 and 525 feet. When last inspected, in May, 1919, no work was being done above the 350-ft. level. On that level preparations were being made to remove the ore left in the floor. From the 400-ft. and 450-ft. winze levels stoping was in progress, and on the 525-ft. winze level drifting was being done.

No work was done during the year at the No. 7 or No. 20 shaft.

The mine is owned by M. J. O'Brien, Limited. J. G. Dickenson, Cobalt, is manager; B. C. Crowe, Gowganda, superintendent; W. F. Melville mine foreman and John Cummings, mill foreman. Ninety-two men were employed, of whom 53 were underground workers and 6 mill men.

Reeve-Dobie.—The Reeve-Dobie Mines, Limited, did 650 feet of cross-cutting and 20 feet of raising on the 100-ft. level, and closed down the mine on July 26th, 1918. A. S. Crowe, Timmins, superintended this work.

In the spring of 1919 the mine was again pumped out. The property was inspected on May 16th, when six men were employed on surface work. It was then stated that a flotation plant was being bought.

The company is capitalized at \$2,000,000, divided into shares of \$1.00 par value each. The officers are: president, Charles Ward, Livonia, N.Y.; vice-president, Herman Meyring, Rochester, N.Y.; secretary-treasurer, Robert Thompson, Rochester, N.Y.; manager and director, Martin H. Jacobs, Gowganda, Ont.

T.C. 177.—Mining claim T.C. 177, situated south of the Miller-Lake O'Brien mine, was worked until November, 1918, by the T.C. Mining Company, Limited. In April, 1919, the claim was acquired by the Palmer-Paine Mines, Limited, which proceeded to prospect it.

On May 14th, 1919, the date of the last inspection, the shaft was 208 feet deep, with a level at 200 feet. On the level 371 feet of drifting had been done to the northeast of the shaft; all this work was in diabase.

The plant consists of a 60-h.p. r.t. boiler, a Canadian Fog Signal Company compressor, 10 in. by 12 in. by 10 in., and a 12 by 14-in. Jenckes hoist.

Neil Morrison, Gowganda, was superintendent, employing seven men. The president of the company is B. P. Paine, Niagara Falls, Ont., and the head office address is Box 429, Toronto.

T. C. 220.—In the summer of 1918 P. Howard Collins, of Gowganda, began work on claim T.C. 220, situated on the southwest shore of Leroy lake. On May 15th, 1919, the work done underground consisted of a shaft 130 feet deep. A 6 by 8-in. Jenckes hoist and a 35-h.p. locomotive-type boiler were then being set up. Six men were employed.

Walsh.—The Crown Reserve Mining Company, Limited, worked from January until October, 1918, on claim R.S.C. 98, comprising land on the south shore and part of the bed of Miller lake. This property formerly belonged to the Walsh Silver Mines, Limited.

The shaft was 60 feet deep and on the 50-ft. level about 50 feet of drifting and 50 feet of cross-cutting had been done. The work done by the Crown Reserve Mining Company consisted of, deepening the shaft to 200 feet; on the 100-ft. level, about 250 feet of drifting to the northeast and 30 feet of cross-cutting; on the 190-ft. level, about 200 feet of drifting to the northeast and 50 feet of cross-cutting.

South Lorrain Area

Curry; Wettlaufer.—The Pittsburgh-Lorrain Syndicate operated the Curry and Wettlaufer silver mines in South Lorrain until November 30th, 1918, when work was suspended at both properties. The surface dumps were worked over and a considerable amount of mill rock obtained from the underground workings.

H. F. Strong was in charge of operations, employing on an average 20 men.

Keeley.—This property was in operation between July and September, 1918, and a car of ore shipped. Work was under the supervision of Malcolm Black, of Silver Centre.

IV.—EASTERN ONTARIO

Pyrite

Grasselli.—The Grasselli Chemical Company, Limited, is developing a pyrite mine on lots 1 and 2, concession 1, Blithfield township. The mine is situated a mile and a half northeast of Clyde lake siding on the Kingston and Pembroke railway. This siding is at railway mileage 22.5 south from Renfrew.

Two shafts have been sunk. No. 1 is inclined at 60 degrees and is 75 feet deep. From the bottom of this a drift is being driven east to connect with No. 2 shaft. This drift was about 400 feet long on April 9th, 1919. No. 2 shaft is being sunk at 56 degrees in the hanging wall; and was 105 feet deep on the above date; this will be the main shaft.

Near No. 2 shaft, an ore bin, boiler and compressor building, dry and warehouse have been built. The plant at this shaft consists of a 100-h.p. horizontal tubular boiler, a 15-h.p. Doty vertical boiler and hoist, and a 465-c.f. Fairhurst compressor.

There are 35 men employed. David S. Tovey is superintendent, and George W. Thomas, mine foreman. The mine post-office is Flower, Ont.

Queensboro.—The Queensboro pyrite mine on lot 9, concession X, Madoc township, was worked continuously by the Canadian Sulphur Ore Company, Limited, and about 80 men were employed.

The main shaft (No. 3) was sunk to a depth of 460 feet, and the sixth level was started at this point. On March 11th, 1919, the west drift on this level measured 90 feet, and the east drift, 64 feet. Most of the stoping done in 1918, was between the second and third levels.

The officers of the company are: president, Alex. Longwell, Toronto; vice-president, Geo. H. Gillespie, Madoc; superintendent, H. F. Smeaton, Queensboro, Ont.

Sulphide.—The mine and plant of the Nichols Chemical Company at Sulphide operated throughout the year 1918. The company manufactured sulphuric, nitric and hydrochloric acids and salteake. The greater part of the acids was disposed of to the Imperial Munitions Board and the United States Government for war purposes. Production was greatly increased during the war, but immediately after the signing of the armistice it dropped to the pre-war basis.

The ore used was taken from the second, third and fourth levels. The mine was successful in winning the prize in the inter-mine safety competition of the Nichols Chemical Company in the United States and Canada.

During 1918 the company built and equipped a manual training and household science building in connection with the public school, the first rural school in the Province to be thus equipped.

The officers of the company are: president, P. W. Nichols, New York; gen-



Electric furnace for producing ferro-chrome, Cordova Mines.

eral manager, E. S. Pincott, New York; secretary, Thos. F. Burgess, New York; treasurer, James L. Morgan, New York; manager, W. H. DeBlois, Sulphide. About 170 men are employed.

Gold

Cobalt-Frontenac.—The Cobalt-Frontenac Mining Company, Limited, near Flinton, Ont., remodelled the mill during the year. The following plant was installed: a 14-in. by 24-in. jaw crusher; two 100-h.p. motors and an Ingersoll-Rand compressor with a capacity of 732 cu. ft. per second. A concrete foundation 72 ft. by 115 ft. for the cyanide plant was also built.

The shaft is 7 ft. by 11 ft., at an angle of 65 degrees, and was sunk 50 feet during 1918, the work being done in the latter part of the year.

The officers of the company are: president, George W. Millan, Stoney Creek; vice-president, Noah Dymont, Guelph; secretary-treasurer, M. Doyle, Hamilton; manager, D. H. Fletcher, Flinton. Twenty men are employed.

Cordova Mines, Limited.—The gold mine of this company in Belmont township, Peterborough county, was not worked in 1918, but the company erected an electric smelting plant at Cordova for the production of ferro-chromium. Owing to delay in the delivery of electrical equipment, the plant was not completed till February, 1919, by which time the market for ferro-chromium was such that it was not considered advisable to operate. The furnace had a capacity of 5,000 lbs. of ferro-chromium a day.

Peter Kirkegaard is managing director of the Cordova Mines, Limited.

Iron

Wallbridge.—G. Wallbridge shipped 245 tons of hematite ore from the dumps of the old Wallbridge mine, near Eldorado, on lot 12 in the sixth concession of Madoc township. This ore was mined eighteen years ago. The shipments were made to the Armstrong Whitworth Company at Longueuil, Quebec.

Talc

Connolly.—The Anglo-American Talc Corporation worked the Connolly talc mine and mill during all of 1918. This property is situated near the village of Madoc, on the northwest quarter of lot 15, in the fourteenth concession, Huntingdon township.

Stoping was carried on between the 50-ft. and 127-ft. levels. On the 188-ft. level, drifts were run 100 feet west and 275 feet east from the shaft, but no stoping was done from this level. Twenty men were employed, of whom nine were underground.

The officers of the company are: president, H. S. Predmore, New York; secretary, H. J. Gilchrist, 82 Beaver St., New York; superintendent, Thos. Carswell, Box 55, Madoc, Ont.

Henderson.—The Henderson talc mine, which has for some years been worked by Cross and Wellington under lease, is now being operated by The Henderson Talc Mines, Limited. The officers of this company are: president, M. H. Ludwig, K.C., Toronto; vice-president, Alex Longwell, Toronto; secretary, Geo. H. Gillespie, Madoc. This mine supplies the George H. Gillespie and Co. talc mill at Madoc.

The work at the mine is being done by Kiviaho and Jackson under contract. Five men are employed.

Geo. H. Gillespie and Co.—Geo. H. Gillespie and Co. worked their talc mill at Madoc station throughout 1918. Eighteen men were employed. Geo. H. Gillespie, Madoc, is manager, and L. Ashley, mill foreman.

International Pulp Company.—The International Pulp Company, of Gouverneur, N.Y., are continuing to prospect for talc on the Pitts farm near Madoc in lot 16, concession XIV, township of Huntingdon.

From No. 1 inclined shaft, which is 50 feet deep, 100 feet of cross-cutting was done in a north-easterly direction. The plant was then moved to a point about

a quarter of a mile west of No. 1, and No. 2 shaft was commenced. The latter was sunk to a depth of 80 feet and is vertical. When last inspected, in March, 1919, about 70 feet of cross-cutting had been done on the 80-ft. level.

Daniel Brownson, Box 97, Madoc, is in charge of the work, and six men are employed.

Eldorado.—The plant of the Eldorado tale mine, near Eldorado, was overhauled in 1918, and mining and milling were resumed in February, 1919. This mine is now worked by the Eldorado Mining and Milling Company, Limited, successors to Eldorite, Limited.

The officers of the new company are: president, S. J. Morand; secretary, J. J. Morand; treasurer, R. J. Morand; all of Chicago. The superintendent is R. M. Phillips, Eldorado.

Twenty men are employed, of whom four are underground and twelve in the mill.

Fluorite

Bailey.—This mine, on lot 1 in the fourth concession of Madoc township, was idle in 1918.

Blakeley.—On the farm of W. Blakeley, lots 9 and 10, concession XII, Huntingdon township, S. Wellington, of Madoc, has stripped some fluorite veins. When visited in March, 1919, the best showing was a vein up to three or four feet in width, which was exposed by test pits for some 300 feet.

Canadian Fluorite.—After being idle for several months, the Keen, situated on lot 9 in the fourteenth concession of Huntingdon township, was reopened in March, 1918, by Canadian Fluorite, Limited.

On March 15th, 1919, the shaft was 65 feet deep, with a level at 50 feet. The drifting amounted to 160 feet to the north of the shaft, and 100 feet to the south. At 150 feet north of the shaft on the 50-ft. level a winze has been started, and was 16 feet deep at the date mentioned. No stoping has been done, but several shipments were made in 1918 from development work. Seventeen men are employed.

The surface plant consists of one 40-h.p. and one 60-h.p. locomotive-type boiler, one Ingersoll compressor, capacity about 200 cu. ft. per min., and a Wm. Beatty and Sons hoist, 10 by 14 in.

The officers of the company are: president, F. R. Miller, Toronto; vice-president, Roy Miller, Toronto; secretary-treasurer and manager, E. N. Tutt, 503 Lumsden Building, Toronto; superintendent, A. W. Grierson, Madoc.

Dwyer Prospect.—In 1918 P. J. Dwyer, Wilberforce, Ont., shipped one car of uncobbed fluorite from his claim on lot 8, concession XXII, township of Cardiff.

Lee.—The Lee fluorite mine, on lot 1 in the first concession of Madoc township, was worked continuously in 1918 by H. L. Osborne.

A shaft was sunk to a depth of 60 feet, and at the bottom drifts were driven north 30 feet and south 70 feet. The vein is vertical, from 3 to 8 feet wide, and

contains a mixture of calcite, fluorite and barite in granular form, locally known as "gravel spar." Shipments in 1918 amounted to 600 tons.

Frank Cassin was in charge of the work.

Noyes.—The Canadian Industrial Minerals, Limited, continued work on the Noyes mine in 1918. This lies in lot 13 of concession XII, Huntingdon township, and is about three miles south of Madoc village. On the first of March, 1919, the underground work done at this mine was as follows: Two shafts sunk: No. 1, inclined, 100 feet deep, and No. 2, vertical, 125 feet. No. 2 is the working shaft and lies 210 feet northwest of No. 1. The 100-ft. level connects the bottoms of these shafts. On this level about 800 feet of drifting and cross-cutting has been done. At a point 80 feet southeast of No. 1 shaft, a winze has been sunk from the 100-ft. to the 200-ft level. On a level at 150 feet, 35 feet of drifting has been done to the north and the same amount to the south, while on the 200-ft level the drifting amounted to 25 feet. Stopping has been confined to the ground above the 100-ft level adjacent to No. 1 shaft.

The fluorite is cobbled and hauled by motor lorry to Moira Lake siding, on the Grand Trunk railway, about a third of a mile away. About 35 men are employed.

The officers of the company are: president, J. P. Watson; vice-president, W. R. P. Parker; director, G. M. Clark; secretary-treasurer, W. W. Perry; all of Toronto; manager, R. C. Bryden, Madoc. The head office is 1,511 to 1,520 Bank of Hamilton Building, Toronto.

Perry.—The Perry fluorite mine, situated on the north shore of Moira lake, on lot 11, concession XIII, Huntingdon township, was worked in 1918 by Wellington, Cross and Bowman.

At the time of last inspection, March 6th, 1919, the underground work was as follows: Nos. 1, 2 and 3 shafts were respectively 35, 80 and 95 feet deep. From No. 3, the working shaft, levels have been established at 50 and 90 feet. On the 50-ft. level the vein has been stoped for a distance of 30 feet north from the shaft. On the 90-ft. level 40 feet of drifting has been done to the north and 50 feet to the south. This mine makes a large amount of water.

Albert Terrill, of Madoc, is manager, employing ten men.

Wallbridge.—The Wallbridge mine, on the west half of lot 4 in the first concession of Madoc township, was worked continuously in 1918 by H. L. Usborne.

A shaft 75 feet deep was sunk, and 40 feet of drifting done south of the shaft. The vein, which can be traced for 400 feet, was from one to three feet wide on the surface, but pinches to six inches on the 75-ft. level. Eighty tons of fluorite were shipped during 1918. This mine was closed during the winter of 1918-19, but work was resumed in March, 1919.

Frank Cassin is in charge.

Lead

Galetta.—The lead mine, concentrator and smelter on Chats island, near Galetta, belonging to the estate of James Robertson, Montreal, was in continuous operation during 1918.

Early in 1919 a new operating company was formed known as the Kingdon Mining, Smelting and Manufacturing Company, Limited, of which Chas. M. Robertson is president, John J. Milne, secretary-treasurer, and A. G. Munich, managing director. The head office is at 314 Beaver Hall Hill, Montreal.

Underground work was confined to the 2nd and 3rd levels from the new shaft. At the close of 1918 the 2nd level had been opened up 192 feet to the west and 368 feet to the east; on the 3rd level 208 feet to the west and 384 feet to the east.

Plans are under way for the enlargement of the concentrating plant during 1919, the smelting capacity being greater than is necessary to take care of the present mill production.

Part of the grey slag from the Scotch hearth is being treated by the Kingston Smelters at Kingston.

C. M. Thompson is mine superintendent, employing on an average 65 men.

Feldspar

Dwyer Prospect.—P. J. Dwyer, of Wilberforce, Ont., shipped a carload of feldspar in 1918 from his claim in lot 31, concession VI, Glamorgan township, about $1\frac{1}{4}$ miles east of Gooderham station, on the Irondale, Bancroft and Ottawa railway.

Eureka Flint and Spar Company.—The quarry at Verona adjoining the Hurlburt property, operated during the year with a capacity of about 20 tons per day of feldspar. The output is shipped to Trenton, New Jersey, where the head office and pottery works of the company are located. Several quarries in the United States are owned and operated by the same company.

The quarry, which is now 200 feet long, 60 feet wide and 30 feet deep, is worked in three benches. An additional 30-h.p. boiler was installed during the year for hoisting the rock to the surface, where it is loaded on wagons and drawn $2\frac{1}{2}$ miles to the railway at Verona. Fifteen men were employed.

The officers of the company are: John E. Throp, president; Frank W. Throp, treasurer; Peter D. Throp, secretary; John C. Wilkes is manager for the Canadian quarry.

Feldspars, Limited.—The feldspar quarry near Verona owned by this company was operated up to December 21st. Work was carried on at maximum capacity, owing to the demand for war material, up to November, when the demand ceased, and work was discontinued in December.

There were no changes in the operation; stoping was continued in benches, principally in the southern end of the quarry. The ore is taken up the incline in cars, and transported across the lake to Glendower station on scows.

The officers of the company are: S. H. Worth, president; R. F. Segsworth, secretary-treasurer; Ralph Scott, manager; the head office is at 103 Bay Street, Toronto. About 55 men were employed.

Feldspar Quarries, Limited.—The quarry near Verona, owned by this company, operated during the year 1918, and shipped about 20 tons per day of clean spar

to Rochester, New York. A small quantity of quartz was also shipped. The quarry is about 150 feet long, 85 feet deep and 45 feet wide, and was extended about 30 feet to the south during the year.

George W. Hurlburt, Verona, is manager, employing 15 men.

Mica

Loughborough Mining Company.—The Lacey mine, near Sydenham, in Loughborough township, is operated by the General Electric Company.

The mine was operated continuously during 1918, about 7,000 lbs. of mica per week being produced and shipped to the company's plant at Sorel, Quebec.

During the summer months work was carried on in the open pit, and during the winter stoping was continued on the main vein, which is about 16 feet wide. This stope was lowered 15 feet for a distance of 45 feet, which necessitated the installation of a hoist on the fourth level, which raises the mica to the seventh level, where it is hand-cobbed. It is then taken to the sorting room at the shaft house, where it is trimmed and packed in barrels for shipment.

George M. McNaughton is manager, and Richard Smith, superintendent; an average of 22 men was employed.

Davis Township Mica Prospect.—A mica prospect is being developed in a portion of Ontario in which mica of commercial grade has not hitherto been mined. It is situated on the southeast quarter of the north half, concession I, of the township of Davis, and is reached by taking the Canadian National railway to Ess Creek, 59 miles west of North Bay. An alternative route is by tote road running north from Markstay on the main line of the Canadian Pacific railway for 14 miles to Ess Creek. The vein is a mile and a quarter east of the point where the Canadian National trains stop, and is about two hundred yards south of the railway with Ess Creek intervening.

The claim was staked by B. A. Grant, of Sturgeon Falls, on October 21st, 1910, and was bought the following year by D. J. Finlan, of Markstay. In 1918, under a working arrangement with the owner, Clarke and Lounsbury of North Bay shipped some mica from an open cut. In 1919 Mr. Finlan sold the claim to W. C. Smith, of 218 South Wabash Avenue, Chicago, who at once began work on the vein. Negotiations are in progress whereby a company, to be called the Standard Mica Company, will be the operator.

The mica occurs irregularly distributed in a pegmatite vein of pink and white feldspar and quartz. The strike of the vein is N. 65° E. (magnetic), parallel to the foliation of the adjoining gneiss, and the dip is perpendicular.

When visited on July 3rd, 1919, a pit, 16 feet in depth at the deepest point, had been excavated on the vein for 130 feet. At one place in the pit the vein is missing for fourteen feet, and here a pillar of rock has been left. The vein is from two to nine feet wide in the pit, and can be traced for 450 feet to the northeast by occasional outcrops. The wall-rock is hornblende-gneiss, and is in part garnetiferous. Embedded in a soft, bronze-coloured, micaceous mineral on the north wall of the vein crystals of brownish-red garnet up to five inches in diameter have been found. These large crystals were much altered.

In colour the mica is light to smoky brown, and none of the pieces had a well-

defined crystal outline. The largest piece seen measured about 5" x 8". Judging from the nature of the occurrence, the species is probably muscovite, but it is darker in colour than muscovite generally is. A complete analysis was not made of any of this mica, but a partial analysis of one specimen by W. K. McNeill, Provincial Assayer, showed 8.38 per cent. potassium oxide (K_2O) and 0.89 per cent. sodium oxide (Na_2O).

Shipments made from this vein consisted of 300 pounds by Clarke and Lounsbury in 1918, and 1,000 pounds by W. C. Smith up to July 1st, 1919. These shipments were of untrimmed mica.

There are nine workmen employed and two log cabins have been built for their accommodation. The only piece of machinery yet obtained is a Chris D. Schramm and Son combined gas engine and air compressor. This is housed in a third small log building. The work is in charge of James W. Cohn, superintendent, and Richard J. Stacey, foreman. The postal address is Ess Creek, Chudleigh, Ont.

Molybdenite

British Molybdenite, Limited.—This company has acquired a molybdenite prospect on lot 32 in the fifth concession of Glamorgan township, about $1\frac{1}{4}$ miles east of Gooderham station on the Irondale, Baneroft and Ottawa railway. During the summer of 1918 six men were employed in trenching.

The officers of the company are: president, Harry Secord, Toronto; secretary, George W. Hunt, Toronto; head office, 34 Victoria Street, Toronto.

International Molybdenum Company.—The mine owned by this company in Brougham township was not operated in 1918, and the custom concentrator at Renfrew was also idle during the year. The smelter and refinery at Orillia was closed in January, 1918.

The Electro Foundries, Limited, an associated company occupying the plant at Orillia, was a producer of ferro-molybdenum and ferro-magnesium up till December, 1918.

The Orillia Chemical Company, a subsidiary of the Electro Foundries, Limited, with a capacity of between 3,000 and 4,000 lbs. of molybdenum chemicals per month, and utilizing the plant of the International Molybdenum Company, was in operation during 1918, using molybdenite concentrates obtained from Quyon, Quebec.

The officers of the International Molybdenum Company are: J. L. Murray, president; H. A. Jordan, secretary-treasurer; B. C. Lambie, smelter manager.

Joiner.—W. E. Joiner, 553 Sherbourne Street, Toronto, is prospecting a molybdenite deposit on lot 3, concession XX, Cardiff township, about a mile and a half southeast of Wilberforce village. At the end of February, 1919, a prospect shaft was being sunk and was then about 25 feet deep. Seven men were employed, with Clarence Godfrey as foreman.

Molybdenum Products Company.—The Molybdenum Products Company, Limited, is operating on lot 32, concession XV, and lot 32, concession XVI, township

of Monmouth, near the village of Wilberforce on the Irondale, Bancroft and Ottawa railway.

The power plant consists of two r.t. boilers, one Jenckes 150-h.p., and one Goldie and McCulloch 180-h.p.; one 135-h.p. compound Wheelock-Goldie and McCulloch engine, and one 50-h.p. Erie engine.

The ore is hoisted in a 11 $\frac{1}{4}$ -ton skip from a quarry up a 10-degree tramway to the mill. The skip dumps into a bin holding 200 tons, which is the estimated capacity of the mill per 24 hours. The ore is crushed to one inch by a 11 by 26-inch jaw crusher. It is then hoisted by a bucket and chain elevator to a 115-ton bin, whence it is fed by an automatic feeder to a No. 64 Marcy ball mill. The discharge from the mill is elevated to a 14 ft. 8 in. Dorr duplex classifier. The oversize from the classifier returns to the ball mill, and the undersize goes to five Callow roughing cells. The concentrates from the latter pass to two Callow cleaner cells and the tailings to waste. The concentrates from the cleaning cells pass to an 80-mesh Callow screen. The oversize from the latter is the final product, and is de-watered in a drag de-waterer; these concentrates are then dried over a brick oven. The tailings from the cleaning cells return to the roughing cells, as does also the undersize from the Callow screen.

The mill and tramway were completed in December, 1918, and work was then begun in the quarry.

The officers of the company are: president, O. D. Walters, Council Bluffs, Iowa; vice-president and managing director, M. B. R. Gordon, Wilberforce, Ont.; secretary-treasurer, George Urquhart, St. Paul, Minn.; directors, the above-mentioned, J. J. Hennen, St. Paul, Minn., and George Moss, Lohrville, Ia.

Forty men are employed. I. L. Church is foreman at the mine, and J. C. Duval at the mill.

Ontario Molybdenum Company, Limited.—This company owns a molybdenite deposit situated about 11 $\frac{1}{2}$ miles northwest of Tory Hill station, Irondale, Bancroft and Ottawa railway. Work was carried on during part of the summer of 1918, and 7 cars of uncobbed ore were shipped to the Department of Mines, Ottawa. Work was stopped in August, 1918. There is no plant on the property.

The officers of the company are: president, R. J. Lillico; vice-president, C. Leslie Wilson; directors, A. Watson, J. A. Gilmour, C. Leslie Wilson; all of Toronto. The head office is in the Mail and Empire Building, Toronto.

Steel Alloys.—The Steel Alloys Corporation continued to work the Sunset molybdenite mine in lots 35 and 36, concession XIV, Brougham township, until October, 1918. One carload of ore was shipped to the Department of Mines Laboratory, Ottawa, and the remainder was stock-piled. The ore was taken from an open cut.

During the year the company bought the Spain mine, consisting of lots 30, 31, 32 and 33, concession IV, and lots 30, 31 and 32, concession V, Griffith township, 700 acres in all. This purchase makes the total holdings of the corporation 900 acres. Since October, 1918, work has been in progress to effect certain changes in the mill. Two Callow roughing cells and one cleaning cell are being put in,

and it is expected that the remodelled mill will be ready to start in May, 1919. Twelve men are employed while the alterations are in progress.

The officers are: president, Wm. Wernick, Newark, N.J.; vice-president, John A. Howard, Wheeling, W. Va.; secretary and treasurer, Miss M. Johnston, Wheeling, W. Va.; manager, Joseph E. Cole, Dacre, Ont.

Graphite

Black Donald.—The Black Donald Graphite Company, Limited, own the following property in Brougham township, on Whitefish lake, 14 miles west of Calabogie: part of lot 20 in the first concession; lots 17, 18 and 19 in the third concession; part of lots 15, 16, 17 and 18 in the fourth concession. All of the work done to date has been on the southeast side of Whitefish lake in the third concession.

The mine and mill were operated continuously on a double shift during 1915, 1916, 1917 and 1918, and an average of 105 men were employed, 29 underground and 76 in the mill and on surface work. During February, 1919, the operations were changed to a pre-war basis, or daylight shift.

The output of finished material on a two-shift basis is 13 tons of refined graphite, and on a single shift is $6\frac{1}{2}$ tons per day.

The Black Donald deposit is a large and rich body of flake graphite. The ore averages 65 per cent. graphitic carbon, but material averaging as high as 80 per cent. is frequently encountered. The two principal deposits, or parallel veins, dip to the northeast at an angle varying from 20 to 40 degrees, and have been traced for 800 feet. The width of the main vein averages 20 feet for a distance of 700 feet, at which point it swells out to 70 feet in thickness. The country rock is crystalline limestone.

The first operations were begun in 1896 by The Ontario Graphite Company, Limited. In 1901, owing to failure to leave sufficient cap rock in the stope under the lake, the mine was flooded by the lake breaking in, and as a result was closed down for several years.

In 1904 Rinaldo McConnell leased the property and built a dam around the break, thereby effectually shutting out the lake water and permitting the resumption of mining operations.

In 1908 the Black Donald Graphite Company, Limited, took up the work of mining and refining under a long-term lease, and finally purchased the property in 1917.

The first shaft sunk, No. 1, was 80 feet deep and vertical. From the bottom of this shaft drifts were run 200 feet northeast towards the lake and 24 feet southwest. In the northeast drift a stope 120 feet long was carried to a height of from 30 to 50 feet above the level. In 1902, after the water broke into the stope, a 34-foot shaft, No. 2, was sunk 200 feet southwest of No. 1. From the bottom of the new shaft 50 feet of drifting was done, and the deposit was found to widen to 46 feet at one point. In 1905 No. 3 shaft was started 170 feet southeast of No. 1 shaft, and was sunk 170 feet at an angle of 50 degrees, dipping to the northeast. From this shaft the deposit was stoped in both directions, but principally to the east. This opening, through the continuous removal of ore, finally became an open pit through which hoisting is still carried on by means of an incline skipway. At

the present time stoping is being carried on 500 feet northeast of the No. 3 shaft and 175 feet below the level of the lake. The deposit at this point is 70 feet thick and 125 feet wide. The underground work done to date has shown the deposit to be 800 feet long. The presence of an important parallel deposit has been proved 30 feet to the southeast of the original vein at a depth of 90 feet. This vein is 14 feet thick and 70 feet wide, and contains rich ore, but is not at present being worked, as the company is confining its operations to the big mine, having found it to be more economical to work one vein at a time.

During the year 1917 this company mined, refined and shipped 2,844 short tons of graphite, and in 1918, 2,867 short tons.

The officers of the company are: president and treasurer, R. F. Bunting; secretary, J. N. Snead; superintendent, John D. Patno. Head office is at Calabogie, Ont.

Desert Lake.—A graphite prospect, situated on Desert lake, eight miles east of Godfrey station, Kingston and Pembroke railway, was being diamond-drilled in March, 1919. This property belonged to L. Beardmore, Toronto, but was recently sold.

Globe.—The Globe Graphite Mining and Refining Co., Limited, did no underground work at the mine near Port Elmsley in 1918 until June. Then they resumed work in the old workings, which are served by an inclined shaft. On the third level, which is at a depth of 260 feet, measured along the slope, a drift was advanced 100 feet on the vein to the northeast, making a total distance of 180 feet from the shaft. Forty-five feet of raising was done in ore above this level, and part of the ground was stoped.

The mill worked at intervals during the year. One unit of the Spearman concentration process was put in use.

Operations ceased in February, 1919.

The officers are: president, Windsor Morris, Syracuse, N.Y.; secretary-treasurer, Geo. C. Fryer, Syracuse; superintendent, R. W. Sweet, Port Elmsley, Ont. Head office, 410 Dillaye Building, Syracuse, N.Y.

National.—In 1918, National Graphite, Limited, did some surface work and placed a 50-ton concentrating unit of the Spearman process in the mill at Orser siding, about one mile west of Harcourt (Mumford Station). The holdings here comprise lots 9, 10 and 11 of concession XXII, Cardiff township.

Milling was started in January, 1919, the ore being obtained from an open pit near the mill. When last inspected, in February, 1919, 45 men were employed.

No work was done at the Maynooth graphite mine, which is also owned by this company.

The officers of the company are: president, W. A. P. Schorman, Toronto; manager, H. T. Bush, Harcourt, Ont.; superintendent, G. Gill, Harcourt, Ont.

Timmins Mine.—In 1918, Noah Timmins, of Montreal, bought a graphite property situated on the Frank Haughan farm at the western end of Black lake. The holdings acquired were the land and mineral rights of the north half of lot 25,

concession V, and the south half of lot 25, concession VI, and the mineral rights only of lots 24, 26 and the south half of lot 25, concession V, in the township of North Burgess. The mine may be reached by driving some fourteen miles southwest from Perth, or seven miles northeast from Westport.

Previous to 1918, no work had been done to test this deposit, with the exception of the sinking of a few test-pits. In the summer of that year, considerable stripping was done, and about 1,000 feet of diamond drilling, with satisfactory results. In September, construction work was begun, and when last inspected on April 5th, 1919, the mill building, 42 feet by 72 feet, was completed, and the following machinery was being placed in position: two locomotive-type boilers, a Lidgerwood and a Jenckes; a duplex vertical engine 12 by 12 inches; two Gates gyratory crushers, a No. 3 and a No. 5; a bucket elevator; two units of the Spearman process; a rotary dryer and four bolting machines. It is expected that milling will be started before May 15th. Eventually, hydro-electric power will be used.

The ore body lies in crystalline limestone, has a strike of about N. 80 degrees E., and seems to have a dip to the south of about 70 degrees. In width it reaches a maximum of 30 feet, and an average of about 10 feet, and has been traced for three-quarters of a mile. The graphite is disseminated in a gangue of calcite and pyroxene with small amounts of pyrite, barite and apatite. The ore will for some time be obtained from open-cut workings, and 10,000 tons has already been stockpiled. The deposit is promising, and may develop into an important shipper.

It is intended to haul the product to Narrow Locks on the Rideau Canal in the summer, a distance of two miles, and to Westport in the winter months.

The property is in charge of W. P. Alderson, and 48 men are employed. The mine post-office is Stanleyville, Ont.

Marble

Bancroft Quarries.—The Bancroft Marble Quarries, Limited, have leased the property of the Ontario Marble Quarries, Limited, whose quarries have been idle since 1915.

In August, 1918, repairs were begun on the plant, which is situated near Bronson siding, some three miles south of Bancroft in lots 29 and 30, concession X, Dungannon township. The mill was started in December, 1918. When last inspected, in February, 1919, marble was being excavated, sawed and polished for the Federal Parliament buildings, and from 20 to 25 men were employed.

The mill contains a Whitelaw boiler, a Whitelaw engine, four F. R. Patch Mfg. Company gang saws, a rubbing-bed and two polishing machines.

The officers are: president, Walter Page, Toronto; vice-president, John T. Hepburn, Toronto; secretary and manager, John T. Hoidge, Bancroft, Ont. The head office is at 34 Price Street, Toronto.

Other Quarries

Canada Cement Co., Plant No. 5.—Work was carried on in the limestone quarry of the Canada Cement Company Plant No. 5 at Point Anne, Ont., during all of 1918, and in the clay pit during part of the year.

When last inspected, April 17th, 1919, the clay pit was idle, but 20 men were employed in the quarry. A cut, 20 feet deep, was being made along one face preparatory to deepening the whole quarry.

H. L. Shock is superintendent, and E. W. Bailey assistant superintendent. The post-office address of this plant is Belleville, Ont.

Ontario Rock.—The quarry of the Ontario Rock Company, Limited, near Havelock, was operated from April 1st to December 15th, 1918, the output being considerably reduced owing to scarcity of labour and smaller demand. This trap-rock quarry has a face of 85 feet and is 450 feet in length. The drilling has been done in 16-ft. benches. In the latter part of the year a cyclone drill was started which will be used to drill holes the total depth of the face. The product shipped ranges in size from 1¼-inch to 2-inch; also a coarser grade from 2-inch to 5-inch. The greater part of the product is used for paving in Toronto. The shipments during 1918 amounted to 18,000 tons. Forty-five men were employed.

The officers of the company are: president, Alex. Longwell, Toronto; vice-president and general manager, Geo. W. Rayner, Toronto; superintendent, S. Bradley, Preneveau, Ont.

Point Anne.—Crushing was carried on at the plant of the Point Anne Quarries, Limited, Point Anne, during all of 1918 with the exception of one month. Most of the rock (limestone) was shipped to Hamilton and Toronto. Forty-eight men were employed.

The officers of the company are: president, M. J. Haney; secretary-treasurer, A. M. Harnwell; manager, J. F. M. Stewart; all of Toronto; superintendent, A. G. Bennett, Point Anne, Ont. The head office is in McKinnon Building, Toronto.

V.—SOUTHWESTERN ONTARIO

Gypsum

Ontario Gypsum Company, Limited.—This company is an amalgamation of the Crown Gypsum Company of Lythmore and the Alabastine Company of Caledonia. At Lythmore the grinding plant was not operated during the year, and the equipment at the mine 3½ miles distant was dismantled. A new shaft is being sunk near the grinding plant. This shaft is now down 42 feet. Sinking operations were greatly retarded by the large volume of water encountered.

At Caledonia both mine and mill were operated continuously during the year, the production being about 200 tons of crude ore daily from the mine.

Hardwall plaster, plaster of Paris, land plaster and bug finish are manufactured, and crushed gypsum rock is shipped to Portland cement companies.

The Ebsary Fireproofing and Gypsum Rock Company, whose plant adjoins that of the Ontario Gypsum Company at Caledonia, take about 15 tons a day of plaster of Paris. Another industry, which has located beside the plant of the Ontario Gypsum Company, is the Canada Plaster Board Company; they will take about 20 tons of plaster of Paris daily.

The Carson mine was operated during the winter months. Operations at the Caledonia mine were confined to the second or 70-ft. level. Production from the third level was discontinued.

W. C. Case, Buffalo, is president of the company; R. C. Haire, Paris, is secretary-treasurer. The head office is at Paris, Ont., and the works office at Caledonia. A. J. Parkhurst is general manager; about 80 men were employed on an average during the year.

Quarries

American Cyanamid Company.—In 1913 the American Cyanamid Company of Niagara Falls purchased 77 acres about a mile east of Ingersoll; approximately 50 acres of this is available for quarry purposes.

In 1918 development work was commenced on a 10-acre tract. A canal 2,000 feet long was dug, and the Thames river was diverted from the site of the proposed quarry. A dike is now being built to the elevation of the railroad.

A 300-k.w. transformer house will be built and electric power used on all equipment. A cyclone drill and air compressor have been purchased.

The company expects to be shipping rock in the early summer of 1919 to its plant at Niagara. Up to the present time material has been purchased from other quarries.

D. R. Thomas, of Ingersoll, is manager.

Beachville White Lime Company.—The quarry owned by this company is situated about six miles west of Woodstock. Operations were carried on continuously during 1918. Lime kilns were also operated and produced about three car-loads of white lime per week.

The quarry covers about three acres, the face varying from 30 to 40 feet in depth, and holes are drilled to this depth.

One steam hoist and two electrically driven hoists are used on the derricks. The electric power for the hoists and pump is supplied by the Hydro-Electric Power Commission.

About 80,000 tons of stone were supplied to blast furnaces for flux during the year.

About 1,500 feet of railway line to the adjoining property on the west was graded, and a small amount of development work done. This will be opened up during 1919 and worked in addition to the present quarry.

The officers of the company are: M. S. Schell, president; J. W. Blow, secretary-treasurer; C. E. Downing, manager; about 42 men were employed during the year.

Canada Cement Company, Limited.—The quarry and mill at Port Colborne were shut down on January 15th, 1918, owing to the demand for power from the munition plants. Advantage was taken of the shut-down to make thorough repairs throughout the mill.

S. R. Prescott is manager, and L. M. McDonald superintendent.

Canada Crushed Stone.—The Canada Crushed Stone Corporation, Dundas, worked throughout the year supplying flux to the blast furnaces at Hamilton; also building and road material. The production during 1918 was about 300,000 tons, two-thirds of which was supplied to the road and building trades.

Electric power, supplied by the Cataract Power Company, is used throughout the plant and quarry. The total capacity of the motors connected is 1,000 horsepower. About 60 men are employed.

The officers of the company are: C. M. Doolittle, president and general manager; J. B. Hart, secretary-treasurer and assistant manager.

Christie-Henderson Quarry.—The Christie-Henderson quarry, about five miles west of Milton, operated two kilns during the year, producing about 10 tons of lime per day. The part of the quarry now being worked is 400 feet long and has a face of 65 feet.

D. D. Christie is president, and Neil Martin manager at Kelso; 14 men were employed during the year.

Constructing and Paving Company.—This company is operating about two miles from the village of Erin. The pit has a face of 14 feet. The material is hauled by cable to an elevator on the surface and hoisted to screens, where it is separated into grades for loading into cars. The products are: sand, pea gravel, ½-inch and 2-inch stone. The capacity of the plant is 200 tons per day.

Elora White Lime Company.—The Elora White Lime Company worked throughout the year 1918. The quarry is 70 feet long, 70 feet wide, and has a face of 22 feet. The stone is hauled up an incline to the plant. The greater part of the production is hydrated lime, but lump and agricultural lime is also shipped. A cyclone well-drill is used for drilling. Twenty men are employed.

The officers of the company are: president, M. B. Church; secretary-treasurer and general manager, P. E. Hare; superintendent, T. F. Robinson, Elora.

Hambleton.—The Hambleton quarry, near the village of Hagersville, was operated for two weeks only in 1918, owing to scarcity of labour and cars for shipping.

The company is preparing to enlarge the crushing plant and to add another crusher in 1919. Electric power will be used instead of steam.

The production is used almost entirely for road-building.

The quarry is owned and operated by Robert Hambleton, Hagersville.

E. Harvey and Son.—The quarry owned by this firm, at Rockwood, near Guelph, operated for nine months during 1918. Only one of the three kilns was in operation, as demand was limited. The quarry now covers about 2 acres and has a face of 30 feet. An electrically driven compressor was installed. The stone is hauled in carts to the kiln, which produces about 20 tons per day. An average of 10 men was employed.

The quarry is operated by the owners, E. Harvey and Son.

Longford Quarry.—The Midland Iron and Steel Company operates a quarry on lots 26 and 27 in range one of the township of Rama, near Longford, for limestone. The product is used as a flux at the blast furnace at Midland. The work is being done by contract by Thos. Morgan, who employs about 20 men. The equipment comprises steam drills, crane and hoist.

Maple Sand, Gravel and Brick Company.—This company, at the village of Maple on the Grand Trunk railway, operated from April 1st, 1918, to the end of the year.

The pit is about 200 feet long and has a face of 115 feet. About 90 per cent. of the sand is hoisted by a 15-ton locomotive crane with a $1\frac{1}{2}$ yard bucket to a screen which separates the sand and the gravel; the remaining 10 per cent. is loaded directly into the cars. About 30 per cent. of the product is gravel. Only a small amount of culvert tile was manufactured during the year, as a large stock of drain tile and cement bricks had been carried over from the previous year. The greater part of the sand and gravel is shipped to Toronto for concrete work. Five men were employed.

T. Cousins is president and general manager; George C. Lovies, 78 Spadina Avenue, secretary-treasurer.

Michigan Central Quarry.—This quarry, near the village of Hagersville, is owned and operated by the Michigan Central Railway. It was operated during 1918 up to November 2nd, and the output was used by the company on its railway lines in Canada.

The quarry now covers an area of about 16 acres, has a face of 16 feet and is about 600 yards long. The holes are drilled the full depth of the face, and the rock is trammed by horses to the foot of the incline and elevated by hoist to the crushers, where it is crushed to 1-inch and $3\frac{1}{4}$ -inch by two crushers, a No. 5 and a No. $7\frac{1}{2}$ Austin gyratory. Power is furnished by steam boilers, two of which are 75-h.p. each, and one is 80-h.p. The screenings are sold to the municipalities for road-building, and about 500 yards of crushed stone was also sold for the same purpose.

D. E. Cronin is superintendent, employing about 40 men.

National Potash.—The National Potash Corporation, Limited, has an authorized capitalization of 1,500,000 shares of a par value of \$1.00. The directors are: E. L. Wetflafer, Toronto, president; G. W. Morris, Buffalo, vice-president; W. S. Milne, Toronto, secretary-treasurer; J. L. McPherson, Islington; A. B. Crosby, Toronto; W. L. Wetflafer, Toronto, general manager. The head office is at 178 Spadina Avenue, Toronto. The reduction works and quarry are at Gravenhurst (Muskoka Wharf).

The quarry is operated for crushed rock for road material, the feldspar being sorted out for treatment in the reduction works. Work in the quarry, which was operated most of the year, is being done under contract by R. Theodore.

At the reduction works a 200-ton blast furnace, 192 by 42 in., and the necessary blowers were installed during the summer of 1918, and in October the furnace was put in operation. Results were not satisfactory, and it was decided to replace the blast furnace by an electric one.

Three acid towers, 40 feet high and built of concrete, have been completed, as well as the necessary concrete vats and evaporating pans.

Patterson Sand and Gravel Company.—The sand and gravel pit at Stamford operated during the year, although during the winter months the output was greatly decreased.

The pit is 200 yards wide and 2,100 feet long, and has a face of 66 feet.

The material consists of moulding sand, gravel and sand for building purposes. It is loaded directly into the cars by a 12-ton derrick and a clam-shell driven by a 40-h.p. electric motor.

Robt. Patterson, of Stamford, is manager, employing an average of 8 men.

Queenston.—The quarry was worked during the entire year, although the demand for building stone was considerably below that of the previous years. It is 500 feet long, with 30-foot face. A layer of about 15 feet of grey rock is taken off for road-building and concrete. The material is crushed and carried to the chute by a 16-inch conveyor belt, where it is loaded in Michigan Central cars. A quarry a short distance from the main one is also worked. The capacity of the crushing plant is 250 tons per day.

Two derricks are used continuously and two others at intervals. An average of 20 men was employed during the year.

Chas. Lowery is president and manager, and T. W. McKeown secretary.

D. S. Robertson Company.—On the property near Milton owned by this company one kiln was operated with a capacity of 20 tons of lime per day. The quarry is 120 ft. by 30 ft., has a 60-ft. face and is worked in eight benches.

The officers of the company are: D. Robertson, president; J. S. Robertson, secretary. Fifteen men were employed.

Roesand.—The Roesand Company, at Erin, operated from June 17th to December 10th, 1918, employing about 7 men. The company owns a property of 33 acres of sand and gravel. The material is loaded into cars of 9 cu. ft. capacity and is hauled up an incline to the crusher. All material passes through the crusher, as a small percentage of the rock is oversize. It is then elevated to the screens and separated into three grades: sand, 1-inch, and 2-inch. The product is loaded into cars from the bins, or passes to an elevated belt conveyor and is carried to the stock piles. The face of the pit is 500 feet long, and the plant has a capacity of 500 tons per day.

The officers of the company are: H. N. Kittson, president and secretary-treasurer, Hamilton; W. S. Connolly, vice-president, Hamilton; W. J. Dickson, superintendent.

St. Marys Cement, Limited.—The St. Marys quarry was operated throughout the year 1918 and produced about 80,000 tons of rock for the cement plant. This was about 65 per cent. of the normal output, the amount of power being restricted.

The quarry covers about four acres at present, with a face of 36 feet. The holes are drilled 5 inches in diameter and 38 feet deep, from 100 to 150 lbs. of dynamite being used for each hole. About 20 holes are blasted at each shot, which is sufficient to supply the mill for one month. The tramming is done with horses and cars, and the rock is hoisted by three 10-ton hoists to the crusher and carried to the mill on a belt conveyor. The floor of the quarry has an even surface, and tracks are not required for the cars.

A new concrete building, 26 by 70 ft. and 84 ft. high, has been completed and is to be used as a crushing plant.

The rock will be loaded in cars with a steam shovel and hauled to the foot of an incline by two 6-ton Plymouth gasoline locomotives, then taken up the incline by a hoist driven by a 40-h.p. motor, and dumped into the crusher. The latter is a 48 by 60 Traylor jaw crusher with a capacity of 500 tons per hour, driven by a 200-h.p. motor, and crushes to 6 inches. The product from the crusher passes through a No. 7 Mammoth Williams Hammer mill and is carried to the storage bins on a 36-inch belt conveyor.

About 30 men were employed in the quarry during the year.

The officers of the company are: Geo. H. Gooderham, president; Mark Irish, secretary; J. G. Lind, manager.

Standard White Lime Company.—This company, with headquarters at Guelph, operates quarries at Beachville, St. Marys and Guelph. The largest plant is located at Beachville, where the company has two quarries. The main quarry is about 700 feet long and 70 feet wide, with a face of 21 to 30 feet, from which shipments are made to the blast furnaces at Hamilton and the American Cyanamid Company at Niagara Falls. The rock from the other quarry at Beachville is used in making white lime in the kiln, which has a capacity of 50 tons per day. A new bridge was built across the Thames river in 1918 over which the cars are hauled to the kiln. At this plant 55 men are employed.

The works at Guelph have three kilns, only two of which were operated during 1918, with a daily capacity of 10 tons each. At this plant hydrated lime is produced; lump lime is also shipped. Ten men are employed.

At St. Marys one kiln was operated for eight months. The quarry has a face of 21 feet and drilling is done by hand. The rock is hauled to the kiln in carts. Eight men are employed.

The production of the company for the year was as follows:

Beachville:

Lump lime	7,588 tons.
Stone	70,314 "

Guelph:

Hydrated lime	1,397 tons.
Lump lime	1,095 "

St. Marys:

Lump lime	12,078 tons.
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D. D. Christie is president; J. Kennedy, Guelph, manager.

The Toronto Lime Company.—One kiln, situated at Dolly Varden, near Georgetown, was operated by this company during 1918. The quarry has a face of 28 feet. The company has four kilns.

The plant at Limehouse was shut down during the year.

The officers of the company are: F. S. Brown, president; W. L. Scott, secretary-treasurer; W. Gowdy, Limehouse, superintendent; the head office is at 26 Queen St. East, Toronto. About nine men were employed.

Toronto Plaster Company.—This company operated at Teeswater for eight months during 1918.

The quarry has a face of 35 feet and is 40 feet wide. The rock is hauled on an incline to the kilns, and, after being burned, is carried by a belt conveyor to the de-hydrating plant. The production during 1918 was 77,114 bushels of hydrated lime, the only form in which the product is shipped.

Power is supplied to the main engine and drills by two steam boilers with a total capacity of 210 horsepower. Thirteen men were employed.

The officers of the company are: president, John Kennedy, Guelph; vice-president, H. W. Calkins, Toronto; secretary-treasurer, D. E. Kennedy, Teeswater.

Wentworth Quarry Company.—The Wentworth Quarry Company, at Vinemount, near Hamilton, operated their limestone quarry continuously during the year, but the crushing plant was running for about nine months only.

The quarry covers an area of 8 acres, and has a face of 16 feet. Drilling is done by one cyclone drill driven by a gasoline engine. The rock is loaded by two steam shovels into 4-ton cars and hauled up an incline to the crushers. A gas-producing plant supplies the power to two crushers and a set of rolls. The rock is crushed to sizes from $\frac{1}{4}$ -inch to 3-inch, and is used for building and road material.

About one-half of the production is used in Toronto for building purposes. Sand is also supplied from the rolls for the manufacture of fertilizer.

The plant has a capacity of about 45 tons per day.

The officers of the company are: William Martin, president; James Thompson, secretary. S. Schwendiman, of Vinemount, is manager, employing an average of 18 men.

Brickyards

Don Valley Brick Works.—The plant of the Don Valley Brick Works in Toronto was operated at reduced capacity during the year 1918.

The material is taken from three pits, the lowest one being in Hudson shale with a face of 70 feet. This is worked in benches of 8 feet and hauled to the surface by an inclined tram.

The second pit has a face of 65 feet, and the clay is loaded into cars by a steam shovel and trammed to a pulverizer by horses. The level of this pit is slightly above the presses.

The third pit has a face of 35 feet; the clay is loaded into cars by a steam shovel and trammed to the gravity incline and lowered by hoist. The second and third pits are in Erie clay.

During 1918 pressed brick, stiff and mud brick and hollow ware were manufactured.

The plant is operated by the Executors of the Robert Davies Estate. John Bowman is general manager, and William Burgess superintendent: an average of 85 men were employed.

Interprovincial Brick Company.—The plant of this company, situated one mile south of Cheltenham, was working continuously during the year 1918. The production was 20,000 bricks a day, which is only one-half the capacity of the five kilns.

The quarry is 450 feet long and has a face of 25 feet, from which the clay is hauled to the crushers on an incline by an electric hoist. Red, buff and fire-flash brick are manufactured.

Plans have been drawn for a large extension to the plant, only part of which may be built in 1919.

The officers of the company are: A. O. Dawson, Montreal, president; E. G. Glenn, Toronto, secretary; F. B. McFarren, manager; K. Stillwaugh, superintendent. About 20 men were employed.

John Price, Limited.—The plant of the John Price brick works on Greenwood Avenue operated throughout the year, producing six and a half million bricks.

George Price is manager, employing 42 men.

Milton Pressed Brick Company.—The Milton Pressed Brick Company manufactured brick throughout the year at the plants situated about two miles west of Milton. No. 1 plant has a total capacity of 180,000 bricks per day, but did not require to work to full capacity to supply the demand. Red and buff brick and rough texture of all colours are manufactured.

No. 2 plant, situated about half a mile farther west, was also operated during the year. Its capacity is 20,000 bricks per day. Both quarries have a face of 60 feet of Medina shale.

The officers of the company are: J. S. McCannell, Toronto, president; A. W. Holmsted, Toronto, secretary.

C. E. Hill is manager, employing an average of 130 men.

Standard Brick.—The plant of the Standard Brick Company on Greenwood Avenue worked from May 8th to October 8th, 1918, producing 2,300,000 red bricks; about 25 men were employed.

G. J. Steel is president, and Charles Bulley is secretary-treasurer and manager.

Sun Brick.—The plant of the Sun Brick Company was operated continuously during 1918, partition and building tile and about 200 tons of chimney blocks being manufactured. The daily production of tile averaged 20 tons. The pit has a face of about 45 feet, and hoisting is done by steam derrick. Forty men are employed.

The officers of the company are: president, Henry M. Pellatt; secretary-treasurer, G. A. German; sales office is at 32 Toronto St., Toronto.

A. H. Wagstaff.—The plant of A. H. Wagstaff, brick manufacturer, was in operation for five months during the summer of 1918, the daily production being 19,000 bricks.

A. H. Wagstaff is manager, employing 25 men.

York Sandstone Brick.—The plant of the York Sandstone Brick Company, Toronto, was in operation from May 4th to December 20th, 1918, manufacturing 3,180,000 sand and lime bricks. The pit has a face of 25 feet, and the sand is carried to the press by a 15-inch belt conveyor driven by a 15-h.p. electric motor. Fifteen men are employed.

Alexander McCurdy is president, and Thomas J. Smyth secretary-treasurer and general manager.

York Sand and Gravel.—The York Sand and Gravel Company of Toronto operated from April 3rd to the end of the year 1918. The material is loaded in cars by a clam-shell bucket operated by steam, and hauled by a locomotive to the screens. The product from the screens drops into the railway cars on the siding. The face of the quarry is 30 feet. Nine men are employed.

Emma Ryan is president, and Frank Ryan secretary-treasurer and general manager.

VI.—SMELTING AND REFINING WORKS

Blast Furnaces

Algoma Steel Corporation.—At the plant of the Algoma Steel Corporation, at Steelton, there are now four blast furnaces: Nos. 1, 2, 3 and 4, of 300, 300, 500 and 400 tons capacity respectively. No. 1 furnace ran during all of 1918; since November it has been making spiegel at the rate of 110 tons a day. No. 2 furnace was in blast except from May 6th to June 23rd, 1918. No. 3 furnace was idle until October 22nd and was blown out on January 20th, 1919. No. 4 was originally a 275-ton furnace in use at the Midland smelter. It was moved to Steelton, enlarged to 400 tons capacity, and blown in March, 1918. During the greater part of the year the furnaces ran on basic pig, but some foundry pig and spiegel were also made.

Two Daniel Adamson steam turbines, with a blowing capacity of 20,000 cubic feet each, have been added.

The Greenawalt sintering plant has been moved to a point west of the blast furnaces. It contains three pans 7 ft. by 12 ft. Each pan is connected to a Greenawalt exhaust fan driven by a 75-h.p. motor. During 1918 blast-furnace flue dust was sintered, the capacity of the plant being from 130 to 140 tons of product per day. Twenty men are employed.

A calcining plant has been in operation since August, 1916, for the burning of limestone and dolomite. The calciner is a 125-foot steel rotary kiln, 7 ft. in diameter at the upper end, and 7 ft. 6 in. at the lower. The firing is done by means of coke-oven gas. Dolomite is obtained from the Ozark quarry near Trout Lake station, Michigan, and when calcined is used for lining the bottoms of the reverberatory furnaces.

In August, 1918, the manufacture of various shapes of silica brick was begun. Quartzite from the McPhail and Wright quarry, at Bellevue, Ont., is used. Two coal-fired kilns have been built with a capacity of about 85,000 bricks each.

The officers of the company are: president, W. C. Franz; vice-president and general manager, David Kyle; vice president and comptroller, James Hawson; secretary, A. Taylor; treasurer, E. W. Shell; directors: W. C. Franz, J. Frater Taylor, R. Home Smith, Herbert Coppel, Joseph S. Dale, Frederick McOwen, A. Taylor, James Hawson, David Kyle, H. I. Underhill, W. Cunningham, Sidney Mason, H. C. Coleman, W. K. Whigham; smelter superintendent, J. H. Bell; metallurgical engineer, John M. Knote; superintendent, Greenawalt plant, V. H. Taylor; superintendent, silica-brick plant, C. W. Desing.

Canadian Furnace Company.—The blast furnace at Port Colborne operated at full capacity during the year, with the exception of a few days' interruption in the early part of the year due to a shortage of coke.

The two large ore bridges were rebuilt during the year, but no additions were made to the plant. The adjoining property, which belonged to the Cronmiller and White Brewery Company, was purchased, which will give an additional 1,000 feet of frontage on the lake.

Plans have been made for erecting a building 40 feet by 30 feet for the convenience of the employees. It will contain shower baths, lockers, washrooms and a rest-room.

The production for the year was 98,154 tons of pig iron: 150 men were employed.

The officials of the company are: Frank B. Baird, president; Harry Yates, 1st vice-president and treasurer; C. A. Collins, 2nd vice-president; F. C. Slee, secretary; B. Marron, manager; F. E. Deschenes, superintendent; H. J. Higgins, mechanical superintendent. The head office of the company is at 51 Hamburg St., Buffalo, N.Y.; the works office at Port Colborne.

Midland Iron and Steel Company, Limited.—This company in 1918 took over the works of the Canada Iron Corporation at Midland, and began the production of pig iron October 10th, 1918.

The company is capitalized at \$1,000,000, divided into 10,000 shares of a par value of \$100. The officials of the company are: James Playfair, president and general manager; D. S. Pratt, treasurer; M. E. Tully, secretary; E. Heist, superintendent of works. The directors are: Jas. A. Paralgy, Cleveland; E. L. White, Midland; V. J. Hughes, Montreal; C. K. Quinn, Duluth. The head office is at Midland.

The 275-ton blast furnace was sold by the old company to the Algoma Steel Corporation at Sault Ste. Marie. The 90-ton furnace was rebuilt by the new company, and now has a capacity of 135 to 150 tons of pig iron per day.

The iron ore and coke and part of the limestone are imported from the United States. Some limestone is obtained from the Company's quarry near Longford. An average of 140 men are employed.

Parry Sound Iron Company.—The Parry Sound Iron Company, Limited, was incorporated in July, 1918, with a capitalization of 20,000 shares of a par value of \$100 each. Colonel J. A. Currie, of Toronto, is president of the company. This Company has taken over the plant of the Standard Iron Company at Parry Sound, and is operating the iron blast furnace at this place. The furnace has a capacity of 125 tons of pig iron per 24 hours and was blown in on January 22nd, 1919.

Iron ore is imported from the American side, though an effort may be made to use some of the bog iron ores of the district. Limestone for flux is obtained from the Ontario Stone Corporation at Uthoff, near Coldwater Junction.

W. I. MacTavish is assistant superintendent, employing about 80 men. The first operations were confined to the production of foundry pig.

Standard.—The Standard Iron Company, Limited, worked the Deseronto blast furnace in 1918, making coke pig-iron. Charcoal pig was formerly made at

this furnace, but in 1918 charcoal was not available. About equal quantities of Moose Mountain and Mesabi ores were used. Seventy men were employed.

The officers of the company are: president, R. J. Mercer, Montreal; secretary-treasurer, S. F. Belknap, Montreal; superintendent, O. O. Laudig, Deseronto; assistant superintendent, J. J. Dunn, Deseronto. The head office is 318-321 Coristine Building, Montreal.

Steel Company of Canada.—The blast furnaces at Hamilton operated continuously throughout the year. Two furnaces of 200 and 250 tons per day capacity supply foundry iron to the market in addition to supplying the steel mills.

Since the heavy demand for war material has ceased, plans have been prepared for relining the larger furnace in 1919.

The officers of the company are: Robert I. Hobson, president; R. G. Wells, general superintendent; Chas. Grimes is superintendent of the blast furnace department, employing an average of 190 men.

Tivani.—The Tivani Electric Steel Company, Limited, made a low-phosphorus, high-carbon pig from steel turnings at Belleville. Work was discontinued in January, 1919. Sixteen men were employed.

The officers of the company are: president, J. W. Evans, Belleville; vice-president, R. F. Ketcheson, Belleville; manager, Jas. Wallace, Oakville.

In March, 1919, W. M. Goodwin and G. Cadenhead, of Kingston, rented the plant and proceeded to carry on some experiments on titaniferous magnetites to save the vanadium content and produce a vanadium steel. Ten men are now employed.

Refineries

Coniagas Reduction Company.—The refinery at Thorold was operated during the year on the reduction of the silver ores from the Cobalt mines. The products and manner of treatment were the same as in the previous year. Considerable experimenting was done with the Cottrell installation to increase the production of arsenic from the smelter fumes. There is now a total transformer installation of 450-k.w. on the motor load and 180-k.w. on the electric furnace.

The officers of the company are: R. W. Leonard, president and general manager; R. L. Peek, superintendent; J. J. Mackan, secretary; 162 men are employed. The head office is at St. Catharines.

Deloro Smelting and Refining Company, Limited.—The smelting and refining works of this company at Deloro, Hastings county, operated to full capacity during 1918, treating about 450 tons of ore and concentrates per month.

The production of stellite was increased to meet the demand of the munition factories, the monthly production being about 21,000 lbs.

A one-storey building, 50 by 150 feet, was constructed for the extension of the metals department. Plans have been completed for the manufacturing of "festelite" to be supplied to the Canadian and European markets for the manufacture of cutlery.

The officers of the company are: M. J. O'Brien, president; Thomas Southworth, vice-president and managing director; S. B. Wright, general manager;

S. F. Kirkpatrick, consulting metallurgist; F. A. Bapty, secretary-treasurer.

Two hundred and fifty men were employed during the year.

Metals Chemical, Limited.—The refinery at Welland was operated during the year on residues from the Cobalt mines, the greater part of which were purchased from the Nipissing Mining Company. Such residues had been shipped to Germany previous to the war, but after active research at this plant means were devised to recover a full series of nickel and cobalt products. The works are now making nickel oxide, nickel sulphate, nickel carbonate, nickel ammonia sulphate, nickel nitrate, metallic nickel, cobalt oxides (black and grey), cobalt hydroxide, cobalt sulphate, cobalt carbonate, cobalt acetate, cobalt arsenate, bar silver and metallic cobalt. They also manufacture an arsenic compound which is used as a weed killer, and is purchased largely by the railway companies of Western Canada.

During the year a new Wedge furnace was installed, with a capacity of 45 tons of ore per day.

J. S. Gillies is president, and J. H. Charles secretary-treasurer and general manager: 130 men are employed.

Nickel Refining Plant

One of the most important developments in the home refining of metal-bearing ores, and one for which there had been a long-continued and insistent popular demand, was the establishment of a plant for producing nickel and copper from the Sudbury mattes. In July, 1918, the International Nickel Company of Canada Limited, completed a magnificent refinery of this kind at Port Colborne, on the northern shore of lake Erie, of which a good description has been published¹ by W. L. Wotherspoon, consulting engineer of the above company. It is herewith reproduced.

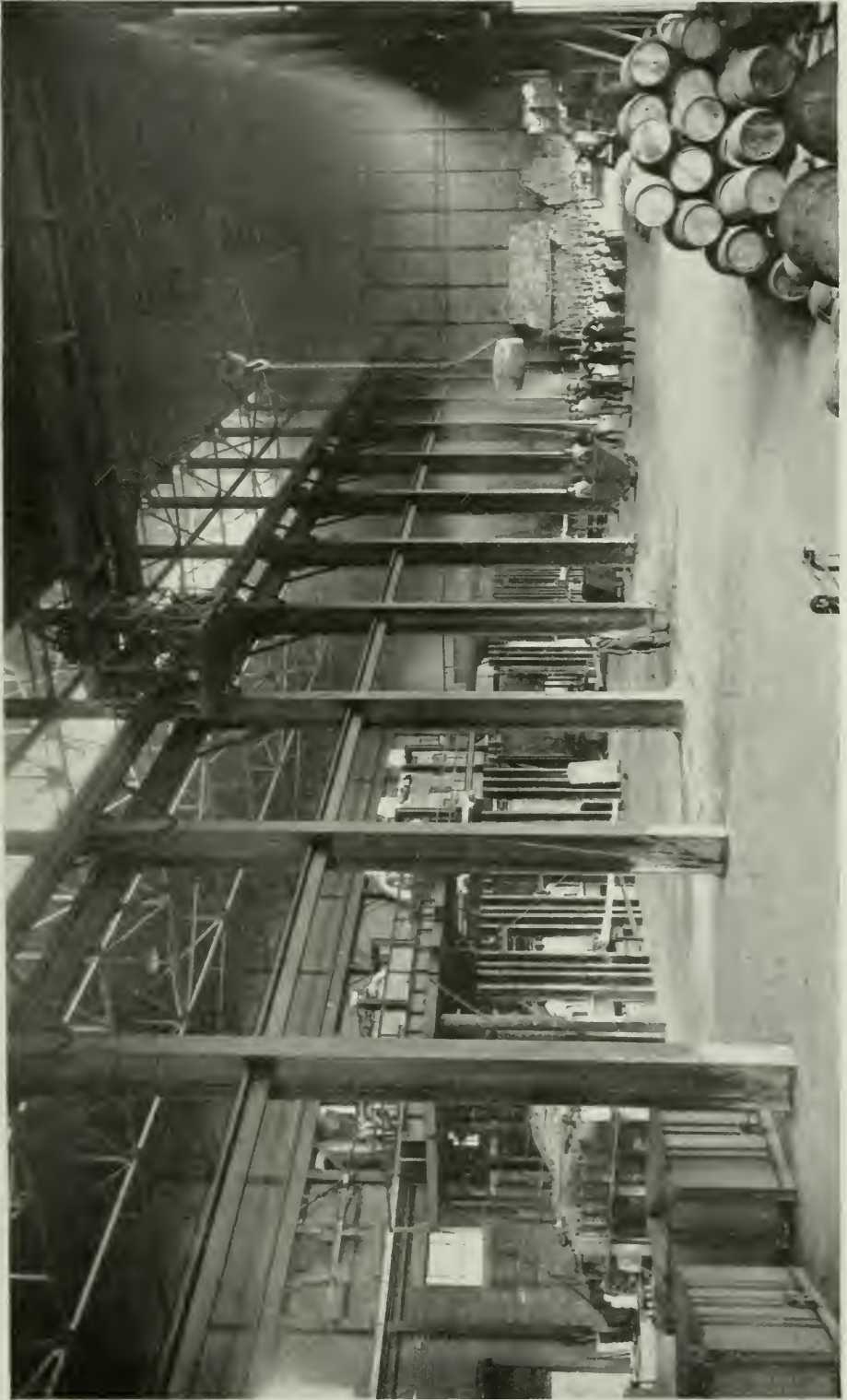
The increased demand for nickel products caused the International Nickel Co. to decide, late in 1916, to proceed with the construction of a refining plant in Canada, of sufficient capacity to meet the nickel requirements of the British Empire. An extensive examination of numerous sites was conducted, and it was decided to erect the refining works at Port Colborne, Ontario. Port Colborne is situated on the shore of Lake Erie and is about 20 miles due west from Buffalo. The Welland canal, connecting Lake Erie with Lake Ontario, passes through the town.

The works site consists of 330 acres and has a frontage on Lake Erie of about a mile. This frontage immediately adjoins that of the Canadian Furnace Co., and is somewhat to the eastward of the entrance to the canal. In addition to the acreage mentioned, the company acquired extensive water rights on the lake front and convenient to the canal basin, where there is a deep-water frontage, to meet the requirements of lake transportation. Railroad facilities are provided by the Grand Trunk Ry, a branch line of which passes the north boundary of the refinery site.

The site is almost level, and about 8 ft. above the lake, except along the shore, where sand dunes about 300 ft. wide and 30 ft. high have been formed by wind. The ground consists of 1 to 2½ ft. of peat, on top of 1 to 10 ft. of blue clay, which lies directly on a limestone bedrock, which provides excellent foundations.

There are, in all, 31 buildings of steel-and-brick construction, plans for which were begun in October, 1916. The land was so near the high-water elevation of the lake that the area to be occupied by the buildings and streets was raised about 3 ft., sand being obtained from the dunes by steam shovels and spread over the site, this work following the clearing of trees and brush and the removal of peat. Foundations of all buildings and equipment were carried down to bedrock, and were built, to a great extent, in winter under severe climatic conditions, when the temperature was frequently 10 degrees or more below zero.

¹Eng. and Min. Jour., N.Y., March 8, 1919.



International Nickel Company of Canada, Port Colborne—Nickel room interior.

The plant was designed with a view to securing maximum efficiency, by the introduction of mechanical and metallurgical apparatus, and was arranged to reduce the labour required for operation to a minimum. All equipment is of permanent character, so that charges for maintenance will be as small as possible. The buildings are of steel frame and brick walls. The roofs are of special wood construction, and are covered with Johns-Manville salamander roofing.

The design of the works provided for a complete power plant, a water-supply system, a separate sewerage scheme for storm water and sundry drainage, an electric-conduit distribution system for power and lighting, as well as piping systems for steam, oil and compressed air. All piping and cables are carried underground so that there are no obstructions between the buildings.

The various units of the plant are served by both standard-gauge and narrow-gauge railroad tracks for facilitating the unloading and handling of materials.

The water supply is obtained through a 4-ft. square concrete conduit, over 3,000 ft. long, extending from the Welland canal to the centre of the plant, under the power house. This conduit was built in a trench blasted out of the solid rock, so that a gravity supply of water, up to 50,000,000 gal. per day, can be obtained. This system made it possible to place all pumps in connection with the water supply in the basement of the power house, giving important advantages of control.

The area of the works site between buildings has been graded so as to provide adequate means for the disposal of storm water. A series of sewers, connecting with large trench ditches excavated through the property, has been arranged, the water finally discharging through a concrete culvert which passes through the sand dunes into Lake Erie. The sanitary pipe service flow is at such a low level that an ejector-chamber pumping station is provided, from which sewage is discharged to a disposal plant situated in the sand dunes. This plant is constructed on the activated sludge process, which provides for the aëration and clarification of sewage, resulting in an effluent free from objectionable matter. This sewage plant is the only one of its kind in the district, and was installed on the recommendation of the Provincial Board of Health of Ontario.

Several change houses have been provided, supplied with modern lockers, shower baths, and other improvements. A hospital, in a detached building, has an examination room for the reception of patients, for the administration of first aid, and a completely equipped operating room with sterilizers and other modern appliances. Particular attention was paid to this department, the nearest hospital being at Welland, six miles away.

The question of comfort and health of the employees has been given every consideration. A staff house is provided for the employees and a clubhouse for the accommodation of the unmarried men and executive heads. The clubhouse contains both residential and recreation facilities, and both buildings are situated at the entrance to the works, amid the pleasant surroundings of well-laid-out lawns, flower beds and shrubs. The chief officials have houses of attractive design which were built by the company, to the west of the canal in the main residential district of Port Colborne.

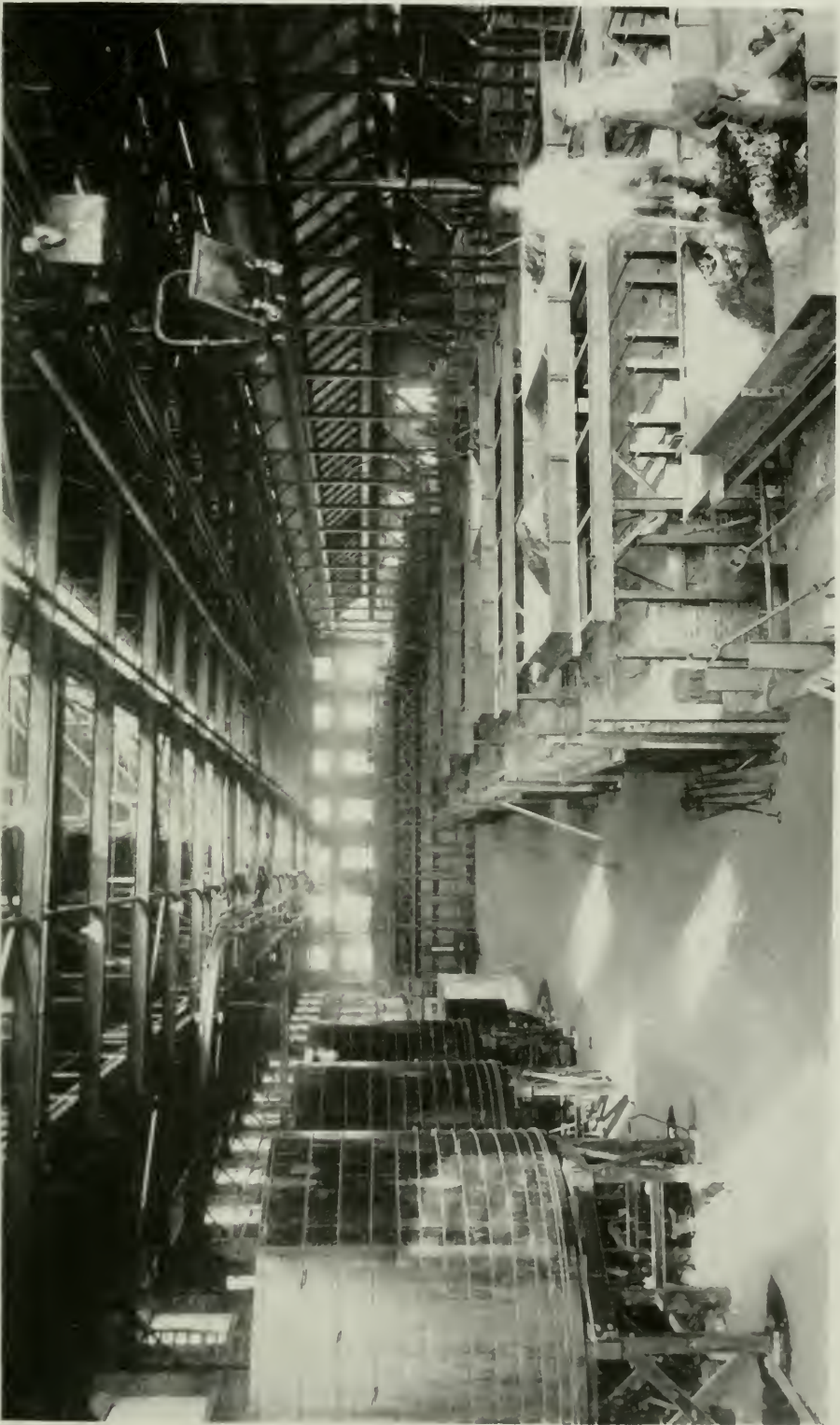
The largest process building is 746 ft. long and 125 ft. wide, divided into two bays, and containing the major portion of the heavy machinery and metallurgical equipment, among which are three cupolas, three reverberatory furnaces, two slag furnaces, and three converters. Here the matte received from the smeltery at Copper Cliff undergoes initial treatment. The method of handling the raw materials is of interest. Matte, coke, and fluxes are brought in on an elevated trestle of reinforced concrete. This trestle connects with bins of similar construction at the back of the process building, and is of sufficient strength to take standard railroad equipment. The materials are dumped from the cars into the various bins, from which they are drawn at the main floor, where arrangements are made for making up and weighing the furnace charges.

The matte, which consists of 55 per cent. nickel and 24 per cent. copper, is smelted with salt cake, the nickel separated and the copper bessemerized in 84 by 126-in. Allis-Chalmers converters. Electric tilting gear is used, and the converters are controlled from a pulpit conveniently situated across the aisle. One 50-ton, one 35-ton, two 20-ton, and two 5-ton cranes are installed in this building, all of which were manufactured by the Dominion Bridge Co., of Montreal.

Among other machinery of special interest are three electrically driven direct-connected turbo-blowers of 7,500-cu.ft. capacity and 20-oz. pressure. These are used for cupola service and were furnished by the Rateau-Battu-Smoot Co. of New York, and are situated in an annex to the main building where good light, accessibility and cleanliness are easily obtained.

Flues for the various furnaces are arranged to insure minimum heat losses and obstruction in the building, and are jointly connected to a concrete chimney 350 ft. high and 12 ft. at its smallest diameter. One of the most modern Cottrell electrostatic precipitation plants for the treatment of flue gases is provided, consisting of seven treaters, conveniently placed in relation to the main flue so that any portion or all the gases can be subjected to the process, or discharged directly to the base of the chimney.

Among other process buildings are those devoted to leaching and roasting, the former



International Nickel Company of Canada, Port Colborne—Men shovelling in nickel room.

part of the process being carried out in a structure 420 ft. long by 90 ft. wide. The roof trusses span the entire width of this building, so that the whole area is free from columns.

Ball mills are used for reducing the nickel sulphide previous to its being chemically treated in concrete tanks, which occupy the major portion of the area of this department. These reinforced-concrete tanks are elevated about 3 ft. from the floor, and, on account of the nature of the product handled in them, were cast at one pouring. The supports, post girders, and sides of the tanks are made in one monolith, without construction joints, for the length of 150 feet.

Special attention was paid to lighting and ventilation in this department, and the handling of materials is carried out mechanically by means of an overhead trolley system arranged to reach all parts of the building, together with electrically driven distributing machines for charging the tanks. To facilitate the handling of the product between the leaching and roasting departments, these are connected by three overhead bridges, the overhead trolley system being arranged for service in both departments. Weighing sections are provided at these overhead bridges to facilitate the quick and accurate determination of the quantities of the products handled.

The building in which the roasting furnaces are installed is 380 ft. long, 110 ft. wide, and has one clear span of 90 ft. in which the 10 mechanical and hand-calcing furnaces were installed. Extending the entire length of the building is a space of 20 ft. used for a reinforced-concrete overhead coal bunker. The coal is received on standard railroad cars and dumped in a hopper below the track outside the building, from which it is fed, by a reciprocating gate feeder, to a coal crusher. After being reduced in size, it is hoisted with a bucket elevator and discharged to a belt conveyor extending the entire length of the coal bunker. A travelling tripper is provided to unload the belt at any desired point.

The flues from the roasting furnaces are carried below the floor level and connected with a large dust chamber of the wire-hung type. This dust chamber is 300 ft. long by 60 ft. wide and is divided, lengthwise, by a centre wall, to form two large flues, each of which is nearly 30 ft. wide and 24 ft. high. The bottoms of the flues are of concrete, and the top is of brick arch construction sprung between steel crossbeams. Crosswalls, 8 ft. high, are provided every 32 ft. of the length of the dust chamber, thus making a series of pockets.

The entire area of the dust chamber is hung with wires placed on $4\frac{1}{2}$ -in. centres, 500 miles of wire being used for this purpose. The wires are suspended on special frames, which are, in turn, connected with an operating device outside the chamber, conveniently arranged so that the dust caught can be periodically precipitated. The dust collects in the pockets previously described, access to which is provided by steel doors which permit the use of small cars for handling the product. The flue gases, after passing through the dust chamber, are discharged into the base of a concrete chimney of the same size and construction as that already described in connection with the main process building. It may be added that these concrete chimneys were built by the General Concrete Construction Co., and, although heavily reinforced, are designed as gravity chimneys for a wind velocity of 100 miles per hour. They are lined throughout with fire brick and have terracotta caps; the design of the base called for extra heavy construction, owing to the large number and area of the flue entrances.

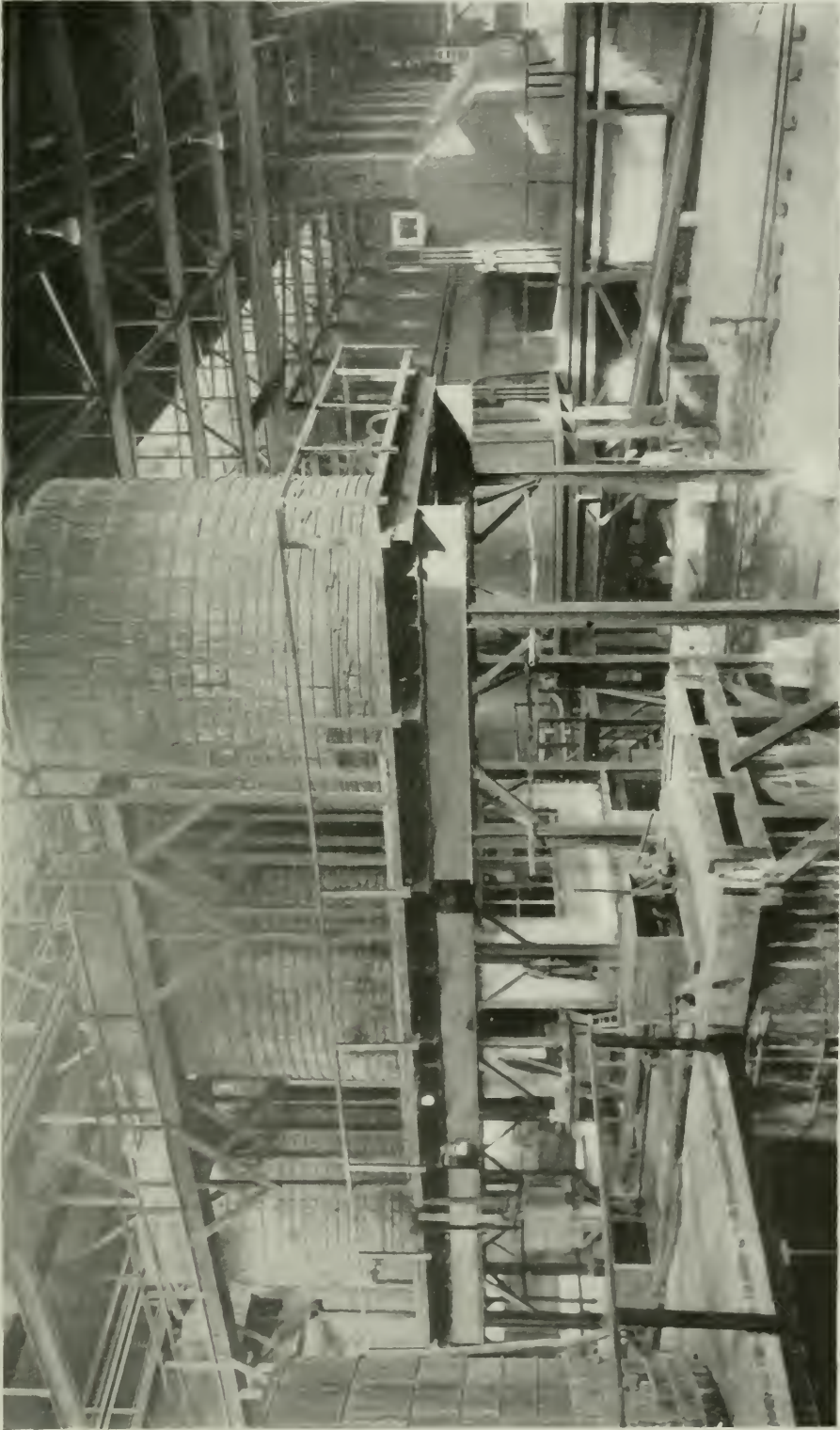
The nickel-refinery department received particular study in connection with the working out of the details of equipment and the arrangement of the installation. One part of the building is used for the storage of chemicals and other products, and contains an elaborate system of bins, and measuring and weighing devices, for the preparation of furnace charges to go to the nickel-refining furnaces, which are in the main portion of the building. These furnaces are of special design, owing to the high temperatures which exist under the operating conditions desirable. They are equipped with oil burners, and a special grade of fuel oil is used.

The power plant shows evidence of careful planning, and the design indicates that future conditions have been anticipated. The equipment at present installed provides for ample plant extension, and space has been reserved for future enlargement of the boiler house and turbine room. The building is of the usual brick, steel, and reinforced-concrete power-house design.

The main power-house boiler room contains four Babcock & Wilcox standard water-tube boilers, each of 4319 sq. ft. heating surface, set in two batteries. These boilers are built for a working pressure of 160 lbs. per sq. in., each being fitted with B. & W. superheater, which raises the temperature of the steam about 100°. B. & W. chain-grate stokers are also a feature of the equipment.

Two B. & W. boilers of special design are installed for utilizing the waste heat from the reverberatory furnaces in the nickel refinery. These boilers are built for an output of about 400 boiler horse-power each, and are of particular interest, as their design represents the latest development in this phase of engineering, resulting from extensive investigations by the Babcock & Wilcox Company.

Coal is received from the cars in a track hopper, crushed in a Jeffrey crushing roll, elevated, and conveyed overhead to a suspended bunker, from which it is fed as required to



International Nickel Company of Canada, Port Colborne—Nickel room, three large vats,

the stokers. The ashes are removed from the ash pits by ash cars running in an underground tunnel to the elevator and ash-storage bin, from which they are dumped into cars for removal. One 6 x 175-ft. reinforced-concrete chimney conveys the products of combustion from the boilers in the power house. The waste-heat boilers are served by two 5 x 100-ft. reinforced-concrete chimneys.

Two Ridgway-Rateau high-pressure turbines furnish power for the direct-connected d.e. generators, each of 1,000-kw. capacity. These turbines operate under 150-lbs. initial steam pressure and 28-in. vacuum and run at 1,700 r.p.m. The power house also contains two other turbo-driven high-pressure blowers, which supply air for the converters. Like the turbo-generators, these units are of Ridgway-Rateau make. The turbo-blowers are each of 15,000-cu. ft. capacity, and deliver air at 15-lbs. pressure. They are connected in high-pressure condensing turbines operating at 8,500 r.p.m. and were designed by the Rateau-Battu-Smoot Co., of New York.

The superseding of the reciprocating engine by the turbine in large power plants has facilitated the elimination of the cumbersome blowing engine. The high rotating velocities obtainable to-day are especially suitable for the operation of centrifugal blowers, and the turbo-blowers at this plant are much more economical of space than blowing engines of similar capacity would be. The impellers are built up around a large-diameter shaft with dovetail radial slots milled in it. The impeller blades are of nickel steel and tapered in section, being much thinner at the tip than at the root, and are driven into these slots. Distance pieces are inserted between the blades in several stages. All turbines are equipped with Frahm tachometers, supplied by James Biddle, of Philadelphia.

Two No. 7 Westinghouse LeBlanc jet condensers, with individual air and circulating-water pumps, serve the turbo-generators. Each unit is fitted with a 31-h.p. steam turbine, and a reduction gear for the pump drive. These condensers are each capable of handling 17,500 lbs. of condensate per hour, and maintain a 29-in. vacuum with 40° cooling water. For the turbo-blowers, two similar No. 5 units are installed. They are fitted with 21-h.p. steam turbines, and are capable of handling 11,000 lbs. of condensate per hour at 29.05-in. vacuum with 40° cooling water.

The main switchboard supplies the plant with direct current at 250 volts. Lighting and other 110-volt services are supplied by means of a three-wire service, operated by two 20-kw. motor-generator balancing sets. I. T. E. circuit breakers, Weston indicating ammeters, and Sangamo wattmeters are installed on the generator and feeder panels.

The feed water is heated by exhaust steam from the various plant auxiliaries in Webster-Lea units. The heaters were supplied by Warren Webster & Co., of Camden, N.J., and the Lea meters by the Yarnell-Waring Co., of Philadelphia. Two units were installed, one for 5,000 h.p., equipped with Lea recorders and having a capacity of 275,000 lbs. per hour, and the other similar in construction to the first, having a capacity of 1,500 h.p., or 100,000 lbs. per hour. Both are of extra heavy construction, and were designed to withstand a back-pressure of 10 lbs. per square inch.

A two-inch Venturi meter measures all feed water, and the feed pumps are of Lea-Courteny make, direct-connected to Terry steam turbines of standard type. Owing to the provision for the horizontal parting of the casing when necessary, the interiors are easily accessible for repair; and, as no oil comes in contact with the steam, an oil separator is unnecessary.

In a plant of this size facilities for repairing machinery are not only advisable but necessary, and ample provision has been made. The machine shop is of good size, and has space to contain a large amount of equipment. Although the installation is not fully complete, and all of the machinery is not yet installed in permanent position, a good idea of equipment may be gained from a description of the various units.

A 12 and 28-in. McKabe double-spindle lathe, with a 24-ft. bed, is provided for the heavy turning, and a Willard engine lathe serves for the finer and smaller repair jobs. A Hamilton drill and a Niles-Bement-Pond radial drill are also provided. A Bertram double punch and shear, a Kelley shaper, and Racine hack saws form part of the equipment. The machine-shop building is about 175 ft. wide and 200 ft. long, with two side bays and a centre aisle for a crane runway, and it also serves to house the forging equipment and a complete electrical repair shop. All repairing work is done here. Armatures and field coils are rewound, and a complete stock of repair parts is kept on hand.

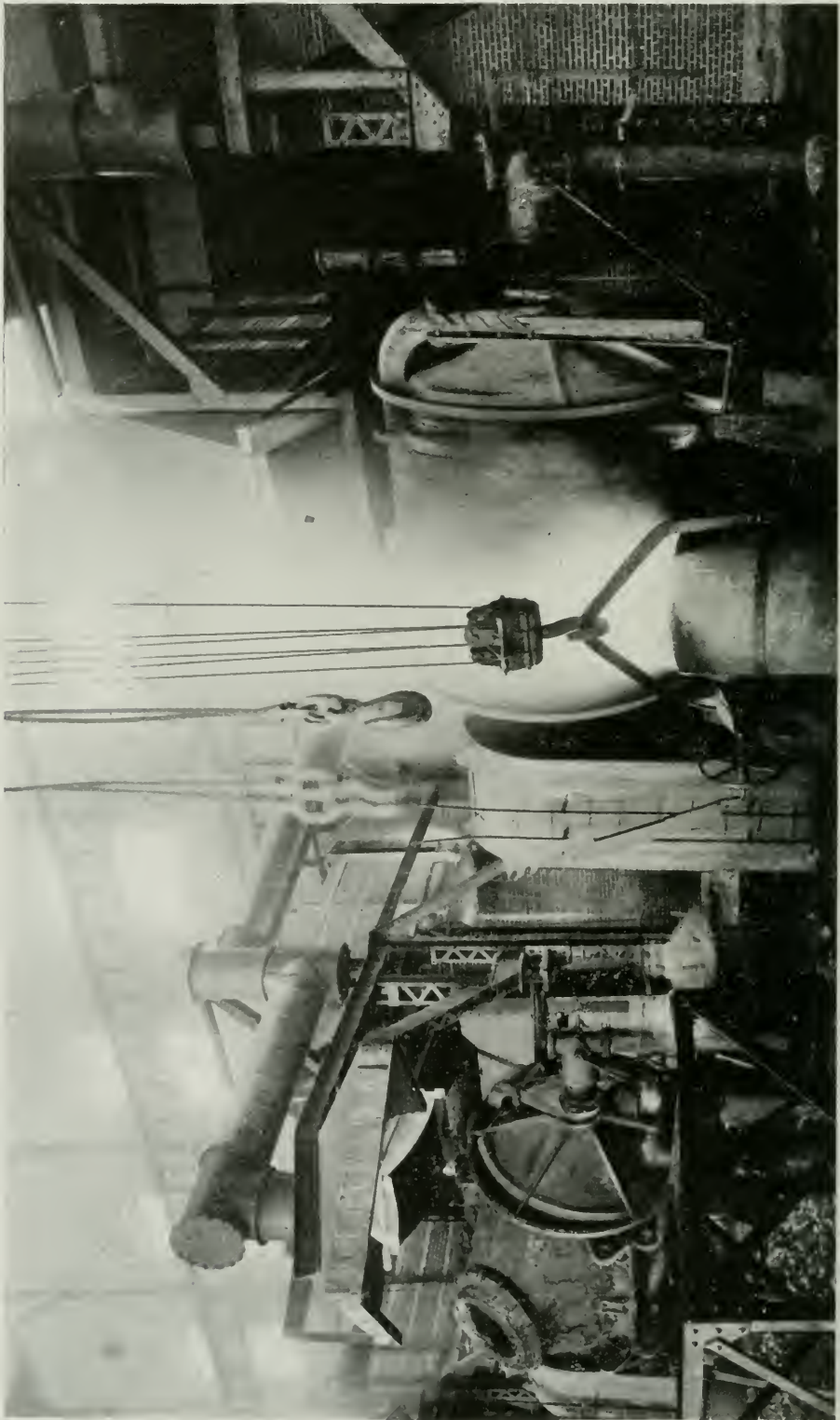
A separate building houses a carpenter shop, which also serves as a cooperage in which all the barrels required for shipment purposes are assembled.

In a plant of this magnitude it is wise to make adequate provision for the workmen's health. The sanitary features indicate that a considerable amount of care and thoughtfulness has been given to the question.

All water used in the plant is chlorinated, not only the drinking water, but that used in plant operations as well. The water supply is obtained through a 4-ft. square intake from the Welland canal, and is passed through the pumps and chlorinated, and then goes to an elevated tank, where time is given for its complete purification. Mention has previously been made of the sewerage system.



International Nickel Company of Canada, Port Colborne—Bird's-eye view of casting room.



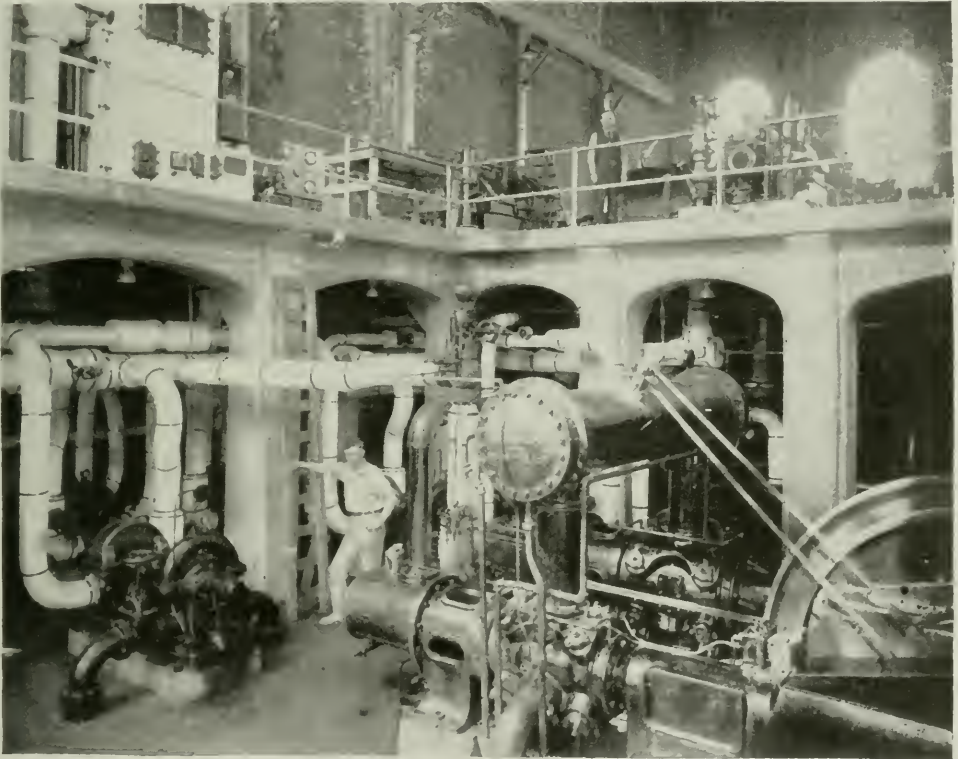
International Nickel Company of Canada, Port Colborne.—Pouring molten blister copper into casting ladle after separation from nickel.

For workmen engaged in laborious occupations, provision must be made for the changing of wet and dirty clothing, and the donning of comfortable and warm apparel for street wear. Four change houses have been built, with a total of 600 lockers and with hot and cold showers and lavatory accommodations.

The Port Colborne refinery began operations last June, and when at full capacity will be capable of a yearly production of about 15,000,000 lbs. of nickel and 8,000,000 lbs. of copper.

The engineers responsible for the installation have given special attention to the design and construction of the plant and to the possibilities of expansion, and have arranged the equipment in such a way that additions to machinery and equipment can be made in an efficient manner.

The plant was built at a cost of over \$5,000,000. The result impresses the visitor and makes him feel that not only is Canada—and Ontario in particular—to be congratulated on the introduction of nickel refining upon a permanent basis, but that credit is also due to the



International Nickel Company of Canada, Port Colborne—Main power house, showing turbo blowers running at 8,500 r.p.m., supplying air to the copper converters.

Foundation Co., of Montreal and New York, as the main contractor responsible for the construction, and to The International Nickel Co. for the broad and liberal attitude shown in having this plant built under the stress of war conditions.

A description of the turbo-blower was published by W. Wotherspoon in the *Engineering and Mining Journal* of May 17th, 1919, and is as follows:

The turbo-blower is a part of the mechanical equipment of the International Nickel Co.'s new plant at Port Colborne, Ontario, Canada.

The unit, which was furnished by the Rateau-Battu-Smoot Company, New York, has a capacity of 15,000 cu. ft. of free air per min., delivered at 15 lbs. gauge pressure. The speed of 8,500 r.p.m. at which it operates is believed to be the highest attempted or attained for a machine of this capacity and type. The outside dimensions of the turbo-blower are 9 ft. 6 in. long, 5 ft. 0 in. wide, and 3 ft. 11 in. high from floor line.

The driving end of the unit consists of a three-stage steam turbine in which the wheels are forged integral with the shaft. The turbine is designed to operate on steam at 150 lbs. pressure, superheat 100° F., and exhaust 2 in. of mercury absolute, under which conditions it can develop a maximum of 700 h.p. The turbine and blower shafts are connected by means of a flexible-pin type coupling. An important feature is the design of the blower impellers.

The equipment contains many special features, illustrating an advanced stage of turbo-blower design in both steam and air ends. In view of the high speed to be maintained, special attention was given to the question of exact dynamic balancing and efficient lubrication. Some repairs were found necessary at the beginning of operations, as a result of fracture of the impeller blades in the blower, due to faulty steel; but the adoption of nickel steel for these parts obviated further trouble.

The unit is equipped with a sensitive, constant-pressure regulator; and, as the compressed air delivered is for use in copper converters, a stabilizer has been added to permit the blower to run without tendency to surge on all loads from zero to maximum. A safety device to prevent over-speeding is also provided. This consists of a small fan on the end of the turbine shaft, which maintains a definite pressure on a tripping device controlling a butterfly valve in the steam line. This tripping device is capable of operating practically an unlimited number of times on these high speed machines without liability to damage to the movable parts.

Lead Smelter

Kingston Smelters.—Alex. McKinnon has operated the lead smelter at Kingston since February 14th, 1919, under the name of Kingston Smelters. This smelter was formerly the property of the North American Smelting Company, Limited, and now belongs to the bondholders of the defunct company.

Slag from the Galetta lead smelter is being treated in the blast furnace. Twenty-four men are employed.

FIRST REPORT OF JOINT PEAT COMMITTEE

By B. F. Haanel, Secretary

[NOTE.—The question of fuel is always an important one for the people of Ontario, both for climatic and industrial reasons, and during the early part of 1918 the situation was grave. There seemed no prospect of an early ending of the war. The entry of the United States into the struggle had diminished the supply of labour in that country, and the enormous movement of troops and war material to the Atlantic ports had congested the railways beyond any previous experience. Not only was the production of coal greatly lessened, and Canada's share cut down in common with all parts of the United States, but the difficulties of transportation were so great that it seemed as if national disaster were immediately ahead. Two things averted a catastrophe: one was the sudden termination of the war by the signing of the armistice on November 11, and the other was the unprecedented mildness of the winter of 1918-19. With the object of investigating and utilizing other sources of fuel, the Legislature in the session of 1918 appropriated the sum of \$100,000, and the government naturally turned to consider the possibilities of two combustibles which the Province has in abundance, namely, wood and peat. In Algonquin Provincial Park the Crown possesses large supplies of hardwood, principally birch, maple and beech, and steps were taken to secure a quantity of this wood for use in the public institutions of the Province, and to eke out the supplies of fuel generally. Some 15,000 cords of this cut wood are still in the Park, of the best quality and in first-class condition for use.

The possibility of obtaining a good commercial fuel from our peat bogs has been the subject of more or less inquiry and discussion for many years, and the subject was investigated pretty thoroughly by the Bureau of Mines some seventeen years ago. The results of the investigation will be found in the Bureau's Twelfth Annual Report (1902), under the heading Peat Fuel: Its Manufacture and Use. Later, experiments were carried on by the Mines Department at Ottawa in the making of machine peat fuel at a bog near Alfred, in the county of Prescott. It was now decided by the Governments of Canada and Ontario to investigate the subject anew, in the belief that a satisfactory solution of the fuel problem would be a great public boon. Consequently, a joint committee was appointed by these governments, the cost of whose operations was to be borne by them in equal shares. Mr. B. F. Haanel, Secretary of the Committee, narrates the steps taken by the Committee up to the spring of 1919.—T. W. G.]

Introduction

On account of the shortage of fuel with which Canada was confronted during the latter part of the war, and which threatened to become very serious so far as Canada was concerned, renewed interest in the development and utilization of our peat resources was manifested by private parties and industrial organizations, who urged upon the Federal Government and the Provincial Government of Ontario the necessity of utilizing our peat deposits.

As a result of the representations made, the Legislature of Ontario, through Hon. George Howard Ferguson, Minister of Lands, Forests and Mines, appropriated \$100,000 for the manufacture of peat and the cutting of wood, and a little later decided to construct and install a peat manufacturing unit similar to that which was last erected on the Alfred bog. At this time, also, the Federal Government was considering the advisability of assisting in the development of the peat industry by appropriating money for the construction of and experimentation with a new type of machine designed by E. V. Moore; and after a few days decided to undertake the construction of this machine. Mr. Moore was employed for a period of eleven months—the remainder of the calendar year—at a salary of five hundred dollars per month to superintend the making of detail drawings, construction of machine, and finally its operation on the bog during the period of experimentation. The Federal Minister of Mines, Hon. Martin Burrell, was respon-

sible for the interest taken in this work by the Federal government, and also for the union of the two Governments in the entire undertaking which followed a short time thereafter.

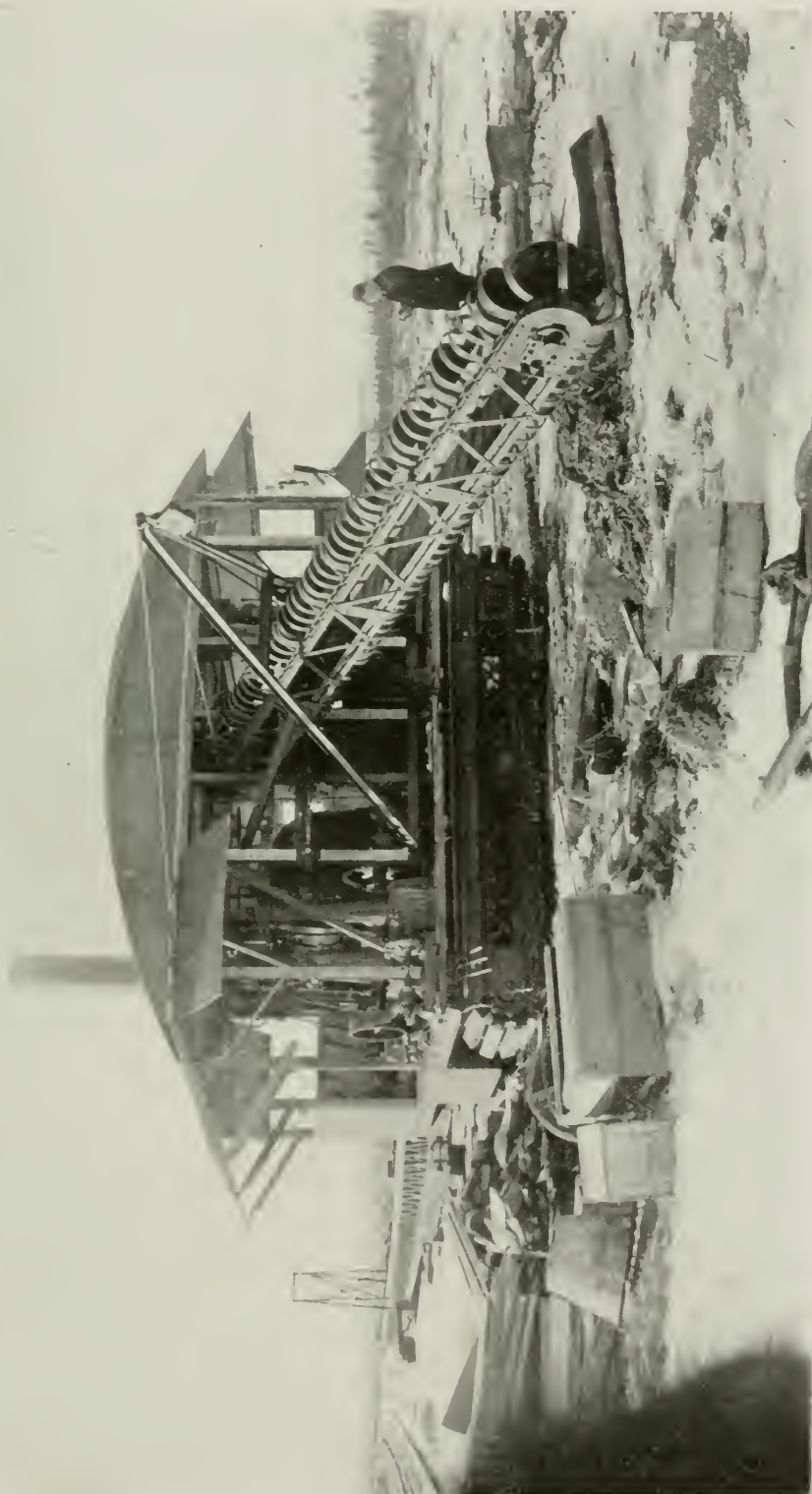
Appointment of Peat Committee

In order to carry out the plans formulated by the two governments for carrying to completion the investigation and experimentation involved in the design, construction and development of a type of peat machine best suited to meet the conditions prevailing in Canada, and to determine whether or not peat fuel can be manufactured at a cost which will permit of its competition with coal, it was decided to appoint a committee composed of two Provincial and two Federal representatives, who would have full charge of the expenditure of money and all operations: A. A. Cole and R. C. Harris were appointed representatives of the Government of Ontario, and R. A. Ross and B. F. Haanel were appointed for the Federal government.

It was agreed that all costs incurred in the investigation conducted by this Committee would be divided equally between the two governments, and Mr. Moore, who was previously engaged by the Federal Minister of Mines, as engineer, now became the engineer of the Peat Committee subject to their instructions.

Selecting a Bog

The inaugural meeting of the Peat Committee was held in the office of R. A. Ross, Montreal, on April 30th, 1918, shortly after the members were officially informed of their appointment. At this meeting the Committee appointed A. A. Cole chairman and B. F. Haanel secretary, and the question of choosing a suitable bog for carrying on manufacturing operations was discussed. It was the desire of the Hon. Mr. Ferguson to have the demonstration of the machine, to be constructed by the Provincial government, carried out on some bog conveniently situated with respect to Toronto, and the Holland river bog was considered to be the most suitable both because of the quality of peat and its situation with regard to Toronto and surrounding towns and villages. However, subsequent investigation carried out through the courtesy of the Hydro-Electric Commission of Ontario and by our own Committee, showed that this bog could not be employed to advantage for the work of the Committee on account of the high cost involved in its drainage. The choice of bogs was, therefore, after further careful consideration, confined to the Brunner, situated near Stratford, the Luther, Marsh Hill and Alfred bogs. The cost of preparing the different bogs for manufacturing operations, and the time such preparation would require, constituted the deciding factors in making the final selection. If it had not been for the exceedingly high cost of draining and preparing the Holland river bog for operations, this bog would have been the unanimous choice of the Committee. The second choice was the Brunner bog, but owing to the short time available for beginning the work of experimenting with the machines, which the Committee had every reason to believe would be ready for erection on the bog early in the fall of 1918, it was decided that the only bog which would prove suitable was the Alfred bog, on account of the fact that it had been drained and levelled for several years, and had a working face already prepared.



Moore-Anrep peat machine, showing 150-ft. arm carrying conveyor belt. The excavator is seen on the right, and the belt conveyor arm on the left.

The Committee accordingly recommended this bog to the Hon. Mr. Ferguson, who approved the recommendation. Arrangements were immediately made with a representative of the owners of the Alfred bog for terms on which the Committee could lease the bog for the time required to conclude the experimental work and put the machines in condition for manufacturing peat fuel on a commercial basis.

Designing and Making the Peat Machines

Considerable time was lost in completing the drawings of the two peat machines, since it was necessary for the engineer to the Committee to see and examine the various bogs from which the choice was to be made, in order to determine what changes would be required to adapt to the best advantage the two types of machine to the particular bog. Until, therefore, the choice of bog was actually made the design of the machines could not be completed.

In order to keep the expenditure on the two plants as low as possible, and to insure their completion in time to make a mechanical demonstration before winter set in, it was deemed advisable to design the plants with a view to utilizing such machinery and raw materials as could be obtained promptly, and although Mr. Moore was able to personally spend considerable time on the designs and drawings, much of his time was occupied in looking up various parts for the plants, attending meetings of the Peat Committee, and investigating the several peat bogs which were under consideration by the Committee. Notwithstanding the time thus lost, the designs of the two plants were sufficiently complete by May, 1, 1918, to permit of tenders being called for. The Committee received tenders from several reputable firms, among which was the William Hamilton Company, of Peterborough. The contract for the construction of the two machines was awarded to this firm on account of the fact that their shops were considered to be the best equipped for this special kind of work, and also because the Committee had every reason to believe that they would be better able than the other firms to complete the work on time, inasmuch as they had built the last peat machine erected on the Alfred bog. Notwithstanding the fact that the William Hamilton Company accepted the contract for the construction of the two machines to be completed and delivered early in September, with the full knowledge that penalties were attached to their contract to insure that their part of the contract would be carried out, this company only succeeded in delivering one plant practically complete late in November, while the other plant was still in the shops only partly completed.

Failure to Deliver Machinery Causes Delay

Failure to deliver these plants on time was due to disorganization in the William Hamilton Company's shops, labour troubles, shortage of skilled workmen on account of the influenza epidemic, but more particularly to lack of organization which would make it possible to get the required amount of work out of the staff or plant in general. Even under these circumstances the Committee as a whole considered itself most fortunate in getting the machines delivered even at such a late date, inasmuch as war work and disorganization resulting from the war made it almost impossible for many manufacturing concerns to live up to their contracts, either as regards time of delivery or estimated cost of the work undertaken.

The late delivery of the first plant precluded any possibility of giving it a mechanical try-out, since winter had already set in. The plant, however, was assembled, and its machinery thoroughly tested under steam. This plant now lies along the Canadian Pacific railway adjacent to that portion of the bog where it is expected its operation will begin. Such tests as were made to determine the reliability of the new mechanical features of the plant were most satisfactory.

At the end of 1918, the Anrep peat plant, which is still in the shops of the William Hamilton Company at Peterborough, was more than half completed. The fabrication of the steel and the assembling of the parts of the excavator, all of which are on hand at Peterborough, will require only a comparatively short time to complete. Other work to be performed before this plant is complete is the manufacture of various fittings for the cable traction system, the procuring or manufacture of a number of steel dump cars, and the construction of an Anrep spreader.

I desire, however, to draw attention to the fact that a number of the parts of the two plants are of the same design, and that all such parts were machined at the same time. This made it possible to complete a large part of the machine work on the Anrep plant by the end of 1918. As the work is now progressing, we have every reason to believe that this plant will be completed without fail before the snow is off the ground.

The construction of both machines is very strong, and it is not considered likely that any serious trouble will arise from the breakage of any important parts when the machines are put in operation. In designing the Anrep plant care was exercised to adhere as closely as possible to the original drawings which were made by the inventor, the late Alaph Anrep, Sr., and the changes which we found it imperative to make have been of a structural nature only. The machine has been greatly improved by placing it on caterpillars, a feature in the design which was stipulated in the original agreements made with Mr. Moore when he was appointed to act as engineer for the Peat Committee.

No arrangements have yet been made to lease that portion of the Alfred bog which runs along the Canadian Pacific railway track in a westerly direction, where it is expected Plant No. 2, or the Moore plant, will be operated, but it is not anticipated that any difficulties will be met in obtaining this portion of the bog at the same terms as the Peat Committee received for the bog owned by Mr. McFarlane and his associates.

Expenditure to December 31, 1918

The total moneys paid by the Peat Committee up to December 31st, appears in the following statement, which was prepared by the Accountant of the Mines Department, Ottawa:

WAGES:

To E. V. Moore, engineering services, 1 Feb. to 30 Nov., 10 months at \$500	\$5,000 00
“ F. O. Orr, draughting, supervising, 4 May to 30 Nov., 6 28-31 months at \$200	1,280 65
“ E. H. Morley, designing, draughting, 19 March to 19 June, 3 months at \$200, \$600; 24 June to 9 Aug., 156 hrs. at \$1, \$156	756 00
“ Dominion Engineering and Inspecting Co., checking drawings of 2 peat plants	150 00
	\$7,286 65

MACHINERY:

To Wm. Hamilton Co., Ltd.:

On Contract No. 1,	Estimate,	\$2,132 65	less 15 p.c.	\$319 90	
" " 2,	"	6,237 95	" "	935 69	
" " 3,	"	6,306 42	" "	945 96	
" " 4,	"	5,992 13	" "	898 82	
" " 5,	"	1,644 10	" "	246 62	
		<u>\$22,313 25</u>	" "	<u>\$3,346 69</u>	18,966 26

To Miller Bros. & Sons, Ltd., 6 vertical boilers	\$2,420 00	
" H. W. Petrie, Ltd., 1 boiler	1,620 00	
" A. R. Williams Machinery Co., 1 boiler (used)	1,555 00	5,595 00

TRAVELLING EXPENSES:

To E. V. Moore	\$1,499 57	
" B. F. Haanel	440 97	
" A. Anrep	\$222 29	
wages, rod and chain men, guide	16 00	
	238 29	
" A. A. Cole	193 49	
" R. A. Ross	29 00	2,401 32

SUNDRIES:

To E. V. Moore:

Office rent, etc., from 1 March to 30 November, 9 months at \$40.00	\$360 00	
Blue prints	63 47	
Office supplies, stationery	30 59	
Draughting materials	28 80	
Freight charges	225 30	
Miscellaneous	40 40	
	<u>\$748 56</u>	

To Estate A. Anrep:

½ royalty on Macerator plant No. 1	\$600 00	
½ Royalty on Macerator plant No. 2	300 00	900 00
" Mount Royal Tunnel and Terminal Co., rental of crane, wages of crew, freight, etc.	263 20	
" F. Minden Cole, insurance premium on peat machinery	183 06	
" Bell Telephone Company, long distance calls	27 45	
" Dominion Express Company, express charges	1 30	
	<u>2,123 57</u>	

Total net payments to 31st December, 1918 \$36,372 80

REPORT OF ADVISORY GAS BOARD

Letter Transmitting Report

THE HON. G. H. FERGUSON,

Minister of Lands, Forests and Mines,
Toronto, Ont.

SIR,—We, your Advisory Board, beg leave to lay before you our Report on Natural Gas Conditions in Ontario.

The main recommendations growing out of our discussions on the mass of detail which came before us, and which we present for your consideration, are:—

That all Natural Gas in the Province be conserved, and that measures be provided for the prevention of waste and misuse; allowance being made for a variation of treatment as between the Gas Fields of the east and west—the older and the newer fields—which, having reached different stages of decline, call for slightly different treatment.

That the present available supply of Natural Gas be allotted as far as possible for use in the homes.

That all rights existing under agreements be respected; provided that, where these rights interfere with the carrying out of conservation principles for the common good, they be modified and adjusted subject to proper protection.

That provision be made for appeal from the administration of the Natural Gas regulations, subject to such limitations as the Legislature may deem practicable.

That the diligent search for new gas areas and the tapping of the same be wisely encouraged; so that additional sources of this valuable fuel may be made available for the public, and that the utility of the existing costly systems of distribution now serving the public be preserved, which otherwise would soon be rendered useless or of small value owing to the decline and extinction of the present fields.

That consideration be given to the adjustment of rates and the establishing of an equitable scale of prices proportionate to the cost of discovering, producing and selling Natural Gas, and consistent with the general conditions prevailing in each district and the extent of available supply. That the intelligent allotment of any available supply not required for domestic use to those classes where its economical use will bring the most good, be fully considered.

That such supervision be established over field operations as will, by the aid of the operators and owners, encourage the general adoption of a policy of which extension of the life of the fields will be the main feature.

These matters are treated in detail in the following report, together with other important questions which we thought advisable to bring to your notice; all of which is respectfully submitted.

We have the honour to be, Sir,

Your most obedient servants,

PERRY A. LITTLE.
T. P. PINCHARD.
H. R. DAVIS.
T. J. MAHONY.
WARD STANWORTH.
W. S. WEST.
C. E. STEELE.
ALEX. MCKEE,
J. S. COATE.
E. R. GRAY.
E. S. ESTLIN, *Chairman.*

CHATHAM, ONT., February 12, 1919.

Introduction

It is well known that Ontario possesses no established source of fuel suitable for general distribution throughout the Province, and it is therefore apparent that immense quantities of coal and other fuels must be procured from other parts of the Dominion or the United States, to supply the domestic and industrial requirements. This commodity, therefore, upon which life and prosperity depend, has to run the gauntlet of the uncertainties of transportation and labour before it can be laid down at the furnace or home of the consumer.

While this is true of the Province as a whole, there is a section stretching from Niagara Falls and Hamilton on the east to Windsor on the west, and along the Lake Erie shore on the south to Sarnia, London, and Galt on the north, that is supplied with fuel in the form of natural gas produced within the area mentioned, the eastern districts having been supplied as long ago as 1889, and the extreme western portion in the same year.

The records show that in 1894 it was regarded as prudent that certain restrictions should be placed upon the use of gas, and a Committee of the Legislature was appointed to inquire into the conditions, which made the following recommendation in its report:

That as regards the economic use of Natural Gas, witnesses are agreed that it is one of the most valuable of all fuels, and in view of the limited supply it appears desirable that its use as far as possible should be confined to the purposes of domestic fuel and in the production of the finer classes of manufacture.¹

The extravagant use of this valuable fuel, however, seems to have gone on,² particularly throughout the area supplied by the Kent gas field, until a serious shortage in the supply occurred in the winter of 1917-18 owing to extreme weather conditions, when, at the instance of the Government, the Legislature took measures to meet the emergency, and restrictions³ were put in force whereby the remaining supply of gas should be conserved for domestic purposes.

During the summer of 1918, while gas was being "rationed" to industries in diminishing quantities, so that the supply of war necessities should be least interfered with, and suitable changes in apparatus might be effected, it became apparent that definite and permanent regulations should be devised governing all phases of natural gas transactions. Hence the Natural Gas Advisory Board was appointed on December 14th, 1918, by the Minister of Lands, Forests and Mines, consisting of ten members, for the purpose of recommending methods for solving many of the gas problems.

Meetings have been held each week at different places. The public have had access to the councils of the Board, and brought to its notice certain matters worthy of adjustment. The same may be said of those representing private interests, who appeared and laid their requests before the Board.

¹ Journal of Legislative Assembly, Vol. XXVII, 1894, Appendix No. 1, p. 6.

² Bur. Min. Rep., Vol. XXVII, 1918, Part 1, p. 53 *et seq.*

³ The Natural Gas Act, 1918 (8 Geo. V, chapter 12).

It has been the Board's endeavour to ascertain and display conditions as they exist, and to suggest methods which would make for a better administration of gas transactions. Consequently, in the following pages are submitted many explanations setting forth in detail the subjects which require regulation and control.

Some of the subjects treated are matters of administration, and are brought out herein for the purpose of reference and to show the need of adjustment. It is the Board's opinion that the situation admits of much improvement, and that gas production and consumption can be carried out with better satisfaction to all concerned if conducted under suitable regulations and restrictions. The changing conditions affecting the future supply of gas call for discretionary powers on the part of the executive, so that regulations may be made to conform thereto.

The members of the Board have been constantly reminded, in the course of their deliberations, that there are two parties to the gas question: First, the public, who pays the bills, and for whose comfort it becomes necessary to allot the remaining supply of gas for as long a period as possible. Second, the producers, who shouldered the hazard of the initial discovery and on whom, by further search, lies the burden of maintaining the supply, and to whom, with the distributor, the public must look for effective service in the future. It is a matter of regret that the general features and difficulties incident to this particular form of service are not well understood by the public.

It may be interesting to mention that there are approximately eighty thousand domestic users of gas in the Province, and as five is generally conceded to be the average number of people in a home, it follows that there are about four hundred thousand people affected by the prolonged supply of gas as a fuel; also that about one hundred dollars is the average investment for gas equipment in each home, amounting to about \$8,000,000—the gas supply for which calls for an outlay of three times that amount, or about \$24,000,000.

Conservation of Supply

Under this heading we include measures of different kinds that can be taken to prevent waste and misuse, all the way from the well to the consumer.

As this is the fundamental principle dominating our discussions, we will quote extracts from the reports made by members of the Board on subjects germane to its investigations, and make use also of other sources of information:

This means economy of management; proper distribution of drilling; prevention of waste through leakage at the well, in transportation and distribution; waste through improper appliances in burning gas. It becomes incumbent upon the companies producing, transporting and selling gas, for their own protection, to remedy faults in this respect, yet supervision should exist to protect against careless operations.

Conservation in a broader sense has come to mean the elimination, as far as possible, of the factory user, and the reservation of the remaining supply for the home. When the fields were flush and the supply plentiful, year after year the householder used natural gas without really appreciating its benefits, but when the fields weakened and the time of a lean supply came, then the home users awoke to the fact that it made for a convenience and comfort that was lacking in every other fuel. Its commonness had made it cheap and unappreciated. To-day governments and communities have recognized its worth and are everywhere seeking to prolong its use.

True conservation is not hoarding, but the wise use of natural resources, and it implies not merely the preserving in unimpaired efficiency, but also a wise and equitable exhaustion with a maximum efficiency and a minimum waste. The heart of the natural gas conservation problem is the conflict between the present and the future. The individual land-owner is interested primarily only in immediate present personal returns. That is, he is thoughtless and indifferent with respect to the future. The public—at least the domestic natural gas consumers, and the people dependent on natural gas for their cooking, heating and lighting purposes—are interested in conserving the supply and bringing about a slow, wise, and economical exhaustion of the field so as to insure continuity of service for the future.¹

Conservation, therefore, demands intensive rather than extensive use, takes cognizance of equitable distribution, aims to bring about social justice, and means the greatest good to the greatest number—and that for the longest time. (See Prof. C. R. Van Hise's "The Conservation of Natural Resources in the United States," and Prof. Richard T. Ely's "Conservation and Economic Theory," *Trans. Amer. Inst. Min. Eng.*, vol. 54, p. 458.)

For eleven years the natural gas resources in the Kent field have been drawn upon without proper and adequate restrictions, to such an extent that if consumption were continued at the same rate the field would inevitably be completely exhausted in six years.

The Essex field was exhausted by reason of unrestrictive methods in fifteen years and is extinct.

The Eastern field (including the gas fields of Welland-Haldimand counties, etc.), has yielded gas for thirty years, but early in the history of this field it became apparent that the supply would fail if the output was not restricted. Small quantities of gas were therefore supplied to industries, and the domestic consumers furnished under economical measures, with the result that the life of the field has been materially extended.

We therefore recommend that all natural gas in the Province be conserved for the homes as far as possible, because:

It is the most valuable fuel in the Province.

It is rapidly diminishing in supply.

There is only a limited amount remaining in the known fields.

No evidence can be found that natural gas is being formed to replace what has been used up or wasted.

Other fields the world over demonstrate beyond doubt the failing supply.

Efforts by further drilling in depleted fields have proven unsuccessful.

Experiences of half a century show conclusively that natural gas is the most convenient and useful of fuels.

The governments of the United States have found it necessary to take drastic steps and make careful laws for conserving natural gas in all their gas and oil fields, thus assuring a supply for domestic consumers for the longest possible period.

Measures are necessary to prevent too rapid a decline in the fields, because a rapid depletion of a gas field is a factor which is contrary to conservation.

Gas wars result in the drowning out of wells.

The aim of all legislation should be to prolong the life of the gas fields.

The history of all gas fields is one of constantly changing conditions, and legislation should take into account that what will apply satisfactorily to the early life of a gas field will be injurious at a later stage.

¹ Bulletin 102, Smithsonian Institution, p. 18.

The endurance of gas fields is not generally understood to be limited.

The early value of gas was not recognized, because gas was incidental to the early search for oil and was more or less of an encumbrance to the oil enterprise.

Gas was used as an inducement in the establishing of factories, and little consideration was given to the rapid dissipation of supply.

Salt water is the greatest enemy to natural gas: it underlies the gas and rises as pressures reduce.

Many fields are drowned out by careless methods in spite of remaining high pressure.

The following tables show some interesting indications of the decline in supply:

COMPARATIVE OUTPUT OF THE CANADIAN GAS COMPANY.

1917.—174,111.93 M. cu. ft.; last six months, 83,609.36 M. cu. ft.
 1918.—125,664.90 M. cu. ft.; last six months, 46,184.85 M. cu. ft.

The Dominion Natural Gas Company's gas production fell off 35 per cent. in three years, and the total over all their wells 20 per cent (1917-1918).

OPEN FLOW PRODUCTION DOMINION NATURAL GAS Co. (EASTERN FIELD.)

1915.—No. of wells, 372; production, 21,825 M.; average open flow, 58 M.
 1916.—No. of wells, 579; production, 27,294 M.; average open flow, 47 M.
 1917.—No. of wells, 751; production, 27,793 M.; average open flow, 36 M.
 1918.—No. of wells, 747; production, 25,547 M.; average open flow, 34 M.

KENT FIELD; PRODUCTION AND DECLINE OF PRESSURES.

	Pressures	Million Cubic Feet
	Lbs. per sq. in.	
Estimated Waste		2,000
1907		297
1908		848
1909		1,996
1910		4,589
1911		5,649
1912		7,752.5
1913	512	7,975.8
1914	491	10,121.6
1915	475	10,819.1
1916	434	13,752.5
1917	368	15,449
1918	330	9,389.4

UNION NATURAL GAS Co.

Original open flow of 111 wells 177,994 M.
 Same wells in 1915 90,097 M.
 Original open flow of 124 wells 168,502 M.
 Same wells in 1916 55,000 M.
 Original open flow of 119 wells 50,799 M.
 Thirteen new ones added—
 Same wells in 1917 58,165 M.
 Original open flow of 132 wells 39,865 M.

NOTE.—25 per cent. of open flow is effective commercial delivery.

OPEN FLOW OF GLENWOOD AND BEAVER GAS COMPANIES.

1916	56,554 M.
1917	46,385 M.
1918	30,096 M.

Prevention of Waste

Gas transactions all the way from well to burner are a history of waste, most of which is preventable.

This waste is a direct money loss to the consumer as well as to the producer, which can never be restored.

Conditions in the Welland-Haldimand Fields prove the error, that because the early wells were large producers the supply was limitless. This idea has led to enormous waste.

In the State of West Virginia, eight years ago, not less than five hundred million (500,000,000) cubic feet of this precious gas was daily escaping into the air from two counties alone.¹

Regulations should provide stringent measures for the prevention of waste:

- At the wells.
- In transmitting gas to distribution.
- In distributing.
- In the use of gas in improper appliances for burning.
- By the use of properly constructed appliances, and their proper adjustment.
- By economical methods in handling in the homes.
- By limiting the use for specific purposes.
- By restricting as far as possible all natural gas to domestic uses.
- By the closing of new wells promptly.
- By the use of proper casing.
- By the proper placing of packer.
- By proper methods of use under boilers used in drilling.
- By prohibiting the use of torches.
- By restricting the drilling of off-set wells.
- By the proper plugging of abandoned wells.
- By prohibiting waste of gas to obtain oil.
- By careful and prompt repairs to transmission lines.
- By the abolition of flat rates.

Syndicate Gas Lines Tapping High Pressure Lines

For the convenience of supplying gas to rural inhabitants in the vicinity of high pressure transmission lines, it has become a common practice for residents to club together and run their own gas line along the highway, which taps the high pressure line where most convenient. The lines do not receive the best of care, and being subject to high pressures and generally fully exposed, are a very prolific source of leakage.

¹ Bulletin No. 102, Smithsonian Institution.

There are approximately five hundred miles of such lines in the Kent gas area. If we assume three hundred joints to the mile and figure a safe average size of pipe to be one-inch, then we have on these lines alone approximately one hundred and fifty thousand sources of leakage.

But this is not all. Each house service is controlled by a regulator, and, the line being small, it is a common practice to load the arm with additional weight so as to increase the pressure at the burner, the result being an enormous waste at the relief valve.

Attention should be given to some means of control by meter at the point of junction, so that all gas can be measured into the line and paid for, or by putting the lines under control of the gas company supplying them with gas.

It is estimated that in many cases consumers on these lines waste three times as much as they burn.

Semi-Annual Reports Showing Line Leakages

The waste encountered in the transmission of gas over long distances, under high pressures, did not come to be appreciated until quite recently, because there was no reliable device for correctly measuring the flow of large volumes of gas under pressure. Meters are now being installed which are constructed under scientific principles, and the measuring in of gas volume can be easily checked with the total distributed or delivered. The true condition could be easily recorded and remedied if statements were rendered by the gas companies to the Government every six months, showing the amount of gas delivered into the lines or to distributing companies and the amount taken over and sold.

It is urged, therefore, that much good will result if reliable reports are handed in at prescribed dates consistent with the operations of the companies, showing the volume of gas handled and other particulars, so that sources of waste may be detected and remedied.

Measuring all Gas Through a Standard Meter

All gas should be metered, no matter what the purpose for which it is consumed.

The meter used in the houses is one of the most reliable instruments made, and has stood the test of time.

No meter can possibly record unless gas is being passed through it.¹

No general waste can be properly dealt with without metered service.

Flat rates, where there is no check on the amount used, have proven to be a great encouragement to waste.

There is an existing means of protection afforded to the public under a Dominion Act which provides for the Government testing and sealing of any meter suspected of recording incorrectly.

¹ Bulletin No. 102, Smithsonian Institution.

Control of Gas from Oil Wells

It is quite common for large flows of natural gas to be encountered while drilling is being carried on for oil. This gas was formerly considered as a valueless product which increased the difficulties of the oil driller, and accordingly it was allowed to escape as quickly as possible.

It can be reasonably expected that future exploration work will reveal pools where gas and oil are associated. This is true to-day in the Dover field, but in Dover the gas is being piped into the lines and sent to market.

There are, however, in Lambton county, a large number of oil wells from which gas in large quantities has been allowed to escape for many years. Part of it is piped to the dwelling, but pressure is regulated by allowing the excess to escape and by maintaining flares around the buildings, which have been kept burning for years. This is a matter requiring control and regulation, but it may be found that former legislation has some bearing upon the question.

Protecting Gas Wells from Injurious Interference

One feature which has caused great loss in the operation of gas fields, not only to the producer but to the community, and which also worked a certain disadvantage to the lessor, is the unfair and unwise practising of competitive drilling.

Instead of larger areas being opened up and acreage holdings being more uniformly covered, wells have been bunched together for the purposes of participation, and the company which could carry the lowest pressure won from its wells the larger production.

Valuable pools have been ruined by the crowding of wells for competitive purposes.

Allotting Gas Supply to the Homes

There are approximately eighty thousand homes using natural gas in Ontario. About five hundred industries used it prior to the restrictions of 1918.

In the winter of 1917-18 the supply of natural gas from the Kent field failed to keep pace with the demand, and much suffering in the homes was narrowly averted by the prompt action of the government in putting into force measures which cut off the industrial consumers temporarily, and allowed the available supply to be quickly delivered to the homes. Thus the crisis passed.¹

The eastern gas fields, having been drawn upon for about thirty years, only produce about twenty per cent. of the total gas consumed, and that amount has automatically been restricted to the service of domestic consumers, who use it economically and are fully aware of the uncertainty of the supply.

The Kent field produces about eighty per cent. of the natural gas used, and domestic consumers do not yet realize that a stage has been reached where the utmost economy must be practised in order to provide them with enough fuel to meet requirements.

Within the area supplied by the Kent fields there are about 35,000 homes equipped with heating appliances more or less suitable for using gas, and not convenient for the use of coal.

¹The Natural Gas Industry in 1917, by G. R. Mickle.

The restrictive use of the remaining gas, if confined to domestic service, will mean the extended life of the field for many years, as has been clearly shown in the history of the eastern field, and by analysis in the records of the Department of Mines.¹

Classification of Gas Consumers

The following classification is suggested as giving an order of preference when further decline in supply demands discrimination in the ranks of consumers:

1. Household cooking.
Household lighting.
2. Cooking elsewhere than above included.
Lighting elsewhere than above included.
3. Household heating.
4. Special industrial purposes where artificial gas would be used if obtainable, upon quantity limitation.
5. (1) Heating other than above included, but according to the following order of preference:

(a) Where individual rooms are each separately heated by individual appliances.

- | | | |
|----------------|------------------------------|-----------------------|
| (1) Hotels; | (4) Offices; | (7) Stores; |
| (2) Hospitals; | (5) Boarding Houses; | (8) Private Garages; |
| (3) Schools; | (6) Charitable Institutions; | (9) Apartment Houses. |

(b) Churches;

(c) Theatres: Waiting Rooms: Public Buildings: Assembly Halls: Clubs, and other than above included.

(d) Where individual rooms are not each heated by individual stoves.

- | | | |
|----------------|------------------------------|-----------------------|
| (1) Hotels; | (4) Offices; | (7) Stores; |
| (2) Hospitals; | (5) Boarding Houses; | (8) Private Garages; |
| (3) Schools; | (6) Charitable Institutions; | (9) Apartment Houses. |

It is further urged in the attached memorandum that special rulings may be necessary to meet emergencies and to modify the classifications as given above, and that each case be considered on its merits.

Rights under Agreements

The transactions of the natural gas industry are fraught with the obtaining of concessions and privileges which are essential to the marketing of the product; thus, in many cases, the barter has generally included, as a consideration, the supplying of cheap or even free service, or perhaps the according of rights of priority. Almost any form of restriction runs counter to these agreements, which

¹ The Natural Gas Situation in the Counties of Kent, Essex and Lambton, by G. R. Mickle.

were entered into at a time when the conditions of supply, and prospects of maintaining it by drilling efforts, seemed to warrant any obligations for the purpose of securing ample market.

These agreements consist mainly of specially guaranteed supply under contracts, together with rights-of-way and privileges under franchises and lease contracts. There can be no doubt that where gas was allowed at a low price or without charges, it was intended to offset a privilege given, and the difference became part if not the whole of the consideration. It is also apparent that in some cases restrictions bring a direct benefit to the consumer, without which he would not enjoy the benefits of his bargain for very long.

It is therefore urged that some plan be propounded whereby contracts which may be affected by the conservation of natural gas for the common good, should be modified or adjusted so that the rights of the parties should not be unduly interfered with, and that in the conservation of natural gas, the rights of any person, company or municipality existing under contract or franchise, should not be prejudicially affected: nevertheless, should the policy of conservation prejudicially affect any person, company or municipality, the government should devise a means of protecting such rights.

We, your committee, wish it understood that if any variations of the said contracts are made, it is solely for the purpose of conserving the natural gas supply for domestic use.

Providing Appeal

In administering regulations covering such an involved array of interests, it is reasonable to expect that contentions will arise.

It is considered necessary that provision be made for an appeal from the person or body administering the regulations, but that this appeal be limited as the government may deem wise.

The gas fields are rapidly declining, and where appeals are made and relief expected, the process should be expeditious, because of the changing nature of the gas conditions.

Encouraging Search and Development Work

So much depends upon the enterprise of searchers after new sources of supply that no obstacle should remain to discourage operations in this direction.

Large areas, prolific with possibilities, surround the chief gas fields of the United States, and the decline within these fields has not made itself so manifest because search could be carried on with a reasonable expectation of success by extension of the field in these surrounding areas.

This is not so in Ontario, where the gas area is circumscribed and confined within meagre limits in most cases.¹ That there are still some undeveloped areas where pools may be opened up, seems evident, but if these pools prove to be insignificant and scattered, and distant from market, the outlay will be great and the returns small. Thus the hazards of the business, with special reference to the developing of new fields, should be kept in view when regulations are contemplated.

¹ Bur. Min. Rep., Vol. XXIV, Part II.

A large area of gas-bearing rock has been tested out in Ontario, but there is a possibility of opening new sources by persistent exploration.

Present producing companies, in order to protect their established enterprise, will continue to carry on a certain amount of exploration if a fair return from their outlay is assured.

Expropriation for Rights of Way

In order to facilitate the extension of gas service where rights-of-way are required for the laying of new pipe-lines, and satisfactory negotiations are found impossible, it seems desirable that expropriation principles should be the remedy, as provided for in the Ontario Municipal Act.

The Protection of New Discoveries

In the case of an entirely new gas field being opened up, it is possible that this may call for the relaxing of restrictions within certain necessary limits.

There should be a measure of protection afforded to the pioneers of a new field so as to protect, in so far as is considered possible, against predatory competition in production and distribution.

Administration of New Gas Fields

Regulations and restrictions which are suitable to a declining gas field will not always be found workable in a new field.

That history has taught us that certain measures may result in the better preservation of a gas field, is very clear, and with years of experience to draw from, and the knowledge of abuses having existed in the past, which called for remedies, any new gas field should be surrounded with such safeguards as may be most suitable.

Adjustment of Rates

Considering the depletion of the present gas fields and the conservation of natural gas, the rights of the producing, transmitting, and distributing companies should be duly considered, and provision should be made for compensation to the said companies to meet the increased cost of operating a declining gas field, by a return commensurate with the nature of the enterprise:

Also by an adjustment of the price of natural gas to consumers, having due regard to the conditions in each municipality where sold:

By fixing a higher rate for summer, say from 1st May to 31st October, because of the limited consumption during that period, and a different rate for the remainder of the year:

Further, by setting a price for the sale of mixed, artificial and natural gas, having regard to the proportion of each used and local conditions where sold.

As regards the last, in some Ontario cities artificial gas plants are operated as auxiliary to the natural gas supply, and the products are mixed in the mains. The time may come when artificial plants may be established to furnish a supply through the present high-pressure systems calculated to finally take the place of the gas fields.

This would call for the establishing of a rate based upon the proportion of each gas metered into the mains, having regard to the increased cost per unit M.C.F. in the production of artificial gas below the normal capacity of the artificial gas plant.

Supplying New Domestic Consumers

Gas should be supplied to all new consumers whose property abuts on the present mains and lines.

New consumers should not be encouraged when located beyond the reach of existing mains, except in special cases approved by the Administrative Board.

No new districts in settlements or municipalities should be supplied unless from new sources.

Additional Matters for Regulation

In preparing Natural Gas Regulations, the following should also be duly considered:

- Establishing supervision of operations.
- The appointment of officials, etc.
- Exempting Departmental officials from giving evidence in court.
- The cutting off of supply where necessary.
- The control of works, machinery, and plants.

Licensing of Drillers and Prospectors

Ready access to reliable data would have saved immense sums which have been spent in fruitless drilling.

It is a matter of common observation in natural gas mining that offset well locations are frequently dry holes. This is because most natural gas pools are not strictly continuous, but are made up of many small local pools, frequently surrounded in whole or in part by a gas rock of low porosity. For this reason, if a producing well has been drilled into one of these small local gas pools there is a large chance that the offset well location may go beyond the limits of the pool, and therefore be a dry hole.¹

If government records are obtained they must be reliable, and if drillers and prospectors are operating under the protection of a licensing system, their license should provide for the making of returns to the Government. From these returns geological surveys may be made which would be of vast importance in guiding the prospector in the intelligent locating of new wells. Co-operation in this manner would endure to the benefit alike of the driller and the prospector.

The prospector's license should provide for a true record of new well locations, and proper maps could be kept up-to-date.

Protection Against "Boosters"

There are several kinds of "boosters" known to the gas trade.

The "booster" alluded to here is sometimes used on the premises of a consumer, as a means of maintaining pressure when the supply is not great enough

¹ Bulletin No. 102, Smithsonian Institution.

to go round. The result is that one man is able to secure gas at the expense of his neighbour. This should not be allowed; it is already forbidden under some by-laws, but the prohibition should be made general.

The use of any appliance which tends to interfere with the local gas service should be prohibited.

Drilling for Gas on Public Highways

At various times during the life of the natural gas industry, efforts have been made by gas companies to secure from a number of township councils, permission to operate for natural gas upon the public highways.

In practically every case the permission sought has been refused because it was not considered in the interests of the general public.

Producing natural gas from wells on the public highways can only result in waste from excessive drilling, in the early exhaustion of the fields, and in loss to the abutting property owners by withdrawing gas from their lands without adequate compensation.

Efforts, however, are still being made for the securing of this privilege, and the Board would therefore strongly urge that the necessary steps be taken to co-operate with the various township councils for the purpose of preventing the use of any road or public place within any township for the purpose of drilling for natural gas.

The Ontario Gas Fields

General Conditions

Everywhere the natural gas business is in a state of transition: changes in field and market are being forced by conditions which for years, like the slow and sure growth of a cancer, have eaten into the vitals of the supply.

When natural gas began to be universally used for domestic and commercial purposes, it was thought to be free and everlasting. Usually discovered in the search of oil, it was considered of incidental value. Even when companies were organized and hard money invested to develop and market natural gas, its real value was not appreciated either by producer or user. Contracts for its sale were governed by exigency rather than equity. Cities were boomed and real estate inflated on the strength of cheap gas. Factories were called from afar to burn gas at prices ranging from three to ten cents per thousand cubic feet.

Whenever a gas field was found productive enough to attract attention, the citizenship of the connecting markets actually planned through civic bodies how best to quickly dissipate the supply at a ridiculous price. Nor did the producing companies exercise a greater degree of intelligence at their end of the business.

The inevitable result came. The supply weakened; the factories, lured in by cheap gas, moved on; the real estate inflation collapsed; many cities awoke to learn too late that they had dissipated—actually given away—one of Nature's fine gifts to man.

The shortages which have occurred almost universally throughout the United States and Canada have alarmed the people. They are now awake, and they see ahead the loss of a vanishing fuel.

The arms of the pipe-lines have been flung, year by year, farther afield to get more gas to supply the shortages: enormous expenditures of money have been made in drilling campaigns and line extensions throughout almost all gas-using sections of the United States. Yet last winter there was actual suffering because of gas shortage. In Buffalo, after thirty-five years of continuous service, the Iroquois company has had to issue an order cutting off heating furnaces during three winter months, the supply being adequate only for cooking purposes during this period. This instance reflects the condition of the natural gas shortage throughout the United States. It forecasts exactly what soon would have occurred in Ontario if the Government had not taken steps to conserve the remaining supply of natural gas for household uses.

Throughout this section a few of the older gas fields, after years of service, are approaching exhaustion. Others still yield sufficient gas to give reasonable household service. The Tilbury field, by far the most important in size and production, has yet remaining, according to pressure measurement, one-half of its original supply, or about eighty billion cubic feet.

Three important problems must be effectively solved in treating this remaining supply so as to secure the greatest and longest-lived benefit to the gas-using public of Ontario.

First: The credit of eighty billion cubic feet of gas to this field holds true only under the most careful management of the wells. In the same stratum and immediately underlying the gas, is a body of salt water. A high rock pressure held this water in check, but as the pressure diminishes it ascends in the wells and must be pumped out, otherwise the flow of gas will cease. Hard pulls create sharp declines in pressure, and then the water becomes a menace. This field, to yield the estimated volume remaining, must be handled with extreme care. The pull must be gradual and uniform, otherwise the water will drown the field just as it did at Kingsville years ago.

Second: Perpetual vigilance must be exercised against waste in the production, distribution, and consumption of gas—a waste, as already pointed out, possible and even likely, in a multitude of ways. Further, gas must be restricted as far as possible to domestic use.

The third problem is one of cost, for the gas remaining in the Ontario fields is of no benefit to the consumer without efficient service, and this cannot be given unless a price, fair in the face of existing conditions, is fixed for the commodity. Service stands equally important with supply: they should go hand in hand, for either is worthless without the other.

The Possibility of New Fields

Also there is still another factor to be considered, apart from the conservation of the remaining supply of the present fields: and, under proper incentive, it may rank of even greater importance. It is the possibility of discovering new fields.

A large part of Ontario has been tested and condemned as gas-bearing territory, yet there are possibilities of opening new sources of supply by persistent exploration.

Wild-cattling for new fields is a hazardous and costly operation. It would be

an interesting story bearing directly upon future prospects, if the record of failures and their cost could be told. Unfortunately these facts are unavailable. An estimate based on data gathered from various sources shows that probably \$1,000,000 has been expended during the past two years in western Ontario in search of new pools. With the exception of a few wells in Dover township of unknown stability, this money has been lost.

Exploration for natural gas should be encouraged on the part of everyone. However, the present producing companies, because of their established business and the immense value of their fields, associated pipe-lines and markets, will expend by far the most money, time and energy in work of this character.

For them, new gas fields mean a longer life to their business; to the homes within pipe-line reach of such discoveries, they mean a continuing supply of an ideal fuel; to the whole Province of Ontario a tangible, valuable asset.

Yet no person or company, or the present producing companies, will hazard their money in wild-cat ventures without a reasonable assurance of an adequate return should gas be discovered. So thus a simple, though age-old, law of trade will regulate the quest of new gas supplies.

Every consumer each day burns up part of the actual property of the producing, transporting and distributing companies. The output of the fields each day is gone forever; no more is being created. It follows that a persistent and costly search for new gas is the method by which the supply may be kept continuous.

Samuel S. Wyer, of Columbus, Ohio, is recognized as one of the foremost authorities on natural gas in the United States. He states, in Bulletin 102, Part 7, issued by the United States Government through the Smithsonian Institution:—

In no case would it be prudent business or good judgment to attempt to conserve a waste of gas, or develop a new supply, that would not take care of the fixed charges on the investment and the operating cost during the life of the gas that is saved or developed, on the basis of the volume of gas that can be obtained from such an enterprise and measured through the ultimate consumer's meter at the present market prices. An adequate price is therefore the crux of the natural gas conservation question. Unless it is made worth saving by the public it will not be good business judgment to attempt to save it.

Since the hazards are greater than in any other mining enterprise, the profits ought to be correspondingly greater. This element of profit is the only incentive which impels men to engage in so speculative an enterprise. If, in the aggregate, this amount of profit does not measure up to the hazards in the business, the men will cease their work of prospecting and put their capital in safer enterprises. Wherever a close connection exists between effort and profit, a stronger resulting incentive is furnished for a further and continuous expenditure of effort. Therefore, a high rate of profit, which will induce men to prospect continuously for natural gas, brings about the condition that more people can use gas and represents a distinct saving to the community.

Natural gas has never been equalled by any man-made product. The worth of natural gas for most high-grade utility services is ahead of any competing commodity or utility service. The only thing that will effectively conserve the supply for future use, and thereby insure continuity of future service, is an adequate price commensurate with the worth or value of the service. Therefore, the public is served best when natural gas mining is made profitable.

The Welland County Gas Field

Welland county is the oldest producing gas field in Ontario, the first well being drilled in the township of Bertie in 1889. This field has produced during the past thirty years a very large quantity of natural gas, but an estimate of the

amount produced is not available for this Committee. The depth of the wells in the Welland field range from 500 feet to 900 feet, according to their location. Twelve deep wells have been drilled to the granite, a depth of nearly 4,000 feet, but only three of these wells have produced gas in sufficient quantities to justify their retention.

Practically all the gas in this field has been secured in the Clinton and Medina gas sands. The original rock pressure of the former was 360 lbs., and of the latter 510 lbs., to the square inch. It is doubtful if there is a square mile in the whole southern part of Welland county in which a gas well has not been drilled. The northern part of the county has also been thoroughly tested, but the wells in that part of the county produce very little gas, and the majority of holes drilled were dry.

The early history of the natural gas industry of this field is similar to that of practically all fields. The mistaken idea prevailed that because the early wells were large producers, the supply was practically limitless. This old but vital error was followed by a large measure of waste. Wells were sometimes allowed to remain open for a considerable time after being drilled in. Leaks in gas lines were not promptly repaired, and these, together with excessive drilling, resulting from undue competition, have had a serious effect on the available gas supply. The original rock pressures have dropped from 510 to 100 lbs., and from 360 to 45 lbs., but these pressures vary somewhat in different locations.

The most serious loss, however, in the field has resulted from the ridiculously low price at which gas was sold in the early days.

In 1892 the Mutual Natural Gas Company supplied the Erie Glass Company with gas at \$1,000 per year, and the only stipulation contained in the agreement was that the use should not exceed 200,000 cu. ft. per day, which would be about 1 2-3 c. per thousand cu. ft. Unfortunately for the glass company, but very fortunately for the gas company, this glass plant burned down within a year of its erection. Records which have been made available to the committee show that gas was first sold for domestic use for a cook stove and a heater at \$27.00 per year, without any limit upon the amount consumed. In a very large majority of cases this amount was the limit paid for gas used in a private residence, and as the facilities for burning the gas were very crude, the results were extremely wasteful.

In 1899 meters were first placed in the town of Port Colborne, and although the price charged was only 17½ cents per thousand cu. ft. there was a strong popular objection to the placing of meters.

In 1901 the price was raised to 20c., in 1907 to 25c., in 1909 another advance brought the price to 30 cents, and in 1915 the price was raised to 40 cents, and under a town franchise the price will be advanced this year to 50 cents net per thousand cu. ft.

During the history of the gas in Welland county many serious shortages have occurred, resulting in deplorable loss and inconvenience to the public. These conditions would not have been experienced had both the companies and the public exercised reasonable judgment in the use of gas, and had a price been paid commensurate with its real value. The cities of Niagara Falls and Welland have been

able to secure only a fraction of the gas they require for domestic use, notwithstanding the fact that the residents of these places would be prepared to pay almost any price if they could secure an adequate supply.

Haldimand and Norfolk Counties

The first well in the Haldimand district was drilled about 1889 in the village of Caledonia. The first wells drilled by the Dominion Natural Gas Company in this county were in 1905, and a line was laid to Hamilton the same year.

Gas fields are fairly well distributed throughout Haldimand county. The wells are shallow, averaging about 900 feet, and the cost of drilling is comparatively small. These conditions favoured the creation of many small operating companies, who engaged in a destructive competition to exhaust the gas as rapidly as possible.

In 1906 the Manufacturers Natural Gas Company, Limited, laid a line from the Selkirk field in Haldimand county to Hamilton. They produced no gas, but purchased their supply from local operators and sold it for industrial purposes. In the seven years from January, 1907, to December, 1913, this company marketed 5,494,402,000 feet of gas, almost all of it going to Hamilton manufacturers. The maximum was reached in 1910, when 967,548,000 feet was sold.

The Dominion Natural Gas Company has absorbed many of the small producers in this field, and purchases gas from most of the others. Competitive drilling has been largely eliminated, and every effort is made to keep the wells and fields in a condition of maximum efficiency. To maintain its supply it has, in the last three years, drilled 196 wells, 51 of which were dry holes.

A condensed statement of the condition of the field of the Dominion Natural Gas Company from 1915 to 1918 follows. Many wells were acquired by purchase during this time. If the original volumes and pressures of these wells were available, the statement would be still more impressive.

DOMINION NATURAL GAS COMPANY, LIMITED.

Summary of Open Flow of Gas Fields

Division	1915		1916		1917		1918	
	No. of Wells	Pro-duction MCu. ft.	No. of Wells	Pro-duction MCu. ft.	No. of Wells	Pro-duction MCu. ft.	No. of Wells	Pro-duction MCu. ft.
Simcoe	85	6,292	86	5,666	97	5,464	101	5,580
Tillsonburg	31	3,683	31	3,509	34	3,730	34	2,444
Onondaga					29	105	21	102
Blackheath	73	4,500	94	4,471	141	5,263	145	4,721
Dunnville	25	834	139	5,979	182	6,315	195	6,516
Selkirk	158	6,516	229	7,669	268	6,916	251	6,184
Total	372	21,825	579	27,294	751	27,793	747	25,547
Average Open Flow		58		47		36		34

The Tilbury Field

The Tilbury gas field is situated on the north shore of Lake Erie, forty miles east of Windsor. In 1906 it was discovered by the Leamington Oil Company while drilling for oil. This company is now the Canadian Gas Company.

About the same time the Volcanic Oil and Gas Company, in drilling on the Halliday lease, struck a gas well and from it laid a small-sized line to Chatham. Here it contracted with the Chatham Gas Company to distribute its output.

The Northern Pipe Line Company was then organized, and entered into a contract with the Leamington Oil Company to purchase sufficient gas to supply certain factories and all the domestic consumers of Wallaceburg: and it constructed a line to that place.

In 1909 the United Fuel Supply Company and the Ridgetown Fuel Supply Company were organized: each had secured leases in the field and was pushing development work. The United Fuel Supply Company made a contract with the Leamington Oil Company to purchase all of its gas other than that needed to supply Wallaceburg interests. It had also developed a supply of gas from its independent leases. A line was laid to Sarnia by this company, and the Sarnia Gas Company engaged to distribute the gas in that city under a percentage contract.

At the same time, the Volcanic Oil and Gas Company, having developed sufficient gas for the purpose, constructed a line to Windsor, and the Windsor Gas Company became the distributor under a percentage contract.

The Beaver Oil and Gas Company, from a small acreage in the field, supplied gas to Leamington. So rapid had been the development work throughout the field that in 1910 its limits were practically defined, although many inside locations remained to be drilled. It extended along the lake shore for nine miles, and averaged four miles in width running inland. Most of this area was owned and controlled by the Volcanic Oil and Gas Company, the United Fuel Supply Company and the Ridgetown Fuel Supply Company. Throughout the field their leases were intermingled, and in consequence offset wells were being drilled too closely. Under these competitive conditions each company had the incentive to produce and sell gas to the utmost capacity of its markets.

To eliminate wasteful competition, an amalgamation between these interests was planned and effected January 1, 1912. Included in this amalgamation was 60 per cent. of the capital stock of the Northern Pipe Line Company which had been previously acquired by the United Fuel Supply Company. This gave birth to the Union Natural Gas Company, which took over the assets and business of the Volcanic, the United Fuel, and the Ridgetown Fuel Supply Company. It was now thought that competition had been eliminated, and that the field was under the control and management of one company.

But in 1912 the Glenwood Natural Gas Company was organized by H. D. Symmes, and this company secured a lease on part of the Lake Erie front parallel to the gas field, and commenced the drilling of wells in the lake.

In 1913 H. L. Doherty and Company purchased the Glenwood Company, and also the Beaver Oil and Gas Company. The Doherty interests then organized the Southern Ontario Pipe Line Company, and built a line and transported gas to markets east of London.

Thus to-day the companies producing gas in the Tilbury field are:

Union Natural Gas Company.

The Glenwood Natural Gas Co. and Beaver Natural Gas Co. Associated.

The Canadian Gas Company.

The Pipe Line companies transporting gas are:

The Northern Pipe Line Company. (The Union Co. owns 60 per cent. of its stock.) This line gets its gas from the Canadian Gas Company.

The Southern Ontario Pipe Line Company. This company gets its gas from the Glenwood and Beaver Companies. It is owned by the Cities Service Company of New York.

The Union Natural Gas Company. The pipe lines operated by this company are owned directly by the Union Company, and are not subsidiaries, with the exception of the Northern Pipe Line, of which the Union owns 60 per cent.

The distributing companies for gas in the markets are:

At Windsor, The Windsor Gas Company. This company receives the gas at the city line from the Union Natural Gas Company and delivers it to consumers throughout its mains. The proceeds from the sales of gas are divided between the distributor and producer upon a percentage basis.

At Chatham, The Chatham Gas Company. Under the same plan as at Windsor, this company gets gas from the Union Natural Gas Company and distributes it in that city.

At Sarnia, The Sarnia Gas Company. In like manner this company acts as distributor for natural gas delivered to it by the Union Natural Gas Company.

At Petrolia: Here the Petrolia Utilities Company distributes for the Union Natural Gas Co., following the percentage division of receipts.

At Wallaceburg: The Wallaceburg Gas Company is distributor for the Northern Pipe Line Company.

At other small places supplied by the Union Natural Gas Company it owns the plants and distributes gas.

The Beaver Oil and Gas Company, Limited, sells gas to the town of Leamington on a percentage basis. The distributing plant in this town is owned by the municipality. Until recently most of the gas was sold at a flat rate per stove per month, regardless of the amount consumed. Now meters are installed for all consumers.

The Beaver Oil and Gas Company owns the plants and distributes gas in the towns of Kingsville, Wheatley, Romney, Merlin and Cottam.

The Southern Ontario Gas Company, Limited, owns the plants and distributes gas in a number of villages and townships west of the city of London. It also sells gas wholesale to the distributing companies in the cities of Brantford, Woodstock, Ingersoll, Paris and Galt. These distributing plants are owned and operated by companies under the same ownership as the Southern Ontario Gas Company.

This company formerly sold large quantities of gas to the Manufacturers' Gas Company, which distributed it to industrial users in the city of Hamilton. By reason of the orders of the Ontario Railway and Municipal Board, it is now doing only a small fraction of its former business.

Increasing Yield of Tilbury Field and Decreasing Pressures

	Million cubic feet	Average pressure
Waste (estimated)	2,000.0	
1907 Production.....	297.0	
1908 "	848.0	
1909 "	1,996.0	
1910 "	4,589.0	
1911 "	5,649.0	
1912 "	7,752.5	
1913 "	7,975.8	512 lbs.
1914 "	10,121.6	491 "
1915 "	10,819.1	475 "
1916 "	13,752.5	434 "
1917 (estimated).....	15,000.0	368 "
1918.....		330 "

Decline in Wells of Union Natural Gas Co.

The original open flow capacity of 111 wells was 177,944,220 cubic feet.

In the summer of 1915 a measurement of the same wells showed an open flow capacity of 90,097,280 cu. ft. This is equal to .5063 per cent. of original capacity.

In the fall of 1916 an open flow measurement of 124 wells, whose original capacity was 168,502,581 cu. ft., showed a capacity of 55,090,261 cu. ft., or .3269 per cent. of original capacity.

This year eleven new wells were completed whose combined capacity was 13,952,127 cu. ft., which brought the Union field capacity up again to 69,042,388 cu. ft.

In 1917 the open flow measurement of 119 wells was 50,799,204 cu. ft. To this was added the production of 13 new wells, of 7,365,897 cu. ft., making the total capacity of 132 wells, 58,165,101 cu. ft.

In 1918 the open flow was 39,865,452 cu. ft.

Life of the Tilbury Field

G. R. Mickle, Mine Assessor of Ontario and natural gas expert, and other authorities, estimate the future life of the field to be fifteen to eighteen years, providing the remaining gas is conserved for household use and the operation of the wells conducted in a careful manner.

We would refer in this connection to Mr. Mickle's report on the natural gas situation in the counties of Kent, Essex, and Lambton, issued in 1916.

Salt Water

The great enemy of natural gas is salt water. Occurring in most gas fields, it underlies the gas, gradually rising as the pressure is lowered. Many gas fields have been ruined by salt water while the pressure was still comparatively high.

This occurred in the Essex field which was drowned completely within a period of sixty days while the pressure stood at about 250 lbs.

While there are many measures (such as installing pumps on individual wells) which will prolong the life of a gas field so threatened, none of them are of any avail unless the demand on the field is reduced to such a point that the flow of gas to the wells does not draw salt water with it. Pulling gas from a field beyond its reasonable capacity will almost inevitably end its production abruptly, and will seal up in the rock, beyond all hope of recovery, millions of feet of gas which would otherwise have been available for use.

These considerations apply with the greatest force to the Tilbury field, where the salt water menace has already made its appearance, and where the utmost care in operation is necessary if the field is to give up its remaining gas for the service of mankind.

Compressor Stations in Tilbury Field

In 1913 the producing capacity of the Tilbury field and the demand for the gas was so great that compressing stations were erected. The use of these stations is to compress the gas to higher pressures and so increase the capacity of the pipe lines.

In the winter of 1916-1917 the Southern Ontario Gas Company was carrying a pressure of 325 lbs. on its pipe line, and was handling a maximum of 14,000,000 feet per day. At the same time it was maintaining 160 to 175 lbs. pressure on the field lines.

At that time the open flow capacity of its wells was over 45,000,000 cubic feet per day. At the present time the open flow capacity of the field is about 19,000,000 cu. ft., from which about 6,000,000 feet per day can safely be taken.

The pipe line can carry this quantity of gas with a pressure of 125 lbs. at the field, and since the field can maintain this production against 125 lbs. pressure, it is unnecessary to operate the compressing station.

The same conditions are true of the Union Natural Gas Company's system.

The following are the total open flow capacities of the wells of the Glenwood Natural Gas Co. and the Beaver Oil and Gas Company:

1916	56,554,000 cu. ft.
1917	46,385,000 cu. ft.
1918	30,096,000 cu. ft.

The Essex Gas Field¹

This field was opened in January, 1889.

There were numerous producing wells with a capacity of several million feet per day.

The first well at 1,020 feet struck a flow of ten million feet per day, and the rock pressure was four hundred and sixty pounds.

Another well sunk on the road by the Citizens' Gas, Oil and Piping Company of Kingsville, had a capacity of seven million feet per day.

¹ See "The Oil and Gas Fields of Ontario and Quebec," by Wyatt Malcolm: Geol. Survey Can., Memoir 81, 1915.

Then followed other wells of large capacity as follows:

On Lot 6, Con. 1, 6,422,000 at 1,030 ft.
 On Lot 7, Con. 1, 5,877,500 at 955 ft.
 On Lot 8, Con. 1, 5,700,000 at 990 ft.
 On Lot 9, Con. 1, 7,000,000 at 950 ft.

In December, 1894, a pipe-line to Detroit was laid and gas supplied to that city as well as to Windsor and Walkerville: also to towns and villages in the vicinity. Gas was also piped through an unused pipe-line from Detroit to Toledo.

In 1901 the United Gas and Oil Company of Ontario, the chief operator, owned ninety-five wells, fifty-two producing, twenty-one abandoned, and twenty-two dry holes. Five wells were being drilled in.

The Essex field was about one mile wide and five miles long, stretching along the Lake Erie shore.

The field was apparently not as well managed as it should have been, and many of the wells became choked with salt water.

The decrease in pressure during the winter of 1900-1 alarmed the citizens of Essex, and the Government was petitioned to prevent export.

An Order-in-Council was passed in October, 1901, revoking the license to export, and the practice ceased. The supply then rapidly fell off.

The Windsor and Walkerville customers were notified that their supply would cease on April 1st, 1904, and in this year the field was practically exhausted.

Between February, 1895, and July, 1901, the Essex field exported to Detroit 9,639,355,600 cubic feet, and produced, outside of what large amount was wasted in the early operation of the wells, 22,500,000,000 cubic feet.

CHRONOLOGICAL SUMMARY

Opening of field	January, 1889	} FIFTEEN YEARS.
Piped to Detroit	December, 1894	
United Gas had 52 producing wells	1901	
Pressures alarmingly decreased	1900-1901	
Export ceased	October, 1901	
Windsor and Walkerville supply ceased	April, 1904	
Field exhausted	1904	
	{ February, 1895	} SIX YEARS.
	1896	
	1897	
9,639,355,600 cubic feet	1898	
exported to Detroit	1899	
	1900	
	{ July, 1901	

Conclusions

Your Advisory Board have keenly felt the responsibility placed upon them, a responsibility that carries, with the recommendations we submit, the welfare and comfort of the gas-using public of Ontario, and what is equally important, the future life and stability of all the companies participating in serving natural gas to the people.

We have drawn freely upon the mass of data bearing upon the natural gas

industry in the United States. We have studied carefully the operation and results of the older gas fields of Ontario covering the past thirty years.

From this data, part of which is incorporated in this report, we are forced to the following conclusions:

That it is not only impracticable but impossible for the gas fields of Ontario and especially the Tilbury field, to yield, in the future, gas in the quantities which was produced prior to 1918.

That gas must be produced, transported, distributed, and consumed with the utmost economy: that also it must be restricted to household use, if the life of the field is to be prolonged, and the homes connected with the present pipe line systems are to continue to enjoy this incomparable fuel.

That while the fields were flush and the supply abundant, the home and factory were served with gas at prices lower than the cost of other fuels. Thus, the producers, transporters, and distributors shared with the gas-using public the benefits of their discovery.

Whatever earnings were made by the companies, a greater amount was saved by their customers which would otherwise have been expended for more costly and inferior fuel.

That if in future the remaining gas in the Ontario fields is conserved for domestic use the returns to the producers, transporters and distributors will be proportionately limited.

That the expense of operating a declining field is not lessened under this restricted output, but, on the contrary, constantly increases. It is obvious, then, that the gas companies cannot long continue to perform their respective functions—maintain equipment, explore for new fields, and give efficient service to the public, without a just price for their product.

It follows that an adjustment of rates must be made to meet these new conditions. The benefit of such adjustment will not be confined solely to the gas companies, but it will also be shared by the consumers.

APPENDIX

Waste of Natural Gas

The history of natural gas is a history of waste. Dr. I. C. White, State Geologist of West Virginia, says, "Of all the pieces of extravagance of which the American people have been guilty, perhaps their reckless and wasteful use of natural gas is the most striking—not the most important—but the most striking. This product, severely limited in quantity, which can last only a few years at most, has been handled by us as if it were illimitable."

C. R. Van Hise, in "The Conservation of Natural Resources of the United States," says, "In reference to natural gas, the great and pressing necessity is to stop its appalling waste by enacting and enforcing proper legislation. This ideal fuel should be used with the severest economy in order to prolong its life, which will be brief at best."

Natural gas, like all natural products which are utilized by man, must go through the processes of production, transportation, distribution, sale and consumption, or utilization. In the simplest case, which need not be considered here, the producer and consumer are identical, eliminating some of the intermediate processes.

Every one of these processes is accompanied by waste, as the operation of a machine is accompanied by friction. By proper design and construction, friction in machinery can be reduced to any desired minimum. In the same way waste of natural gas can be cut down. If a machine must be marketed at a low price, it is impracticable to make it as easy running as a similar mechanism selling at a higher price. For the same reason the waste in handling natural gas has always been greater than that of manufactured gas, which commonly sells for several times as much.

The waste in the early history of the natural gas business was inevitable from the circumstances which attended the development of the field. There are close analogies in the history of other industries. The pioneer settlers of this country cleared the forests from the land, and burned the logs and brush to get them out of the way. If lumber had been worth its present price, this would have been an appalling waste. But the imperative need was for land, and there was a seemingly inexhaustible supply of timber, so their action was logical and inevitable. The natural gas industry has progressed from a condition of abundance to one of scarcity in a fraction of the time required by the lumber industry, but the steps have been exactly the same.

Unfortunately there is one striking difference between the lumber and natural gas industries. Scientific forestry effects a perpetual production of timber. The best that can be done with natural gas is to so conserve the remaining supply that as little as possible of it will be lost, and to direct its use so that it may be made of the greatest possible service to the communities which enjoy its benefits.

The Waste Problem in United States

The Smithsonian Institution at Washington has issued a comprehensive bulletin on natural gas. This bulletin goes much more thoroughly into the subject than would be possible for this committee in the limited time at its disposal. The liberty has been taken of quoting from this paper certain paragraphs relating to the waste of gas. Sections which do not apply to Ontario conditions have as far as possible been omitted, and comments have in some cases been added.

True conservation is not hoarding, but the wise use of natural resources, and it implies not merely the preserving in unimpaired efficiency, but also a wise and equitable exhaustion with a maximum efficiency and a minimum waste. The heart of the natural gas conservation problem is the conflict between the present and the future. The individual land owner is interested primarily only in immediate present personal returns. That is, he is thoughtless and indifferent with respect to the future. The public—at least the domestic natural gas consumers, and the people dependent on natural gas for their cooking, heating and lighting purposes—are interested in conserving the supply and bringing about a slow, wise and economical exhaustion, so as to insure continuity of service for the future.

Conservation, therefore, demands intensive rather than extensive use, takes cognizance of equitable distribution, aims to bring about social justice, and means the greatest good to the greatest number—and that for the longest time.

Most of the supply and service problems of to-day are the inevitable result of waste in producing and handling natural gas. The annual reports of the Conservation Committee of the Natural Gas Association of America are stinging indictments of a criminal system, fostered by both the gas companies and the public, which has resulted in wasting more gas than has ever been utilized.

The various forms of waste may be grouped under drilling, well operation, transmission, and utilization operations.

Drilling Wastes:—

1. Not closing wells promptly:—Much gas is wasted on account of delay in closing wells, caused primarily by poor judgment and failure to supply material promptly. In many cases the rock pressure over quite a district has been materially lowered by the delay in closing properly a single large well in that section.

2. Improper Casing:—There is much underground waste by improper casing methods, which allow gas or water to migrate from their original strata into other strata. This is an especially important feature in the West Virginia fields, where in many instances several gas-bearing formations are superimposed with intervening barren formations.

3. Waste of gas to air:—As a result of improper casing methods gas frequently works up around the packer or into the casing above the packer and is wasted in the air.

4. Gas waste in well-drilling boilers:—Most gas burning appliances used in well-drilling boilers are crude and inefficient, and gas is handled as if it had practically no value and were of little use to other people.

5. Waste of gas in torches:—A large number of open-flame (flambeaux) torches are still in use. Not only is this an inefficient and therefore wasteful method of securing illumination at night, but in many instances the torches are not shut off during the day.

6. Offset wells:—The drilling of offset wells is not only frequently a waste of capital, resulting from over-drilling, but very frequently results in marked waste of gas.

7. Improper plugging:—Where a well is abandoned and the casing pulled, if the hole is not properly plugged, it may result in the ruination of other gas-bearing formations by the migrating of gas or water from one to the other, or the very great waste of gas leaking into coal veins or coming up and passing out into the air.

These sources of loss were important in the early days of the Ontario fields, but all responsible operators are now fully aware of them and do their best to keep them down to the lowest possible point.

Well Operation Waste:—

1. Wasting gas to get oil:—Where oil and gas are found in the same field it is quite a general practice for oil operators to blow off the gas, that is, waste it, in order to procure the oil. This is the principal cause of the depletion of many gas fields, and is responsible for a greater volume of gas waste than probably all other causes put together.

There is very little gas wasted in this way in Ontario at present.

2. Excessive blowing:—Where wells are blown into the atmosphere for water-freeing purposes, the gas must, of course, be wasted. However, in many cases the wells are blown longer than necessary, and in others it would be feasible to install siphons for the removal of the water so as to curtail this form of waste.

Most wells in Ontario are now equipped with siphons or pumps.

3. Salt water troubles:—In some instances salt water exists in the gas-bearing formation and in others it works in from other strata, due primarily to improper drilling and casing methods. This results in a large waste of gas when the wells must be watered to free them of the salt formation below in the tubing.

4. Too rapid lowering of the rock pressure:—The irregular or too rapid lowering of the rock pressure by exceedingly rapid production will always produce undesirable operating conditions, and must ultimately result in a large waste of the total amount of gas that might have been removed with more rational operating methods.

This last is the principal source of danger to the Tilbury field. The remedy is only partially in the control of the producer. The demand of the public must be reduced until the field can supply it with safety and efficiency.

Transmission Wastes:—

Gas leakage:—The difficulty in keeping gas joints tight is not ordinarily appreciated and results in an enormous waste from defective joints and minute openings in gas-carrying equipment. The laws controlling gas leakage may be stated as follows:

1. The relative leakage tendencies of any two fluids under the same conditions are practically inversely proportional to the square roots of their respective densities. Natural gas has a density of practically 0.64. With regard to air, the relative leakage of air and natural gas will vary as the square root of 1 and square root of 0.8, or as 1 is to 0.8. That is, the leakage tendency of natural gas will be $1 \div 0.8$ equals 1.25 times that of air under similar conditions. Water has a density 819.5 times heavier than that of air; hence leakage tendency of natural gas in comparison to that of water at the same pressure is much greater than that of water. This accounts for the universal difficulty in keeping gas confined without leakage.

2. The quantity of leakage through a given opening will vary directly as the square root of the differential pressure.

3. Amount of leakage is independent of the quantity or velocity of gas passing through the main. In other words, the pressure remaining the same, the leakage will be just as much during the period of low gas consumption as during the period of high gas consumption.

4. A typical gas main joint coupling has four surfaces adjacent to the rubber and the metal where leakage may be possible. On a 16-inch main each coupler presents about 17 linear feet of such potential leakage surface. The magnitude of this in a large system is evident when we consider that about 270 couplers will be required to the mile, thus making 270×17 equals 4,590 feet of possible leakage surface to the mile of a 16-inch gas main.

The importance of this question of leakage cannot be overestimated. There are no exact figures obtainable, but it is probable that less than 75 per cent. of the natural gas produced in Ontario reaches the consumer's meter, and a large percentage of the gas metered to the consumer is lost in the house piping.

Until very recently the devices for measuring gas in large quantities were inaccurate and unreliable, but meters are now on the market which will measure any quantity of gas with any required degree of accuracy. In order to prevent the waste of gas through leakage, accurate measurement is necessary. Gas should, wherever possible, be measured from the fields to the pipe-lines, and from the pipe-lines to the distributing plants. In this way the leakage can be located and determined, and the effectiveness of such measures as are taken to remedy it will be apparent.

Utilization Wastes:—

Flat rate:—Much natural gas is still sold at a flat rate of so much per consumer, or so much for each fire or other fixture. This puts a premium on waste, and results in the destruction of an enormous amount of gas that might be conserved for more intelligent and appreciated future use.

Cheap gas for manufacturing:—When natural gas is sold at low prices for industrial use, there is no incentive to use the gas in an efficient manner, and it is therefore quite frequently used without regard to efficiency or conservation. This is probably the largest form of waste in connection with utilization of natural gas.

Free gas:—In many cases boom towns in the gas fields have held out the inducement of supplying either free gas, or the gas has been sold at ridiculously low prices for industries that would locate there. This feature has been especially troublesome in West Virginia, and has resulted in depriving many domestic consumers of an adequate supply of the best fuel available for household use.

In an extensive investigation of the amount of gas consumed by domestic consumers in West Virginia having free gas service privileges on account of having gas wells or gas lines on their farms, it was found that the average consumption per free consumer a year was 480 thousand cubic feet. This is a waste of at least 350 thousand cubic feet for each consumer a year. There are at least 4,400 free consumers in West Virginia, and at this rate of waste this item alone amounts to 1,540,000 M cubic feet a year. This is more than half the amount of gas used in Louisville. The following further emphasizes this form of waste:

Average annual consumption for each free domestic natural gas consumer in West Virginia, 480 M.

Average annual consumption for each domestic natural gas consumer in the United States, 100 M.

Average consumption for each domestic consumer at Louisville, 53 M.

These considerations apply with equal force in Ontario.

Carbon black:—This is a form of improper use rather than absolute waste. The carbon black industry in West Virginia uses 50 per cent. more gas than is furnished to all of the domestic natural gas consumers in that State.

There is no carbon black made from natural gas in Ontario.

Inefficient Use.

On account of the low prices that have prevailed, gas-appliance manufacturers have not been stimulated to the development of efficient gas-using equipment. There have been few improvements resulting in increased efficiency in the last fifteen years. In testing house-heating furnaces it has been found that:

1. The use of natural gas in the fire-pot of a coal furnace gives an efficiency of about 25 per cent.

2. The use of natural gas in the ordinary gas furnace gives an efficiency of about 35 per cent.

3. The use of natural gas in a correctly designed and built gas furnace where the construction conditions permit the fullest utilization of the heat in the gas, gives an efficiency of about 75 per cent.

In tests made by the Bureau of Standards, it was found that the ordinary incandescent mantle lamp when used with natural gas wasted nearly half of the possible heat that could be used if such lamps were designed for efficient operation on the high heating value natural gas as they give on the low heating value manufactured gas.

In tests made by the Department of Home Economics Ohio State University, the efficiencies of a natural gas range varied from 37 per cent. down to 13 per cent., while with a manufactured gas range, using natural gas, the efficiencies varied from 43 per cent. to 23 per cent.

Thermostat control:—Thermostats for controlling house-heating appliances are out of the experimental stage, and the large number in use demonstrates their reliability and usefulness. In addition to ministering to the comfort of the house occupants, they aid very materially in conserving the gas consumption by preventing over-heating.

Where natural gas is sold at low prices the practice is still all too common of lowering the temperature of an overheated room by opening a window rather than by lowering the gas fire.

Under present conditions the loss, whether by leakage or by inefficient or improper use, of a thousand feet of gas means to the public the loss of one million heat units of valuable fuel. But whether the loss falls upon producer, transporter, distributor, or consumer, it means to him the loss of so much money, and he will expend time and money in preventing or remedying the loss of gas only in proportion to the monetary loss to him. This is doubtless improper and unethical, but it is a condition which cannot be changed, and gas will continue to be wasted until an adequate incentive is provided for its conservation.

Prevention of Excessive Drilling

The discovery of every new gas field is invariably followed by a rush of prospectors and speculators. The persons or company first making the discovery may have used every care in protecting themselves by securing leases, but no matter how careful they may have been, there are always pieces of land here and there that have not been leased, and these often very close to the gas well just opened.

There are two distinct classes of persons in the gas industry, first the prospector, and secondly the speculator. The former invests his money in an honest effort to discover gas, from the returns of which he hopes to prosper. He sometimes risks all he has, and if he is fortunate enough to discover a new gas field, he is entitled to every reasonable protection. The man who is purely a speculator waits until the prospector has made the discovery, and at once sets about to reap a great measure of the benefits which belong of right to the latter.

Not only is the discoverer of natural gas or any other natural product entitled to proper protection, but in the case of natural gas one of the greatest, if not the greatest, loss it has sustained has been through excessive drilling resulting from



Drilling a gas well.

unfair and unwise competition. Many valuable gas pools have been ruined in a short time by the drilling of wells too close together, thus bringing about a premature exhausting of the supply. It has been thoroughly established that a too rapid depletion of a gas field materially reduces the quantity of gas that it will



First operation of tubing a seven million well, 3-inch tubing being used.

produce if judiciously handled. Water, the great enemy of natural gas, seems always to be waiting for the day when persons or companies start a gas war and rapidly exhaust the field pressure. That is the time when the water will rush in

and take possession, to the exclusion of nature's greatest fuel. Such conditions mean not only a great material loss to the gas companies, but a great injustice to the public, as well as a serious loss to the consumers of natural gas.

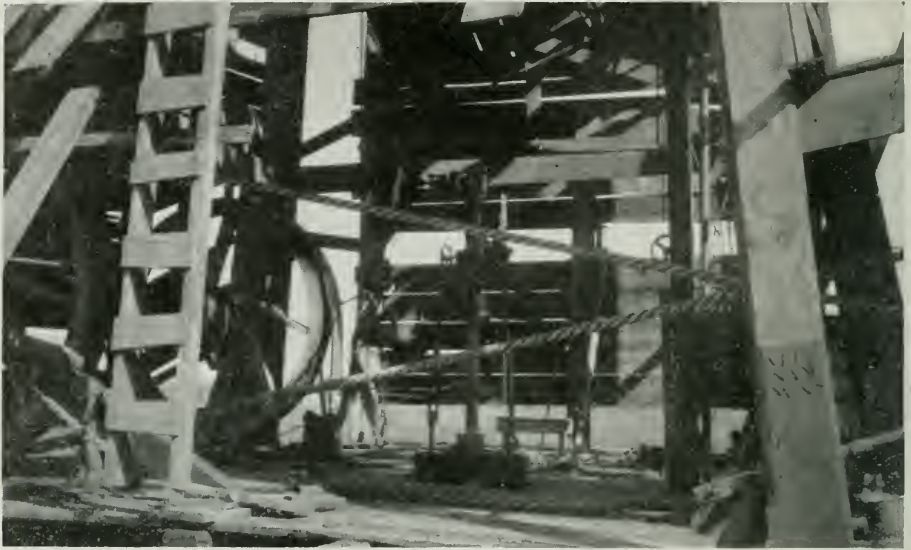


Swinging a length of 3-inch tubing to place over the high pressure gas flow.



"Bucking up" the tubing. "No sleep until the well is closed in."

We believe that suitable legislation might be adopted that would result advantageously to the gas companies and the public generally. With this object in view we have tried to bring to bear upon the subject both our observation and our experience. We appreciate the difficulty in laying down a hard and fast rule for the



Well tubed and closed in.



Gas well after derrick is removed. Ready to turn into the line.

101

control of matters of this kind, but we believe that the object to be attained is of sufficient importance to justify the establishing of a few simple restrictions in order to minimise this great waste of wealth, and at the same time afford a measure of protection to the prospector.

Prospecting for natural gas may be divided into two kinds, first the opening up of an entirely new field, and secondly, the developing of a gas field already fairly well defined. Some difficulty may be encountered in fully establishing what may be properly called "a new field"; distance, however, must always be considered when determining this question. Where new gas wells are opened sufficiently close to wells already in operation, to permit of the supply being delivered to points already supplied or capable of being supplied by such wells, the new wells should be treated in the same manner as the wells already drilled. On the other hand, if an entirely new field not adjacent to an old field is opened up, special consideration might well be given to the discoverers of gas so as to enable them to dispose of their product at a profit, without being placed under the same restrictions as a person or company operating in an old territory where the market is more accessible and fairly well defined.

We would suggest that no person or company be allowed to drill a gas well within one hundred to one hundred and sixty rods from any gas well drilled by any other person or company excepting by consent of the latter. This arrangement would afford reasonable protection to the prospector, and would also result in prolonging the life of the field, to the advantage of the public. If this plan should be adopted we believe reasonable consideration should be given to the farmer or farmers who might be prejudicially affected thereby, and the following suggestion might, we believe, meet such cases: Where a person or company is the actual lease holder at the time of drilling of a farm containing not less than twenty-five acres, and where such person or company is prevented drilling thereon, under the foregoing plan, the person or company being protected thereby might be required to treat the owner of such farm as if he or they had actually drilled thereon.

We realize that in the control of the gas industry, as well as all other public utilities, it is desirable to establish as far as possible a friendly relation between the producer and consumer, and to make only such regulations as will be most conducive to bringing about such friendly co-operation. In our suggestion herein we have endeavoured to give the greatest measure of consideration and protection to the prospector, the consumer and the farmer from the operation of whose lands the gas supply is almost entirely secured.

Adjustment of Rates

In view of the depletion of the present gas field, and the increased cost of operation owing to the low pressure and the pumping of the wells to keep them clear of salt water, the conservation of the gas as far as possible for domestic consumption, and the lengthening of the life of the gas field for domestic consumers, the price of gas in the past being low in certain localities, we believe that the prices should be adjusted commensurate with the extra expense, so as to make a fair return to the producer, transmitter and distributor.

In making an adjustment of rates, the interests of producers, distributors and consumers, together with the different localities affected, should be taken into consideration.

Enlarging on the above paragraph, we have conditions in Ingersoll, Woodstock, Brantford, Paris, Galt, and Hamilton, quite different from those in the western part, in Chatham, Leamington, Kingsville, Essex, Sandwich, Merlin, Ridgetown, Comber, Glenwood and Windsor. In the former places the prevailing price of gas at present is 45 cents net, while in the latter places it is 25 and 30 cents net. True, the pipe-line is longer in the former places than in the latter, but not to so large an extent as the difference in the price of gas would suggest. For example, in Windsor, which is 45 miles from the field, gas is 30 cents a thousand feet, without meter rent, while in Woodstock, which is twice the distance from the field that Windsor is, the price is 45 cents net and 17 cents meter rent. Taking the price of gas in Chatham as the standard field price, 25 cents, then Windsor is paying 5 cents for pipe-lines, while Woodstock and places east are paying 20 cents for their pipe-lines, and also meter rent.

The standard rate which may be fixed for any municipality should include all service, meter or other charges in connection with such meters. We have the following meter rents and service charges at present:

Town.	Meter Rent.
Windsor	Nothing.
Chatham	\$0.20 per month.
Ridgetown	1.00 per year.
Hamilton .....	.50 per month.
Essex .....	.20 per month.
Kingsville	1.00 per year.
Leamington	1.50 per year.
Ingersoll .....	.15 per month.
Brantford .....	.20 per month.
Woodstock .....	.17 per month.
Galt .....	.10 per month.
Paris .....	.10 per month.

A glance at the above figures should be sufficient to show that if any service charge is made it should be added to the price of gas, after due consideration is given to all concerned as between distributor and producer.

When adjusting any rate the fact should be considered that there are three companies operating in the western fields having three sets of operators, three sets of inspectors, and three sets of other employees, being paid out of the profits of the gas fields and indirectly by the consumer. In comparing natural gas with coal as fuel necessary for domestic use, we find in G. R. Mickle's Report,¹ page 5, that 24,000 feet of gas is equal to a ton of coal, and the following relation between prices can be seen, viz.:

Natural Gas at 10c. per 1,000 cubic feet equals	Coal at \$2.40 per ton.
" " " 15c. " " " " " " " "	" " " 3.60 " "
" " " 20c. " " " " " " " "	" " " 4.80 " "
" " " 25c. " " " " " " " "	" " " 6.00 " "
" " " 30c. " " " " " " " "	" " " 7.20 " "
" " " 35c. " " " " " " " "	" " " 8.40 " "
" " " 40c. " " " " " " " "	" " " 9.60 " "
" " " 50c. " " " " " " " "	" " " 12.00 " "

¹ The Natural Gas Situation in the Counties of Kent, Essex and Lambton, 1918, p. 4.

Comparing the above figures with the prices paid for coal in the various municipalities using gas and coal, we have the following table:

Municipality	Miles from the field	Price Paid for Gas	Average price of coal for last five years	Meter rent paid for service charges
		c.	\$ c.	\$ c.
Windsor	45	30	10 00	None
Chatham	20	25	"	.20 per month
Ridgetown	25	25	"	1.00 per year
Essex	30	25	"	.20 per month
Kingsville	30	25	"	1.00 per year
Leamington	20	25	"	1.50 per year
Ingersoll	90	45	"	.10 per month
Woodstock	100	45	"	.17 per month
Paris	115	45	"	.10 per month
Brantford	130	45	"	.20 per month
Galt	150	45	"	.10 per month
Hamilton	150	.....	"	.50 per month

The above figures and facts give ample proof that an adjustment of the price of natural gas in the various municipalities using same is necessary, especially as natural gas will not be used for general heating if its price is much higher than that of coal required to do the same work. Therefore, when there is a sufficient supply of gas for all domestic purposes, the price of coal and other fuels should be taken as one of the factors in fixing the rates, excepting in the Welland and Haldimand fields, in which the gas supply has already passed the point where the price can be made to conform to that of other fuels.

Where any gas is allotted for uses other than domestic, the price charged for same should be equal to that charged for domestic use.

Basis for Rate Adjustment

For a number of years there has been a country-wide demand throughout the United States by public utilities companies for higher rates. This has led to careful search for correct methods on the part of public service commissions, courts, and other authorities dealing with the subject.

At first some confusion of ideas arose because of requests for increases based on capitalization, bonded indebtedness, comparison of service rendered with like service, and many other grounds peculiar to the business of the applicants. Many companies were over-capitalized, and a few were under-capitalized. Some were bonded to the limit; others had no indebtedness.

In the United States the courts and public service commissions have everywhere recognized the necessity of giving relief to utility corporations whose earnings were insufficient to enable them to give satisfactory service to the public; and it was also held that every company was entitled to earnings from its business.

This broad principle has been adopted, and has been endorsed and sustained by courts and public service commissions. Its simple directness needs no explanation, and its fairness is beyond question.

Every public utility company is entitled to a reasonable return upon the value

of the property actually used in the public service as determined by competent appraisal.

In support of this principle the following cases are cited:

In the case of the Board of Trade of Malone *vs.* Mountain Home Telephone Co. before the Public Service Commission, 2nd District, New York, reported in Volume V of the reports of the Public Service Commission, 2nd District of New York, page 74, the Commission unanimously decides (see pages 81 and 82) as follows:

The Company is entitled to a reasonable average return upon the value of the property actually used in the public service, and the necessity for making reservation out of income for surplus and contingencies must also be considered. The complainant desired to show that a large part of the capitalization of the Adirondaek Home Company did not represent money actually paid. This evidence was rejected on the ground that the question before the Commission was whether the rates yielded more than a *fair return on the actual value of the property*, not whether they yielded a return upon the *present or past* capitalization. The complainant also contended that a large portion of the present property of the Mountain Home Company was built up out of gifts made to the Adirondaek Home Company or to Ward, and out of the income of the Adirondaek Company. Inquiry into this was also excluded by order of the Commission made September 30th, 1915, wherein the Commission held that the basis for rate-making must be the *value of the property used in the public service*, and that it is immaterial whether that property was acquired by the issuance of capital, out of income, or otherwise. The first inquiry must therefore be as to the actual present value of the property of the respondent devoted to the public service.

Re Exeter, Hampton & Amesbury Street Railway Case, D-481, May 28th, 1918.

The Commission, in approving proposed fare schedules, reduced the fare zones of the Company from Exeter to Hampton Beach from 4 to 3, and increased the rate from 7 to 10 cents. The Commission said:

The property has never been a paying proposition. It is an inexorable law of economics that capital will not flow to an undertaking which has demonstrated that it cannot be made to pay the investor a fair return. In this particular case the stockholders not only have not received a fair return, but have received no return at all. The increased costs of operation for the present year over even the abnormal costs of last year make the financial outlook for this company anything but cheerful. In this extremity, the Commission is inclined to give the company great latitude in the establishment of rates in the hope that it may hit upon some schedule which will bring about the necessary relief to prevent the loss altogether of this service to the public. It is perfectly apparent that if enough revenue cannot be derived to pay operating expenses, the upkeep of the property, taxes and interest charges, besides the fair return to the stockholders, the company must necessarily eventually go out of business.

We quote also a decision of the Railroad Commission of the State of California in the matter of an application by the Pacific Gas and Electric Company for an order increasing rates for manufactured gas. The case affected upwards of 50 cities and towns in the State, including San Francisco.

OPINION.

EDGERTON and DEVLIN, Commissioners:—

These proceedings together involve the fixing of just and reasonable gas rates for all the territory served by the Pacific Gas and Electric Company outside of the city and county of San Francisco, other than for wholesale service of gas to the city of Palo Alto.

There is here presented an emergency in the financial condition of the company. The marked and sudden increases in the costs of producing and distributing gas have resulted in such a diminution of the net income of the company as to seriously embarrass it unless it had through an increase of rates. These increases in costs have been wholly beyond the control of the company.

The principal item is oil used in the manufacture of gas. The price of this commodity is unregulated, and apparently advances in price are made at the option of the large oil

producers. These large producers will make no contracts at fixed prices for oil, hence gas companies such as applicant are unable to avoid paying whatever price is demanded.

This oil is absolutely essential to the manufacture of gas, and as the producers of the oil increase their price, gas companies must either suffer the loss caused thereby, or rates paid by consumers of gas must be increased.

The gas companies cannot absorb this extra cost and remain sound financial institutions capable of properly serving the public. Therefore this Commission has no choice other than to place this additional burden upon consumers.

We suggest that now, while it is at all possible to increase rates to take care of the mounting costs of producing gas and still fix rates which are possible for consumers to pay and continue the use of gas, nevertheless, it is easily possible that unless steps be taken to regulate the price of oil we may be confronted with a condition where gas rates can no longer be substantially increased, and the companies will be left in the condition of serious financial jeopardy.

Wages of employees have been increased and may be increased still further. This is to be expected, because the cost of living has increased to such a marked extent that the managements of utility companies cannot and should not refuse reasonable increases of wages to meet living conditions, as well as to meet competitive labour conditions.

The costs of practically all materials used in the manufacture and distribution of gas have increased, and there is no assurance that still further increases will not be made.

The above considerations clearly establish this application as an emergency proceeding. The war has produced abnormal business conditions which affect the business of producing and distributing gas, as it has affected all other business, and where the utility service is under regulation and the prices at which the service is sold to the public are dictated by public authority, the companies are helpless, unless public authority will extend prompt relief.

Entirely aside from the question of justice and fairness to the owners of these utility properties, it is seriously to be considered that, unless the public utility companies are maintained in a reasonably sound financial condition, they will no longer be able to serve the public efficiently, as it is a demonstrated fact that a weak and staggering company is incapable of producing good service.

The value of properties used in the service of gas in the Vallejo District, as of January 1st, 1915, is set forth in Decision No. 2444, Case No. 638, decided June 4th, 1915. The value of the properties in the Marin District, as of June 30, 1914, is set forth in Decision No. 2460, Case No. 544, decided June 27th, 1915. In Decision No. 2530, Case No. 665, decided June 26th, 1915, no finding of the value of the properties of the Company used in the service of gas in Los Gatos was made, but there is evidence in this proceeding valuations by both the Company's and the Commissioner's engineers, as of December 31st, 1914. In Decision No. 2572, Case No. 478, decided July 8th, 1915, the Commission made its findings of the value of the property of the Company used in the service of gas in the city of San Jose and suburbs, as of December 31st, 1913. In Decision No. 4039, Cases No. 724 and No. 935 and Application No. 2419, decided January 20th, 1917, the Commission reviewed the gas rates in the Petaluma and Santa Rosa Districts of the Company, and the evidence in these proceedings includes the valuations made by both the Company and the Commission's Engineering Department.

It was agreed in the hearings herein that the evidence submitted in these earlier proceedings be considered as part of the record of the matter now before us.

There is also before the Commission in this proceeding a valuation of the Sacramento gas properties of the Company made by Mr. E. C. Jones, which has been reviewed by the Commission's Engineering staff.

In Cases No. 785 and No. 990 and Application No. 3092, a joint valuation of the generating and transmission properties of the Company in the Alameda County District was made by Mr. E. C. Jones, representing the Company, and Mr. G. S. Jacobs, representing the Commission's Gas and Electric Department, which also included the distribution properties in San Leandro, Hayward and contiguous territory, and in the city of Richmond and suburbs.

For all properties located in other cities and towns included in these proceedings, the Company has submitted the valuations made by J. C. White Engineering Corporation, as of December 31st, 1911, and has filed in evidence statements showing the net additions and betterments according to its books in all these districts, from the dates of former valuations up to and including the net additions and betterments for the year ending December 31st, 1917.

In addition to the above, the Company has submitted evidence as to the value of the lands used in gas operations, of the general capital of the Company pro-rated to the Gas Department, and estimates of working capital and materials and supplies for the year ending August 31st, 1918.

There is before us, therefore, sufficient evidence to fix the valuations of the properties for the purpose of these proceedings.

INDEX VOL. XXVIII, PART I

A.	PAGE
A. A. Robins Mining Co.	85
Abitibi lake, gold	7
Abitibi river, limestone	77
Abitibi Pulp & Power Co.	150
Acacia, Ont.	68
Accidents.	
Patricia Syn. gold mine	116
Report on	96-103
Aeme Engineering Co.	84
Aeme Gold Mines, Ltd.	13, 126
Aerage tax	87
Actinolite.	
Statistics	2, 4
Uses	48
Acton	43
Adair gold claim	130
Adams, J. H.	54
Adanac Silver Mines, Ltd.	15, 131
Adirondack Home Co.	226
Advisory Gas Board	
Report by, on conditions of Natural Gas in Ontario	193-227
Appointment of: members	63
Aetna Gold Mines, Ltd.	84
Africa, nickel	27
Agnew, J. H.	54
Aikenhead, J. B.	131
Aikins, W. J.	56
Ailsa Craig, Ont.	43
Airgiod silver mine	149
Aitchison, Jas. A.	137
Alabama, U.S., graphite	51
Alabastine Co.	165
Aladdin Cobalt Co.	
Development work: officers	132
Dividends	20
Operating	15
Production	145
Profit tax	87
Albertite	92, 93
Aldershot, Ont.	37, 38
Alderson, W. P.	146
Aldrich Gas & Oil Co.	56
Alexander, W. Murray	146
Alexandra silver mine	141
Alexo nickel mine.	
Development work: officers	131
Notes on	25
Operating	24
Production	22
Alfred peat bog	187, 188
Algoma dist.	
Mining revenues	86
Algoma Pyrites Co.	82, 84
Algoma Steel Corporation.	
Accident at mine	98-101
Coking plant	34
Helen m. owned by	31, 32
Iron mining:—	
<i>See</i> Helen m.	
Magpie m.	
Algoma Steel Corporation.— <i>Con.</i>	PAGE
Iron pyrites mining	82
prospecting	105
Notes; officers	173
Spiegeleisen production	33
Algonquin National Park.	
Hardwood for fuel	187
Allan's, Limited	55
Alley, J. A. M.	130
Allied Gold Mines, Ltd.	
Capital; date of charter	84
Work by	115
Alloy Steel Works, Ltd.	84
Alma tp., gold prospecting	83
Alta, J.	98
Alvinston brick plant	37
Amabel tp., gas wells	66
America. <i>See</i> United States.	
American Cyanamid Co.	40, 41
Work by, near Ingersoll	166
Amherstburg	46
Amos, A. A.	117
Analyses.	
Mica, Davis tp.	160
Tariff of fees for	89
Telluride of gold	93
Aneaster	68
Anderson, A. J.	114
Anderson, Mr.	25
Anderson, Walter	52
Anderson, William	131
Anglo-American Tale Corp'n.	80, 81
Angus, D. H.	15, 117, 117
Ankerite gold mine	10
Annis, George	41
Anrep, Aleph.	
Peat plant of	191
<i>See also</i> Moore-Anrep peat machine.	
Appleton, Mr.	114
Armstrong, C. J. B.	145
Armstrong, J.	100
Armstrong Brick & Tile Co.	35
Armstrong Bros.	37
Armstrong Supply Co.	44
Armstrong Whitworth Co.	155
Arner, tile plant	43
Arnprior, brick plant	37
Arsenic statistics	2
Arthur, tile plant	43
Asbestos statistics	4
Ashley, L.	155
Ashton, Thos.	44
Asquith tp., gold mining	83, 130
Assay office. <i>See</i> Provincial Assay Office.	
Assays.	
Tariff of fees for	89
Associated Goldfields Mining Co.	
Capital; officers; work by	122
Associated Goldfields of Ontario, Ltd.	
Work on Larder Lake g.m.	10
Associated Goldfields of Western Aus- tralia, Ltd.	15

	PAGE		PAGE
Atkinson, Mr.	103	Bedford, John	137
Atlas Gold Mines, Ltd.	129	Bedford tp., mica mining	51
Attercliffe	68	Beech for fuel	187
Attie Lake Mines, Ltd.	84	Begg, J. B.	43
Atwood cement plant	42	Belanger, Arthur	55
Auto Oil Co.	84	Belknap, S. F.	175
Aylmer, Ont.	68	Bell, J. H.	175
Azoff Natural Gas Co.	56	Belle River	68
		Belle River oil-field	76
		Belle River Oil Co.	84
B.		Belleville.	
Bache, J. S.	123	Blast furnace	175
Baden tp., gold prospecting	83	Cement plant	42
Bagot tp., celestite	79	Quartzite	114, 173
Bagshaw, Geo. A.	120	Bellevue.	
Bailey, E. W.	165	Quartzite mining near	114
Bailey fluorite mine	156	Bellew, H. C.	48
Baird, Frank B.	171	Bellyou, Norman E.	44
Baird & Son, H. C.	37	Belmont, brick plant	38
Baldoon	68	Gas piped to	68
Baldwin gold mine	115	Bennett, A. G.	116
Ball, F. W.	151	Bennett gold claims	130
Baneroft Marble Quarries, Ltd.		Beno, J. W.	
Capital and date of charter	84	Notes by, on Kent gas field	60
Quarrying notes	164	Benoit tp.	93
Bannockburn Pyrites Mg. Co.	53	Gold. <i>See</i> Bourke's g.m.	
Bapst, F. I.	125, 137	Bergin, Pat.	41, 46
Bapty, F. A.	176	Berlin, Ont. <i>See</i> Kitchener.	
Barite.		Bernhard, P. P.	108
Industry	48	Berry, John	150
Langmuir tp.	131	Bertie tp.	
Statistics	2, 4	Natural gas, boring for	59
Barrie tp., gold	11	pipe lines	56-58
Barron, J. G.	114	production	207
Bartlett silver mine	151	Bertie Natural Gas Co.	56
Barton tp.	46	Bickell, J. P.	127, 148, 149
Barton Sand & Gravel Co.	44	Bicknell, Alf.	151
Bartonville	68	Billar, L. B.	114
Barytes. <i>See</i> Barite.		Bilsky, A. M.	129
Bateman, G. C.	138	Binbrook	68
Bathurst tp., barite	48	Binbrook tp., gas wells	57, 58, 67
Feldspar	49	Biotite	53
Battle, J. A.	104	Bireh, for fuel	187
Battle Natural Gas Co.	56	Bischoff, H. R.	135
Baxter, Jas.	44	Bishop, F. J.	135
Bayham tp., gas wells	58, 67	Bismuth telluride	93
Beachville, limestone	46, 170	Bitumen, elastic. <i>See</i> Elaterite.	
Beachville White Lime Co.	41, 46	Black, J. H.	117, 132, 142
Quarrying notes	166	Black, Malcolm	153
Beagard, J. A.	116	Black, W. A.	138
Bear deposit, Goudreau pyrites mine.	105, 112	Black lake, N. Burgess tp.	163, 164
Beardmore, L.	163	Black mica	53
Beatty tp.		Black Donald Graphite Co.	50, 51
Telluride ores	93	Mining notes	162, 163
<i>See also</i> Hill gold mine.		Profit tax	87
Beauty lake	151	Blackheath, Ont.	68
Beaver Consolidated Mines, Ltd.	117	Gas wells; production	209
Development work; officers.	132, 133	Black River formation.	
Dividends	20	Madoc tp.	91
Production	15	Blakeley fluorite mine	156
Profit tax	87	Blandford, W. F. H.	135
Beaver Oil & Gas Co.		Blast furnaces. <i>See</i> Smelters and Re-	
Production.	198, 210, 211, 213	fineries.	
Wells, number of	57	Blenheim, Ont.	68
Beaverton.		Brick plant	37
Brick plant	38	Gas consumption	61, 69
Lime plant	41		
Beekwith, A. G.	140		

	PAGE		PAGE
Blithfield tp.		Brooke oil field	77
Pyrites mining	52, 153	Brougham tp.	
Blow, J. W.	166	Graphite	50, 51, 162, 163
Boetoh hill, Sorvako	26	Molybdenite mining	160, 161
Bohemia, Austria	94	production	34
Boilers.		Brouse, Arthur J.	81, 82
Gas as a fuel for	62	Brown, A. H.	137
Boissonnault, M. B.	120	Brown, F. S.	170
Boland, W. J.	128	Brown, J. W.	37
Bolender Bros.	46	Brown, O. B.	116
Bond, T.	100	Brown, Robt.	47
Bond & Bird	37	Brown, S. H.	106
Bonsall silver claims	150	Brown, W. G.	56
"Boosters" (gas)	204	Browncombe & Sons, H.	37
Booth, C. Jackson	145, 147	Browncombe Bros.	37
Borg, Max B.	146	Brownson, Daniel	156
Boring for gas.		Bruce copper mine.	
Record of wells	66, 67	Production	22
Bornemann, Jr., A. J.	151	Work at	110
Borneo archipelago.		Bruce county.	
Nickel and iron	25, 26	Gas wells	66
Borthwick, W.	55	Bruce Mines, silver mining	47
Boston Creek gold area.		Bruce Mines Trap Rock Co.	47
Gold mining in	115, 116	Brunner peat bog	188
discoveries	83	Bruner Mond, Canada, Ltd.	46, 78
tellurides	93	Bryden, R. C.	90, 92, 157
<i>See also</i> Miller Independence.		Buck, J. L.	37
Boston Hollinger gold mine	116	Bueke tp.	
Bothwell oil field	76, 77	Limestone quarrying	150
Bothwell Oil Co.	84	Oil prospecting	150
Bourget, Ont.	55	Silver mining	135, 136
Bourkes Mines, Ltd.		Buckingham gold claim	83, 130
Capital; officers	115	Buckingham Mines, Ltd.	84
Development work	10	Buffalo, U.S.	
Producing	11	Natural gas shortage	206
Production	9	Buffalo Mines, Ltd.	
Bourne, J. F.	145	Dividends	20
Bowman, John	171	Officers; developments	133
Bradley, S.	165	Production	15
Brantford.		Profit tax	87
Brick plant	38	Bug finish. <i>See</i> Gypsum.	
Cement plant idle	42	Building stone statistics	2, 4
Gas consumption	61	Building trade.	
rates	224, 225	Affected by war	7
supply	211	Bulley, Charles	172
Gravel quarry	44	Bullion, silver	
Brantford Gas Co.	59	Agreement between Great Britain	
Brantford Lands, Ltd.	43	and U.S.	12
Brick.		Bunting, R. F.	163
Industry	35-40, 171-173	Burgard, H. P.	137
Statistics	2, 4, 6	Burgess, Thos. F.	154
Bridgeburg, gas supply	59	Burgess, William	171
Briden	61	Burgess, North, tp.	
Brigham, A. F.	126	Barite	48
Brigstocke, R. W.	117	Graphite	50
British America Nickel Corporation ..	24	Mica	54
Accident at smelter	100	Burke gold claim	130
Capital; officers	106	Burks Falls	54
Production	22	Burlington Steel Co.	84
Work by, at Deschenes, Que.	23	Burnside Gold Mines, Ltd.	10, 121
<i>See also</i> Murray n.m.		Notes	116
British American Feldspar, Ltd.	84	Burrell, Hon. Martin	187
British Chemical Co.		Burrows, A. G.	10, 93
Sulphuric acid made by	52, 53	Barton-Munro gold mine	115
British Molybdenite, Ltd.	160	Bush, H. T.	163
Broadwell & Son, B.	37	Butler, W. J.	129

	PAGE		PAGE
Butler, limestone quarry.....	47	Canadian Pressed Brick Co.	37
Butt tp.		Canadian Industrial Minerals, Ltd.	
Pitchblende, notes	94, 95	Capital and date of charter	84
Butwell, Richard	37	Elaterite in veins	90-93
Byrne, J. J.	115	Formed	141
		Fluorite producing	50
		Officers; work by	157
		Canadian Oil Co.	62
C		Canadian Salt Co.	62, 78, 79
Cabana, Oliver	37	Canadian Steel Foundries, Ltd.	57
Cadenhead, G.	175	Canadian Sulphur Ore Co.	
Cadwell Brick Co.	84	Mining, Madoc tp.	153
Cainsville	68	Elzevir tp.	52, 53
Cairo tp., barite	48	Canadian Union Iron Mines Corpora-	
Gold	83	tion	32
Cairo Brick and Tile Works	37	Canboro tp., gas wells	57, 58, 67
Caistor tp., gas wells	57	Canby, Ben	66
Caistorville	68	Canfield Natural Gas Co.	57
Calaverite	93	Carbon black.	
Calcium carbide, statistics	4	West Virginia industry	219
Caldwell, T. B.	48	Cardiff tp.	160
Caldwell mine.		Fluorite	156
Iron pyrites	52, 53	Graphite	163
Caledonia, Ont.		Molybdenite	160
Gypsum mining	52, 165	Cargill, brick plant	37
Natural gas	68, 209	Carleton Place, limestone plant	41
Caledonia Springs	55	Carlsbad Springs	55
Calkins, H. W.	171	Carlyle, R. J.	108
Cameron, W. M.	41	Carlyle, W. A.	106
Camlachie	43	Carman, F. J.	76
Campbell, A.	44	Carmichael, A. D.	109
Campbell, Angus	146	Carmichael, H. G.	136
Campbell, C. A.	82	Carnotite	94
Campbell, C. L.	15	Carson, John W.	135
Campbell, E. M.	152	Carson gypsum mine	165
Campbell, L.	136	Carswell, Thomas	155
Campbell & Devell, Ltd.	17	Cartwright, M. R.	132
Campbell silver mine	145	Cartwright, R. A.	132
Campbell's Sons, R.	39	Cascaden tp., nickel	25
Canada.		Case, W. C.	166
Iron ores	31, 32	Casey tp., silver mining	141
Mineral production	3	Production	15
Canada Cement Co.	42, 46	Casey-Cobalt Silver Mining Co.	
Limestone quarrying	164, 165	Development work	133
Repairing mill	166	Dividends	20
Canada Crushed Stone Corporation.		Officers	134
Accident	100	Operating	15
Operations	44, 166	Casey-Mountain Mining Co.	134
Canada Feldspar Corporation	49	Cashman, P. W.	148
Canada Iron Corporation.....	174	Cassin, Frank	157
Canada Plaster Board Co.	165	Castle silver mine.	
Canada Sand Lime Pressed Brick Co.,	40	Development work	83
Canadian Copper Co.		Notes	150
History of, ref. to	23	Castle Oil and Gas Co.	
"Rare" metals from ores of.....	29, 30	Capital and date of charter	84
<i>See also</i> International Nickel Co.		Operating	66, 67
Canadian Gas Co.		Cataract Power Co.	167
Absorbed Leamington Oil Co.	210	Catharine tp.	
Bought by Union Nat. Gas Co.	65	Gold mining	83, 115
Production	197	Cavicholo, G.	100
Wells	57, 66, 67	Cayuga	68
Canadian Fluorite, Ltd.		Cayuga North tp.	
Capital and date of charter	84	Gypsum	52
Operating	50, 156	Natural gas	56-58
Canadian Furnace Co.		Cayuga South tp.	57
Accident at smelter	100	Cedar Lake nickel mine	131
Operations	33, 174		
Canadian Kirkland Gold Mining Co.	117		
Canadian National Carbon Co.	85		

- | | PAGE | | PAGE |
|--|--------------|--|--------------|
| Cedar Springs | 68 | Clarke, H. C. | 120 |
| Celestite | 79 | Clarke, Mr. | 159, 160 |
| Cement, Portland | | Clarke & Lounsbury | 54 |
| Industry | 42, 43 | Clay products. | |
| Statistics | 2, 4 | Statistics. <i>See</i> Brick, Pottery, Tile. | |
| Central Pipe Line Co. | 59 | Clergue, E. V. | 31 |
| Ceylon, graphite | 51 | Clergue, F. H. | 31 |
| Chalcopyrite. | | Climate. | |
| Dundonald tp. | 25 | Effect of, on laterite deposits | 25 |
| Strathy tp. | 131 | <i>See also</i> Gas. | |
| <i>See also</i> Copper. | | Clinton, tile plant | 43 |
| Chalmers-Campbell | 41 | Clinton formation. | |
| Chambers-Ferland silver mine | 15, 132 | Gas in | 208 |
| <i>See also</i> Aladdin Cobalt Co. | | Cloutier, J. | 98 |
| Channing, J. Parke | 138 | Clydach, Wales | 29 |
| Chapman, Walter | 44 | Clyde lake. | |
| Charcoal iron | 34 | Pyrite mining near | 52, 153 |
| Charing Cross, Ont. | 68 | Coal. | |
| Charlebois, C. P. | 115 | Comparison with natural gas | 224 |
| Charles, J. H. | 176 | Coate, J. S. | 63, 193 |
| Chatham, Ont. | | Coatsworth | 61, 68 |
| Brick plant | 38 | Brick plant | 37 |
| Gas consumption : | 61, 69 | Cobalt. | |
| pressure | 63, 64 | New Caledonia | 25 |
| rates | 224, 225 | Statistics | 2, 4, 5 |
| Chatham tp., gas wells | 66 | War uses | 6 |
| Chatham Gas Co. | 211 | Cobalt silver area. | |
| Pipe lines | 59 | Dividends | 20 |
| Chatham Sand & Gravel Co. | 44 | Production | 15-17 |
| Chatham. Wallaceburg & Lake Erie Ry. 62 | | Reports on operations | 131-150 |
| Chats island. | | Tailings, re-treatment of | 18, 19 |
| Lead mining | 157, 158 | Cobalt-Central Mines, Ltd. | |
| Cheapside, Ont. | 68 | Dividends | 21 |
| Chedoke | 68 | Cobalt Comet Mines, Ltd. | |
| Cheltenham, brick plant | 38, 171, 172 | Dividends | 20 |
| Cherrywood, Ont. | 38 | Operating | 15 |
| Chestnut, W. D. | 41 | Cobalt-Frontenac Mining Co. | 11, 154 |
| China clay. | | Cobalt Lake silver mine | 140, 141 |
| Helen iron mine | 31 | Cobalt Lake Mining Co. | 21 |
| Chippawa | 18, 68 | <i>See also</i> Mining Corpn. of Canada. | |
| Chippawa Development Co. | 57 | Cobalt Provincial Mining Co. | |
| Chippawa Oil and Gas Co. | 57 | Officers; work by | 146, 147 |
| Chinaware. | | Producing | 15 |
| Clay for, Mattagami river | 39 | Cobalt Reduction Co. | 17 |
| Chisholm, D. D. | 1 | Cobalt Silver Queen, Ltd. | |
| Chisholm iron pyrites mine | 53 | Dividend | 21 |
| Christie, D. D. | 167, 170 | <i>See also</i> Silver Queen silver m. | |
| Christie, Henderson & Co. | 41, 167 | Cobalt Townsite Mining Co. | 140, 141 |
| Church, I. L. | 161 | Dividends | 21 |
| Church, M. B. | 167 | <i>See also</i> Mining Corpn. of Canada. | |
| Churchill, Howard | 117, 132 | Colorado, U.S. | 94 |
| Churchill gold claim | 120 | Colorado-Ontario Dev. Co. | 54, 128 |
| Churchill tp. | 129 | Work by, Fort Matachewan | 10 |
| Churchill Mining & Milling Co. | 84 | Comber, brick plant | 37 |
| Cities Service Co. | 211 | Gas piped to | 68 |
| Citizens' Gas, Oil and Piping Co. | 213 | Comerford, J. C. | 136 |
| City of Cobalt silver mine | 140, 141 | Collins, C. A. | 174 |
| City of Cobalt Mining Co. | 21 | Collins, Charles | 109 |
| <i>See also</i> Mining Corpn. of Canada. | | Collins, E. A. | 96, 104, 108 |
| Clambrasil | 68 | Collins, P. Howard | 152 |
| Clapp, Frederick G. | | Collins silver mine | 83 |
| Notes by, on albertite | 93 | Cole, A. A. | 188 |
| Clarendon tp. | 41 | Cole, Jos. E. | 162 |
| Clark, G. M. | 140, 157 | Coleman, H. C. | 173 |
| Clark, John S. | 149 | Coleman, J. A. | 57 |
| Clark, Walter | 37 | Coleman tp. <i>See</i> Cobalt silver area. | |
| Clark gold claim | 131 | | |

	PAGE		PAGE
Coleman Special Mining division.		Corundum.— <i>Con.</i>	
Receipts and Report	82, 83	Statistics	2, 41
Coboconk	41	Corunna, Ont., brick plant	37
Cobourg, brick plant	37	gas piped to	68
Cochrane gold claim	130	Cottam	43, 68, 211
Coffee, R. C.	119	Cotter Syndicate	115
Cohen, S. W.	135	Courtwright, Ont.	68
Cohn, Jas. W.	160	Cousins, T.	168
Coldwater, Ont.	46	Craig pyrite mine	53
Coniagas Mines, Ltd.		Crandall, C. H.	126
Development work	134	Cranston Estate, J.	39
Dividends	20	Cranston, A. E.	120
Officers	135	Crean, G. C.	123
Production	15	Crean Hill nickel mine.	
Profit tax	87	Accident	98
Coniagas Reduction Co.		Production	22
Accident at smelter	100	Work at	108, 109
Cobalt ores treated by	18	Credit Forks	45
Officers; notes	175	Crediton, brick plant	38
Coniston smelter.		Creep, John	44
Notes	110	Creighton nickel mine.	
Silver for	47	Accident	98
Conmee tp.		Ore of demand for	24
Pyrite mining. <i>See</i> Mokomon py.m.		Production	22
Connaught, Ont.	131	Work at	108, 109
Connell, F. M.	130	Crews, Henry R.	151
Connolly, W. S.	169	Crews-McFarlan Mg. Co.	15, 83
Connolly tale mine	155	Development work	151
Conservation of natural gas. <i>See</i> Ad-		Croesus Gold Mines, Ltd.	9, 10, 115
visory Gas Board.		Cronin, D. E.	168
Constable Hook, N.J. <i>See</i> Orford re-		Cronmiller and White Brewery Co. ...	174
fining process.		Crooks, A. D.	120
Constructing & Paving Co.	167	Crookston, Ont.	46
Construction material.		Crosby, A. B.	168
Statistics		Cross lake, tailings from	19
<i>See also</i> Cement, Limestone, etc.		Cross and Wellington	50, 81
Contact bay, L. Wabigoon.		Crowe, A. S.	127, 152
Gold. <i>See</i> Redeemer gold m.		Crowe, B. C.	152
Contact Bay Mines, Ltd.	81	Crowland, Ont.	68
Contractors' Supply Co.	41	Crowland tp., gas wells	57, 58
Cook, J. S.	46	Crowninshield, A. H.	53
Cook, Mr.	131	Crown lands, revenue from	85-88
Cooper, James	135	Crown Gypsum Co.	85, 165
Cooper, W. C.	37	Crown Reserve Mining Co.	
Cooper, William	149	Development work by	135
Coppell, Herbert	173	of Killoran m.	117
Copper.		Wallace m.	128
Cobalt (Ont.) ores	1	Walsh m.	153
Industry	22	Dividends	20
Prico	24	Production	15
Profit tax	87	Profit tax	87
Sudbury dist., mining notes	106-112	Crushed Stone, Ltd.	46
Copper Cliff.		Cryderman, Russell	43, 83
Smelter, notes	109	Crystal Beach	59
quartz for	47	Crystal Products, Ltd.	49
work at	23, 24	Cuba, nickel	25
Coppleston, Ont.	68	Culver, F. L.	117, 128, 132
Corlova Mines, Ltd.		Cummings, John	152
Electric furnace, notes and photo 154, 155		Cunningham, James	147
Corkill, E. T.	108	Cunningham, W.	173
Corkill tp., silver	151	Currie, Col. J. A.	174
Corless, C. V.	109	Curry silver mine	153
Corlett, A. S.	43	Curtis, Alfred H.	123
Corson, Clayton Smith	129	Curtis, Frank	37
Corundum.		Curtis Bros.	37
Industry	49	Cyanamid	40
		Cyril silver claim	149

	PAGE		PAGE
Daere.		Dickson Creek Mining Co.	135
Molybdenite. <i>See</i> Spain Mine and Steel Alloys Corpn.		Dill quartz quarry	47, 48, 108, 109
Daimpré, C. G.	122	Dillon, John	43
Dalby, Chas. W.	131	Dillon Crucible Alloys, Ltd.	85
Dalby & Co.	66	Dineen, C. M.	128
Dale, Jos. S.	173	Dinwoody, J.	122
Daneies, C.	100	Dividends.	
Dark, S. J.	125	Gold Mining Cos.	12, 13
Darling Road Co-operative Gas Co.	57	Silver Mining Cos.	19, 20
Davidson Gold Mines, Ltd.		Dobbs, Gerald G.	112
Producing	10	Dobell, W. M.	138
Officers	123	Dochart Brick & Tile Works	37
Work by	122	Doherty & Co., H. L.	210
Davies, Robt.	171	Dolan, John	37
Davis, H. B.	63, 193	Dolly Varden, Ont.	41, 170
Davis, Mortimer	136	Dolomite.	
Davis tp., mica mining	51, 159	Ozark quarry, Mich.	173
Davis & Son, John	39	<i>See also</i> Limestone.	
Dawn tp., gas wells	67	Dome Extension Mines Co.	124
oil	77	Dome Lake Mining & Milling Co.	
Dawson, A. O.	172	Development work	124
Dawson, S. B.	128	Producing	10
Day, Fred. A.	120	Production	9
Dealton	68	Dome Mines Co.	
Dean, Harry F.	44	Capital; officers; report	123, 124
DeBlois, W. H.	154	Dominion silver mine	135
Decewsville	68	Dominion Engineering & Inspection Co.	191
De Jersey, O. W.	43	Dominion Forge & Stamping Co.	62
Delaware, Ont., brick plant	38	Dominion Glass Co.	62
Delhi, Ont.	68	Dominion Mica Mining Co.	49
Deller, Wm.	37	Dominion Mineral Resources Co.	84
Deller & Son, Geo.	37	Dominion Mines & Quarries, Ltd.	47, 48
Deloro.		Accident	100
Hessite	93	Work by	114
Silver refinery	18	Dominion Natural Gas Co.	
Deloro Smelting & Refining Co.		Pipe lines	59
Accident at smelter	100	Production	197, 209
Officers; notes	175, 176	Wells	57, 66, 67
Silver ores treated by	18	Dominion Reduction Co.	17
Delta, limestone plant	41	Officers; work by	135, 136
Delta Lime Co.	41	Producing	15
Delzotti, G.	98	Dominion Salt Co.	79
Denison, Chas. L.	120, 133	Dominion Sewer Pipe Co.	37, 39
Dennett, Wm.	108	Dominion Sugar Co.	62
Dennis, John B.	111	Donaldson, Oliver	121
Denny, Jas. J.	142	Donnen Feldspar Co.	
Denver, Col.	34	Capital and date of charter	85
Department of Public Highways.	44, 46	Operating	49
De Pencier, H. P.	123	Doolittle, C. M.	167
Deroche tp., quartzite quarrying	114	Don Valley Brick Works	171
Desehones, F. E.	174	Dorchester, Ont.	38, 68
Desehones, Que.	23	Dorfman, A.	127
Deseronto, blast furnace	33	Dover, Ont.	68
Desert lake, graphite	163	Dover gas field.	
Dosing, C. W.	173	Boring in, cost of	65
Dethloff, W. L.	109	Gas	207
Detroit, U.S., gas piped to	214	Oil	200
Detroit river	78	Dover tp.	
Detroit-Glencoe Oil Co.	84	Gas wells	58, 66
Deveney & Campbell	43	production	68
Devonian limestone	77	Oil	76
Dewey, A. H.	136	Dover Oil Co.	84
Dickenson, J. G.	146, 152	Dowling tp., nickel	25
Dickson, Chas. C.	135	Downey & Sons, I. J.	44
Dickson, W. J.	169	Downing, C. E.	166
		Dows, David	114

	PAGE
Doyle, M.	154
Drain tile. <i>See</i> Tile.	
Dreany iron mine	105
Dresden, Ont.	38, 61, 68
Drilling for natural gas.	
Prevention of excessive	219
Drogowski, J.	98
Drummond, Geo. E.	148
Dublin, Ont., brick and tile plant	38
Dundas	46, 68
Dundas Oil & Gas Co.	84
Dundonald tp.	
Nickel. <i>See</i> Alexo nickel m.	
Dunegan Oil & Gas Co.	57
Dungannon tp., marble	164
Dunlap, D. A.	126
Dunn, J. H.	106
Dunn, J. J.	175
Dunn tp., gas wells	57
Dunn Natural Gas Co.	57
Dunnville	68
Gas wells and production	209
Duntroon, limestone plant	41
Durham, Ont.	42
Dutch East India.	
Iron and nickel ores, notes	26
Dutton	38, 68, 69
Dutton oil field	76, 77
Dwyer, P. J.	50, 156, 158
Dyment, Noah	154
Dyment tp., limestone	150
E.	
Eager, F. J.	109
Earle, E. P.	142
East India.	
<i>See</i> Dutch East India.	
India, East.	
Eastern Gap, Toronto	73-75
East Neebich island.	
Quartz quarrying	47, 48, 114
Eastside Gas Co.,	57
Ebsary Fireproofing & Gypsum Rock Co.	165
Eby tp., gold	83, 115
Eden, Ont.	68
Edwards, John	136
Edwards, W. S.	123
Edwards & Wright, Ltd.	
Capital and date of charter	84
Green-Meehan mine owned by	15
Silver production by	145
Eganville, lime plant	41
Tile plant	43
Egmondville, brick plant	38
Egypt.	
Demand for silver	14
Elarton Salt Works Co.	79
Eldorado.	
Iron mining near	155
Eldorado tale mine	156
Eldorado Mining & Milling Co.	84
Eldorite, Ltd.	155
Electro Foundries, Ltd.	160
Electrolytic process of refining.	
Improvements in	30

	PAGE
Electro-Metals, Ltd.	
Quarrying notes	47, 48, 114
Elfrida, Ont.	68
Elgin gas field, production	68
Elk Lake silver area.	
Mining reports	150-153
Elliott, Robt.	54
Elliott, Wm.	95
Elliott & Son, Jas.	37
Elliott-Kirkland Gold Mines, Ltd.	
Capital; officers; work by	117
Development work	10
Elliott, Stimson & Murphy	54
Elmsley North tp.	
Graphite. <i>See</i> Globe Graphite Mg. & Refining Co.	
Elmsley South tp.	46
Elmstead, Ont.	68
Elora White Lime Co.	41, 167
Elzevir tp.	
Iron pyrites. <i>See</i> Queensboro.	
Emerson, Troughton & Laidlaw	57
Empire Limestone Co.	44
Gas wells	57
Ennis, R. J.	127
Report by, on Temiskaming silver m.	148
Enniskillen gas wells	57, 58
Enniskillen oil field	76, 77
Eric lake.	
Natural gas. <i>See</i> Essex gas field.	
Eric Glass Co.	208
Erin, Ont.	167, 169
Ernst, Irving L.	146
Essex, Ont.	68
Brick plant	39
Gas rates	224, 225
supply	61
Tile plant	43
Essex gas field	60, 196
Notes by Advisory Gas Board	213, 214
Wells	66, 67
Estlin, E. S.	193
Notes by, on natural gas legislation	60, 61
Euphemia tp.	
Gas wells	58, 66
Oil wells	77
Eureka Flint & Spar Co.	49, 158
Euxenite	99
Evans, David Owen	105
Evans, J. W.	175
Evans, Russell	129
Eveling, Walter	135
Evered, N. J.	123, 127
Excelsior Gas & Oil Co.	85
Exeter, Hampton & Amesbury Street Ry. Co.	226
Explosives, accidents due to	96-102
F.	
Fairbank, J. H. (Estate of)	57
Fairburn, W. H.	136
Fairlie, M. F.	140
Falconbridge Mines, Ltd.	85
Fallahay and Walters	131
Farr, Mrs. C. C.	40, 150
Farr limestone quarry	150

	PAGE
Fasken, Alex.	123, 132, 138, 142
Fasken, David	138, 142
Fawcett tp., gold	130
Fees for analyses and assays	89
Feighan, R.	151
Feldspar.	
Industry	49
Statistics	2, 4
Feldspar Quarries, Ltd.	49
Feldspars, Ltd.	49, 158
Fenwick, Ont.	68
Fergus, tile plant	43
Ferguson, Hon. George Howard	63, 187, 188, 193
Ferland, A.	132
Ferro-chrome.	
Belmont tp., notes and photo of furnace	154, 155
Ferro-molybdenum.	
Made at Orillia	6
Ferro-silicon, quartz for	47
Fertilizers. <i>See</i> Cyanamide.	
Festelite	175
Filtean, Chas. A.	146
Fingal, Ont.	68
Finkenstaedt, F. C.	117, 132
Finlan, D. J.	54, 159
Finlan mica mine	51
Finlan, Clarke & Lounsbury	51
Finucane, T. R.	123, 140
Finucane, Thos. W.	140
Fires.	
Eric Glass Co.'s plant	208
Patricia Syndicate mine	116
Fisher-Eplett silver mine	139
Fisherville	88
Fisherville Gas Co.	57
Flesherton	77
Fletcher, D. H.	151
Fletcher, J. I.	57
Fletcher, Ont.	37, 68
Fletcher & Sons, J. H.	43
Flat rates for natural gas.	
Waste caused by	198, 199
Flielers, Edward	41
Flinton gold mine	11, 151
Flotation process for tailings.	
Cobalt silver mines	18, 19
Flower, Ont.	153
Fluorite.	
Elaterite in	90-93
Huntingdon tp.	156
Industry	50
Madoc tp. mill, photo	92, 156
Statistics	2, 4
War uses	6, 7
Flynn, T. J.	120, 128
Foisey gold claim	130
Fonthill, Ont.	43, 68
Fonthill Gravel Co.	44
Forbes, D. L. II.	121
Ford, Ont.	68
Forest, Ont., tile plant	43
Forest fires	116

75 -	PAGE
Forrester's Falls.	
Brick plant	39
Lime plant	41
Forst, S. G.	146
Fort Erie	59, 68
Fort Frances.	
Iron pyrites mining	53
Fort Matachewan gold mine	10
Foster silver mine	15, 136
Foster Silver Mining Co.	21
Foster Pottery Co.	39
Foster Silver Mining Co.	21
Foxboro, brick plant	38
Frank, E. D.	37
Franz, W. C.	173
Frederick brook, Albert co., N.B.	93
Frederickton, Mo.	26
French chalk	80
French river, limestone	77
Frid Bros.	37
Friedman, Isaac	129
Frome, Ont.	68
Fryer, Geo. C.	163
Fuel.	
Brick making, compared with fuel ..	37
<i>See also</i> Coal, Gas, Peat, Oil.	
Fuller, F. F.	132
G.	
Gadsby, J. O.	128
Gainsboro tp., gas wells	57
Gales. <i>See</i> Wind.	
Galetta.	
Lead mining near	157, 158
production	34
Gallagher, Z.	135
Gallagher Lime & Stone Co.	41
Galt.	
Gas rates	221, 225
supply	68, 211
Tile plant	43
Galt Foundry Co.	84
Gaus lot, Temiskaming silver mine ...	148
Gardiner, Wm.	37
Gardner, A. G.	135
Garson nickel mine.	
Accident	98
Mining notes	110
Production	22
Gas (natural).	
Comparison with coal	221
Consumption affected by temperature	70-73
Consumption affected by wind	73, 74
Industry	56-65
Legislation	60-63
Map showing distribution of pipe lines. <i>Facing</i>	60
Reports by Advisory Board	193-227
Gibson and Mickle	56-75
Statistics	2, 4
Northern Ontario, chances of	78
Tax	87
Gas engines.	
Effect of gas prices on use of	62

	PAGE		PAGE
Gas & Oil Co. of Springvale.....	57	Gooderham, Geo. H.	170
Gauthier, G. H.	82	Gooderham, feldspar	158
Gear, Wm. I.	135	Molybdenite	160
General Chemical Co.	104	Goodwin, W. M.	175
General Electric Co.	159	Gordon, M. B. R.	161
General Mining and Exploration Co.,	85	Gordon, W. A.	117, 120
General Research and Development Co.,	84	Gorrie, tile plant	43
Genesee Mining Co.	136	Gorsline, R. H.	136
Gentles, Chas.	115	Gosselin gold claim	130
George lake	55	Goudreau, iron mining, 52, 53, 82, 105, 112	112
George Taylor Hardwood Co.	150	Gouverneur, U.S., tale.....	80
Georgian bay, quartz quarrying	47, 48	Gowdy, W.	170
German, G. A.	172	Gowganda Mining division,	
Gesner, Dr. A.	93	Receipts and report	81-83
Gibson, Thos. W.		Gowganda silver area,	
Notes by, on fuels of Ont.	187	Mining reports	150-153
Statistical Review by	1-95	Production	15
Gilson gold claim	131	Graham, J.	100
Gifford Cobalt Silver Mg. Co.		Grand river, gypsum	51, 52
Developing	137	Grand Gypsum, Ltd.	52
Finied	103	Granite, statistics	2, 46
Gilechrist, H. J.	155	Granite lake	120
Gill, G.	163	Granite Concrete Block Co.,	43
Gillan, W. J.	55	Grant, B. A.	159
Gillespie, Geo. H.	80, 151, 155	Grant, Gideon	129
Gillespie, J. M.	14	Grant, James	122
Gillies, A.	43	Graphite,	
Gillies, J. S.	176	Industry	50, 51
Gillis, J. H.	108	Mining notes	162, 163
Gilmour, J. A.	161	Profit tax	87
Gilpin, Reg.	151	Statistics	2, 4
Gim, H. G.	81	Grasselli Chemical Co.,	
Glamorgan tp.		Pyrites mining	153
Feldspar	158	Sulphuric acid made by	52, 53
Mica	51	Gravel,	
Molybdenite	160	Eastern Ont., quarrying.....	167, 168
Glanford tp., gas wells.....	57, 58	Royalties	86
Glen, E. G.	172	Statistics	2, 4, 43, 41
Glenwood Natural Gas Co.	211	Gravenhurst,	
Capacity	213	Feldspar	49, 168
Efforts to reduce sulphur	65	Limestone	47
Formation	210	Gray, E. R.	63, 193
Production	198	Gray, R. M.	128
Wells	57, 66, 67	Great Britain,	
Globe, A. R.	114	Bullion agreement between, and	
Globe Graphite Mining Co.	50, 51	U. S.	12
Mining by, notes	163	Graphite imports	51
Glooucester tp., mineral water	53	Great Lakes Oil Refining Co.	84
Goderich Salt Co.	84	Greece, G. C.	43
Godfrey, Clarence	160	Green, Richard T.	142
Godfrey, feldspar	49	Green-Meehan silver mine	15, 136
Goetz, Alois	31	Grey co., gas wells	67
Goff, P. M.	146	Grierson, A. W.	156
Gold,		Grierson & Sons, John K.	51
Belmont tp.	155	Griffith tp.,	
Dividends, mining	13	Molybdenite mining.....	161, 162
Flinton	154	<i>See also</i> Spain m.m.	
Industry	10-12	Grimes, Chas.	175
Michipicoten area	104, 105	Grotch, Frank	116
Statistics.....	2, 4, 5, 8, 9, 12, 30	Guelpf,	
Sudbury matte, production	24	Limestone plant	41
Taxes on profits of mining	87	quarrying	170
Tellurides	93	Tile plant	43
Gold Lake Mining Co.	84	Guess, Geo. A.	30
Golden Fleece gold mine	11	Guilds, Ont.	68
Golden Gate Mining Co.	84		

	PAGE
Guns.	
Molybdenite for	6
Ni-Cu steel for	28
Gurd & Co., Charles	55
Gypsum.	
Mining notes	165
Statistics	2, 4, 51, 52

H.

Haanel, B. F.	
Report by, on Joint Peat Committee.	189-193
Haentschel, C. W.	115
Hager, Ham	57
Hagersville Crushed Stone Co.	46
Hagersville.	
Gas piped to	68
Limestone quarrying	46, 168
Road material near	167
Haileybury.	
Limestone quarrying	46
Oil prospecting	150
Haines, Jansen D.	146
Haines, R. B.	146
Haines, Wm. J.	146
Haire, R. C.	166
Haldimand gas field	196
Notes, by Advisory Gas Board.	209
Production	68
Hale, J. M.	44
Haliburton, limestone	46
Hall, O.	
Notes by, on Levaek ore-body	109, 110
mining methods at Worthington nickel m.	111, 112
Hallatt, H.	37
Halley, C.	67
Halliday gas well	210
Halton Brick Co.	37
Hambleton, Robt.	167
Hamilton, F. H.	127
Hamilton, W. A.	151
Hamilton.	
Brick plants	37, 38
Gas line to	68, 209, 212
rates	224, 225
Lime plants	11, 46
Sewer-pipe plants	37, 38
Sulphuric acid plant	52, 53
Hamilton & Toronto Sewer Pipe Co.	39
Hamilton Gas & Oil Co.	57
Hamilton Portland Cement Co.	42
Hamilton Pressed Brick Co.	37
Hamilton Sand & Gravel Co.	44
Hancy, M. J.	165
Hanning, G. F.	131
Hansen, H. C.	44
Hanson, Edwin	138
Harcourt	163
Hardwood, for fuel	187
Hare, P. E.	167
Hargrave Silver Mines, Ltd.	15, 137
Harmak Mining Co.	81, 133
Harnwell, A. M.	165
Harris, John F.	114
Harris, L. G.	127
Harris, R. C.	188

	PAGE
Harris-Maxwell gold mine	122
Hart, J. B.	167
Hart & Harrington	57
Harvey, E.	41
Harvey & Son, E.	167
Harwich tp., gas wells	66, 67
Salt	60
Harwood, T. J.	128
Hasselbring, A.	105
Hastings Land Co.	81
Hattie Gold Mines, Ltd.	81
Haughan, Frank	163
Havelock, Ont.	165
Havilah copper mine	22
Hawk Junction, iron pyrites	165
Hawkesbury	41
Hawson, Jas.	173
Heckscher, August	142
Hedges, A. J.	151
Heist, E.	171
Helderberg formation, Upper	77
Helen iron mine.	
Closed down	31
Iron pyrites	52, 53
Mining notes	104, 105
Hematite.	
Helen iron mine	31, 104
Hendee Natural Gas Co.	57
Henderson, F. D.	123
Henderson Farmers Lime, Ltd.	81
Henderson Mines, Ltd.	81, 84
Henderson Tale Mines, Ltd.	155
Hennen, J. J.	161
Hensall, Ont.	43
Hepburn, John T.	164
Hepworth	67
Hepworth Silica Pressed Brick Co.	40
Herbert, Dennis	132
Herman, Charles E.	114
Herriek Gold Mines, Ltd.	129
Herrington, Wm. T.	151
Hershman, Mr.	129
Hespler, limestone	41
Hessite, Deloro tp.	93
Hewitt lake	151
Hewitt & Son, A. B.	43
Hibbert, Ernest	108
Higgins, H. J.	171
Higginson & Stevens	41
Highgate, Ont.	68, 69
Highways, Dept. of Public	44, 46
Hildreth, Chas.	46
Hill, A. W.	37
Hill, C. E.	172
Hill, J. S.	37
Hill, W. J.	37
Hill Gold Mining Co.	11
Capital and date of charter	81
Production	9
Prospecting	10
Hiram Walker & Sons	62
Hiscoek & Son	37
Hitch, Mrs. Susan	38
Hitchcock, E. R. and W. R.	151
Hitchcock gold mine	151
Holson, Robt. T.	175
Hochsteller, Ralph	124

	PAGE
Hodorobar, W.	98
Hoffmann, W. J.	54
Hohenaur gold mine	117
Hohl, John	38
Hoidge, John T.	164
Holden, J. B.	126
Holding gold claim	11, 83, 130
Holdsworth, John	105
Holland & Son, Wm.	38
Holland River peat bog	188
Hollands-Hurst, H.	135
Hollinger gold mine	9, 11
Accident	98
Developments	125, 126
Hollinger Consolidated Gold Mines, Ltd.	
Notes; officers	125, 126
Profit tax	87
Hollinger Gold Mines, Ltd.	13, 126
Holloway, E. G.	127
Holloway tp., gold	10
Holmes Gas Co.	85
Holmsted, A. W.	172
Hoover, D. E.	57
Hoover, Matt.	66
Hopkins, P. E.	10
Horne, William	47
Houses, scarcity of	36
Houston, J.	118
Howard, John A.	162
Howard, R.	108
Howe, Albert E.	151
Howlett, Fred.	38
Hoyt, C.	123
Hughes, V. J.	174
Humber bay	37
Humberstone	59, 68
Humberstone tp., gas	57, 58
Humes, Augustine L.	114
Hudson Bay Mines, Ltd.	
Development; officers	137
Dividends	21
Producing	15
Hudson Copper Co.	22
Hunt, Geo. W.	160
Hunt, R. S.	98
Hunter, A.	115
Huntingdon tp.	
Fluorite	50, 156, 157
Tale	81
Hurd, Ralph	120
Hurlburt, Geo. W.	159
Hurst, Phillip	135
Hutchins, J. C.	114
Hutchinson, F. L.	125, 137
Hybinette, V. N.	23
Hydro-carbon.	
Madoe tp., notes and photo.	90-93
Hyndman, Jno.	43
. I.	
Ignace, limestone	47
Iler Concrete Tile Co.	43
Illuminating oil. <i>See</i> Petroleum.	
Imperial Oil Co.	62, 67
India, East	
Demand for silver	13, 14

	PAGE
Iron pyrites.	
Blithfield tp.	153
Goudreau	82
Helen iron mine	31
Industry	52, 53
Madoe tp.	153
Mining notes	104, 105, 112
Statistics	2, 4
Indian Peninsula Mining Co.	84
Industrial Natural Gas Co.	57
Ingersoll.	
Brick plant	38
Gas consumption	61, 69
rates	224, 225
supply	68, 211
Limestone quarrying near	166
Ingersoll Gas Light Co.	59
Insizwa, South Africa	27
International Molybdenite Co.	160
International Nickel Co.	
Accidents, mining	98-101
Capital; officers	108, 109
History of, ref. to	23
Production	22
Refinery at Port Colborne	1
description and photos	176-186
<i>See also</i> Port Colborne.	
Silica for	47, 48
Tax on profits	87
Work by, notes	108, 109
International Pulp Co.	
Tale mining, Huntingdon tp.	153
Interprovincial Pressed Brick Co.	38, 171
Inverhuron, lime plant	41
Iona, Ont.	68
Irish, Maek	170
Iron.	
Beneficiation of low-grade ores.	31, 32
Dutch East India	26
Industry	30-33
Madoe tp.	155
Statistics	2, 3, 45
Sudbury ores, waste of	27, 28
Iroquois Gas Co.	206
Irwin, Geo. A.	147
Italy, tale from	80

J.

Jackman, H. R.	141
Jackson Bros.	38
Jacobs, G. S.	227
Jacobs, Jacob A.	129
Jacobs, Martin H.	152
James bay	77
Jamieson, Geo.	150
Jamieson, J. M.	41
Jarvics, Ont.	68
Jasperperson, B.	38
Jeannette Creek	68
Jeffrey, R. T.	127
Jenkins, Charles	76
Jervis & Son, John	38
Jessop, H. J.	145
Jewelville	49
John Price, Ltd.	172
Johnson, Col. H. H.	132

	PAGE
Johnston, Albert W.	120, 133
Johnston, E. F.	127
Johnston, James	142
Johnston, Miss M.	162
Joiner, W. E.	160
Joint Peat Committee.	
Report by	187-192
Jones, E. C.	227
Jones, E. H.	108
Jones, F. P.	128
Jones, J.	100
Jones, J. H.	108
Jones, James S.	57
Jones, Nelson	57
Jones, T. R.	133
Jordan, D.	38
Jordan, H. A.	160
Joseph, W.	100
Joyce, W. B.	138
J.S. 280. <i>See</i> Crews-McFarlan Mining Co.	

K.

Kaeding, C. D.	123
Kalgoorlie, West Australia.	
Telluride ores	93
Kalgoorlite.	
Kirkland lake, notes	93
Kalsomine. <i>See</i> Gypsum.	
Kaolin.	
Helen iron mine	31
Karr & Rose	43
Katano lake	26
Kearney, E. W.	117
Kearney nickel mine	54, 94
Kee, H. A.	128
Keeley silver mine	15, 153
Keen fluorite claim	156
Keival, R.	100
Kell Bros. & Perriault	151
Kelly, W.	146
Kelso, lime plant	41
Kemp, Jas. T.	108
Kennedy, D. E.	171
Kennedy, J.	170, 171
Kennedy, J. P.	100
Kenora dist.	
Mining revenue	86
Kent, W.	108
Kent co.	
Gas supply to farms in	69
<i>See also</i> Kent gas field.	
Kent gas field.	
Notes	60, 61
Output, diagram	63
domestic uses	71
Production	68, 69, 197, 200
Salt in	69
Sulphur in	65
Waste	194, 196, 199
Wells	66, 67
Kent Bros.	54
Kent Centre	38
Kerosene. <i>See</i> Petroleum.	
Kerr Estate, Jno.	44

	PAGE
Kerr Lake silver mine.	
Production	15
Profit tax	87
Kerr Lake Mines, Ltd.	137, 138
Kerr Lake Mining Co.	20, 137
Kerwood, brick plant	38
Ketcheson, R. F.	175
Kilbourne & Son, Harvey	44
Kilgown, D. G.	43
Killarney, Ont., quartzite	47, 48, 114
Killoran gold claims	117, 120
Kilpatrick, J. A.	128
Kineh, W. H.	125, 137
Kindy & Sons, D.	57
Kindy Gas Co.	57
Kingdon Mining, Smelting and Manufacturing Co.	158
King Edward silver mine	19, 141
Kingston, Ont.	
Corporation limestone quarry	46
Lead smelter	186
Kingston Feldspar & Mining Co.	17, 48
Kingsville.	
Gas, drowned by water	206
rates	224, 225
supply	61, 68, 69, 211
Kirkegaard, Peter	155
Kirkfield, limestone	46
Kirkfield Portland Cement Co.	42
Kirkland lake.	
Photo	118
Telluride ores	93
Kirkland Lake gold area.	
Development satisfactory	83
Operations	116-122
Production	9
Kirkland Lake Gold Mining Co., 10, 117, 118	
Kirkland-Munro Gold Mines, Ltd.	84
Kirkland-Porphry Gold Mines, Ltd., 10 118	
Kirkpatrick, S. F.	176
Kitchener, Ont., brick plant	38
Kittenger Gas Co.	59
Kittson, H. N.	169
Knight, C. W.	10, 25
Notes by on elaterite	90-93
pitchblende	94, 95
Knote, John M.	173
Koebel, Joseph Z.	38
Kohler, Ont.	68
Kohler, May & Hoover	57
Komula, E.	98
Kowkash Gold Mines, Ltd.	81
Kowkash mining division	81, 82
Kraft, Harry N.	54
Krusse Bros.	38
Kubiak gold claim	131
Kuhn, Henry J.	38
Kulyk, Peter	103
Kwataboahagan river	77, 78
Kyle, David	173

L.

Labe & Son, Geo. A.	38
Labour troubles, effect on production. .	5
Lacey, W. C.	123

	PAGE
Lacey mica mine	54
Lahay, L. J.	130
Laidlaw, E. C. P.	146
Lake Erie, natural gas. <i>See</i> Essex gas field.	
Lakefield, cement plant idle	42
Lake Huron	22
Lake Shore Gold Mines, Ltd.	11
Dividends	13
Photo of mine and report on.....	118-120
Production	9
Lake Shore Natural Gas Co.	59
Lake Superior Power Co.	31
Lalor, F. R.	57
Lalor & Vokes	57
Lamb, Alfred	57
Lambeth, Ont.	68
Lamble, B.C.	160
Lambton co., oil	76
Lambton gas field.	
Production	68
Waste of gas	200
Wells	66, 67
Lamport, W. M.	146
Lamark co., cuxenite	95
Lang, Henry	
Limestone quarrying	150
Langmillen, Edwin	121
Langmir tp., barite	48, 131
Larder Lake district	122
Larder Lake gold mine	10
Larder Lake mining division.	
Receipts and report	81-83
Larmonth, A. E.	117
La Rose silver mine.	
Developments	139, 110
Production	15, 115
La Rose Consolidated Mines, Ltd.....	15, 20
La Rose Mines, Ltd.	138, 110
Larter, Chas.	45
Laterite	23, 26
Laudig, O. O.	175
Lavery, H. H.	101
Lawson silver mine	138, 139
Lawson tp., barite	48
Lead.	
Chats island	157, 158
Smelter at Kingston	186
Statistics	2, 4, 5, 31
Leamington, gas	67
Supply	61, 68, 69, 211
Tile plant	43
Leamington Oil Co.	210
Lebel tp.	116
Ledoux & Co.	91, 92, 95
Lee fluorite mine	156
Legislation.	
Natural gas	60, 61
<i>See also</i> Advisory Gas Board.	
Le Huray, Stephen J.	138
Leisinger-Lembke Co.	57
Leonard, Col. R. W.	135, 175
Leroy lake	157
Levack nickel mine	22
Notes on and work at	110, 111
Levant tp., barite	48
Lewisohn, Adolph	138
Lewisohn, S. A.	138

	PAGE
Licenses. <i>See</i> Miners' licenses.	
Lightning river	10, 83
Lilloic, R. J.	161
Lime.	
Industry, notes	40, 41
<i>See also</i> Limestone.	
Statistics	2, 4, 40, 41
Limehouse	41, 170
Limestone.	
Cobalt area, quarrying	150
Eastern Ont., quarrying	166-171
James bay coastal plain	77
Operators, list of	46
St. Clair and Detroit rivers	78
Statistics	46
Limonite	31
Lind, J. G.	170
Lindsay, Stephen	38
Lindsay, Ont.	37, 39, 43
Lindstrom, N. O.	151
Linton, W.	148
Little, Perry A.	63, 193
Little, Walter	151
Little silver claim	143
Little Nipissing silver mine	110
Lively, J. C.	150
Logan, F. G.	117
Logierait, Ont.	68
London, Ont.	37, 39, 68
London Oil Co.	81
Long portage, Mattagami river	39
Longford, limestone	167
Longford Quarry Co.	46
Longmore, E. L.	126
Long Point	67
Longwell, Alex.	135, 154, 155, 165
Longyez, B.	103
Lookout Mines, Ltd.	81
Lott, G. C.	114
Loughborough tp., mica	159, 160
Loughborough Mining Co.	51
Profit tax	87
Work by	159
Louisiana sulphur deposits	6
Louisville, U.S.	70, 71, 218
Lounsbury, Mr.	159, 160
Lount tp., mica	51
Lovelace, F. L.	117, 132
Lovies, Geo. C.	168
Low, E. H.	131
Lowbanks, Ont.	59, 68
Lowe, Jos.	38
Lowery, Chas.	169
Lowes, Gordon	38
Lucan, Ont., bricks	38
Lucknow, Ont., bricks	38
Ludwig, M. H.	155
Lumsden Mining Co.	15
Luther peat bog	188
Lyall, Trenholme & Macdonnell.....	55
Lyman, R. H.	117
Lyndhurst	47
Lynedoch	68
Lynne Valley	68
Lyons Fuel & Supply Co.	45
Lythmore, gas to	68
Gypsum	165

Me.	PAGE
McAllister, J. E.	127
McArthur, T. A. ....S1.	82
McAulay, N. J. ....S1.	82
Mauley, P. L.	15
McAuslan, Mr.	25
McCallum, Clara B.	121
McCamus, T.	125
McCannell, J. S.	172
McCartney, D. H.	122
McConkey tp., feldspar	49
McConnell, Rinaldo	162
McCort tp., nickel	25
McCredie & Reid	38
McCurdy, Alex.	172
McDonald, L. M.	166
McDougald, Dr. W. L.	126
McFall, A. A.	122
McFarlan, W. J.	151
McFarren, F. B.	172
McGibbon, D. Lorne	138
McIntosh, J. A.	131
McIntyre gold claim	130
McIntyre-Porcupine gold mine.	
Development; officers	126
Dividends	13
Gold production	9, 126
Newray m. worked by	10
Producing	11
Profit tax	87
MacKan, J. J.	175
McKay, Dr. Donald	151
McKay, Geo. A.	122
McKay, R. W.	122
McKay, Wm. David	129
McKay Bros.	38
McKeechie, S.	57
McKee, A. E.	116
McKee, Alex.	63, 193
McKelvie, A. A.	125, 137
MacKenzie, Wm.	111
McKeown, T. W.	169
McKillop, Kohler, May & Hoover Svn.	58
McKinley-Darragh-Savage Mines, Ltd.	
Dividends	20
Profit tax	37
Silver production	15
Work by; officers	140
McKinnon, Alex.	186
McLaren, G. R.	105
McLaren, W. L.	54
McLean, W.	98
McLean & Sons, A. B.	45
McLenaghan, W. A.	13
McLennan, Ont. <i>See</i> East Neebish isld.	
McMillan, Ewen J.	136
McMurray, Geo.	45
McNaughton, G. M.	159
McNeill, W. K.	
Analyses by	93, 160
Pitcheblende, Butt tp., identified by.	94
Report by, on Provincial Assay Office	88-90
McOwen, Fred.	173
McPhail & Wright Construction Co.	45, 114
Silica mining	47, 48

	PAGE
McPherson, J. A.	168
McQueen, Alex.	43
McQuire, H. F.	82
McRae & Maguire gold claim	131
McReavy, I. S.	148-150
McTavish, W. I.	174
McTernan, John	41

M.

Madagascar, graphite	51
Nickel	25
Madoc, brick plant	37
Fluorite	6
Tale	80
Madoc tp.	
Elaterite, notes and photo.	90-93
Fluorite	50, 156, 157
mill	92
Pyrite and tale	153-157
Magnetite. <i>See</i> Moose Mountain iron m.	
Magpie iron mine.	30, 98, 105
Mahony, T. J.	63, 193
Maidens-McDonald gold mine	10
Maidstone, Ont.	68
Maisonville tp.	93
Malcolm, Jno.	43
Malloy, T. F.	151
Maluga, W.	100
Mandarin, Ont.	68
Mann, Sir Donald	111
Manufacturers Natural Gas Co.	
Pipe lines	59
Production	209
Map.	
Showing natural gas pipe-lines in Ontario	facing p. 60
Mapes-Johnston silver mine	151, 152
Maple, for fuel	187
Maple, Ont.	168
Maple Leaf Acrated Water Co.	55
Maple Leaf Cement Co.	42
Maple Sand, Gravel & Brick Co.	45, 168
Marble, Dunganon tp.	164
Statistics	26
Marco, S.	100
Marcus, Wm., Ltd.	15, 46
Marine Contracting Co.	45
Marks, R. L.	128
Markstay, feldspar	49
Marlbank	42
Marron, B.	174
Marshall, Jas.	57
Marshall, W. W.	38
Marshall Lime & Cement Works, Jas.	41
Marsh Hill peat bog	188
Marshville	68
Martin, David	38
Martin, Edward	57
Martin, Neil	167
Martin, Wm.	171
Mason, Sidney	173
Mason, Wm. Thomas	117, 132
Matachewan gold area.	
Development work	83
Report	128

	PAGE		PAGE
Matachewan Gold Mines, Ltd.	84, 128	Miller, Geo. N.	148
Matheson, John	132	Miller, Roy	156
Mattagami river	39	Miller, W. G.	25
May, A. G.	57	Miller, W. N.	82
Maynooth graphite mine	163	Miller lake.	
Mazato, P.	100	<i>See</i> Castle silver m.	
Meaford	38	Walsh silver m.	
Medina formation.		Miller-Independence Mines, Ltd.	11
Gas in	208	Capital; officers; work by	116
Milton, for bricks	35	Production	9
Westerdown, for pottery	39	Tellurides	10
Medina Natural Gas Co.	58, 67	Miller Lake O'Brien silver mine....	15, 152
Mehlenbacher, J. H.	59	Millerton Gold Mines, Ltd.	13
Meighen, F. S.	135	Millistone Mining Co.	115
Melinda	67	Milne, John J.	158
Mellar, L.	98	Milne, W. S.	158
Melville, David	151	Milner tp.	151
Melville, W. F.	152	Milton.	
Melville Junction	41	Brick shale	35
Mendels, J. H.	49	yards	172
Mercer, R. J.	175	Lime plant	41
Merlin	61, 68, 211	Limestone quarrying	46, 169
Merritton	68	Trenton	77
Mersea tp., gas	60, 66	Milton Pressed Brick Co.	38, 172
Mesopotamia, silver requirements	14	Medina shale used by	35
Metallurgical works.		Mimico	38, 39
Accidents	96-103	Minaker Kirkland Gold Mines, Ltd. ..	120
<i>See also</i> Smelters and Refineries.		Mineral (s).	
Metals, production. <i>See</i> Statistics.		New to Ontario, report on	90-95
Metals Chemical, Ltd.	176	Statistics, review by Gibson	1-80
Capital and date of charter	85	Mineral pitch. <i>See</i> Albertite.	
Cobalt ores treated by	18	Miners' licenses	86
Metals Chemical & Development Co....	85	Mines of Ontario, reports	104-186
Meters for natural gas.		Mines Branch, Dept. of Mines.	
Advice regarding	199	Molybdenite plant, production	34
Meyring, Herman	152	Mining accidents	96-103
Mica.		Mining and Smelting Division of Inter-	
Butt tp.	95	national Nickel Co.	
Davis tp.	159	<i>See</i> International Nickel Co. of	
Industry	53	Canada.	
Loughborough tp.	159	Mining Companies.	
Profit tax	87	List of, incorporated, 1918.....	83-85
Statistics	2, 4	Mining Corporation of Canada.	
Mica lake	91	Dividends	20
Mica Products, Ltd.	48	Ophir mine worked by	146
Michigan Central Ry.	46, 168	Producing	16
Michipicoten area.		Report	140, 141
Mining notes	104, 105	Silver production	15
Michiwakenda lake	129	Thompson mine worked by	149
Mickle, G. R.	56, 68, 212	Mining divisions.	
Notes by, on Mining Tax Act	87	Reports on, by Recorders	81-83
Mickle, Geo. T.	58	Mining revenue	85-88
Middlesex oil field	77	Mining Tax Act	87
Middleton, Charles	38	Minnitiki lake	53
Middleton tp.	58	Missouri Cobalt Co.	26
Midfield Natural Gas Co.	58	Mitchell, Alex.	130
Midland Iron & Steel Co.		Mitchell, J. J.	114
Capital; officers; notes	174	Mitchell, Victor E.	138
Limestone quarrying	167	M. J. O'Brien, Ltd.	
Operating	33	<i>See</i> O'Brien, M. J., Ltd.	
Miles, A. D.	108	Modrok, S.	100
Millan, Geo. W.	154	Mokomon pyrite mine	52, 104
Miller, Charles	115	Molybdenite.	
Miller, F. R.	156	Eastern Ont., mining notes	160-162
Miller, Geo. C.	122, 133	Industry	34
Miller, Geo. J.	116	Sault Ste. Marie mg. div.	82

	PAGE		PAGE
Molybdenite.— <i>Con.</i>			
Statistics	2, 4, 5	Murphy, J.	115
War uses	6	Murray, J.	115
Molybdenum Alloys, Ltd.	84	Murray, J. L.	160
Molybdenum Products Co.		Murray nickel mine.	
Capital and date of charter	84	Notes	106, 107
Work by	34, 160, 161	Production	22
Mond Nickel Co.	24	<i>See also</i> British-American Nickel Corporation.	
Accidents	98-101	Muscovite	53
Capital; officers; mining notes	109-112	Muskoka Wharf. <i>See</i> Gravenhurst.	
Bruce copper mine owned by	22	Mustafa, A.	98
Production	22	Mutual Natural Gas Co.	208
Profit tax	87		
Silica for	87	N.	
Works in Wales	29	Nanticoke	68
Monel metal	29	Napanee	41, 46
Momouth tp., molybdenite	34, 160, 161	National Fire Proofing Co.	38
Montana, nickel	26	National Gas Co.	58
Monteagle tp., graphite	51	National Graphite, Ltd.	51, 163
Montreal Kirkland Gold Mines, Ltd.	81, 120	National Iron Corporation	84
Montreal River mining div.		National Mines, Ltd.	
Receipts and report	81-83	Officers	141
Moore, D. G.	43	Nickel mining	131
Moore, E. V.	187, 188	Silver producing	16
Moore & McDonald gold claim	131	from tailings	19
Moore tp., oil	76, 77	National Peat, Ltd.	84
Moore-Anrep peat machine	191	National Portland Cement Co.	42
Photo.	189	National Potash Corporation.	
Moorehead & Tough	147	Accident	100
Moose river, limestone	77	Capital; officers	168
Moose Mountain iron mine.		Operating	47, 49, 168
Accident	98	Natural gas. <i>See</i> Gas.	
Concentrating plant; plan of flow-sheet	30, 113	Natural Gas Act, 1919	63
Mining notes	112, 114	Natural Gas Advisory Board. <i>See</i> Advisory Gas Board.	
Morand, J. J.	156	Near, A. E.	
Morand, R. J.	156	Report by, on Welland gas field	59
Morand, S. J.	156	Neilly, B.	146
More, John	108	Nelles Corners	68
Morgan, J. L.	154	Nels Nelson silver mine	111
Morgan, J. W.	81, 82	Nepean tp., limestone	47
Morgan, M. R.	82	Nepigon Reserve Iron Co.	84
Morgan, Thos.	167	Nesbitt, E. W.	138
Morley, E. H.	191	New, Edward	38
Morpeth	68	New Brunswick.	
Morris, G. W.	168	Albertite deposits	92, 93
Morris, Windsor	163	New Caledonia	25, 26
Morrison, G. A.	109	New Extension Mines, Ltd.	85
Morrison, J. W.	117	Newfoundland, iron	32
Morrison, Neil	152	New Liskeard, limestone	150
Morrison pyrite claim	112	Newray gold mine	9-11
Mosa tp., oil	76, 77	New York & Ontario Oil & Gas Co.	85
Moss, Geo.	161	Niagara Falls, gas supply	59, 68, 208
Mosure, Frank B.	137	Limestone	41
Moulton tp., gas	56, 78	Niagara National Gas & Fuel Co.	58
Mountain Home Telephone Co.	226	Nichols, J. C.	108
Mt. Dennis, tiles	43	Nichols, P. W.	154
Mt. St. Patrick molybdenum mine	98	Nichols Chemical Co.	
Mount Salem, Ont.	68	Accident at mine	98
Mueller & Co., H.	62	Iron pyrites mining	52, 53, 82, 104
Muirkirk, Ont.	65	<i>See also</i> Northern Pyrites m.	
Mull, Ont.	68	Goudreau pyrite m.	
Mumford, W. J.	111	Work by, at Sulphide, Ont.	154
Mumford, Ont., graphite	51, 163	Nickel.	
Munich, A. G.	158	Cobalt, Ont.	1
Munro tp., gold	10, 11, 115	History of, in Ont., ref. to report on	22
Nickel	25		
Murdoch, Jas. T.	128		

	PAGE	PAGE
Nickel.— <i>Con.</i>		
Industry	22-24	
New sources of	25-27	
Profit tax	87	
Statistics	2-5	
Sudbury	22-24	
mining notes	106-112	
Nickel, Chas. M.	146	
Nickelton	108	
<i>See also Murray nickel m.</i>		
Ni-cu steel	28	
Night Hawk river, barite	48	
Nipissing dist.		
Mining revenue	86	
Pitchblende	94, 95	
Nipissing Mines Co.	16	
Dividends	20	
Option on Ophir mine	146	
Production	15	
Profit tax	37	
Report on operations	142-145	
Nipissing Reduction Co.	15	
Norfolk gas field	68	
Norite	25, 27	
Norrington, R. W.	115	
North American Chemical Co.	79	
North American Smelting Co.	186	
North Bay, brick plant	39	
North Buxton	68	
North Cobalt	136, 141	
North Davidson gold mine	127	
Northern Canada Power Co.	123	
Northern Customs Concentrators, Ltd.	17, 145	
Northern Gas & Gasoline Co.	66, 84	
Northern Pipe Line Co.	210, 211	
Pipe lines	59	
Production	210, 211	
Northern Pyrites mine.		
Accident	98	
Mining operations	104	
North Oxford	68	
North Pelham	68	
Northpines, pyrite	52	
North Ridge	68	
North Shore Gas Co.	58	
Norway, electrolytic refining process..	23	
Norwich, bricks	37	
Nova Scotia silver mine	19	
<i>See also Dominion silver m.</i>		
Noyes fluor spar mine	141, 157	
O.		
Oakes, Harry	118	
O'Brien, J. A.	146	
O'Brien, M. J.	130, 146, 175	
O'Brien, Ltd., M. J.		
Bonsall claims worked by	150	
Capital and date of charter	85	
Miller Lake O'Brien mine worked by	152	
Producing	16	
O'Brien silver mine	15, 145, 146	
O'Connell, C. A.	93	
Odell & Sons, Wm.	38	
Odessa, Ont., limestone	46	
Ogilvie, Shirley	138	
Oil. <i>See Petroleum.</i>		
Oil City	68	
Oil Springs	43, 68	
Oil Springs oil field	76, 77	
Oil Springs Oil & Gas Co.	58	
Oil Springs Tile & Cement Co.	43	
Old Castle, Ont.	68	
Olinda, Ont.	68	
Oliver-Rogers Stone Co.	46	
Ollman Bros.	38, 45	
Oneida tp., gas wells	58	
Oneida Lime Co.	45	
Onondaga, Ont.	68	
Gas wells; production	209	
Onondaga tp., gas	56-58	
Oil	76	
Ontario.		
Mineral production	1-90	
Minerals, new to	90-95	
Mines, Report	104-186	
Natural gas, Report by Advisory		
Gas Board	193-227	
Peat, Report by Haanel	187-192	
Ontario Graphite Co.	162	
Ontario Gravel Freighting Co.	45	
Ontario Gypsum Co.	52	
Gas wells	58	
Mining notes	165	
Ontario Kirkland Gold Mines, Ltd. 10,	120	
Ontario Malleable Iron Co.	45	
Ontario Marble Quarries, Ltd.	161	
Ontario Molybdenite Co.	161	
Ontario Paving Brick Co.	38	
Ontario Peat Products, Ltd.	85	
Ontario People's Salt & Soda Co.	79	
Ontario Portland Cement Co.	42	
Ontario Roek Co.	47, 165	
Ontario Sewer Pipe Co.	39	
Ontario Stone Corp.	46, 174	
Ophir-Cobalt Silver Mines, Ltd.	146	
Orangeville, limestone	46	
Ord, John A.	43	
Ore Chimney Mining Co.	11	
Orford refining process	29	
Orillia, ferro-molybdenite	6	
Lime plant	41	
Orillia Chemical Co.	160	
Orr, F. P.	191	
Orser, S. H.	54	
Orser siding, near Mumford	163	
Osler, Britton	108	
Osmak, John	103	
Oso tp., barite	48	
Oswald, H. A.	149	
Otisse gold mine	128	
Ott Brick & Tile Mfg. Co.	38	
Ottawa, limestone	46	
Molybdenite plant	34	
Ottawa Brick Mfg. Co.	38	
Owen Sound, cement plant	42	
Lime plant	41	
Limestone	46	
Ouvry, Ont.	68	
Ozark dolomite quarry	173	
Ozias, Geo. W.	116	

P.	PAGE	PAGE	
Pacaud tp.	83	Peterboro, bricks	37
Pacific Gas and Electric Co.	226	Gravel	44
Page, Walter	164	Tiles	43
Paine, B. P.	152	Peters Coal Co.	46
Painter, C. B.	147	Peterson lake	49
Paisley, Ont., bricks	37	Peterson Lake Silver Cobalt Mg. Co., 16, 20	16, 20
Palestine	14	Officers; development work	146
Palladium statistics	5, 29, 30	Petroleum.	
Palmer-Paine Mines, Ltd.	152	Albert shales	93
Palmyra, Ont.	68	Bucke tp., prospecting for	150
Pan-Silver claims	131, 132	Industry	76-78
Papoose creek	130	Northern Ont., chances of	78
Paragon-Hitecock Mines, Ltd.	151	Statistics	2, 1
Paralgy, Jas. A.	171	Wasting gas to obtain	217
Paris, Ont.	68	Wells, control of gas from	200
Gas consumption	61	Petrolia, Ont.	
rates	224, 225	Brick plant	38
supply	211	Gas supply	61, 63, 68
Park, Hugh	142	Tile plant	43
Parker, W. R. P.	131, 110, 157	Petrolia oil field	70
Parkhill, bricks	37	Petrolia Oil & Refining Co.	85
Parkhurst, A. J.	166	Petrolia Utilities Co.	59, 211
Parks, H. W.	38	Petty, Chas.	38
Parks, Dr. W. A.	77, 78	Petzite	93
Parks Bros.	41	Pfaff, W. E.	43
Parry Sound	33	Pfeiffer, P. E.	142
Parry Sound Iron Co.	84, 174	Phillips, R. M.	156
Parry Sound Mining division	82, 83	Phinn, Geo. E.	38
Parsons, A. L.	10, 35	Phlogopite. <i>See</i> Mica.	
Parsons, Robt. S.	151	Phosphate of lime	1
Pashler, L. J.	149	Pig iron, statistics	2, 3, 30, 33
Patno, John D.	163	<i>See also</i> Iron.	
Patricia gold mine	9, 11	Pig lead. <i>See</i> Lead.	
Patricia Syndicate	116	Pilkington Bros.	58
Patterson, Robt.	169	Pinehard, T. P.	63, 193
Patterson Sand and Gravel Co.	168, 169	Pinecott, E. S.	151
Paxton & Brey	38	Pipes. <i>See</i> Sewer pipes.	
Pears & Son, James	38	Pitoh, mineral. <i>See</i> Albertite.	
Peat.		Pitohblende.	
Report of Joint Committee	187-192	Butt tp., notes by Knight	91, 95
Statistics	4	Pitt, Chas.	151
Peck, R. L.	135, 175	Pitts farm, near Madoc	155
Pegmatite Butt tp.	94	Pittsburg Lorrain Syn.	16, 153
Pelee Island Sand & Gravel Co.	45	Plantagenet N. tp.	55
Pellatt, Sir Henry M.	127, 140, 172	Plaster of Paris. <i>See</i> Gypsum.	
Pembroke, bricks	38	Platinum statistics	5, 29, 30
Limestone	16	Platt, L. G.	123
Pembroke Brick Co.	38	Playfair, James	171
Penhorwood tp., barite	18, 83	Playfair iron mine	32
Penn-Canadian Mines, Ltd.		Plympton tp., oil	76, 77
Dividends	20	Poe Mining Co.	32
Officers; work by	146	Pohribay, W.	103
Producing	16	Point Abino	59, 68
Profit tax	87	Point Anne	42
Penrose, R. A. F.	94	Point Anne Quarries, Ltd.	16, 161, 165
Pentlandite	131	Point Edward	68
People's Silver Mines, Ltd.	146	Pomeroy, Robt. W.	120, 133
Perram, G. W.	135	Ponsford, A. E.	45
Perrault, Mr. <i>See</i> Kell Bros.		Porecelain, clay for, Mattagami river ..	39
Perry, W. W.	134, 157	Porepine gold area.	
Perry fluorite mine	157	Barite	48
Perseverance nickel mine, Santo Domingo island	27	Nickel. <i>See</i> Alexo nickel m.	
Perth, Ont., bricks	39	Production	9
		Report on	122-128
		Porepine Crown Mines, Ltd.	11
		Accident	98

	PAGE
Poreupine Crown Mines Ltd.— <i>Con.</i>	
Developments; officers	127
Dividends	13
Production	9
Profit tax	87
Poreupine Mining division	82, 83
Poreupine V.N.T. Gold Mines, Ltd.	11, 127
Port Arthur Mining division	81
Port Colborne	68
Blast furnace	174
Gas meters for	208
Limestone quarry	46, 166
Nickel refinery. <i>See</i> Port Colborne refinery.	
Port Colborne Nickel refinery.	
Copper production	22
Description and photos	176-186
Gold and silver production	9
Opened	108
Photos	107
<i>See also</i> International Nickel Co.	
Port Colborne-Welland Natural Gas Co.	58, 66
Port Credit Brick Co.	38
Port Dover	68
Port Elmsley, graphite	50, 51, 163
Port Lambton	68
Portland tp., barite	48
Feldspar	49, 158
Port Maitland	68
Port Neebish, silica	47, 48
Port Rowan, bricks	37
Port Royal	68
Pottery, industry	2, 4, 39, 40
Powell tp., gold	83, 128
Power Glen	68
Pratt, D. S.	174
Premier-Langmuir Mines, Ltd.	48, 131
Preneveau, limestone	47
Prescott, S. R.	166
Prescott co.	
Peat. <i>See</i> Alfred peat bog.	
Pressed Brick. <i>See</i> Brick.	
Price, C.	100
Price Estate, John	38, 84, 172
Price, George	172
Priecville	41
Prince silver claim	132
Princess silver mine	138, 139
Princeton	43
Procurier farm, Bayham tp.	67
Producers' Fuel & Light Co.	58
Profit tax	87
Prohibition laws.	
Effect on mineral water trade	55
Prosecutions for accidents	103
Prospecting for natural gas.	
Notes by Advisory Gas Board	223
Proton, Ont., bricks	39
Provincial silver mine	15, 146, 147
Provincial Assay Office.	
Report on, by McNeill	88-90
Provincial Brick & Tile Plant	38
Provincial Natural Gas & Fuel Co.	58
Notes by Near	59
Wells in Welland co.	66
Public utilities.	
Entitled to profits	225, 226

	PAGE
Pullen, Major E. F.	131
Pullen, Capt. F.	131
Puslinch, lime plant	41
Putnam, Ont.	68
Pyrite. <i>See</i> Iron pyrites.	
Pyrrhotite, Strathy tp.	131

Q.

Quarries, accidents	96-103
Notes and statistics	44-48
Quartz statistics	2, 4, 46, 47
Quartzite.	
Bellevue	173
Quarrying notes	114
Queen of Sheba gold claim	130
Queensboro, pyrites	52, 53, 153
Queenston	169
Queenston Quarry Co.	46, 100, 169
Quin, C. K.	174
Quinlan & Robertson, Ltd.	46
Quyong, Que.	160

R.

Radium	94, 95
Rainham tp., gas	56, 58
Rainham Centre	68
Rakaunen, J.	98
Raleigh tp., gas	57, 60, 66
Salt	37
Rama tp., limestone	167
Rand Consolidated Mines, Ltd.	106
Pyrite mining by	52, 53
Randall, C. A.	125
Raty gold claim	141
Rayner, Geo. W.	165
Rea Consolidated Gold Mines, Ltd.	13
Reddiek gold mine	122
Reddington, John	147
Redeemer gold mine	9, 10
Redford, R. W.	135
Reeve-Dobie Mines, Ltd.	83, 152
Refineries. <i>See</i> Smelters and Refineries.	
Regnall, R. T.	126
Reid, C. F. T.	45, 46
Reid, F. D.	135
Reliance silver mine	147
Reliance Leasing Co.	16, 147
Renfrew, limestone	46
Renfrew Molybdenum Mines, Ltd.	
Accident. <i>See</i> Mt. St. Patrick m. revenue.	
Rentals of mining lands. <i>See</i> Mining revenue.	
Rents, rise in	7, 36
Rettich, Edwd.	116
Revenue. <i>See</i> Mining revenue.	
Rhodium	29, 30
Ribble vein, Wasapika gold mine	130
Richards, Ben.	126
Richardson, Charles	116
Richardson, Charles A.	132
Richardson, H. W.	49
Richardson, J. W.	58
Richardson & Son, James	38
Richardson Gas & Oil Co.	58
Richard tp., gold	141

	PAGE
Rideau Canal Supply Co.	45
Ridgetown, bricks	38
Gas	61, 68, 69
rates	224, 225
Ridgetown Fuel Supply Co.	210
Ridgeway	68
Right-of-Way silver mine	16
Developments	147
Production	115
Right-of-Way Mines Ltd.	21
Right-of-Way Mining Co.	21
Ritcheie, Samuel J.	22
R.L. 402 silver claim	143
Roach, W. H.	109
Road material.	
<i>See also</i> Trap, etc.	
Quarrying	166-169
Robb gold mine	128
Robbins, P. A.	126
Robbins, R. W.	126
Roberts, H. N.	131
Robertson, Chas. M.	158
Robertson, D.	169
Robertson, J. F.	109
Robertson, J. S.	169
Robertson Co., D.	41, 46
Robertson Estate, James	34, 157, 158
Robillard, H., & Son	46
Robins Mining Co. <i>See</i> A. A. Robins.	
Robinson, A. H. A.	25
Robinson, T. F.	167
Robinson Road Gas Co.	58
Rock, natural. <i>See</i> Cement, Portland	
Roesand Co., Ltd.	45, 169
Rockwood	41, 167
Roddy & Monk	46
Rodney, Ont.	68
Rogers, Geo. R.	129, 130
Rogers, Lina	129
Rogers, Major R. P.	135
Rognon gold mine	9, 11
Romney, Ont.	68, 211
Romney tp., gas	57, 60, 66
Rondeau	68
Rondeau Park, salt	60, 79
Roscoe, H. L.	108
Roschill	68
Roschill Natural Gas Co.	59
Ross, R. A.	188
Rothwell, T. E.	88
Row, V. P.	109
Royal Ontario Nickel Commission ..	27, 28
Ruseomb	38, 68
Russell, Alexander	136
Rustenburg dist., Transvaal	27
Ruthven	68
Ryan, Emma	173
Ryan, Frank	173
Ryekman	68
S.	
Sadler, F. L.	38
St. Anthony gold mine	9, 11, 104
St. Catharines	38, 68
St. Clair river	78
St. Clements, bricks	38

	PAGE
St. David, limestone	46
St. George	68
St. Jacobs	68
St. Marys, limestone	41, 46, 169, 170
Tiles	43
St. Mary's Cement, Ltd.	169, 170
St. Mary's Horseshoe Quarry, Ltd.	46
St. Mary's Portland Cement Co.	42
St. Thomas, bricks	38
St. Williams	68
Sales of mining lands. <i>See</i> Mining revenues.	
Salo, A.	98
Salt, Harwich tp.	60
Industry	79
Statistics	2, 4
Water. <i>See</i> Salt water.	
Salt water.	
Enemy to natural gas.	197, 206, 212, 213, 217, 220
Kent gas field	69
Sand, industry	167, 168
Royalties	86
Statistics	2, 4, 43, 44
Sand & Supplies, Ltd.	45
Sandoe, R.	146
Sanitaris, Ltd.	55
Sand-lime brick.	
Industry	40
<i>See also</i> Bricks.	
Sandstone, industry	45, 46
Sandwich, Ont.	68
San Patricio Mining & Milling Co.	84
Santo Domingo island	27
Sarjeant Co., Ltd., The	45
Sarnia, gas	61-64, 68, 69
Sarnia tp., oil	76, 77
Sarnia Gas Co.	59, 210, 211
Sault Ste. Marie	34
Sault Ste. Marie Mining division.	
Receipts and report	82
Saville gold claim	130
Schaeffer, John C.	116
Schell, M. S.	116
Schorman, W. A. P.	163
Schram, A. J.	43
Schumacher, F. W.	128
Schumacher Gold Mines, Ltd.	11
Officers; work by	128
Production	9
Schwendiman, S.	171
Scott, John	77
Scott, Ralph	158
Scott, W. L.	147
Sebockoe island, near Boruco	25
Secord, Harry	160
Sedgwick, Geo. H.	137
Sedgwick, H. B.	132
Sealey Bay	43
Segsworth, R. P.	158
Selkirk	68, 209
Selkirk gas field	59
Sellwood. <i>See</i> Moose Mountain iron m.	
Seneca tp., gas	57, 58, 67
Seneca-Superior Silver Mines, Ltd.	
Dividends	21
Tailings from mine of	19

	PAGE
Sewer pipe, industry	39, 40
Shale, Albert. <i>See</i> Albertite.	
Shale Brick Co.	85
Shallow Lake	42
Shaw, J. T.	137, 147
Shaw, J. W.	134
Shebandwan lake, nickel	25
Shedden, Ont.	68
Sheffield Molybdenite Mining Co.	53
Shell, E. W.	173
Sheppard, H. E.	81, 82
Sheppard, W. J.	127, 148, 149
Sherbrooke tp., Ont.	57
Sherkston	68
Sherriff, Dan.	129
Sherrill, C. L.	125, 132, 137
Shetland, Ont.	68
Shillington, R. T.	132
Sibley, Harper	140
Sibley, Hiram W.	140
Sicily, sulphuric acid	6
Siderite	104, 105
Silbojoun, P.	98
Silica. <i>See</i> Quartz.	
Silicate Brick Co.	
Silver.	
Bullion. <i>See</i> Bullion, silver	
Cobalt area, report on mining	131-150
Coinage	12, 14
Dividends	19-21
Mines producing	15, 16
Price	11
Production, Ont.	2, 4, 5, 12-21
Sudbury matte	24, 26
world's	14
Taxes on profits of mg.	87
Silver Cliff mine	19, 111
Silver Eagle Mg. Co.	16
Silver Leaf mine	135
Silver Queen mine	15, 147
Silvester, G. E.	108
Simcoe	68
Gas consumption	72, 73
wells and production	209
Simionki, G.	100
Simons, B. J.	128
Simons, Chas.	151
Simpson, W. E.	110
Sinclairville	68
Singer, Albert	122
Singer, Israel	129
Sipprell, J. H.	38
Slaght, Art. G.	118
Sleemon, Phillip	45
Sloan, D.	123
Smart, Chas. A.	135
Smeaton, H. F.	154
Smelters and Refineries.	
Accidents	96-103
Iron, list of, operating	33
Report on	173-186
Smith, A. G. C.	43
Smith, Anthony E.	135
Smith, Chas. H.	114
Smith, R. Home	173
Smith, J. W.	45

	PAGE
Smith, John S.	41
Smith, W. C.	159
Smith, & Son, Alex.	38
Smyth, Thos. J.	172
Snead, J. N.	163
Snelgrove & Teer	38
Soapstone. <i>See</i> Tale.	
Sombra, Ont.	68
Soroako, Borneo archipelago	26
Soule, W. H.	109
South Africa, nickel	27
South Buxton	68
South Cayuga	68
Southern Ontario Pipe Line Co.	
Pipe lines	59
Production	210, 211, 213
South Lorrain tp., silver	15, 153
Southworth, Thos.	175
Spain, W. J.	34
Spain molybdenite mine	34, 161
Spanish chalk	80
Sparham, A. F.	58
Speed gold claim	131
Spence, J. H.	140
Spiegel Eisen	33
Springvale	68
Spry, W. L.	82
Stacey, Rich. J.	160
Stamford	168, 169
Standard Brick Co.	38, 172
Standard Chemical Iron & Lumber Co.	41
Standard Gravel Co.	45
Standard Iron Co.	33, 174, 175
Standard Mica Co.	159
Standard Smelting & Refining Co.	18
Standard White Lime Co.	41, 46
Work by, notes	170
Stanleyville	51, 164
Stanton Oil Producing Co.	84
Stanworth, Ward	63, 193
Staples, W. A.	134
Starr, J. R. L.	140
Statistics. <i>See</i> Mineral statistics.	
Steel, G. J.	172
Steel.	
Fluorite and molybdenite for	6, 7
Production. <i>See</i> Iron, statistics	
Steel Alloys Corporation.	
Molybdenite mining	161, 162
production	161, 162
<i>See also</i> Spain mo.m.	
Sunset mo.m.	
Steel Co. of Canada	33
Coke-making battery	34
Furnace of	175
Gas consumption	62
Steele, C. E.	63, 193
Steeltown.	
Brick plant	37
Furnace. <i>See</i> Algoma Steel Corpn.	
Stecman, Leonard F.	136
Steep gold mine	131
Steindler, D. M.	136, 138
Steindler, T. J.	138
Stellite	6, 175
Sterling Natural Gas Co.	58-60

	PAGE		PAGE
Stern, May	129	Tale,	
Stevenson, Wm. E.	117, 132	Industry	79-81
Stevensville	59, 68	Madoc & Huntingdon tps.	153
Stevensville Gas & Fuel Co.	58	Statistics	2, 4, 7
Stewart, H. J.	127, 135	Uses of	7, 80
Stewart, J. F. M.	165	Tariff of fees for analyses and assays ..	89
Stillwaugh, K.	172	Tarablyn, G.	128
Stoddart, Mr.	103	Taxes. <i>See</i> Profit tax.	
Stoness, J. M.	51	Mining Revenue,	
Storms. <i>See</i> Wind.		Taylor shaft, Bruce copper mine	110
Stovel, J. H.	96, 101	Taylor, A.	173
Straffordville	68	Taylor, Gordon	119
Stranahan Pyrites Co.	53	Taylor, J. Frater	173
Stratford, peat. <i>See</i> Brunner p. b.		Taylor, V. H.	173
Strathroy, brick plant	37	Taylor & Hall	43
Strathly tp.	25, 131	Taylor gravel pit	45
Streit, C. H.	151	T. C. 177 and 220 silver claims	152
Stromness	68	Teck tp., gold	116, 117, 120
Strong, H. F.	153	Teck-Hughes Gold Mines, Ltd.	11
Strontium, Bagot tp.	79	Capital; officers; photo of mine 120, 121	
Stroup, William	116	Production	9
Sturgeon, R.	114	Tecumseh, Ont.	68
Sturgeon lake. <i>See</i> St. Anthony gm.		Teeswater, limestone	41, 171
Sudbury, brick plant	38	Telluride ores,	
Sudbury district,		Occurrences and notes	93
Copper	22	Temiskaming & Hudson Bay Mg. Co. ...	21
Nickel mining	106-112	Temiskaming Mining Co.	15
new discoveries	25	Capital; officers; report	148, 149
Revenues from mining	86	Hohenaur claim worked by	147
Refinery. <i>See</i> International Nickel Co.		Producing	16
Waste of iron and sulphur	27, 28	Profit tax	87
Sudbury Brick Co.	38	Temperature,	
Sudbury Diamond Drilling Co.	81	Influence of, on gas consumption ...	70-73
Sudbury mining division,		Terra Cotta, Ont., brick plant	37
Receipts and report	82, 83	Terrill, Albert	157
Sulphide, Ont.	52, 53	Tetradymite,	
Sulphur,		Boston Creek	93
<i>See also</i> Iron pyrites.		Texas sulphur deposits	6
In natural gas	65	Thamesville, bricks	38
Louisiana and Texas	6	Thamesville oil field	76, 77
Sudbury district, waste of	27, 28	Theodore, R.	168
Sulphuric acid,		Thoenen, J. R.	109
Manufacturers	53	Thomas, R. D.	166
Scarcity during war	6	Thomas, W.	153
Sun Brick Co.	38, 172	Thompson, Arthur	119
Sunny Gas Well Co.	58	Thompson, C. M.	158
Sunset molybdenum mine	34, 161, 162	Thompson, G. L.	110
Superior Mines, Ltd.	81	Thompson, H. M.	136
Susman, J. H.	138	Thompson, James	171
Sutherland, H. B.	123	Thompson, J. F.	120
Sutherland, H. H.	123	Thompson, Robt.	152
Sutherland, T. F.	91	Thompson gold claim	131
Report by, Mines of Ontario	103, 186	Thompson silver claim	111, 149
mining accidents	96, 103	Thorndale, bricks	37
Swansea, Ont.	39	Thornton, H.	100
Sydenham, Ont. <i>See</i> Loughborough		Thorold,	
Mg. Co.		Gas piped to	68
Sylvanite gold mine	121	Limestone quarry	46
Symmes, H. D.	127, 148, 210	Silver refinery	18
Symmes & Co.	66	Throp, P. W.	158
Syndicate gas lines,		Throp, J. E.	158
Objections to	198	Throp, Peter D.	158
Syria, demand for silver	14	Three Stars Silver Mines, Ltd.	149
		Thunder Bay district,	
		Mining Revenues	86
Tailings,		Thunder Mining Co.	11, 101
Re-treatment of, from Cobalt, notes		Thurlow tp., limestone	46
Talbotville	68		

	PAGE
Tilbury, Ont.	68
Tilbury East tp., gas wells	57-60, 66
Tilbury gas and oil field.	
Conditions in	63, 64
Gas remaining, amount of	206
Notes by Advisory Gas Board	210-215
Production	76
Tilbury Town Gas Co.	59
Tile.	
Industry	36-39
Notes on yards	172
Statistics	2, 4
Tillsonburg	6
Gas wells	209
Tile plant	43
Tillson Quarries, Ltd.	47
Timagami forest reserve	25
Timiskaming district.	
Mining operations, report	115-153
revenues	86
Timiskaming Mining div.	
Receipts and report	81-83
Timmins, J. R.	126
Timmins, L. H.	126
Timmins, Noah A.	126, 163, 164
Timmins Graphite Co.	50, 51
Tisdale tp., gold	122, 123, 127, 128
Tivani Electric Steel Co.	175
Torbolton, lime plant	41
Todmorden, bricks	37
Toronto.	
Brick yards	36, 171, 172
Building permits, decrease	7
Limestone quarrying	46
Wind velocities	73-75
Toronto Brick Co.	41
Toronto Lime Co.	41, 170
Toronto Plaster Co.	11, 171
Tory Hill, molybdenite	161
Tory Hill Marble & Mica Co	54, 98
Tough, Mr. <i>See</i> Moorehead & Tough.	
Tough, Geo.	117
Tough-Oakes Gold Mines, Ltd.	11
Dividends	13
Production	9
Profit tax	87
Tellurides in mine of	93
Work by	121
Tovey, David S.	153
Townsite Extension silver mine	110, 111
Transvaal, S. Africa.	
Nickel deposits	27
Trap, Havelock	165
Statistics	2, 46
Tremain, H. E.	117, 132
Trenton	52, 53
Trenton formation, oil in	77
Trethewey Silver-Cobalt Mining Co.	16
Dividends	21
Officers; developments	149
Production	15
Profit tax	87
Work by, on Castle silver mine	150
Trout Lake station, Mich.	173
Troy, Ont., lime plant	41
T R S 318 & 508 gold claims. <i>See</i> Hold-	
ing gold m.	

	PAGE
Tudhope, J. B.	127, 148, 149
Tudhope tp., silver. <i>See</i> Hitchcock	
silver m.	
Tully, M. E.	174
Turner, Walter	108
Twin City Tug Line	45

U.

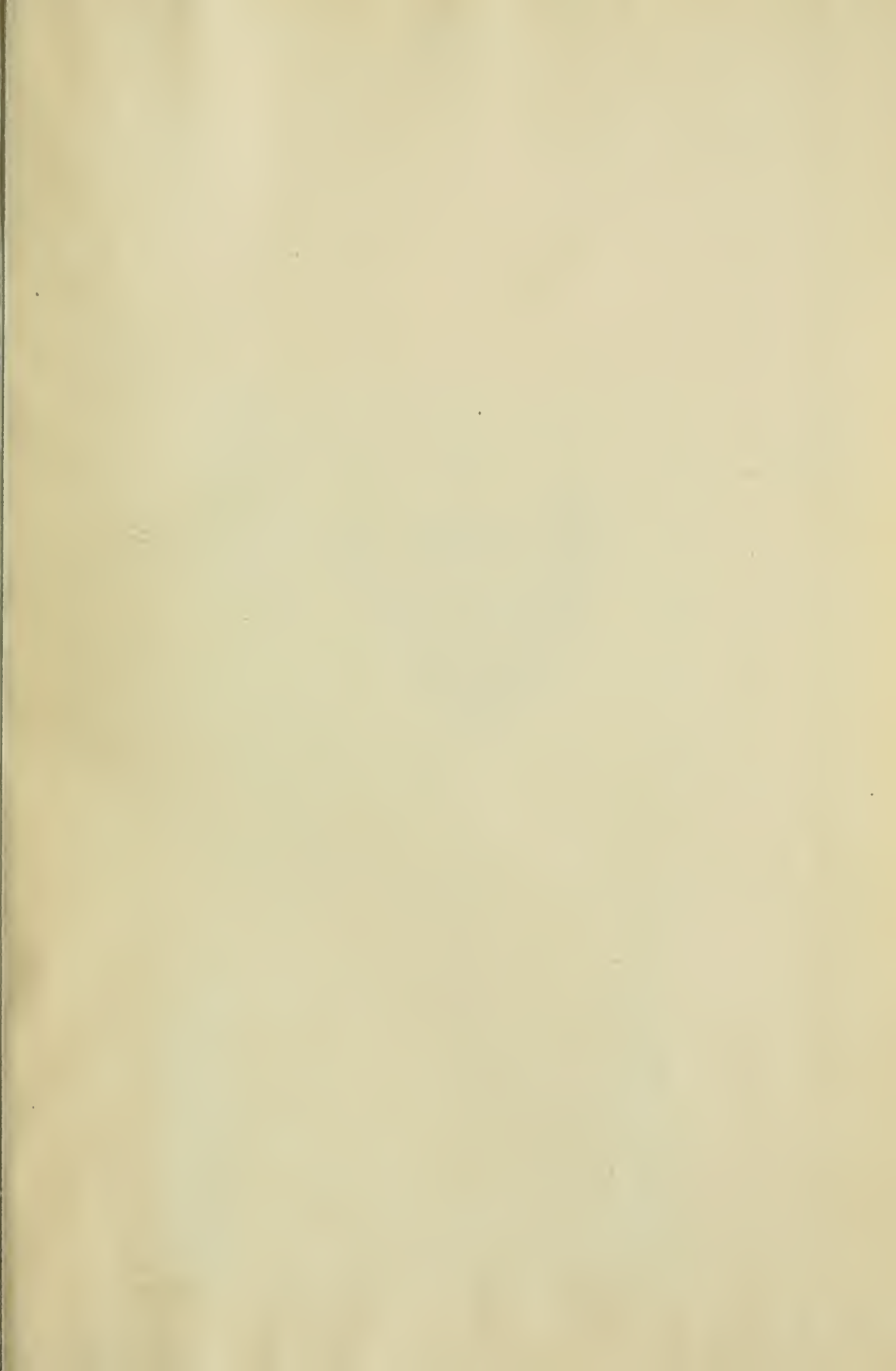
Uthoff, Ont.	46, 174
Underhill, H. I.	173
Union Cement Co.	42
Union National Gas Co.	
Canada Gas. Co.'s field bought by... ..	65
Formation of	210
Production by	197, 212
Wells of	57, 58, 66
United Development Co.	66
United Fuel Supply Co.	45, 210
United Gas & Fuel Co.	59
United States.	
Agreement with Gt. Britain <i>re</i> silver	
bullion	12
Graphite	51
Natural gas conditions	206
waste	216-219
Nickel. <i>See</i> Frederikton.	
Radium and uranium	94
Sulphur	6
Universal Coal Co.	85
University silver mine	139
Upper Helderberg formation	77
Uranium	94, 95
Urquhart, Geo.	161
Ushome, H. L.	156
Utah, U.S., radium	94

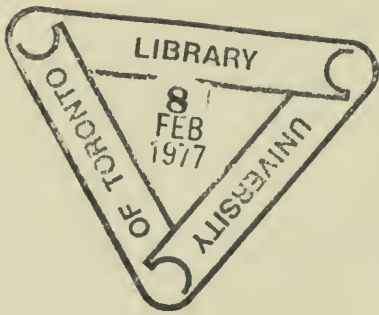
V.

Vacuum Gas & Oil Co.	58, 66, 67
Valetta, Ont.	68
Vanadium steel	175
Van Cutsem, E. G.	140
Van der Voort, M. P.	127, 118
Van Hise, C. R.	218
Vansickle, A. W.	58
Van Zandt, C. F.	136
Vaughan, Mr.	103
Verbeek mountains, Borneo archipelago.	
Nickel and iron ores	26
Vermilion lake, pyrites	53
Vermilion nickel mine	29
Verona, Ont., feldspar and quartz 47-49, 158	
Victoria nickel mine.	
Mining notes	111
Production	22
"Rare" metals	29
Victory Gold Mines, Ltd.	85
Victory Oil & Gas Co.	85
Vienna, Ont.	37, 68
Vindicator Gold Mines, Ltd.	85
Vincemount, limestone	46, 171
Violet silver mine	138, 139
Vittoria, Ont.	68
Vlakfontein, Transvaal	27
Volcanic Oil & Gas Co.	210

W.		PAGE
Wabigoon lake.		
Gold. <i>See</i> Redeemer g.m.		
Wagstaff, A. H.	172	
Wainfleet tp., gas wells	57	
Wainfleet & Moulton Gas Co.	58	
Waldman silver mine	141	
Waldman Silver Mines, Ltd.	16	
Wales, nickel refinery	29	
Walker & Sons, Hiram	62	
Walker Bros.	46	
Walkerville, gas	61, 68, 214	
Wallace, James	175	
Wallace gold mine	128	
Wallaceburg.		
Brick plant	38	
Gas conditions	61	
pressure	63	
production	210	
Tile plant	43	
Wallaceburg Gas Co.	59, 211	
Wallacetown	68	
Wallbridge iron mine	32, 155	
Fluorite in	157	
Wall plaster. <i>See</i> Gypsum.		
Walpole tp., gas	57	
Walsh silver mine	83, 153	
Walsingham tp., gas	67	
Walters, Mr.	131	
Walters, O. D.	161	
Walton, L. O.	145	
War, effect on mineral production	5	
"War Minerals."		
Notes by Gibson	6-8	
Ward, Charles	152	
Ward, H. W.	127	
Ware, G. G. T.	117	
Wasapika lake, gold. <i>See</i> next entry.		
Wasapika Gold Mines Ltd.	11, 83, 129, 130	
Waste of natural gas. <i>See</i> Advisory Gas Board.		
Water, mineral		
Industry	55	
Statistics	2, 4	
Water, salt. <i>See</i> Salt water.		
Waterdown	39	
Watford, bricks	37	
Watson, A.	161	
Watson, Jas. S.	140	
Watson, J. G.	140	
Watson, J. P.	134, 140, 157	
Watson, R. B.	142	
Watts, Alfred	43	
Way, Arthur E.	129	
Weatherbee, D'Arcy R. E. G.	140	
Webster, A. R.	96	
Wedriek, M.	58	
Welch, G. H.	136	
Welland.		
Gas supply	59, 68, 208, 209	
Refinery	18, 176	
Welland co., gas wells	57, 58	
<i>See also</i> next entry.		
Welland gas field	196	
Notes by Advisory Gas Board	207-9	
Estlin	65	
Near	59	
Welland gas field.— <i>Con.</i>		
Production	68	
Welland County Lime Works Co.	16, 58, 60, 66	
Wellandport	68	
Well-drilling for gas. <i>See</i> Boring for gas.		
Wellesley, bricks	38	
Wellington, S.	156	
Wells, R. G.	175	
Wells, W. P.	151	
Welsh, J. P.	151	
Wende, A. E.	119	
Wentworth Quarry Co.	16, 171	
Weppler, Henry	41	
Wernick, Wm.	162	
West, W. S.	63, 193	
West Australia.		
Telluride ores	93	
West Dome gold mine	9	
Western Canada Flour Mills Co.	79	
Western Ontario Oil Co.	85	
Western Salt Co.	79	
Westlake, E. H.	138	
West Lorne	13, 68	
Westmorland co., N.B.		
Albert shales	92, 93	
Westmount Mining Co.	151	
West Shiningtree gold area	129-131	
West Shiningtree lake	11	
West Tree Mines, Ltd.	129, 130	
West Virginia, gas waste	198, 218, 219	
Wettlaufer, Conrad E.	118	
Wettlaufer, E. L.	168	
Wettlaufer, W. L.	168	
Wettlaufer Lorrain Silver Mines, Ltd.	21	
Wexler, Sol.	123	
Weylie & Benjamin	58	
Whalen, John	53	
Wheatley, Ont.	63, 61, 68, 211	
Wheaton, Isaac G.	151	
Whelpdale gold mine	128	
Whigham, W. K.	173	
Whitbeck, Earnest C.	111	
White, E. L.	174	
White, Elsie	129	
White, Dr. I. C.	215	
White mica	53	
Whitefish lake. <i>See</i> Black Donald graphite mine.		
Whiting & Son, R.	15	
Warton, limestone	46	
Wickett, S. R.	149	
Wilberforce	34, 160, 161	
Wilder, J. E.	79	
Wilgress, A. T.	23	
Wilkes, John C.	158	
Wilkesport, bricks	38	
Willcox Lake Brick Co.	40	
Williams, Chas. G.	126	
Williams, E. J.	43	
Williamson, Robt. G.	124	
Willmott & Co.	47	
Willoughby tp., gas	57	
Wilson, Leslie C.	161	
Wind, influence of, on natural gas consumption	73, 74	

	PAGE		PAGE
Windsor, Ont.		Worthington nickel mine.— <i>Con.</i>	
Gas consumption	69	"Rare" metals	29
piped to	68, 214	Wotherspoon, W. L.	
pressure	63, 61	Description by, of Port Colborne	
rates	224	nickel refinery	176-186
supply	61	Wray, W. H.	136
Windsor, Essex & Lake Shore Ry. Co. . .	45	Wright, S. B.	121
Windsor Gas Co.		Wright, Spencer D.	146
Pipe lines	59	Wright, Wm. H.	175
Production	210, 211	Wright-Hargreaves Mines, Ltd.	
Windsor Sand & Gravel Co.	45	Capital; officers; photo; work by.	
Windy lake, nickel	25	10, 121, 122	
Winger, Ont.	68	Wyatt, W. J.	43
Wingham Salt Works	79	Wyer, Samuel S.	
Winning & Boyd	54	Notes by, on prospecting for gas ...	207
Wood, Albert	136	Wyoming, Ont., bricks	38
Wood, J. W.	117		
Wood, John T.	45	Y	
Wood gold claim	130	Yarrow tp., barite	48
Woodburn	68	Yates, Harry	174
Woodhouse tp., gas	67	Yogodo, M.	98
Woodruff, W. S.	135	York Sand and Gravel Co.	45, 173
Woodslee	39, 68	York Sandstone Brick Co.	40, 172
Woodstock	68	Young, A. J.	146
Bricks	37, 38	Young, A. W.	126
Gas consumption	6	Young, G. A.	130
rates	224, 225	Young, W. C.	121
supply	211	Yurdieki, A.	98
Woodstock Gas Light Co.	59		
Workman, Mark	129	Z	
Worth, S. H.	117, 158	Zacoruski, A.	100
Worthington nickel mine.		Zinc, statistics	5
Mining notes	111	Zurich, Ont.	37
Production	22		





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