NORTHERN ONTARIO GOLD ORE

SPECIMEN FROM THE DOME MINE, PORCUPINE
(ACTUAL SIZE)

CANADA—DEPARTMENT OF MINES
HON. CHARLES STEWART, Minister; CHARLES CAMSELL, Deputy Minister
MINES BRANCH—JOHN MCLEISH, Director

THE MINERAL INDUSTRIES OF CANADA

COMPILED BY
A. H. A. ROBINSON
WITH THE COÖPERATION OF THE
STAFF OF THE MINES BRANCH

BRITISH EMPIRE EXHIBITION EDITION
1924

No. 611

PRINTED AT
GOVERNMENT PRINTING BUREAU
OTTAWA

CONTENTS

	PAGE
Preface	9
Introductory	11
Mineral Production of Canada	15
Metals	17
Aluminium	17
Antimony	18
Arsenic	18
Cobalt	19
Copper	20
Gold	24
Iron	29
Lead	33
Manganese	35
Mercury	36
Molybdenum	37
Nickel	38
Platinum and Platinum Group Metals	43
Silver	44
Tin	49
Titanium	49
Tungsten	51
Zinc	51
Non-Metallic Minerals	53
Abrasives	53
Corundum	53
Grindstones	54
Diatomaceous Earth	55
Garnet	55
Volcanic Ash	56
Quartz Sand	56
Artificial Abrasives	56
Actinolite	57
Asbestos	57
Barytes	59
Bentonite	60
Bituminous Sand	61
Celestite	63
Chromite	64
Coal	64
Feldspar	69

	PAGE
Non-Metallic Minerals—*Continued*	
Fluorspar	72
Graphite	73
Gypsum	75
Iron Oxides	78
Kaolin	78
Magnesite	79
Mica	80
Mineral Waters	82
Natural Gas	82
Natural Magnesium Sulphate (Epsomite)	84
Natural Sodium Carbonate	84
Natural Sodium Sulphate (Glauber's Salt)	84
Oil Shale	85
Peat	86
Petroleum	87
Phosphate	88
Pyrites	89
Salt	91
Talc (and Soapstone)	92
Clays and Quarry Products	94
Pottery Clays	94
Fireclay and Firebrick	96
Cement	99
Cement Products	100
Quarried Stone	100
Mineral Production by Provinces	102
Nova Scotia	103
Prince Edward Island	105
New Brunswick	107
Quebec	109
Ontario	113
Manitoba	117
Saskatchewan	121
Alberta	123
British Columbia	125
Yukon	129
Northwest Territories	130
Explanatory Remarks and General Information	131
Mineral Index	135

ILLUSTRATIONS

Photographs

Plate		PAGE
Plate	I. Northern Ontario gold ore. Specimen from the Dome Mine, Porcupine, (actual size)... *Frontispiece*	
"	II. Gold-copper mines, at Rossland, British Columbia.....	21
"	III. Hollinger Consolidated Gold Mines. 5,000-ton mill at Timmins, Ont.....	25
"	IV. Underground in an Ontario gold mine. Hollinger mine, Porcupine.....	26
"	V. Electric underground haulage. Hollinger gold mine, Porcupine, Ont.....	27
"	VI. Iron blast furnaces and stockyard. Algoma Steel Corporation, Sault Ste. Marie, Ont.....	30
"	VII. Iron ore dock with unloading bridges, Algoma Steel Corporation, Sault Ste. Marie, Ont.....	31
"	VIII. An Ontario iron mine and iron ore roasting plant. Magpie mine, Michipicoten district, Ont.....	32
"	IX. International Nickel Company's smelter at Copper Cliff, Ont.....	39
"	X. Underground in an Ontario nickel mine, Crean Hill mine, Sudbury district, Ont.....	40
"	XI. Miners going on shift, Creighton nickel mine, Sudbury district, Ont.....	41
"	XII. British America Nickel Corporation's refinery at Deschenes, Que., as seen from an aeroplane....	42
"	XIII. Cobalt silver vein.....	45
"	XIV. Hydro-electric power for mining purposes. No. 2 power house, Premier mine, Stewart, B.C...	47
"	XV. Making grindstones in New Brunswick.....	54
"	XVI. A Canadian asbestos mine, Thetford Mines, Que..	58
"	XVII. Asbestos bagged for shipment, Black Lake, Que..	59
"	XVIII. Bituminous sand outcropping on the Athabaska river, Alberta. The bed is 40 feet thick..	61
"	XIX. A British Columbia colliery. Coke ovens and plant at Michel, B.C.....	66
"	XX. A coal washing plant in Nova Scotia. Dominion Coal Company's washery at Sydney, N.S.....	68
"	XXI. A Canadian feldspar quarry, Bedford township, Ont.....	69
"	XXII. White microcline feldspar from Villeneuve, Que..	70

Plate XXIII. In the Black Donald mine, Brougham township, Ont., the largest graphite deposit in America... 74
" XXIV. A Nova Scotia gypsum quarry, Walton, N.S.... 76
" XXV. The world's largest amber mica mine. Lacey mine, Loughborough, Ont..... 81
" XXVI. Digging fireclay at Willows, Sask..... 97
" XXVII. A great Nova Scotia coal mine. Dominion Coal Company's Nos. 2 and 9 collieries, Glace Bay..... 102
" XXVIII. A New Brunswick gypsum quarry..... 106
" XXIX. A Quebec asbestos mine, Thetford Mines, Que.. 108
" XXX. An Ontario waterpower harnessed for mining purposes. The general use of hydroelectric power is characteristic of Ontario's mining districts..... 112
" XXXI. A Manitoba gypsum quarry, Gypsumville, Man. 116
" XXXII. White fireclay beds in Saskatchewan (Twelve Mile Lake)..... 120
" XXXIII. Alberta's bituminous sands. A bed 85 feet thick on the Steepbank river..... 122
" XXXIV. A British Columbia metallurgical works. The Consolidated Mining and Smelting Company's plant at Tadanac, B.C..... 124
" XXXV. A Gold dredge operating in Yukon..... 128

Map

No. 613. Mineral map of Canada.....In pocket

THE MINERAL INDUSTRIES

OF

CANADA

1924

British Empire Exhibition
Edition

PREFACE

This handbook is designed to present in popular form a brief sketch of the more important economic minerals so far discovered in Canada and of the mining and metallurgical industries founded thereon. It is believed that Canada possesses enormous potential possibilities for the future development of mineral wealth, compared with which the present production, important though it is, is but a small beginning.

A similar report under the title of "Economic Minerals and Mining Industries of Canada," was first published in 1913 (Mines Branch Report No. 230). A revised second edition (Report No. 322) was published in 1914 for distribution at the Panama Pacific Exposition at San Francisco.

The present handbook has been revised and re-compiled at the request of the Canadian Exhibition Commission for special distribution at the British Empire Exhibition to be held in London during 1924. It has been prepared under the supervision of Dr. A. W. G. Wilson, Chief of the Division of Mineral Resources, by Mr. A. H. A. Robinson, who has had associated with him in its preparation several members of the Mines Branch staff, more particularly Messrs. L. H. Cole, H. S. Spence, A. Buisson, S. C. Ells, V. L. Eardley-Wilmot, and J. C. Casey.

The particulars and the statistics here given have all been compiled from official sources, Provincial and Dominion, and a number of the illustrations have been furnished by mining and metallurgical companies, for all of which general acknowledgment is here made.

More detailed information respecting any particular mineral, ore, product, or district may be obtained from the proper official department of the various Provincial governments, as indicated in the report, or from the Dominion Department of Mines at Ottawa.

John McLeish,
Director.

MINES BRANCH,
DEPARTMENT OF MINES,
OTTAWA, CANADA,
JANUARY 12, 1924.

INTRODUCTORY

The mining and metallurgical industries of Canada have become of great importance only within recent years; their development has been rapid, and Canada to-day occupies no mean place among the mineral producing countries of the world. The value of the annual mineral output of the Dominion, which was less than $10,250,000 in 1886, was $227,859,665 in 1920, the year of maximum production, and, in the same year, Canada ranked first in asbestos, nickel, and cobalt, third in silver, fourth in gold, and tenth in coal, among the mineral producing countries of the world. Her coal reserves are exceeded only by those of the United States and China, and she has developed mines of nickel, zinc, gold, asbestos, talc, feldspar, mica, and graphite that take their place among the largest known. The variety of her mineral resources includes, with few exceptions, all the useful minerals, though only a small fraction of her mineral bearing territory has been prospected.

Canada's metallurgical works, also, will compare favourably with those of any country. The smelters, reduction plants and refineries at Sudbury, Trail, Anyox, Thorold, Deloro, and Deschenes, and the gold mills of Porcupine, are all models of their kind, while great iron and steel works at Sydney, Hamilton, and Sault Ste. Marie have enabled the Dominion to take seventh place among the iron and steel making countries of the world.

Of even greater interest than Canada's past achievement and present development, however, are her possibilities in the future. These, a glance at the mineral map of the country will serve to demonstrate. The present known mineral occurrences are found thickly clustered along the southern, long settled border of the Dominion, but thin out rapidly in the newer and more sparsely inhabited regions of the north; nevertheless, these northern regions are underlain by the same rock formations that have proved so prolific in the south. In point of fact, much the greater part of Canada, whose total land area is more than 3,600,000 square miles, is still entirely unprospected, and only sufficiently explored to indicate in a general way its main

geological features and enable forecasts to be made of its mineral wealth. In order to estimate its ultimate possibilities, the chief characteristics of each of the five great physiographic divisions into which the country naturally falls may be briefly passed in review.

Surrounding Hudson bay, in the form of a huge V and covering some 2,000,000 square miles, or over half Canada, is an upland region underlain by rocks of pre-Cambrian age—the so called Laurentian plateau or Canadian shield. The rocks of which the Laurentian plateau is composed are remarkable, wherever they have been explored, for the variety of useful minerals they contain, yielding as they do, copper, nickel, iron, cobalt, silver, gold, platinum, corundum, graphite, talc—in short, nearly all the minerals, common or rare, that are used in the arts. It is the partly prospected, merest southern fringe of this great pre-Cambrian area that has yielded the gold of Porcupine and Kirkland Lake, the silver of Cobalt and Thunder Bay, the nickel of Sudbury, the copper of the Pas, the pyrites of Northpines and Goudreau, the iron of Michipicoten and Moose Mountain, and the mica, feldspar, graphite, talc, and corundum of eastern Ontario and western Quebec. What is known of the vast remaining bulk of this huge area is that scattered over it are patches of all the rock formations that go to make up the rich pre-Cambrian of its southern border, and that practically all the minerals known to occur there have also been noted by explorers in the north.

The second great physiographic unit is the Cordilleran mountain belt that, extending along the Pacific coast includes British Columbia, Yukon, and western Alberta, thus covering an area 1,300 miles long and 400 miles broad. The Cordilleras, which throughout their length stand unequalled for the continuity, extent, and variety of their mineral resources, maintain in Canada the reputation gained in South America, Mexico, the United States, and Alaska. This mountain belt is rich in lodes of gold, silver, copper, lead, and zinc; its streams have yielded much alluvial gold; and on its flanks are enormous beds of coal of excellent quality. Already it has given rise to mining camps like Rossland, Kimberley, Slocan, Boundary, and Copper Mountain, and produced such famous mines as Le Roi, Sullivan, Granby, Britannia, Hidden Creek, and Premier—and yet, probably not one-fifth of the Cordilleran belt in Canada

can be said to have been prospected at all, and not a single district to have been completely tested.

A third great unit is formed by the Appalachian highlands of southeastern Canada. This region, which includes Nova Scotia, New Brunswick, and the southeastern part of Quebec, is the northeasterly extension of that mountain system the mineral wealth of which has made some of the eastern United States such busy hives of industry. In Canada, the Appalachians, besides containing large and valuable coal fields, have yielded salt, gypsum, iron, gold, manganese, and antimony, in Nova Scotia; coal, gypsum, iron, natural gas, petroleum, and oil shale, in New Brunswick; and, in Quebec, chromite, pyrite, copper, lead, zinc, and gold, as well as the largest known deposits of asbestos. It is the Appalachian coal fields of Cape Breton that, in conjunction with iron ores from Newfoundland, have given rise to the great iron and steel works at the Sydneys, in Nova Scotia.

A fourth physiographic unit, the St. Lawrence lowlands, includes the older, more thickly populated southern portions of eastern Ontario and western Quebec. Underlain by flat-lying sedimentary rocks, it is essentially a region of farming and manufacturing, but also yields a large output of non-metallic minerals of great industrial value, including petroleum, natural gas, salt, gypsum, and a wide variety of structural materials.

The fifth, and last, of the great natural divisions included in continental Canada is the great interior plateau, comprising the wheat growing districts of the provinces of Manitoba, Saskatchewan, and Alberta, and extending northward from the international boundary to the Arctic ocean. This, the great plains region, is, like the St. Lawrence lowlands, pre-eminently an agricultural country, and is, also like the latter, underlain by sedimentary rocks, which are, however, of a later geological age. Very large areas are underlain at shallow depth by beds of lignite, and the bituminous coal fields in western Alberta are the most extensive in Canada. Large reservoirs of natural gas have been tapped at a number of places, and discoveries of oil made both in the extreme south and in the far north. Bituminous sands outcrop for miles along the Athabaska river and its tributaries, beds of rock salt and gypsum have been found near McMurray, numerous saline lakes and

sloughs scattered over the country are capable of furnishing a considerable supply of the natural soluble salts of the alkalis, and the most extensive beds of valuable stoneware and refractory clays yet found in Canada occur in southern Saskatchewan. There is little doubt that in the not far distant future the mineral industry will vie with agriculture in many localities in the great plains region.

Development of the mineral industry in Canada, hardly yet out of its infancy, has here as elsewhere its tinge of romance. Some of the Dominion's most productive mines have been found, not through intentionally directed effort but by mere chance. The world-famous nickel deposits of Sudbury were first disclosed in a rock-cutting, during the construction of a railway, as were also the fabulously rich silver veins of Cobalt, from over which the lumberman had previously cut out the pine, unconscious of the vastly greater wealth beneath his feet. Still more recently the sinking of a well on a Nova Scotia farm afforded the clue that led to the discovery of valuable salt beds in an old settled district where the need of a local supply of salt had long been a matter for solicitude. Many more instances of a similar nature might be quoted, to illustrate the inadequately prospected condition of the whole Dominion. The prospector need not go far afield to be successful, indeed, except in the case of rare bonanzas, discoveries made much beyond the outskirts of the settlements may have to await the developments of the future to acquire much commercial value. Neither need there be any lack of elbow room in a country in which the mineral frontier extends 3,000 miles from coast to coast, and the undeveloped territory northward to the pole.

In addition to the many opportunities presented for the fuller development of the country's large known mineral resources, Canada to-day offers to the prospector the largest and most promising extent of mineral-bearing territory that anywhere remains unprospected on the globe.

MINERAL PRODUCTION OF CANADA

The growth and present extent of Canada's mineral production is summarized in the following table, which gives the total annual value and the value per head of population for each year from 1886 to 1923:—

Annual Values of Mineral Production in Canada Since 1886

Year	Value of production	Value per capita	Year	Value of production	Value per capita
	$	$		$	$
1886	10,221,255	2·23	1905	69,078,999	11·49
1887	10,321,331	2·23	1906	79,286,697	12·81
1888	12,518,894	2·67	1907	86,865,202	13·75
1889	14,013,113	2·96	1908	85,557,101	13·16
1890	16,763,353	3·50	1909	91,831,441	13·70
1891	18,976,616	3·92	1910	106,823,623	14·93
1892	16,623,415	3·39	1911	103,220,994	14·32
1893	20,035,082	4·04	1912	135,048,296	18·33
1894	19,931,158	3·98	1913	145,634,812	19·35
1895	20,505,917	4·05	1914	128,863,075	16·75
1896	22,474,256	4·38	1915	137,109,171	17·44
1897	28,485,023	5·49	1916	177,201,534	22·05
1898	38,412,431	7·32	1917	189,646,821	23·18
1899	49,234,005	9·27	1918	211,301,897	25·37
1900	64,420,877	12·04	1919	176,686,390	20·84
1901	65,797,911	12·16	1920	227,859,665	26·40
1902	63,231,836	11·36	1921	171,923,342	19·56
1903	61,740,513	10·83	1922	184,297,242	20·55
1904	60,082,771	10·27	*1923	214,102,000	23·41

*Estimated.

The average annual production of the different minerals and mineral products from 1911 to 1920, together with the production for 1921 and 1922, is shown below:—

Mineral Production of Canada

—	1911-1920	1921		1922	
	Average production	Quantity	Value	Quantity	Value
			$		$
METALLIC					
Cobalt, metallic and contained in oxide..... Lb.	895,476	251,986	755,958	569,960	1,852,370
Copper..... "	88,877,924	47,620,820	5,953,555	42,879,818	5,738,177
Gold.....Fine oz.	748,003	926,329	19,148,920	1,263,364	26,116,050
Iron, pig, from Canadian ore.... Tons	72,987	56,564	1,873,682	8,095	178,980

Mineral Production of Canada—*Continued*

	1911-1920	1921		1922	
	Average production	Quantity	Value	Quantity	Value
			$		$
METALLIC					
Iron ore sold for export..... Tons	96,812	1,058	3,272	1,781	4,938
Lead..... Lb.	38,511,868	66,679,592	3,828,742	93,307,171	5,817,702
Nickel..... "	80,612,038	19,293,060	6,752,571	17,597,123	6,158,993
Palladium.....Crude oz.	97·5	591	38,267	724	47,060
Platinum..... "	114	292	21,910	469	45,783
Rhodium, Osmium, Iridium, Ruthenium..... Oz.	.....	57	9,690	392	31,360
Silver.....Fine oz.	24,985,220	13,543,198	8,485,355	18,581,439	12,576,758
Zinc..... Lb.	24,553,932	53,089,356	2,471,310	56,290,000	3,217,536
Total value Metallics..	.....	.....	49,343,232	.....	61,785,707
NON-METALLIC					
Actinolite..... Tons	132	78	975	50	575
Arsenic, white, and in ore..... "	2,450	1,491	233,763	2,576	321,037
Asbestos..... "	150,421	92,761	4,906,230	163,706	5,552,733
Barytes..... "	903	270	9,567	289	9,537
Chromite..... "	14,803	2,798	55,696	767	11,503
Coal..... "	14,157,420	15,057,498	72,451,656	15,157,431	65,518,497
Corundum..... "	667	403	55,965	.....	.....
Feldspar..... "	19,115	29,868	230,754	27,727	248,402
Fluorspar..... "	4,181	5,519	136,267	4,503	102,138
Graphite..... "	2,411	937	65,862	597	31,353
Grindstones..... "	3,391	1,281	64,067	1,005	43,742
Gypsum..... "	428,465	386,550	1,785,538	559,265	2,160,898
Magnesite..... "	20,088	3,730	81,320	2,849	76,294
Magnesium sulphate. "	1,391	2,029	39,506	1,021	24,107
Manganese..... "	353	68	3,400	73	2,044
Mica..... "	.....	702	70,063	3,349	152,263
Mineral water..... Gal.	.....	328,273	21,716	221,433	14,220
Natro-Alunite..... Tons	.....	30	1,500	50	2,500
Natural gas....M cu. ft.	.....	14,077,601	4,594,164	14,682,651	5,846,501
Iron oxides..... Tons	9,593	9,048	93,610	7,285	110,008
Peat..... "	1,748	1,666	6,664	3,000	14,500
Petroleum, crude.. Bbl.	234,6.9	187,540	641,533	179,068	611,176
Phosphate..... Tons	.....	30	450	190	1,796
Pyrites..... "	232,586	32,173	116,326	18,143	74,303
Quartz..... "	126,476	100,350	312,947	109,947	208,598
Salt..... "	127,606	164,658	1,673,685	181,794	1,628,323
Sodium carbonate. "	.....	197	14,775	202	3,027
Sodium sulphate... "	81·1	623	18,850	504	11,980
Talc..... "	13,790	10,124	144,565	13,195	188,458
Tripolite..... "	419	341	11,268	219	5,781
Total value Non-metallic.....	.....	.....	87,842,682	.....	82,976,794
STRUCTURAL MATERIALS AND CLAY PRODUCTS					
Cement Portland and Puzzolan.... Bbl.	5,971,473	5,752,885	14,195,143	6,943,972	15,438,481
Clay products—					
Bricks, common. No.	398,286,373	220,438,243	3,567,503		
" pressed.. "	76,384,843	80,947,398	1,738,293		
Bricks, hollow building..... "	.....	3,627,777	177,273		
Bricks, moulded and ornamental "	.....	1,995,284	50,576		

Mineral Production of Canada—*Concluded*

	1911-1920	1921		1922	
	Average production	Quantity	Value	Quantity	Value
			$		$
STRUCTURAL MATERIALS, ETC—*Con.*					
Firebrick..... No.	.....	4,502,233	242,462		
Fireclay.....	.....	2,931	29,851		
Fireclay blocks.....	.....	.....	91,685		
Fireproofing and hollow porous blocks.....	.....	.....	452,296		11,438,456
Kaolin..... Tons	823	124	1,888		
Paving brick.... No.	.....	.....	.....		
Pottery from domestic clay.....	.....	.....	231,262		
Sewer pipe.....	.....	.....	1,666,584		
Architectural terra-cotta.....	.....	.....	134,193		
Tile, drain..... No.	.....	.....	473,952		
Lime.....Bush.	7,064,288	6,879,067	2,781,197	7,742,651	3,165,005
Sand and gravel... Tons	.....	11,574,862	2,537,249	11,666,371	3,502,935
Slate.....	.....	.....	22,325	1,899	14,871
Stone..... Tons	.....	3,671,498	6,343,696	3,637,182	5,974,993
Total value of structural and clay products.....	.....	.....	34,737,428	.....	39,534,741
Grand total.....	.....	.....	171,923,342	.....	184,297,242

METALS

Aluminium

Though no commercial ores of aluminium have yet been found in Canada, that metal is produced on a large scale from imported bauxites at Shawinigan Falls, in Quebec, a district in which large quantities of cheap hydro-electric energy are available, and which therefore offers considerable advantages for the carrying on of electrochemical processes such as the production of aluminium.

Though no bauxite has been found, there are some very pure feldspars in Canada that may, in the future, through the introduction of newer processes, become available as ores of aluminium.

In 1921 Canada exported aluminium in bars, blocks, etc., to the amount of 53,998 cwt., valued at $1,259,703, and manufactures of aluminium valued at $273,401.

Antimony

Small amounts of refined antimony, as well as antimony ores, have been produced intermittently for a number of years in the Maritime Provinces of Canada.

The most productive localities are West Gore in Hants county, Nova Scotia, where the ore is an auriferous stibnite (sulphide of antimony), and the parish of Prince William in York county, New Brunswick, where both stibnite and native antimony are found. Some of the silver-lead ores of southern British Columbia also carry antimony as a minor constituent, which is occasionally recovered as a by-product in the lead refinery at Trail.

The occurrence of antimony minerals has also been noted at South Ham, Wolfe county, Quebec, at numerous localities in British Columbia, and in Yukon.

No antimony ores or refined antimony have been produced in Canada since 1917, when shipments of 361 tons of ore and concentrates, valued at $22,000, were recorded.

Arsenic

Arsenic is found in Canada in numerous places and in a variety of ores, but production, at present, is confined to that derived from the cobalt and nickel arsenides and sulpharsenides associated with the silver ores at Cobalt, Ontario, and from auriferous arsenical concentrates from the Hedley gold mine in British Columbia.

Ores and silver refinery residues from Cobalt, Ontario, which provide about four-fifths of the arsenic produced in Canada, are shipped to refineries at Thorold and Deloro, Ontario, where the arsenic is recovered as a by-product and marketed, chiefly as white arsenic (As_2O_3). The Deloro Smelting and Refining Company also has a plant for the manufacture of Paris green, lead arsenate, and arsenate of lime. The concentrates from the Hedley mine in British Columbia are sent to smelters at Tacoma, Washington, U.S.A., where both the arsenic and gold are recovered.

Formerly, white arsenic was made at Deloro, Ontario, from the local mispickel ores, which are quite abundant in that vicinity, and it is not impossible that with the growing demand for arsenical insecticides these central Ontario mispickel deposits may be again worked for arsenic.

For a number of years there was also a small output of auriferous mispickel concentrates from a mine at Goldboro, Nova Scotia. Mispickel has also been reported from Cheticamp, Cape Breton, in the same province.

In northern Ontario, mispickel is found in quantity at Net lake near Timagami, in Davis township in the Nipissing district, near Schreiber on the north shore of lake Superior, and in the Rainy River district.

Most of the white arsenic made in Canada is exported for use in the manufacture of insecticides, though the glass-making and the tanning industries also take considerable amounts.

In 1922 the production of white arsenic in Canada was 2,058 short tons, valued at $299,940, and of arsenic in concentrates, 518 tons, valued at $21,097.

Cobalt

Smaltite and cobaltite, respectively the arsenide and sulpharsenide of cobalt, are found closely associated with the silver of the veins of the Cobalt district, in Ontario, and it is from the silver-cobalt-nickel ores of Cobalt that most of the world's demand for cobalt is now supplied.

Ores from the silver mines and residues from the silver reduction plants at Cobalt are shipped to refineries, chiefly to those at Thorold and Deloro in southern Ontario, where they are treated for the extraction of their total metal content, including cobalt, which is recovered partly as the metal, partly as cobalt oxide or cobalt salts. Considerable quantities of cobalt-bearing residues and ores are also exported to the United States and Great Britain for treatment.

Cobalt is also a minor constituent of some of the nickel-copper ores of Sudbury, Ontario, and a small recovery of cobalt from this source was reported in 1892, 1893, and 1894.

The beautiful pink mineral erythrite, or cobalt bloom, which was so much sought for as an indicator of silver veins in the early days of the Cobalt mining camp, is found in small quantity at numerous places in Canada, but its presence has led to the discovery of commercial ores of cobalt only in, or in the immediate vicinity of the silver producing districts of northern Ontario.

The metal cobalt, together with chromium and tungsten, enters into the composition of stellite, a noteworthy alloy much used for high speed cutting tools, which, on account of its resistance to rusting and corrosion, is also used for the manufacture of a fine grade of cutlery. Cobalt oxide is the essential constituent of the well known cobalt blue, so much used as a refractory colouring material in the porcelain, enamel, and glassmaking industries.

In 1922 the production of cobalt in Canada, both as metal and contained in compounds of cobalt, was 569,960 pounds, valued at $1,852,370. In the same year, there was exported 111,830 pounds of metallic cobalt, valued at $288,776, 4,022 pounds of cobalt alloys, valued at $21,398, and 430,024 pounds of cobalt oxide and cobalt salts, valued at $770,511.

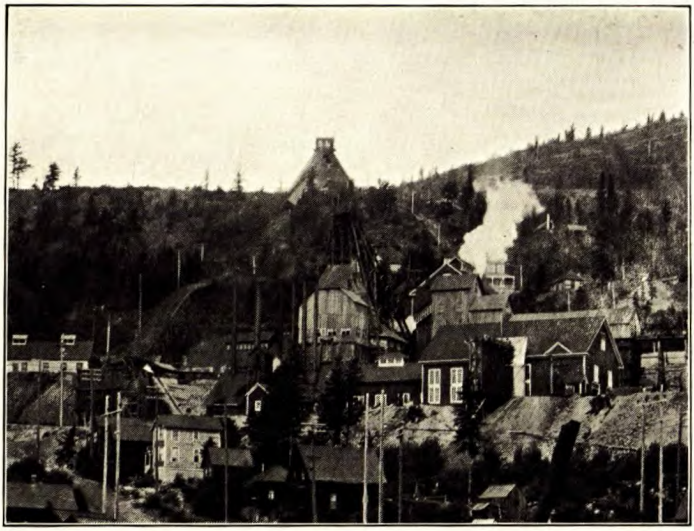
Copper

Copper ores of various kinds, including native copper, copper carbonates, oxides, and sulphides, occur at many places throughout Canada—the sulphide ores chalcopyrite and bornite, however, are the ones at present commercially important. Production so far has been confined to the following provinces, in the order of their importance—British Columbia, Ontario, Quebec, and Manitoba, and to Yukon territory, though deposits of copper minerals are also known in the Maritime Provinces and in the Arctic regions of northern Canada. More than passing mention should be made of the great areas of copper bearing amygdaloidal rocks, similar to the famous copper bearing formations of the state of Michigan, that occur along the Arctic coasts of Coronation gulf and in Victoria land. These, on account of their present inaccessible situation have only been sufficiently explored to confirm the reports of their copper bearing nature, first made a century and a half ago; nevertheless, they constitute one of the possibly great copper producing districts of the future.

In British Columbia, the chief copper producing province of the Dominion, copper bearing minerals, chiefly chalcopyrite and bornite, are found in many localities, either alone, or, more often, associated with pyrite, pyrrhotite, magnetite, sphalerite, galena, mispickel, or other minerals. The most important discoveries yet developed

are in the southern interior parts of the province and in the coast districts—in the southern interior at Rossland, where the ore, a mixture of pyrrhotite, pyrite, and chalcopyrite is primarily a gold ore; near Phoenix, where disseminated chalcopyrite, pyrite, and hematite, carrying copper, gold, and silver were mined; at Kamloops; and at Copper Mountain; on the southern coast, at Britannia Beach, where the ore consists of impregnations and replacements of schist by pyrite, chalcopyrite, and, to a less extent, zinc blende, and carries a little gold and silver;

PLATE II.



Gold-copper mines at Rossland, B.C.

at Anyox on the Portland canal on the northwest coast, where also the ore is a low grade mixture of pyrite, pyrrhotite, and chalcopyrite carrying some gold and silver; at Surf inlet on Princess Royal island; and at Sidney inlet on Vancouver island.

The Granby Consolidated Mining, Smelting and Power Company's Hidden Creek mine at Anyox, which contributed 30,334,180 pounds of copper, or nearly three-quarters of the total Canadian production, in 1922, is tre largest

copper mine in Canada. The Britannia Mining and Smelting Company's Britannia mine is equipped to produce copper, in concentrates, to the extent of about 30,000,000 pounds per annum.

In connection with their mines, the Granby company has a large copper smelter at Anyox, and the Consolidated Mining and Smelting Company has a copper smelter and electrolytic refining plant at Trail. The Britannia Mining and Smelting Company ship their concentrates to a smelter at Tacoma, Washington, U.S.A.

In Ontario, there are many known deposits of copper minerals, especially in the districts of Algoma and Thunder Bay, and attempts have been made to work a number of them, but the actual production of copper in this province is practically all derived from the nickel-copper ores—mixed pyrrhotite and chalcopyrite—of the Sudbury nickel mines, and its amount is, in consequence, largely dependent on the demand for nickel. The copper output of the Sudbury mines has varied from 26,000,000 pounds in 1913 to 47,000,000 pounds in 1918. The producing companies are: the International Nickel Company of Canada, whose smelters are at Copper Cliff and refineries at Port Colborne, Ontario; the Mond Nickel Company, with smelters at Coniston, Ontario, and refinery at Clydach, Wales; and the British America Nickel Corporation, with smelters at Nickelton, Ontario, and refineries at Deschenes, Quebec.

There is also a small amount of copper recovered in Ontario, in the form of copper sulphate, from the Cobalt silver ores and refinery residues that are treated at Thorold and Deloro.

In Quebec, copper is recovered from the residues left after burning the pyritous ores mined primarily for their sulphur content, in the vicinity of Sherbrooke, in the Eastern Townships. The mining of cupriferous pyrites in this district has been carried on for many years, and one mine in Sherbrooke county, the Eustis, attained a depth of nearly 4,000 feet. Latterly most of the production has come from the Weedon mine in Wolfe county, but all have been idle since 1921. The residual cinder left after the sulphur has been burned off the pyrites for the production of sulphuric acid is exported to the United States to be further treated for the recovery of copper.

In northern Manitoba, large sulphide deposits consisting of pyrites with bands of chalcopyrite and zinc blende—constituting low grade copper ore—have been proved by diamond drilling on Flin Flon lake, in the vicinity of the Pas. A railway about 85 miles in length, to provide necessary transportation facilities, will have to be built, however, before these deposits can be profitably worked. Some copper ore at the neighbouring Mandy mine was rich enough to pay the cost of difficult transportation to a railway, high railway freight charges thence to Trail, B.C., and still leave a handsome profit. This very rich ore, however, has now been worked out, and both the Mandy and Flin Flon deposits are lying idle awaiting the provision of adequate transportation facilities and a local treatment plant.

In Yukon territory, there are important copper deposits near Whitehorse that have already produced about 3,000,000 pounds of copper, but which, on account of the low price of that metal and the high cost of transportation and mining, have not been worked for several years.

The production of copper from all sources in Canada, in 1922, was 42,879,818 pounds, valued at $5,738,177; as against 81,600,691 pounds, valued at $14,244,217, in 1920, and 118,769,434 pounds, valued at $29,250,536, in 1918.

Of the production in 1922, about 40,000,000 pounds was contained in blister copper and copper matte produced in British Columbia and Ontario, and the remainder in ores shipped to the United States for treatment, and as contained in copper sulphate.

The production of refined copper in 1922 amounted to about 730,000 pounds, all produced at the Consolidated Mining and Smelting Company's electrolytic refinery at Trail, B.C.; in 1921, it was 4,286,740 pounds, produced in part at Trail and in part at the British America Nickel Corporation's refinery at Deschenes, Quebec, which was not in operation in 1922. These are the only two plants equipped to produce refined copper in Canada at present, the International Nickel Company's plant at Port Colborne, Ontario, being in a position to make blister copper only.

To encourage the production of the higher grades of copper, the Dominion government, in 1923, granted a bounty for five years on copper bars or copper rods made in Canada from copper produced in Canada and sold for consumption in Canada. For the first year this bounty is

1½ cents per pound and diminishes yearly until the end of the five year term.

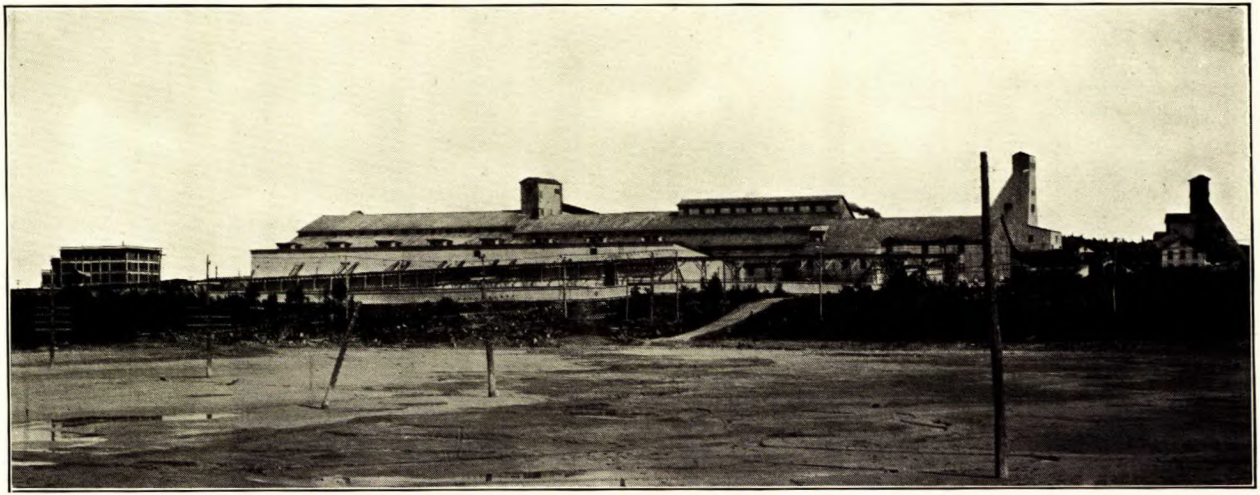
In 1913 the Mines Branch published a detailed report on the "Copper Smelting Industries of Canada," (No. 209) copies of which may be obtained on application to the Director, Mines Branch, Ottawa, Canada.

Gold

Gold in some form is found in every province of Canada except Prince Edward Island, and is, in point of value, next to coal the most important mineral product of the Dominion. Present indications, indeed, point to the possibility of the value of Canada's gold output surpassing even that of her coal during the next few years. Formerly British Columbia and Yukon territory were the most productive regions, but new discoveries and developments have now put Ontario far in the lead.

Although in this province alluvial gold in workable quantity is practically unknown, deposits of lode gold are numerous and widespread. Many of the earlier attempts made to exploit these resulted in financial failure, but the opening up of the Porcupine and Kirkland Lake gold camps marked the beginning of a new era in the history of gold mining in Ontario, which is now one of the important gold producing countries of the world and gold mining one of its most prosperous industries. Though the first productive operations at Porcupine date only from 1909, and at Kirkland Lake from 1913, these two camps had at the end of 1922 paid out $26,846,000 in dividends, principally from three mines in the Porcupine district, the Hollinger, Dome, and McIntyre. With nearly every producing mine increasing both its proved ore reserves and its milling capacity, and with a number of new mines rapidly approaching the productive stage, the gold output of Ontario, which in 1922 amounted to $20,678,862, should show a marked increase within the next few years. The total recorded gold production of the province to the end of 1922 was $108,300,000.

Previous to the discoveries in Porcupine, the best known gold mining district in Ontario was the Lake of the Woods district, in the extreme western part of the province, though gold was also mined to some extent in eastern Ontario and in other parts of the province.



Hollinger Consolidated Gold Mines 5,000-ton mill at Timmins, Ont.

Among the more recent promising new discoveries mention may be made of those at Schreiber, north of lake Superior; those near Goudreau, in the Michipicoten district; at West Shining Tree, in the Sudbury district; at Lightning river, near Abitibi lake; and near Matachewan, on the Montreal river, in the Timiskaming district.

In British Columbia, much gold was formerly derived from placer workings in the Cariboo and Atlin districts, but now by far the greater part of the gold production of

PLATE IV.

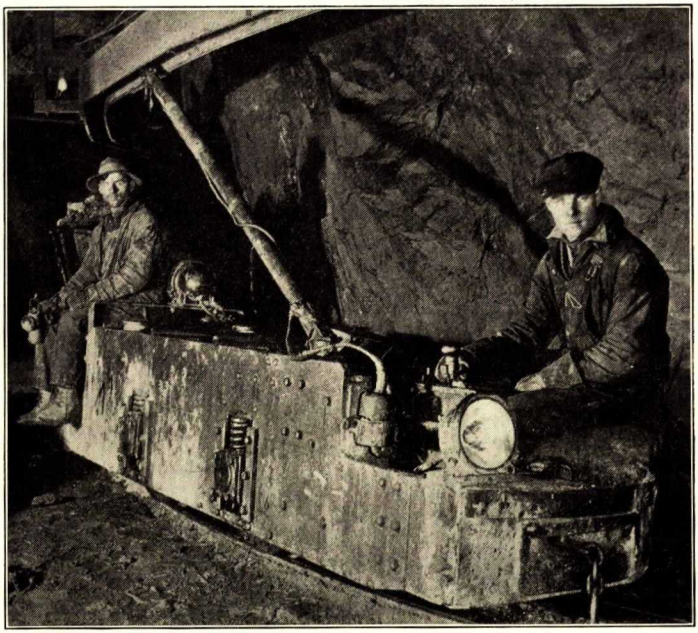
Underground in an Ontario gold mine, Hollinger mine, Porcupine.

this province comes from hard rock mines; among others, from the copper-gold mines of Rossland, Britannia Beach, Anyox, Surf Inlet, Sidney Inlet, and Kamloops; from gold-quartz mines in the vicinity of Salmo, Hedley, Atlin, and Stewart; and from some of the lead and zinc-lead mines of the province. The Premier mine, near Stewart, in the northwestern coast district, which in addition to being an exceedingly rich gold mine is now one of the most productive silver mines in the Dominion, has a remarkable record. Between the time the first shipments of ore were

made from the Premier in 1919 and the end of 1922 it had produced 168,500 ounces of gold and 5,662,000 ounces of silver, and during the same period had distributed $3,-150,000 in dividends.

The production of gold in British Columbia in 1922 amounted to 207,370 fine ounces, valued at $4,286,718; the total recorded production of the province to the end of the same year was $186,189,864, of which $76,542,203 was derived from placer gold and $109,647,661 from lode gold.*

PLATE V.



Electric underground haulage, Hollinger gold mine, Porcupine, Ont.

In Yukon territory, which includes the once famous Klondike, gold is derived chiefly from placers, and production has long since passed its peak of $22,275,000, in 1900. Two large gold dredging companies still operate on Bonanza, Eldorado, Hunker, and other creeks tributary to the Yukon river, near Dawson, and to these most of the present output is to be credited. Gold, however, is

*B.C. figures.

also obtained from quartz lodes, in the Conrad district and other parts of Yukon, and is also associated with the copper and lead ores found in the territory. The gold output of Yukon in 1922 was 54,456 ounces, valued at $1,125,705; the total recorded production is over $178,000-000.

In Nova Scotia, gold bearing formations cover most of the southern part of the province, and gold-quartz mining on a moderate scale has been carried on for over sixty years, though latterly the production has been small.

In Quebec, gold is chiefly derived, as a by-product, from the pyritous copper ores of the Eastern Townships and from the lead-zinc ores of Notre-Dame-des-Anges. In the past, about $2,000,000 worth of gold was won from old placers on the tributaries of the Chaudiere river in Beauce county. Gold quartz veins also have been discovered in the northeastern part of the province, and intensive prospecting is now going on in Rouyn township, Timiskaming county, on the eastern extension of the belt of gold bearing rock that includes the Porcupine and Kirkland Lake gold camps in Ontario.

In Manitoba, which is just at the beginning of its career as a mining province, gold is associated with large copper-zinc sulphide deposits near the Pas; and considerable development has been done on gold-quartz veins in the pre-Cambrian rocks of the Rice Lake and Herb Lake districts to the east and north, respectively, of lake Winnipeg. The recovery of 156 ounces of gold is reported from Manitoba for 1922.

In Alberta, small amounts of gold are recovered by washing the sands of the Saskatchewan river, and in the province of Saskatchewan quartz veins carrying gold have been found in the northern part of the province, and alluvial gold has been won by dredging in the North Saskatchewan river above Prince Albert.

In New Brunswick, quartz veins carrying gold have been reported from only one place.

The total production of gold in Canada in 1922 was 1,263,364 fine ounces, valued at $26,116,050, as against 926,329 ounces, valued at $19,148,920, in 1921. Over four-fifths of the production in 1922 is to be credited to the Hollinger, Dome, and McIntyre mines of northern Ontario.

Iron

Though Canada ranks seventh among iron and steel making countries only a small part of her production has been derived from domestic ores, the iron blast furnaces on the Atlantic seaboard depending for their supply on Newfoundland, and those in the interior on the United States.

Nevertheless, occurrences of iron ore are numerous and widespread, and until 1895 all the pig iron made in the Dominion was made from Canadian ore. But, under the conditions now prevailing, all the known deposits are handicapped, either by being too small for economical operation, by being disadvantageously situated with respect to iron making centres, or because they are so lean or so contaminated with deleterious ingredients that they are not desirable for blast furnace use without preliminary treatment, and hence have not been able to compete successfully with the abundant cheap supplies of foreign ores available.

In Nova Scotia, iron mining and iron making were carried on at Londonderry for many years; and iron ore has also been mined at various places in Annapolis, Kings, Hants, Cumberland, Colchester, Pictou, Antigonish, and Cape Breton counties. But with the depletion of some of the deposits, the more exacting demands of the iron industry, and the discovery of large sources of supply for Nova Scotia furnaces in Newfoundland, the mining of the local ores became unprofitable, and the present great iron industry in Nova Scotia is based entirely on the use of Newfoundland ore.

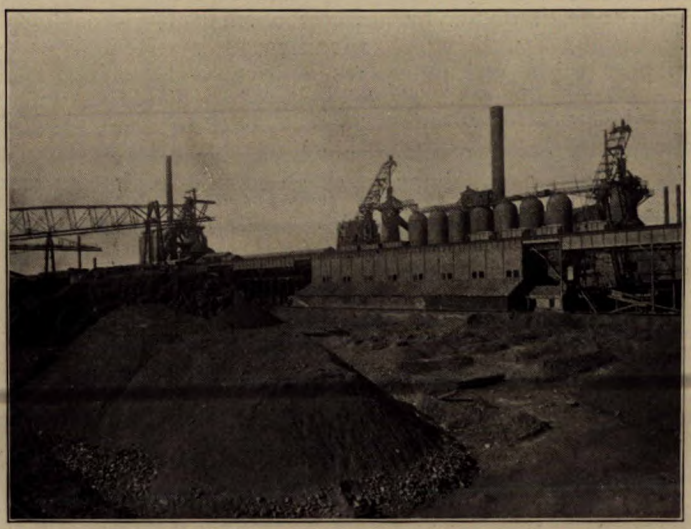
In New Brunswick, a large deposit of rather low grade magnetite was worked for several years prior to 1913.

In Quebec, small quantities of charcoal pig iron of excellent quality were made from the bog ores of the St. Lawrence valley for 180 years or more, and a number of unsuccessful attempts have been also made from time to time to work some of the deposits of magnetite and magnetic iron sands that occur scattered over that province. In northern Quebec, at present beyond reach of transportation, there are large areas of iron bearing formation similar to that of the great iron mining districts of lake

Superior, which, however, remain unprospected on account of their inaccessibility.

Ontario has been more productive of iron ore than any of the Canadian provinces, and in Ontario, the Michipicoten district north of lake Superior has been the most productive locality. In this district the Algoma Steel Company's Helen mine yielded between two and a half and three million tons of good hematite before it was exhausted, and the neighbouring Magpie mine, of the same company, produces a low grade iron carbonate, which is

PLATE VI.



Iron blast furnaces and stockyard, Algoma Steel Corporation, Sault Ste. Marie, Ont.

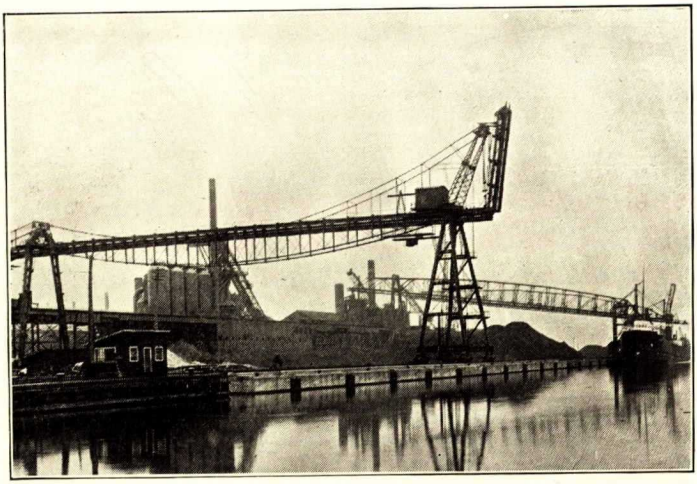
roasted to bring it to merchantable grade. Adjacent to the old Helen mine workings, probably 100,000,000 tons of carbonate ore very similar to that at the Magpie mine has been proved by diamond drilling and partly developed, and the Josephine mine in the same neighbourhood is believed to contain at least a million tons of high grade hematite.

At Moose Mountain, in the Sudbury district, high grade magnetic concentrates and sinter have been derived in an experimental way from a great body of low grade siliceous

magnetite for the last ten years; and formerly there was an occasional small production of magnetite and hematite from some of the numerous small deposits in eastern Ontario. For a few years also a high sulphur magnetite from large deposits at Atikokan, west of lake Superior, was smelted, after roasting, at Port Arthur.

Scattered over all western and northern Ontario, at points too numerous to mention here, are large areas of low grade iron formation, some of which will no doubt ultimately be made available either by improved methods

PLATE VII.



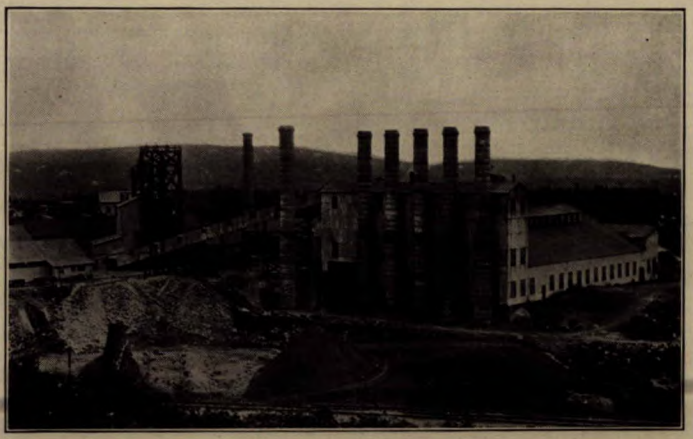
Iron ore dock with unloading bridges, Algoma Steel Corporation, Sault Ste. Marie, Ont.

of concentration or by the discovery in them of bodies of natural ore of merchantable grade.

British Columbia, also, contains deposits of magnetite, limonite, and hematite. Those of more immediate interest are the numerous magnetite deposits found scattered over the islands and mainland of the coast, which on account of their ready accessibility to points where ore, fuel, and flux can be cheaply assembled, promise soon to become a source of supply for a local iron industry. To encourage such a development, the provincial government has offered a bounty of $3 per net ton on pig iron made in British Columbia from local ores.

At present the three great centres of the iron and steel industry in Canada are: Sydney, Nova Scotia, where the British Empire Steel Corporation operates eight blast furnaces having an aggregate daily capacity of about 2,100 tons of pig iron, using Newfoundland ore; Hamilton, Ontario, where The Steel Company of Canada operates two blast furnaces having a combined daily capacity of about 700 tons, on United States ore; and Sault Ste. Marie, Ontario, where the Algoma Steel Corporation operates four

PLATE VIII.



An Ontario iron mine and iron ore roasting plant, Magpie mine, Michipicoten district, Ont.

stacks having a total daily capacity of about 1,500 tons, largely on United States ore, but partly on Canadian ore from their own mines in the Michipicoten district. At Ojibway, Ontario, the Canadian Steel Corporation, Ltd., the Canadian branch of the United States Steel Corporation, has finished, but not yet put into blast, two large furnaces, each having a daily capacity of 550 tons of pig iron, which are the beginning of a fourth large contemplated iron and steel works in Canada.

There is also a blast furnace of about 225 tons daily capacity at Port Colborne, Ontario, and small furnaces not at present in operation are located at Port Arthur,

Midland, Parry Sound, and Deseronto, in Ontario, and at Londonderry in Nova Scotia.

Practically no iron ore has been mined in Canada since early in 1921, but in that year 661,168 tons were imported, and in 1922, 887,370 tons. In 1920, 1,957,738 tons of imported ore were charged to Canadian blast furnaces.

The production of pig iron in Canada was 383,057 tons in 1922, as against 665,676 tons in the previous year and 1,090,326 tons in 1920.

A detailed report on "Iron Ore Occurrences in Canada," (No. 217) has been published by the Mines Branch and may be obtained on application to the Director, Mines Branch, Ottawa, Canada.

Lead

British Columbia is pre-eminently the lead producing province of Canada, where the chief sources of that metal are the zinc-lead and argentiferous galena ores of the Cordilleran mountain belt. Lead is also produced in Ontario, and lead-zinc ores in Quebec, and, formerly, to a slight extent in Nova Scotia.

Though lead ores are of widespread occurrence in British Columbia, most of the output, past and present, comes from the Kootenay districts in the southeastern part of the province. At the present time, the Consolidated Mining and Smelting Company's famous Sullivan mine near Kimberley, in East Kootenay—one of the great zinc-lead mines of the world—is the chief producer, though the numerous silver-lead mines of the Ainsworth and Slocan mining divisions in West Kootenay also make a considerable contribution to the total. Gold and silver bearing ores of galena and blende are also mined near New Hazelton, Stewart and Smithers in the Skeena district, and argentiferous galena at Penticton and Beaverdell, in the Boundary country.

Most of the lead ore produced in British Columbia is treated for the production of refined lead at the Consolidated Mining and Smelting Company's smelter and electrolytic lead refinery at Tadanac (Trail), B.C., though a few mines ship their ore to United States smelters.

In Yukon, rich silver-lead ores are found in the Mayo district, in the northwestern part of the territory, where active mining operations are now being carried on. Several thousand tons of very rich silver-lead ore have been shipped from Keno Hill in this district during the last two years.

In Ontario, galena either alone or associated with zinc blende, and sometimes carrying a little silver, is found at numerous places throughout the province, but few successful attempts have yet been made to exploit these deposits. A galena deposit in Loughboro township, Frontenac county, was worked at intervals during the last fifty years, but Ontario's present production of between 2,000,000 and 3,000,000 pounds per annum all comes from the Kingdon lead mine and smelter, at Galetta, on the Ottawa river, in Carleton county. The ore is galena with a little zinc blende.

In Quebec, lead is obtained from the galena-blende ores of Notre-Dame-des-Anges, which also carry small amounts of gold and silver. In the past there was also a small production of lead-zinc ore from Calumet island, in the Ottawa river, and galena deposits are known to occur in the Eastern Townships. In 1911, promising deposits of galena and zinc blende were discovered in the interior of Gaspé peninsula, near the headwaters of the Cascapedia river, where much exploratory work has since been done and ore bodies of considerable size developed. The isolated situation of these deposits, however, in a mountainous country, forty miles from a railway, has so far prevented their being brought to the productive stage.

In Nova Scotia, occurrences of argentiferous galena, accompanied by zinc blende, are known in Cape Breton county and at various other places in the lower Carboniferous limestones throughout the province. Attempts were made at one time to develop occurrences of this kind near the head of Musquodoboit inlet, in Halifax county, and near Smithfield, in Guysborough county.

Veins carrying galena are also found, in Silurian rocks, at several points in the province of New Brunswick.

Though the active working of lead producing mines in Canada's chief lead producing province, British Columbia, may be said to have only begun in 1888, its lead production, which was about 2,000,000 pounds in 1893, had increased to over 24,000,000 pounds in 1896, and averaged

about 39,000,000 pounds per annum between 1900 and 1920. In 1922 British Columbia produced about 87,000,000 pounds of lead as against 60,000,000 pounds in 1921.

As already stated, most of the lead ores of British Columbia are treated at Trail, and the product is marketed chiefly as refined lead. Ontario's production is all pig lead, from the smelter at Galetta, while lead from Yukon, Quebec, and Nova Scotia has been shipped in the ore to smelters in the United States for treatment.

The lead production of all Canada in 1922, the highest on record, was 93,307,171 pounds, mostly refined lead, valued at $5,817,702, as against 66,679,592 pounds, valued at $3,828,742, in 1921.

Exports were, in 1922, lead in ores, 10,941,800 pounds, and in pig lead 41,481,900 pounds, as against 6,253,700 pounds in ore and 23,779,700 pounds in pig, in 1921. Most of the lead exported during the last two years has been marketed in Japan.

Manganese

The production of manganese ores in Canada is small and irregular, and has been confined to the Maritime Provinces of Nova Scotia and New Brunswick in the east, and British Columbia in the west. The ores that are mined in eastern Canada include pyrolusite, manganite, psilomelane, and bog manganese, usually high in manganese and fairly free from deleterious ingredients, so that most of the output is used in the manufacture of dry batteries and in the chemical and other industries where a high grade raw material is required.

Wad, or bog manganese, has been mined near Kaslo in British Columbia, and manganese ore consisting of a mixture of secondary oxides, principally pyrolusite, psilomelane, and magnetite, derived from the alteration of rhodonite, the silicate of manganese, has been mined from outcrops carrying from 15 to 57 per cent of metallic manganese on the Hill 60 group of claims near the village of Cowichan Lake, on Vancouver island, B.C. Shipments from these deposits have been made to the Bilrowe Alloys Company, of Tacoma, Wash., U.S.A.

A survey of the known manganese resources of the Dominion has not as yet disclosed the existence of any deposits of such size as to be capable of maintaining any very considerable continuous production.

In Nova Scotia, manganese has been mined at Loch Lomond, in Richmond county, Cape Breton island; at New Ross, in Lunenburg county, from which locality all recent production has come; at Tenecape, Walton, and Cheverie, in Hants county; and at East Onslow and Londonderry, in Colchester county.

In New Brunswick, localities in which some manganese ore was formerly mined are: Hopewell, Dawson Settlement, and Waterside, in Albert county; Markhamville and Jordan Mountain, in Kings county; and Ouacco head, in St. John county. Numerous occurrences of manganese have also been noted in other parts of this province.

In Quebec, deposits of manganese are found in the Magdalen islands, and occurrences are known on the east coast of Hudson bay.

In British Columbia, as already stated, recently opened manganese deposits have been mined at Kaslo, on Kootenay lake, and at Cowichan lake on Vancouver island.

No manganese ore was mined in Canada in 1922, though a shipment of 73 tons, valued at $2,044, was made from New Ross in Nova Scotia. In 1921, shipments totalled only 68 tons, valued at $3,400, or $50 per ton. No production has been reported from British Columbia since 1920, when the output of that province was 587 tons, valued at $6,889.

Mercury

The amount of mercury that has actually been produced in Canada is negligible, but veins carrying pockets of cinnabar associated with stibnite in a gangue of quartz, calcite, or dolomite are found near the west end of Kamloops lake, in British Columbia, and were worked for mercury for a short time nearly twenty years ago.

Small quantities of mercury were also recovered in 1918 and 1919 from some of the silver ores of the Kerr Lake mine, and mercury has also been recognized in the ore of the Nipissing mine, both of which are in the Cobalt

district of Ontario, but whether it occurs in the native condition or as a compound has not yet been made clear.

An occurrence of cinnabar and native mercury, at the eastern entrance to Sechart channel, Barkley sound, Vancouver island, is reported to be sufficiently promising to warrant further investigation of its possibilities as a source of mercury. Mercury-bearing minerals are also reported in British Columbia, at Field, and in the gold washings on the Fraser river at Boston bar.

The only officially recorded production of mercury in Canada was that recovered from the deposits at Kamloops lake, where, betweeen 1895 and 1897, inclusive, 138 flasks, equivalent to 10,557 pounds of mercury, were obtained.

Molybdenum

Though numerous occurrences were known to exist, there was practically no mining of molybdenum minerals carried on in Canada prior to the great war. During the war period, however, in response to the demand for war purposes, many prospects were developed and a number of mills erected for the treatment of Canadian ores of molybdenum, the essential constituent of practically all of which is molybdenite, or sulphide of molybdenum. During this time concentrates containing 470 short tons of pure molybdenite were produced in Canada, but with the coming of peace, the demand slackened, and for the last three years there has been no production whatever. At present mines and mills are idle, awaiting the revival of an industrial demand that will warrant a resumption of operations.

The most important, as well as the greater number of the recorded occurrences of molybdenite in Canada are in the provinces of Quebec, Ontario, and British Columbia, but it is also found in Nova Scotia and Manitoba.

Approximately eighty per cent of the Canadian output of molybdenite during the war came from the Moss mine at Quyon, Pontiac county, Quebec. The Mount St. Patrick mine in Renfrew county, Ontario, was another large producer.

Mention may be made of a few of the other widespread occurrences in Canada, some of which have yielded small amounts of ore, some of which are still merely pros-

pects; in British Columbia, those on Alice Arm, Lost Creek, and the Index mine, as well as apparently less important discoveries at Stave lake, Pitt river, and Grande Prairie; in Ontario, a number of mines in the counties of Renfrew, Haliburton, Addington, Frontenac, and Victoria yielded small amounts of ore, and promising prospects are also reported in the northern and northwestern districts of Nipissing and Thunder Bay; in Quebec, a number of occurrences are known in the counties of Hull, Pontiac, and Timiskaming; in Nova Scotia properties have been developed at New Ross, in Lunenburg county and at Gabarus bay, in Cape Breton; and in Manitoba, deposits are reported from the vicinity of Falcon lake.

A detailed monograph on "Molybdenum," having special reference to Canadian deposits, is now in preparation, and when published may be obtained on application to the Director, Mines Branch, Ottawa, Canada.

Nickel

Nickel is one of the metals most abundantly produced in Canada, the output of the Dominion constituting over 80 per cent of the world's supply.

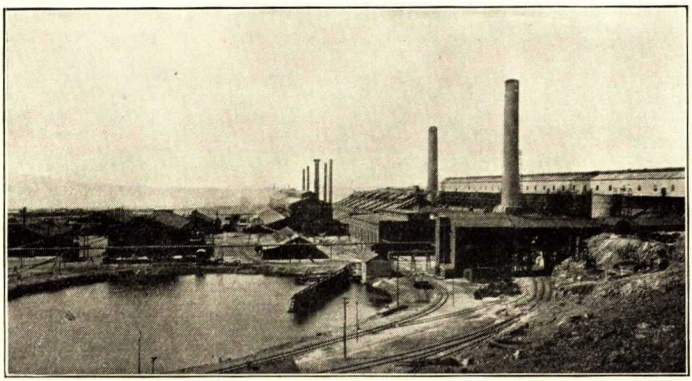
This all comes from the province of Ontario, from mines in the district surrounding the town of Sudbury, supplemented to a slight extent by the output of the Alexo nickel mine, on the outskirts of the Porcupine gold district, and by a much smaller quantity recovered as a by-product of the treatment of the complex silver-cobalt-nickel ores of the Cobalt district.

The Sudbury ores consist essentially of nickeliferous pyrrhotite accompanied by lesser amounts of chalcopyrite; the nickel in the form of pentlandite, a nickel-iron sulphide, occurring disseminated through the pyrrhotite in microscopic particles undistinguishable by the naked eye. The nickel-copper content varies considerably in ores from different mines, but may be said to be, on the average, about 2·00 per cent nickel and 1·85 per cent copper. In addition to nickel and copper they also contain gold, silver, platinum, palladium, rhodium, ruthenium, iridium, and osmium, in quantities so minute in the crude ore as to be hardly detectable, but which become concentrated in appreciable amounts in the nickel-copper matte and

crude nickel and copper, and are finally recovered from the slimes resulting from the refining of the latter.

The ore bodies, which consist of large irregular masses of sulphides closely associated with basic igneous rocks of the norite type, occur at or near the outer edge of an elliptical rock basin, of which the major axis is about 36 and the minor axis 16 miles long, and of which the geological boundaries have been closely defined. They have been mined to depths of nearly three thousand feet, and exploratory work with the diamond drill has proved up in the productive area reserves of ore sufficient to meet all possible demands for very many years to come.

PLATE IX.



International Nickel Company's smelter at Copper Cliff, Ont.

The ore of the Alexo nickel mine at Porquis is, like that of the Sudbury mines, essentially nickeliferous pyrrhotite with some associated chalcopyrite, and the deposit, also like those at Sudbury, occurs at the outer edge of a basic rock of igneous origin, in this case peridotite. The Alexo ore, however, is considerably richer in nickel and poorer in copper than the average Sudbury ore, but the deposit is small compared with those at Sudbury.

Small bodies of rich nickel ore, of which the general mineralogical and geological features are apparently somewhat similar to those of the Sudbury deposits, have also been discovered at Shebandowan lake, west of Port Arthur, but have not yet been worked; and large bodies of low

grade nickeliferous pyrrhotite, too lean to be of commercial value under present conditions, are known to occur at several other places in Ontario.

Outside of Ontario, low grade nickeliferous pyrrhotites are found on the Maskwa river, in southeastern Manitoba; near St. Stephen, in New Brunswick; and are reported from British Columbia and other parts of the Dominion.

PLATE X.

Underground in an Ontario nickel mine, Crean Hill mine, Sudbury district, Ont.

The present nickel industry of Canada is entirely in the hands of three large corporations, all of which operate in the vicinity of Sudbury. The oldest and largest of these is the International Nickel Company of Canada, with smelters at Copper Cliff and refining plant producing refined nickel, nickel oxide, and blister copper, at Port Colborne, Ontario; the Mond Nickel Company, with smelters at Coniston and refining plant at Clydach, Wales; and the British America Nickel Corporation, with smelters at Nickelton and a refinery at Deschenes, Quebec,

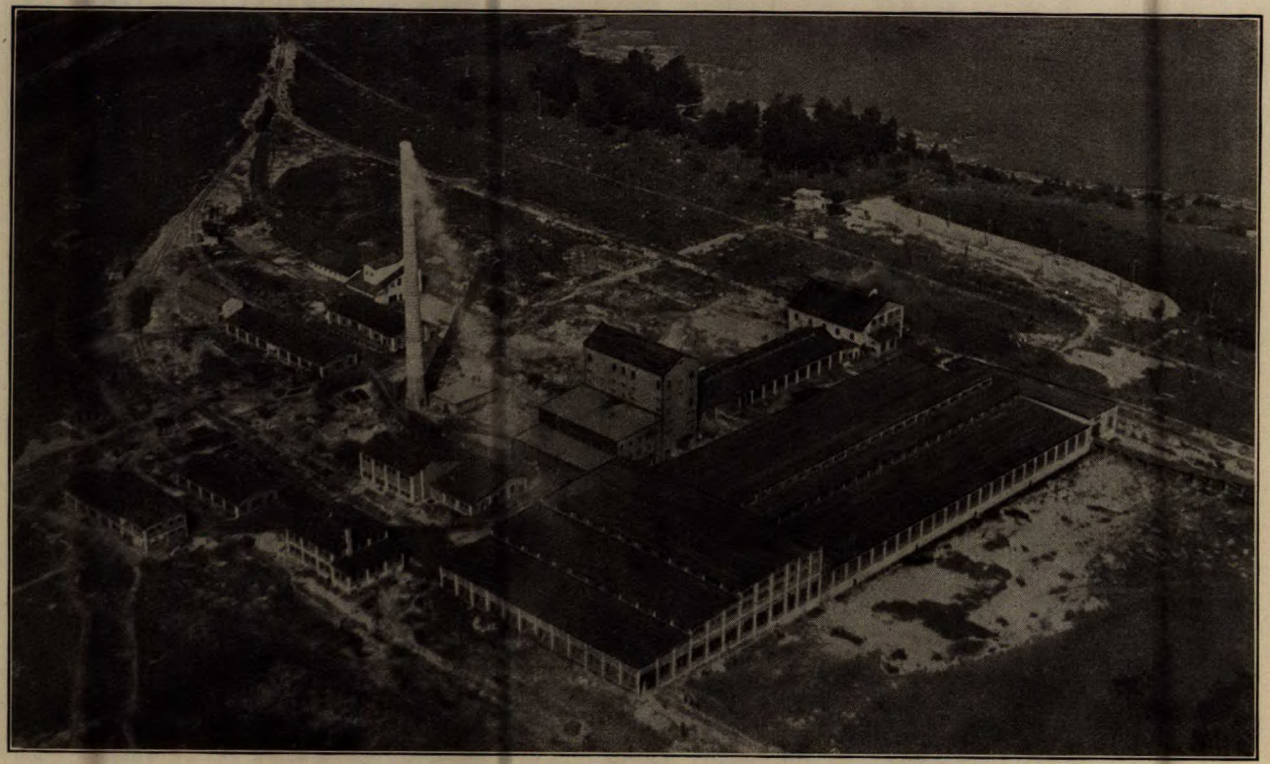
equipped to produce electrolytic nickel and copper and the precious metals platinum, palladium, gold, etc.

The production of nickel in Canada in 1922 was 17,597,123 pounds, as against a maximum production of

PLATE XI

Miners going on shift, Creighton nickel mine, Sudbury district, Ont.

92,507,293 pounds in 1918, and an average annual production of 41,472,000 pounds for the four years previous to the war. The decisions of the Disarmament Conference seriously affected, for the time being, the outlook for the



British America Nickel Corporation's refinery at Deschenes, Que., as seen from an aeroplane

nickel industry in Canada, inasmuch as one of the chief uses of nickel was formerly for the manufacture of armour plate, but the development of new, and the extension of former industrial uses of the metal have largely offset any loss of markets on this account.

Platinum Group Metals

Canada's importance as a source of platinum and allied rare metals is greater than appears to be generally recognized; among the platinum producing countries of the world, Russia and Colombia alone have a greater production. In Canada, Ontario is pre-eminently the platinum producing province.

Metals of the platinum group—platinum, palladium, iridium, rhodium, ruthenium, and osmium—are minute constituents, apparently chiefly associated with the chalcopyrite of the nickel-copper ores of the Sudbury district, in Ontario. When these ores are smelted, the precious metals become concentrated in the resulting mattes along with the nickel and copper and are ultimately recovered from the residues left when the latter are refined electrolytically. Until recently all the nickel-copper matte produced in Canada was shipped abroad for final treatment, so that the Dominion did not get full credit for the precious metals contained therein, which nevertheless were ultimately saved as by-products.

In the International Nickel Company's Vermilion mine, the rare mineral sperrylite, an arsenide of platinum, along with native gold, is found in such quantity that the ore from it is treated separately with a view to the more complete recovery of the precious metals.

In addition to platinum recovered from the Ontario nickel mattes, a few ounces are also won every year from auriferous alluvial sands in the Tulameen district of British Columbia. And at least traces of platinum have been found in many of the gold placers of the Dominion, for example, in the Beauce county placers of Quebec; on the Similkameen, Tulameen, Tranquille, Fraser, and North Thompson rivers in British Columbia; and on the Yukon, Teslin, and other rivers of Yukon territory.

According to authoritative figures recently published, recoveries of platinum, made in Wales, from the Mond

Nickel Company's mattes were: in 1916, 3,722 ounces, in 1917, 4,719 ounces, and in 1918, 4,958 ounces. In 1919, from mattes treated by the International Nickel Company at Port Colborne, Ontario, and Bayonne, New Jersey, there was a recovery of 1,770 ounces of platinum group metals, of which 642 ounces were platinum.

Recoveries of platinum metals in 1920, reported as made by the Mond Nickel Company in Great Britain and the International Nickel Company in the United States, were as follows: platinum, 8,345 ounces, palladium, 10,199 ounces, and rhodium group metals, 522 ounces.

The International Nickel Company, alone, reported the recovery from Canadian mattes in 1922, a year of small nickel production, of 138 ounces of platinum, 301 ounces of palladium, and 125 ounces of iridium, rhodium, ruthenium, and osmium combined.

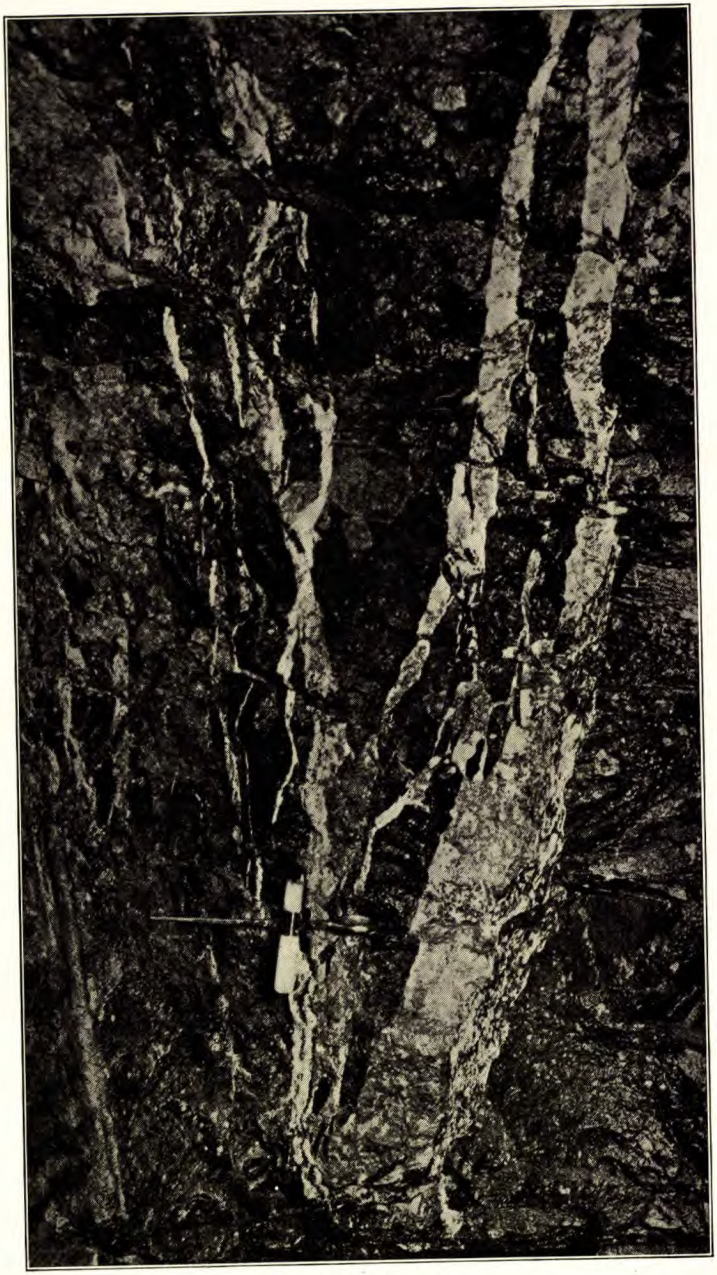
The precious metal residues are allowed to accumulate over irregular periods before being treated, so that recoveries do not bear any definite relationship to the quantity of matte treated in any particular year.

Silver

Silver comes second only to gold among the metals produced in the Dominion, in point of value of annual production, and among the silver producing countries of the world Canada ranks third.

Canada's silver has its origin in three main sources: the silver-cobalt-nickel ores of the Cobalt district, in Ontario; argentiferous galena or galena-zinc blende ores, chiefly of British Columbia; and complex gold-silver-copper ores, also largely of British Columbia. A certain amount of silver is also obtained alloyed with the gold in the bullion from the gold mines in different parts of the country.

Formerly, British Columbia was the chief silver producing province in Canada, but the marvellous developments that followed the discovery of fabulously rich silver ore at Cobalt, in 1903, soon made Ontario not only the premier silver mining province of the Dominion but also one of the greatest silver producing countries of the world. From the time the first shipment of silver ore was made from Cobalt in 1904 to the end of 1922, this and other



Cobalt silver vein.

northern Ontario silver camps have contributed a total of about 325,000,000 ounces, or nearly 11,143 tons of fine silver to the world's stock. The maximum annual production of 30,540,754 ounces was reached in 1911; since that date production has slowly declined, with the gradual exhaustion of the higher grade ores and the treatment of lower and lower grade material as metallurgical processes have improved. Present day developments in British Columbia may shortly put that province back in its old position of first place, but, even leaving out of consideration the ever present possibilities of new discoveries, there are still many years of prosperous life ahead for the Cobalt and other northern Ontario silver camps. Outside the Cobalt district proper, the productive areas are South Lorrain, Gowganda, Casey township, and Elk Lake. Recent developments in South Lorrain have focussed special attention on that locality.

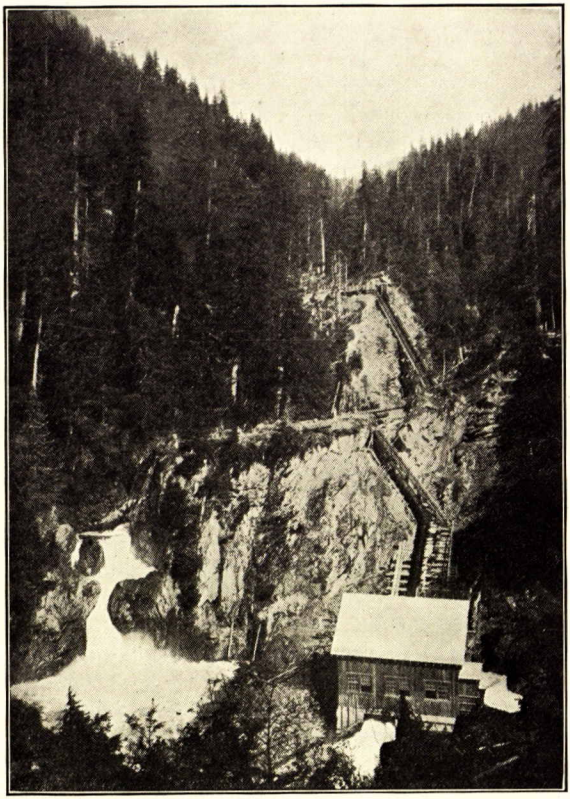
The New Ontario silver ores consist largely of native silver, associated with which are commonly some argentite, dyscrasite, pyrargyrite, and other compounds of silver, as well as smaltite, niccolite, and related minerals, usually in a calcite gangue. Much of the ore, the silver content of the highest grades of which may run into thousands of ounces per ton, is treated at the mines for the recovery of silver only, the remaining ore and concentrates, together with the residues from the local reduction plants, which still contain some silver as well as cobalt, nickel, arsenic, etc., are shipped either to smelters and refineries in southern Ontario, at Thorold and Deloro, or exported for final treatment. The final products derived from the Cobalt ores include, in addition to silver, metallic cobalt and cobalt compounds; nickel and nickel compounds; white arsenic, and, in some cases copper compounds. Mercury also is reported to have been obtained.

Other sources of silver in Ontario are the bullion from the gold mines and to a slight extent the Sudbury copper-nickel mattes.

Between 1869 and 1885 about 4,000,000 ounces of silver, from ores very similar in composition to those later found at Cobalt, were obtained from mines in the vicinity of Port Arthur, in the Thunder Bay district of western Ontario, chiefly from the Silver Islet mine. Encouraged by the results obtained at Cobalt, a number of

recent attempts have been made to again work these old silver mines, but no production from them has been recorded in recent years.

PLATE XIV



Hydro-electric power for mining purposes. No. 2 power house, Premier mine, Stewart, B.C.

In British Columbia, which next to Ontario is the chief silver producing province of the Dominion, that metal is derived chiefly from silver-lead and silver-lead-zinc ores, as well as from gold-silver-copper ores, and from the gold bullion of the gold mines. Much of it is recovered as refined silver, obtained from the gold, copper, lead, and

zinc ores treated at the Consolidated Mining and Smelting Company's plant at Trail, though considerable amounts are also exported in ores and concentrates, and in blister copper.

For many years the silver output of British Columbia ranged between two and four million ounces annually, largely from mines in the Kootenays, but, in 1922, this was increased to over 7,000,000 ounces, due principally to the increased production of the Premier mine, near Stewart, in the northwestern coast district, where ores containing native silver and argentiferous galena, comparable in richness to those of Cobalt, are now being worked.

In Yukon territory, in addition to the silver contained in placer gold bullion, rich argentiferous galena ores are mined in the neighbourhood of Keno Hill, in the Mayo district, and the outlook is good for a continued increasing production from this source.

In Quebec, silver is contained in the pyritous copper ores mined in the Eastern Townships and in the zinc-lead ores of Notre-Dame-des-Anges, in Portneuf county. In the past, there was also a small production of slightly argentiferous galena from Calumet island, in the Ottawa river, and from a deposit on the east shore of lake Timiskaming.

In Nova Scotia, argentiferous galena associated with zinc blende is found near East Bay, in Cape Breton, near Musquodoboit, and at other points in the province.

In Manitoba, the large copper-zinc sulphide deposits found near the Pas also carry values in silver and gold.

The production of silver in all Canada, in 1922, amounted to 18,581,439 fine ounces, of which about 10,800,000 ounces is to be credited to Ontario, 7,150,000 ounces to British Columbia, and 660,000 ounces to Yukon. The total production in 1921 was 13,543,198 ounces.

In 1911 Ontario contributed 94 per cent of the entire silver production of the Dominion, in 1921, 72 per cent, and in 1922, 61 per cent.

Exports of silver in 1922 were: in ores and concentrates, etc., 6,471,159 fine ounces; in bullion, 10,930,538 fine ounces.

Tin

Canada produces no tin ores. Though the occurrence of tin bearing minerals has been noted in a number of localities, they have never yet been found in sufficient quantity to be of any economic importance.

Perhaps the most interesting discovery of tin yet made in Canada is that near New Ross, in Lunenburg county, Nova Scotia, where cassiterite is found associated with chalcopyrite and tungsten bearing zinc minerals in a quartz vein.

In New Brunswick, it has also been found associated with tungsten minerals, in the wolframite deposits of Burnthill brook, in York county.

In British Columbia, the occurrence of tin is reported from several localities, for example, in granular quartz schists in the Lardeau mining division.

In Yukon, a little is sometimes caught with the gold in the placer miners' sluice boxes, and in Ontario it has been recognized in minute crystals associated with sperrylite, an arsenide of platinum, in the ore of the Vermillion mine in the Sudbury district.

Titanium

Of the three titanium bearing minerals that may be classed as ores of that metal, namely, rutile, ilmenite, and titaniferous magnetite, the known deposits in Canada that are at once large enough and rich enough to be of interest as possible commercial sources of titanium all occur in the provinces of Quebec and Ontario. The most desirable ores, rutile and ilmenite, are found in quantity only in Quebec, the Ontario deposits of any considerable size all consisting of titaniferous magnetite.

In Quebec there are large accessible deposits of ilmenite, carrying from 20 to 25 per cent of titanium, in the parish of St. Urbain, north of Baie St. Paul, in Charlevoix county, and at Ivry, on the Canadian Pacific railway, 67 miles north of Montreal, in Terrebonne county. During the last 15 years occasional small shipments of ilmenite have been made from both these localities, all the output going to the United States to be used, for the most part, for the production of the alloy ferrotitanium.

The only known commercial deposit of rutile in Canada also occurs in Quebec, in the parish of St. Urbain, where rutile occurs disseminated through parts of one of the large masses of ilmenite that have been worked there. The owners of this deposit, the General Electric Company of Schenectady, New York, U.S.A., reserve the entire output, which so far has been very small, for their own use in the manufacture of electrodes for flaming arc lamps. Though rutile has as yet been found in only this one deposit, it seems not improbable that fuller investigation would reveal its presence in others of the numerous bodies of ilmenite that occur under identical geological conditions in the near vicinity.

Titaniferous magnetite carrying 5 to 25 per cent of titanium are found at numerous localities in both Ontario and Quebec. Among the largest of these deposits may be mentioned those in the vicinity of Seine bay of Rainy lake, in the Rainy River district of Ontario; on the Saguenay river, near lake St. John, in Chicoutimi county, Quebec, and at Bay of Seven Islands, on the lower St. Lawrence, in Saguenay county, also in Quebec. Though these titaniferous magnetites are on the whole too low in titanium in their natural state to compete with the richer ilmenites as titanium ore, experiments in their magnetic concentration would indicate the possibility of obtaining, from some of them at least, a concentrate having a high titanium content.

Though accurate official figures of the production of ilmenite in Canada are not available (the returns for ilmenite not being always kept separate from those for iron ores) it is estimated that the combined shipments from St. Urbain and Ivry since the deposits were first worked about 15 years ago, is in the neighbourhood of 30,000 tons. There are no means available for estimating the rutile production, but it has been very small.

A comprehensive report on "Titanium", with special reference to Canadian occurrences, has been published by the Mines Branch (Publication No. 579) and may be obtained on application to the Director, Mines Branch, Ottawa, Canada.

Tungsten

Though the tungsten minerals scheelite and, more rarely, wolframite and tungstite are found at a number of places in Canada, the production of tungsten ores in the Dominion has so far been so small as to be almost negligible. For a time there was a very small and intermittent production of scheelite from the Moose River district in the province of Nova Scotia, where it occurs in quartz veins associated with mispickel. In the same province scheelite also occurs in the Malaga gold district and in West Waverley, in Halifax county; near South East Margaree, in Inverness county; and at New Ross in Lunenburg county.

A little tungsten ore, chiefly wolframite, has also been obtained at Burnthill brook in York county, New Brunswick.

In British Columbia, tungsten minerals are known to occur at a number of places, the most important occurrence, apparently, being one at Hardscrabble creek, in the Cariboo district.

In Quebec, scheelite has been found in a quartz vein in Beauce county, and, in Ontario, has been noted in small nodular masses in some of the veins near Pearl lake in the Porcupine gold district.

Its occurrence is also reported in southeastern Manitoba, and, in Yukon, water-worn nodules of scheelite are sometimes caught in the gold miners' sluice boxes in Dublin gulch.

No production of tungsten ores has been reported in Canada since 1918. In that year, 13½ tons, valued at $11,700, was obtained, chiefly from Burnthill, New Brunswick. The only important production previously reported was in 1912, when 14 tons of concentrates were produced by Scheelite Mines, Ltd., of Moose River, Nova Scotia.

Zinc

The ore of zinc of commonest occurrence in Canada is zinc blende, or sphalerite, and as this almost always is accompanied by galena, the history of zinc mining in the Dominion is closely interwoven with that of lead. Blende-galena ores are mined at many places in British

Columbia, and to a much smaller extent in Ontario, Quebec, and Nova Scotia. At present practically all the zinc produced comes from British Columbia, but until recently Quebec also produced about one million pounds annually and Ontario made a few small shipments some years ago.

British Columbia's output of zinc is obtained largely from the huge galena-blende deposits of the Sullivan mine, near Kimberley, but many of the other lead deposits scattered over the province carry also sufficient zinc blende to make its separation and recovery profitable, and since a number of mills for this purpose are in operation these also add their quota. In addition to the Sullivan, zinc ores are produced at a number of mines in the Ainsworth and Slocan mining divisions, and at others near Salmo, Field, Revelstoke, and Hazelton.

In Ontario, a little zinc ore was at one time produced near Rossport, north of lake Superior, and in Frontenac county, in eastern Ontario. At present a little zinc concentrate is made at the Kingdon lead mine, at Galetta, on the Ottawa river, where so far it has been stock-piled and disposed of as occasion warrants.

The zinc in ores produced in Quebec, which formerly amounted to 1,000,000 pounds or more annually, comes chiefly from the lead-zinc mines of Notre-Dame-des-Anges in Portneuf county. Some twenty years ago there was also a small production from Calumet island, in the Ottawa river. Promising deposits of sphalerite and galena discovered in Lemieux township, Gaspe county, in 1911, have had considerable development work done on them, but their location in the interior of Gaspe peninsula, 40 miles from a railway, has so far seriously handicapped the efforts made to exploit them.

Previous to 1916, when the Consolidated Mining and Smelting Company's plant for the production of zinc by electrolysis went into commercial operation at Trail, B.C., all the zinc ores produced in Canada were exported, chiefly to the United States, for treatment. All this is now changed, however, so that in 1922 only about 40 tons of ore were exported, the remainder being worked up into refined zinc in the Consolidated Company's new plant. The mines in eastern Canada, which have been idle for the last two or three years, are still forced through lack of

local smelting facilities to export their product in the raw state.

The production of refined zinc in Canada has increased from about 3,000 tons in 1916 to about 28,000 tons in 1922, all from the plant at Tadanac (Trail), B.C., which now supplies most of the zinc for the domestic market as well as for export.

The total production of zinc in Canada in 1922 was 56,290,000 pounds, valued at $3,217,536, as against 53,089,356 pounds, valued at $2,471,310 in 1921. Of the 1922 production practically all was refined zinc, produced at the Consolidated Mining and Smelting Company's plant at Trail.

Exports in 1922 were 40 tons of zinc ore, valued at $1,095, and 28,519 tons of spelter, valued at $3,054,644, as against 52 tons of ore, valued at $1,293, and 12,828 tons of spelter, valued at $1,336,389, in 1921.

As in the case of lead, much of the British Columbia spelter finds a market in Japan.

NON-METALLIC MINERALS

Abrasives

The natural abrasives produced in Canada include: corundum, sandstones, tripolite, and, to a small extent, garnet; also, small quantities of volcanic ash and alunite, to be used in the manufacture of cleansing compounds and scouring soaps.

Artificial abrasives are also manufactured in considerable quantity.

Corundum

The natural sesqui-oxide of aluminium, corundum, a mineral approaching the diamond in hardness, is found in Ontario in nepheline syenite rocks which cover large areas in the counties of Renfrew, Hastings, and Peterborough. It has been mined in quantity at Craigmont, in Raglan township, Renfrew county, and in Carlow township, Hastings county.

The production of corundum in Ontario began in 1900 and reached a maximum in 1906, when nearly 3,000 short tons of grain corundum was produced. Since 1913, however, the annual output has been steadily decreasing,

owing to the replacement of corundum by artificial products in the manufacture of abrasive cloths, papers, and wheels. For the last four years no corundum has been mined, though a certain amount of grain corundum is obtained from the treatment of old tailing dumps.

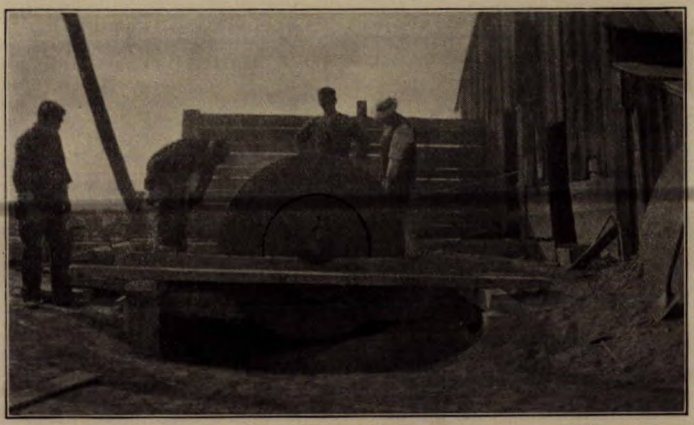
Since the beginning of the industry in 1900, some 367,000 tons of crude rock, yielding 20,500 tons of grain corundum, valued at $2,104,250, have been treated.

Emery, an impure form of corundum, used for the same purposes as the latter, is not produced in Canada.

Grindstones, etc.

Sandstones for the manufacture of grindstones, pulpstones, and scythestones have been quarried in the Maritime Provinces of Canada for the past forty years, the

PLATE XV.



Making grindstones in New Brunswick.

principal quarries yielding stone suitable for these purposes being situated at Stonehaven and Quarryville, New Brunswick, and at Woodburn, in Pictou county, Nova Scotia.

Sandstone beds of the Millstone Grit, a formation which is widely distributed in Nova Scotia and New Brunswick, are quarried and manufactured into grindstones of excellent grades. These range in size from very small stones

to those used for the grinding of wood pulp, which may weigh 2½ tons each.

The grindstones are shipped in the finished condition and are marketed in Canada, Newfoundland, and the United States. A number of pulpstones and scythestones are also made each year, as well as small quantities of grit for marble polishing.

Stone reported to be suitable for grindstones is found in a number of localities in other provinces, but has not been quarried to any extent.

The production of grindstones in Canada in 1922 from quarries in the provinces of Nova Scotia and New Brunswick amounted to approximately 1,000 tons, valued at $43,742.

Diatomaceous Earth

Diatomaceous earth, also known as tripolite, infusorial earth, fossil flour, and kieselguhr, is, when pure, a white chalky substance made up of the minute siliceous skeletons of either fresh or salt water diatoms. It is used for many different purposes, but chiefly for heat insulation and for filtration. Used as an abrasive, for which purpose the shape of the minute skeletons is a matter of importance, it enters as a base into a large number of polishes, cleansers, and scouring soaps. Mixed with hard grease and formed into bricks it is sometimes used on buffing wheels.

This material is found in Canada at the bottom of between 50 and 60 lakes in Nova Scotia, near St. John in New Brunswick, and in the vicinity of Ashcroft, Victoria, and Quesnel in British Columbia. Its occurrence has also been reported in Ontario and Quebec.

There is a continuous production from lakes near Castlereagh, in Colchester and Cumberland counties, Nova Scotia, and a large deposit at Fitzgerald lake, east of St. John, New Brunswick, has been worked intermittently. The British Columbia deposits have not yet been exploited.

The diatomaceous earth from many of these Canadian deposits is of good grade and could be used for some of the many purposes for which material is at present imported.

Garnet

Although garnets are of widespread occurrence in Canada, there are few of the known deposits of apparent com-

mercial value for abrasive purposes. A little garnet has, however, recently been mined and shipped from near Bancroft, in Hastings county, and from Depot Harbour, in the Parry Sound district, both in Ontario.

Volcanic Ash

Volcanic ash is found in large beds in several localities in southern British Columbia. It has also been reported recently from near Swift Current, Saskatchewan. Material from the Saskatchewan deposit is already being used as an ingredient in scouring soaps and other cleansing compounds.

There is little doubt that further search would result in the discovery of other large bodies of volcanic ash, particularly in the Tertiary volcanic rocks of the interior plateau of British Columbia.

Quartz Sand

There are numerous deposits of quartz sand in the Dominion, some of which are utilized to a slight extent in the manufacture of sand papers and abrasive wheels, and for the production of artificial abrasives in the electric furnace.

Artificial Abrasives

Most of the abrasives in use at the present time are artificial products made in the electric furnace. They fall into two main varieties, those made by fusing quartz sand mixed with coke, sawdust, and salt, or the carborundum variety, and the aluminous variety made by fusing an ore of aluminium, such as bauxite, with coke.

In either case the furnace product is pulverized, separated into grains of different sizes, and then made up into grinding wheels, whetstones, abrasive papers and cloths, and other articles, which are marketed under a great variety of trade names.

There are six firms manufacturing artificial abrasives in Canada and the output for the last four years amounted to 85,000 tons, having a total selling value of $9,500,000. All the bauxite and much of the silica sand used in the manufacture of artificial abrasives in Canada is imported.

Actinolite

Actinolite, a fibrous magnesium silicate, is a common Canadian mineral that is mined for industrial use in the province of Ontario only. The village of Actinolite, in Elzevir township, Hastings county, Ontario, where the Actinolite Mining Company owns and operates a mill, is the centre of the industry.

This mineral, when ground in such a way as to preserve the fibre intact and mixed with tar and other ingredients, makes an excellent roofing compound that is a non-conductor of heat and very resistant to the weather.

In Hastings and Addington counties, Ontario, there are considerable areas of rock made up of fibrous actinolite, tremolite, and hornblende, mixed in places with talc and soapstone.

The output of actinolite is small. In 1922, 50 short tons, valued at $575, were shipped, but none was mined. The production was 228 tons in 1918.

Asbestos

Supplying as they do the largest part of the world's demands, Canadian asbestos deposits are of particular interest. Though occurrences of this mineral have been noted in other localities and provinces, the productive areas are practically confined to the Eastern Townships, in the province of Quebec, where active mining operations began about 1880. In this district, and leaving out of consideration some outlying deposits, the principal working mines are found scattered for a distance of about twenty-four miles along a great belt of serpentinized peridotite in the townships of Broughton, Thetford, and Coleraine, with important quarries some distance to the southwest, in Shipton township. The most important deposits are those at Black Lake, in Coleraine township, at Thetford and Robertsonville, in Thetford township, at East Broughton in Broughton township, and at Danville, in Shipton township.

Canadian asbestos, which is the chrysotile, or serpentine variety, is of the finest quality, and, on account of its softness, silkiness, and tensile strength, is in great demand for all kinds of asbestos products, but particularly for asbestos textiles. It occurs throughout the rock in narrow reticulating veins, seldom much over $2\frac{1}{2}$ inches, and usually less than $\frac{1}{2}$ inch in width, in which the asbestos

fibre stands at right angles to the walls. Veins with good fibre 3 or 4 inches in length were plentiful in the first years of working, but as the mines increased in depth the veinlets became narrower.

The deposits are worked in open pits; and the best grades of long fibre material, known as " crude ", are hand cobbed to separate it from the rock; but to recover the asbestos from the smaller veins the rock is crushed and the fibre

PLATE XVI.

A Canadian asbestos mine, Thetford Mines, Que.

separated mechanically, by elaborate processes, in large mills. A wide variety of grades is produced, from the valuable longfibred " crude " asbestos, that may be worth $500 or more a ton, to the shortest mill fibre, and asbestic sand used for wall plaster, worth but a small fraction of that amount. The proportion of long fibre, or " crude ", to short fibre is very small, only about one per cent, so that " crude " is much the more valuable product.

The total asbestos production of Canada in 1922 was 163,706 tons, valued at $5,552,723, as against 92,761 tons, valued at $4,906,230, in 1921.

Barytes

The only barium mineral as yet found in quantity in Canada is barytes, barium sulphate. The occurrences are all vein deposits, some of them in pre-Cambrian crystalline rocks, others in Paleozoic sediments. Some of the veins carry white barytes of great purity, in others the barytes is mixed with fluorite and, in places, calcite. The mineral may be soft and opaque or hard and translucent.

PLATE XVII.

Asbestos bagged for shipment, Black Lake, Que.

Most of the barytes produced comes from large vein deposits of this material in the vicinity of Lake Ainslie, in Inverness county, Nova Scotia. Deposits in other parts of Nova Scotia and at various points in Ontario and Quebec have also been worked in the past, and, in recent years, large bodies of barytes have been discovered in northern Ontario, near Porcupine, Elk Lake, and Tionaga, and in British Columbia, near Spillimacheen. Deposits are also known in Hull, Labelle and Pontiac counties in Quebec, and in Westmorland county in New Brunswick.

The only mine that has been operated in recent years is one in the Lake Ainslie district, in Nova Scotia, the output of which is shipped to a Halifax paint works for grinding. A few years ago a concentrating and grinding mill was erected at the Premier-Langmuir mine, near Porcupine, Ontario, but very little barytes was shipped and the plant is now idle. The deposits near Tionaga, in the township of Penhorwood, and those in the townships of Garrow and Lawson, near Elk Lake, in northern Ontario, all show barytes of excellent grade, but lack of transportation facilities and high freight charges hinder their development.

The production of barytes in Canada in 1922 was 289 tons, as against 270 tons produced in 1921, all of which is used in domestic paint factories. For the most part, the domestic market for barytes is supplied from United States sources.

A detailed report (No. 570) on "Barium and Strontium in Canada" has been published by the Mines Branch, and may be obtained on application to the Director, Mines Branch, Ottawa, Canada.

Bentonite

Bentonite is the name given to a colloidal clay found in certain parts of western Canada. Its extremely fine state of division, and its peculiar property of swelling to several times its original volume and forming a mineral jelly when water is added to it suggest that it may become an important industrial material. Some of the proposed uses to which it may be put are: the loading of paper, textiles, and other fabrics; in the manufacture of rubber and paints; in the sizing of yarns, and in the dye industry. It has already been successfully used in the United States for de-inking old newsprint and to increase the retention of china clay in the manufacture of paper. The progress already made gives ground for the belief that further research will result in the successful commercial utilization of this material in various other industries.

The widespread occurrence of thin seams and beds of bentonite in Alberta and Saskatchewan suggests the possible existence of large deposits of this material in western Canada.

Bituminous Sand

An extensive deposit of bituminous sand, commonly called tar sand, outcrops at frequent intervals along the Athabaska river and its tributaries for an aggregate distance of approximately 200 miles, in the district centering about McMurray in the province of Alberta.

The outstanding features in connection with the bituminous sand at McMurray are: that the deposit is the

PLATE XVIII.

Bituminous sand outcropping on the Athabaska river, Alberta. The bed is 40 feet thick.

largest occurrence of solid asphaltic material known, that it is as yet entirely undeveloped commercially, and that at the present time practically all the asphaltic materials and a large proportion of the other petroleum products used in Canada are imported.

The area represented by outcrops, and presumably underlain by bituminous sand, may be arbitrarily defined as lying between W. long. 111° and 112° 15′ and between

N. lat. 56° 30′ and 58°, all the exposures within this area being within a radius of 60 miles of McMurray. The distance north and south over which the outcrops have been noted is approximately 110 miles, and that from east to west approximately 80 miles. Upwards of 250 exposures, which represent portions of one continuous deposit, have been examined and measured.

Certain of these outcrops represent portions of a deposit that, with reasonably favourable market and transportation conditions, will eventually prove commercially valuable. But it is also true that the economic value of other large portions of the area underlain by bituminous sand must be considered as doubtful, not only on account of the thickness, character, and difficulty of disposing of the overburden, but also through lack of transportation facilities and facilities for working, as well as on account of lack of uniformity of bitumen content in the underlying sand itself. All these factors must be given due weight in estimating the economic possibilities of any portion of the deposit.

Experiments made by the Mines Branch, Ottawa, have demonstrated the merits of the crude sand as a paving material for surfacing streets and highways. Areas of standard sheet asphalt, bitulithic and bituminous concrete wearing surfaces were designed and laid on the streets of the city of Edmonton by an officer of the Branch, in 1915, with, to date, entirely satisfactory results.

The use of the crude sand for paving purposes, however, would be limited by the cost of transportation to populous centres, so that any really large commercial development will depend on the economically successful recovery, in some useful form, of the associated bitumen freed from sand, a problem that presents no more apparent difficulties than many other technical problems that have been successfully solved.

It has been suggested that the bitumen, which is of a high grade, be separated from the sand aggregate by means of either solvents, centrifuges, hot water under pressure, or by the use of flotation cells. Laboratory experiments undertaken by the Mines Branch would indicate that flotation cells using heated water to which certain reagents had been added would be likely to give the best results.

Another suggested method of utilization is that the crude bituminous sand be retorted for the recovery of various hydrocarbons. In this way crude petroleum has been derived from the bituminous sand in the laboratory of the Mines Branch, and the crude petroleum thus obtained fractioned and refined and the characteristics of the refined products determined. It remains to be seen, however, whether such a process could be successfully operated on a commercial basis.

In addition to laboratory investigations on the bituminous sand of Alberta, the Mines Branch has prepared detailed topographical maps, which give the thickness of sand and overburden, and other useful information of a portion of the area underlain by the bituminous sand, and it is expected that the mapping of the whole area so underlain will be completed during 1923.

Those interested may obtain copies of reports, maps, etc., concerning bituminous sand in Alberta, on application to the Director, Mines Branch, Ottawa.

Celestite

Celestite, sulphate of strontium, is the only strontium mineral that is found in deposits of any considerable size in Canada.

The only attempt made to mine strontium in Canada in recent years was in 1919-20, when a deposit near Calabogie, in Ontario, was opened and an experimental mill erected. The ground product is said to have been used with some success in domestic paint works, as a substitute for barytes, and in the rubber industry. Mine and mill are now closed.

Other occurrences of celestite in Canada of possible economic importance are confined, as far as is at present known, to one in Lansdowne township, Leeds county, one in Loughborough township, Frontenac county, and one in Fitzroy township, Carleton county, all in Ontario. A little celestite was taken from the Lansdowne deposit many years ago.

There has been no production of celestite in Canada since 1920, when an output of 75 tons was reported.

A report on "Barium and Strontium in Canada" (No. 570) including celestite, has been published by the Mines Branch and may be obtained on application to the Director, Mines Branch, Ottawa, Canada.

Chromite

Though the output is not large, Canada is, potentially, an important producer of chrome ores, as was shown by its record under the stimulus of war demands.

Chromite is found in several parts of Canada, but the deposits of most economic interest are in Quebec, where they occur irregularly scattered through serpentine rock in the counties of Brome, Megantic, Richmond, and Wolfe, the most productive locality being the township of Coleraine, in Megantic county. Some of the ores are pure enough to be merchantable as mined, but most of them have to be concentrated to raise their chromium content to 25 per cent Cr_2O_3, the minimum demanded by buyers.

In 1918 some shipments of chromite were also made from Cascade, near Rossland, in British Columbia.

It may be noted as an item of scientific interest that minute diamonds are found associated with chromite in certain peridotite rocks of the Tulameen district, in British Columbia, and also with some of the chromite in Quebec.

Shipments of chromite in Canada in 1922 were only 767 short tons of concentrates, valued at $11,503, all of which was exported to the United States. In 1917 the output was 36,725 tons, valued at $499,682.

Coal

Canada's coal resources are her greatest single mineral asset. Including lignite, bituminous, and anthracite, an estimate made in 1913 puts them at 1,234,000 million metric tons. Exclusive of lignite and lignitic coals, of value chiefly for local consumption, her resources of the higher grades—bituminous and anthracite—amounting to 286,000 million metric tons, are exceeded only by those of the United States and China and constitute about 7 per cent of the world's supply.

The distribution of these reserves, including lignites, according to provinces is as follows:—

	Millions of metric tons
Nova Scotia	9,719
New Brunswick	151
Ontario	25
Manitoba	100
Saskatchewan	59,812
Alberta	1,072,627
British Columbia	76,034
Yukon	4,940
Northwest Territories	4,800
Arctic Islands	6,000

Nova Scotia's coals are all bituminous. The output of her largest coal fields, in Cape Breton, is won almost entirely from undersea workings, and goes in part to supply the great iron and steel works of the British Empire Steel Corporation, who own and operate most of the collieries, and in part is shipped to other parts of the province, to neighbouring provinces, and to foreign countries.

The smaller coal fields, on the mainland, in Cumberland and Pictou counties, are also largely controlled by the British Empire Steel Corporation, who own and operate three collieries at Springhill in Cumberland county and five collieries in the vicinity of New Glasgow in Pictou county.

The coals in New Brunswick also are bituminous, and of a good grade, but they lie in flat seams, so thin that they can only be worked profitably by reason of the shallow depth at which they occur. Some of them are stripped and worked opencast.

The only coal found in Ontario is a small amount of interglacial lignite, of poor quality and of little prospective and no present value, that occurs in the uninhabited northern part of the province.

The coals of Manitoba and Saskatchewan are all lignites with a high moisture content. Evaporation of the moisture causes them to disintegrate on a comparatively short exposure to the air, hence their chief value is as a local fuel.

Alberta's reserves are chiefly bituminous and lignitic, but include also some anthracite. Her bituminous coal fields, some of which produce coals of the highest grade,

are the largest and most valuable in Canada. The output is as yet restricted by the lack of a large consuming population within the range of economical transportation, but, if the history of other great coal fields is repeated here, they will one day form the nucleus of a large industrial district in western Alberta. At present Medicine Hat, Drumheller, Camrose, and Edmonton are among the more important colliery districts.

PLATE XIX.

A British Columbia colliery. Coke ovens and plant at Michel.

The coal now being mined in British Columbia is all bituminous, but lignitic coals are also found in that province, and anthracite in the north. The location of some of British Columbia's best coals on Vancouver island, where they are easily available for ocean carriage, gives them a special value, while the inland fields in the southeastern part of the province are well situated to supply coal and coke not only to local metallurgical works but also to those in the neighbouring United States to the south. Comox and Nanaimo, on Vancouver island, and the Crowsnest pass on the eastern flank of the Rocky mountains are among the more important producing districts.

Both bituminous and lignitic coals occur in Yukon, and a little bituminous is mined.

The coal fields of the Northwest Territories and of the Arctic islands are entirely undeveloped.

The growth of the coal mining industry in Canada is outlined in the following table, which shows the total annual production at the end of each decade since 1881:—

Year	Short tons
1881	1,537,106
1891	3,577,749
1901	6,486,325
1911	11,323,388
1921	15,057,498

The output by kinds and provinces in 1920, 1921, and 1922 was as follows:—

Output of Coal for Canada, by Kinds and Provinces, 1920, 1921 and 1922

Provinces	1920	1921	1922*
	Short tons	Short tons	Short tons
Nova Scotia—			
Bituminous	6,437,156	5,734,928	5,558,574
New Brunswick—			
Bituminous	171,610	187,192	297,452
Saskatchewan—			
Lignite	335,222	335,632	302,312
Alberta—			
Anthracite	127,513	96,964	40,417
Bituminous	3,419,147	2,867,833	2,817,985
Lignite	3,361,105	2,944,420	3,101,249
Total Alberta	6,907,765	5,909,217	5,959,651
British Columbia—			
Bituminous	3,095,011	2,860,291	2,926,832
Yukon—			
Bituminous	.....	283	465
Total for Canada—			
Anthracite	127,513	96,964	40,417
Bituminous	13,122,924	11,680,477	11,601,308
Lignite	3,696,327	3,280,052	3,403,561
Grand total	16,946,764	15,057,493	15,045,286

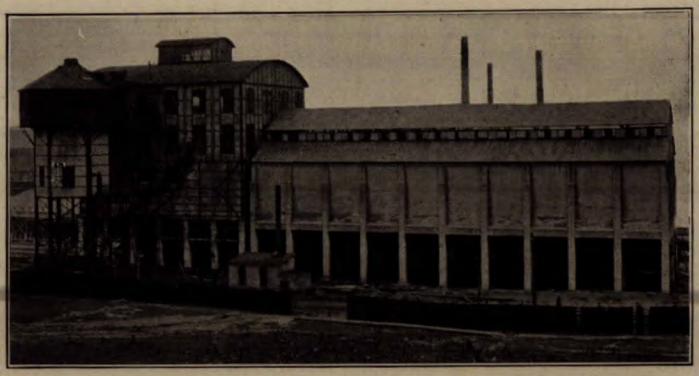
*Unrevised figures.

A comparison of the smallness of Canada's present output of coal with the enormous amount of her known reserves will furnish a basis on which to estimate the future possibilities of the Dominion as a coal producing country. Not only are the present productive fields only

partly developed and furnishing but a fraction of their possible output, but in the west, in Alberta and British Columbia especially, there are great coal fields that have never been touched by the miner's pick still awaiting transportation and markets.

A peculiar situation exists with respect to Canada's fuel supply. Notwithstanding the enormous coal resources that Canada possesses, over 50 per cent of her consumption is imported from the United States. The Canadian coal fields are situated in the extreme east and in the western provinces, while the great central provinces of

PLATE XX.



A coal washing plant in Nova Scotia. Dominion Coal Company's washery at Sydney, N.S.

Ontario and Quebec, the chief centres of population, are more easily and economically supplied with coal from the nearer coal fields of Pennsylvania and Ohio. Further, there is no anthracite coal in eastern Canada, and we have become dependent upon the anthracite output of Pennsylvania for that most desirable of domestic fuels, which is not only the chief domestic or house fuel in Manitoba, Ontario, and Quebec, but is imported even into our eastern coal districts.

The Mines Branch has published for distribution a number of reports on the composition, properties, and

tests of Canadian coals from numerous localities, a list of which and further information may be obtained on application to the Director, Mines Branch, Ottawa.

Feldspar

Feldspar has been mined in Canada since 1890, much the greater part of the output being exported to the United States, where it is used chiefly in the potteries of New Jersey and Ohio, and in the enamelling trades.

PLATE XXI.

A Canadian feldspar quarry, Bedford township, Ont.

Canadian feldspar enjoys a well merited reputation as a raw material for the ceramic industries, being of high grade and of uniform potash content, analyses of samples from a number of quarries showing a potash content of about 12 per cent.

The entire production of Canadian spar comes from the provinces of Ontario and Quebec, the chief producing localities being in the vicinity of Verona, in Frontenac county, Perth, in Lanark county, and Hybla, in Hastings county, Ontario, and in the vicinity of Buckingham, in Hull county,

in the province of Quebec. There is also a small production from the Parry Sound district, in Ontario, and a deposit at Quetachu bay, on the lower St. Lawrence, in

PLATE XXII.

White microcline feldspar from Villeneuve, Que.

Quebec, was developed to some extent in 1922.

Feldspar being a relatively low priced mineral, mining operations are confined to deposits situated within easy

reach of transportation by rail in the districts closest to the principal market, the United States potteries. Ontario and Quebec, however, possess practically unlimited feldspar resources in the regions to the north of the present productive areas, and there is room for great expansion in the feldspar mining industry when conditions warrant it.

Previous to 1921 Ontario furnished practically the entire output of Canadian feldspar, but in that year development work proved several large bodies of exceptionally good spar in the Buckingham district, in Quebec, where one quarry alone produces over 10,000 tons.

Canadian feldspar deposits are in the nature of dikes, of pre-Cambrian age, traversing the ancient granite-gneiss complex that constitutes the major portion of Ontario and Quebec provinces. These dikes sometimes attain a width of 50 to 75 feet, and are commonly composed of feldspar and quartz. In the larger dikes the two minerals are usually segregated in large masses, so that the feldspar can be quarried out clean, while the quartz is either wasted or disposed of to the ferro-alloy industry. The range within which it is profitable to seek out dikes that have the desired physical structure and freedom from deleterious ingredients is, however, limited by the cost of transportation to available markets. For this reason little attention has yet been given to the feldspar producing possibilities of great areas known to contain pegmatite dikes in northern Manitoba, the Northwest Territories, and British Columbia, as well as in Ontario and Quebec.

The production of feldspar in 1922 was 27,727 tons, valued at $248,402, of which about 15,700 tons are to be credited to Ontario and 12,000 tons to Quebec.

Exports of feldspar for this same year totalled 24,995 tons, valued at $170,954, as against 27,293 tons, valued at $169,864 in 1921. The whole of the exports is crude spar, consigned, as in previous years, to grinding plants in the United States. Only a small tonnage is ground in Canada, to partly supply the domestic demand, which is still met to some extent by spar ground in the United States.

A detailed report on "Feldspar in Canada" (No. 401) has been published by the Mines Branch and may be obtained on application to the Director, Mines Branch, Ottawa, Canada.

Fluorspar

Occurrences of fluorite, or fluorspar, have been noted in the provinces of New Brunswick, Quebec, and British Columbia, but deposits known to be workable are confined to Ontario and British Columbia.

In Ontario, in the vicinity of Madoc, in Hastings county, where fluorite is found in veins a few inches to several feet in width, cutting limestones, there has been a small intermittent production for a number of years. The character of the ore varies in the different veins from massive fluorite, often beautifully crystallized and associated frequently with barytes, to the loose friable type known as gravel spar. Some of the veins, also, yield beautifully clear and flawless crystals suitable for optical purposes. Under the stimulus of high prices due to war conditions a number of mines were put into operation in this district, but with the subsequent falling off in demand, production dwindled and is now confined to a few scattered properties. Only 284 tons were mined in Ontario in 1922.

In British Columbia, a large vein of fluorite near Grand Forks was opened up in 1918 and has been developed to such an extent as to provide a considerable amount of material for export after supplying the requirements of the metallurgical works at Trail, where it is used for the production of the hydrofluosilicic acid used as an electrolyte in the electrolytic refining of lead. As the crude mineral mined at Grand Forks contains considerable silica, it is concentrated to bring it up to marketable grade. Foundrymen and steel makers, who use considerable quantities of fluorite as a flux, demand a spar carrying at least 80 per cent of calcium fluoride and free from sulphides, sulphates, and phosphates, while spar for acid making should contain 98 per cent calcium fluoride and not more than one per cent silica.

The production of fluorspar in 1922, nearly all from the Rock Candy mine, near Grand Forks, B.C., was 4,503 tons, valued at $102,138, as against 5,519 tons, valued at $136,267, in 1921.

The exports of fluorspar in 1922 totalled 2,944 tons, valued at $32,914, while the imports amounted to 4,980 tons, valued at $73,343.

Graphite

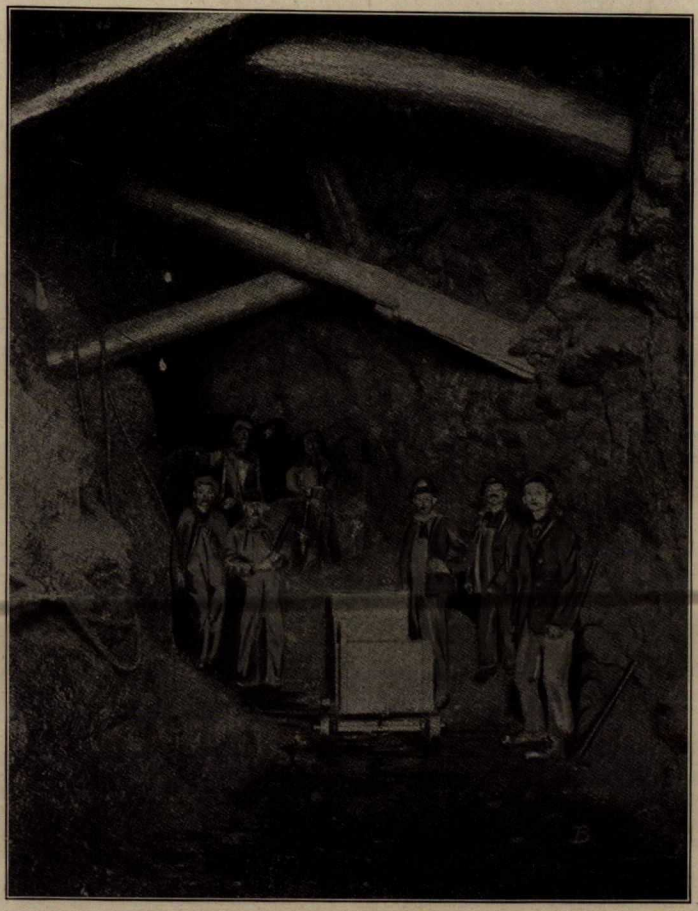
Graphite is found in Canada in the provinces of Ontario, Quebec, New Brunswick, Nova Scotia, and British Columbia, and in the northern parts of Canada, in the Northwest Territories and on Baffin island. Nearly all the production, however, comes from Ontario and Quebec, where graphite has been mined for more than sixty years, most of the producing mines and the nine existent graphite concentrating mills being situated within a radius of 150 miles of Ottawa. The product is all flake graphite derived from disseminated deposits in limestones and gneisses, though crystalline vein graphite, or plumbago, is also found. The commercial flake ores, having a graphite content up to 8 or 10 per cent in the limestone deposits and up to 30 per cent in the gneisses, are usually concentrated, but some of the specially rich flake ores carrying 65 to 80 per cent graphite can, for certain purposes, be marketed as mined. Formerly there was an important output of amorphous graphite from deposits near St. John, New Brunswick, and in 1917 and 1918 a few tons of the crystalline, or vein variety was shipped from Baffin island in the Canadian arctic.

In Ontario, the producing graphite mines and mills are located near Perth, in Lanark county, Bancroft, in Hastings county, and Calabogie, in Renfrew county. The Black Donald mine, near Calabogie, is the largest and richest deposit of flake graphite known in America, the ore body, a vertical vein consisting of a nearly homogeneous mass of graphite having an average width of 20 and a maximum width of 70 feet, and carrying on an average 65 per cent, and locally as high as 80 per cent of graphitic material. Other important occurrences in Ontario, some of which have been worked to a slight extent, are found in the counties of Addington, Frontenac, and Leeds.

In Quebec, the principal deposits are in the neighbourhood of Buckingham, St. Remi, and Guenette, in Labelle county, and in the townships of Grenville and Wentworth in the adjoining county of Argenteuil.

In New Brunswick, though no graphite has been mined there recently, deposits in St. John county, near the city

PLATE XXIII.



In the Black Donald mine, Brougham township, Ont., the largest known graphite deposit in America

of St. John, were formerly worked, intermittently, since 1853. In this province graphite occurrences are also known in the counties of Charlotte, Kings, and Westmorland.

In Nova Scotia, the occurrence of graphite is recorded at various localities in Cape Breton island and in the counties of Guysborough, Colchester, and Kings on the mainland.

In British Columbia, graphite is known to occur at Alkow harbour, in the Bella Coola mining division, near Marysville, in the Fort Steele division, and at Harrison lake, in the New Westminster mining division.

In the far northern regions of Canada, graphite has been noted at various localities in the Northwest Territories, Ungava, and Baffin island. In 1916 and the following years, some development work was done on a deposit near Lake Harbour on the south shore of Baffin island. The few tons produced in the course of these operations are said to have been equal to the best Ceylon plumbago for the manufacture of crucibles.

Artificial graphite, an electric furnace product, is also made in Canada, near Niagara Falls, Ontario.

The production of graphite (natural) in Canada in 1922 was only 597 tons, valued at $31,353, the lowest figure for many years and much below the average annual production of 2,438 tons for the nine years from 1910 to 1918.

A detailed monograph on "Graphite," (No. 511) having special reference to Canadian deposits, has been published by the Mines Branch and may be obtained on application to the Director, Mines Branch, Ottawa, Canada.

Gypsum

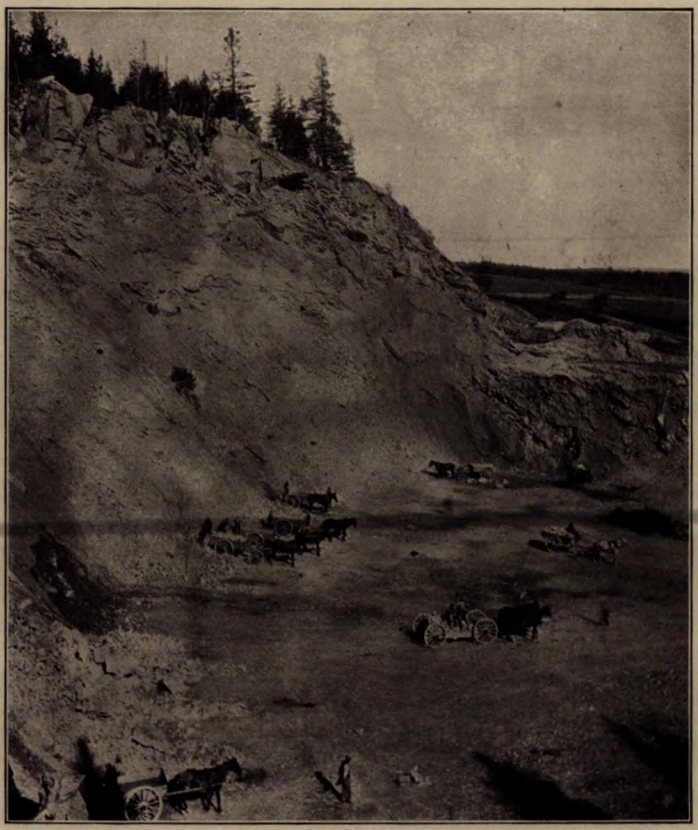
Many large deposits of gypsum occur distributed throughout Canada, the most extensively mined areas being those in the Maritime Provinces of Nova Scotia and New Brunswick, where the mineral, often exposed in cliffs from 50 feet to 200 feet in height, is found associated with rocks of the lower Carboniferous series.

In Nova Scotia, the principal districts in which gypsum is found are in Hants county, near Windsor; in Cumberland county, near Amherst; in Victoria county, near McKinnon harbour; at Baddeck and St. Anne; and near

Cheticamp, in Inverness county. Gypsum also occurs in large quantities in other parts of Cape Breton island.

In New Brunswick, the principal deposits occur in Albert county, in the district around the town of Hillsborough; near Petitcodiac, in Westmorland county; and

PLATE XXIV.



A Nova Scotia gypsum quarry, Walton, N.S.

in the northern part of the province at Plaster Rock on the Tobique river, in Victoria county.

Comparatively little of the mineral mined in these two provinces is manufactured in Canada, the greater part being shipped crude to the United States.

Gypsum also occurs in several of the islands of the Magdalen group, province of Quebec, where it is associated with the limestones of the lower Carboniferous series.

In Ontario, deposits are found in Haldimand county along the banks of the Grand river, in two beds, about 4 and 11 feet in thickness. A small annual output of the calcined mineral has been produced at this place for many years. Occurrences have also been noted in the northern part of the province along the banks of the Moose river, 30 or 40 miles south of Moose Factory.

In Manitoba, large workable deposits of gypsum occur in an area about 8 miles square situated about 170 miles north of the city of Winnipeg. The crude mineral is transported to Winnipeg, where it is calcined. Gypsum has also been encountered in drilling operations in the southern part of the province.

In Alberta, gypsum is found north of the city of Edmonton, at several localities in the district tributary to the Mackenzie river, and has also been encountered in drill holes near McMurray in borings made by the Alberta government for salt.

It is found in British Columbia at the following places: Salmon river in the southern part of the Kamloops mining division; Spatsum on the main line of the C.P.R., about 189 miles northeast of Vancouver; on the banks of the Thompson river, about 20 miles to the north of the town of Kamloops; at Merritt in the Nicola valley, and on Granite creek, in the Tulameen district, about 10 miles up the Tulameen river from the town of Princeton.

The quality of the gypsum found in Canada, more especially the white rock found in Nova Scotia, New Brunswick, and Ontario, is of an exceptionally high grade. It is used in many of the fine arts and is extensively employed in the manufacture of structural materials, such as plaster of Paris, hardwall plasters, cement, etc. It is also used in the crude state as a fertilizer.

In 1922, 559,265 tons of gypsum, valued at $2,160,898, were sold or used in Canada.

The Mines Branch has published a report (No. 245) on "Gypsum in Canada," copies of which may be obtained on application to the Director, Mines Branch, Ottawa, Canada.

Iron Oxides

Ochres, wad, and ferruginous clays suitable for the manufacture of paint, and hydrated oxides of iron for the purification of illuminating gas, are found in many parts of Canada.

The mineral pigments, raw and burnt, made from these give a range of colours including golden ochre, yellow ochre, cinnamon yellow, sienna, umber, Vandyke brown, and Indian red.

Though they have been employed in small quantities for local use in many localities, most of the production at present is from the vicinity of Three Rivers, in the province of Quebec, where three companies are operating. A small production has also been reported in recent years from Lynch township, in Labelle county; Ste. Anne de Beaupre; and Iberville township, in Saguenay county; all of which are also in Quebec.

In Ontario deposits of importance are found in various sections of the province, including Algoma district and Norfolk, Leeds, and Halton counties. In Nassagaweya township, Halton county, there is a deposit from which ochre has been produced in small quantities.

In Nova Scotia and New Brunswick deposits of ferruginous clays and wad, as well as ochre deposits in Colchester county, Nova Scotia, have been worked on a small scale from time to time. In the western provinces deposits of workable size and grade are said to exist, but no production has been reported except some shipments of bog ore for use in the purification of gas, from Mons, in British Columbia, to cities in the United States to the south.

The Canadian production of iron oxides includes material marketed as uncalcined ochreous iron oxide, for the manufacture of paint and for the purification of illuminating gas, calcined ochreous iron oxides, called metallic oxide, and umber and sienna, calcined and uncalcined. In 1922 the total quantity produced was 7,285 tons, valued at $110,608, practically all from Quebec, as against 9,048 tons, valued at $93,610, in 1921.

Kaolin

As kaolin, or china clay, is the product of the weathering of feldspars and feldspathic rocks, and as nearly all of Canada has been subjected to severe glaciation, it is not

to be expected that many large deposits of kaolin will be found in the Dominion.

At present it is known to occur in commercial quantity in only one locality—in Amherst township, Labelle county, Quebec—where considerable deposits are found in a shattered zone of quartzite rocks of pre-Cambrian age. The Canadian China Clay Company, operating at St. Remi d'Amherst, produce a very fine quality of washed kaolin, and, as a by-product, a very pure granular quartz sand that may be used for a variety of purposes. In addition to pure white material, there is also in these deposits considerable quantities of discoloured kaolin suitable for use as fireclay.

The production of kaolin in Canada in 1922* was 1,296 tons, valued at $18,532, as against 124 tons, valued at $1,888, in 1921. Imports of china clay, ground and unground, were 12,898 tons, valued at $173,988, in 1922. The consumption of china clay in the manufacture of newsprint paper alone, in Canada, is much greater than can be taken care of by the one producer.

Magnesite

Magnesite deposits of commercial grade are found in eastern Canada in one small area only, in the townships of Grenville and Harrington in Argenteuil county, Quebec, from which district practically all the Canadian production comes. In British Columbia, high grade magnesite associated with serpentinized peridotite is found in the Bridge River district of the Lillooet mining division, and hydromagnesite of surficial origin in central British Columbia and in the Atlin district, in fairly large deposits, some of which have been worked to a slight extent.

The hard rock magnesite quarried in Argenteuil county, Quebec, is marketed in three forms, crude magnesite, caustic calcined magnesite, and dead burned clinker, to be used largely as refractory lining for the bottom of steel-making furnaces. The British Columbia hydromagnesite, though somewhat similar in composition to hard rock magnesite, is in powdery form and requires a different treatment to prepare it for the market. It is shipped to the coast and there calcined for use in the preparation of oxychloride cement.

* Figures for production in 1922 are taken from the Quebec Bureau of Mines report for that year.

The production of magnesite in Canada (practically all from Quebec) increased from 120 tons in 1908 to a maximum of 58,090 tons in 1917, but dropped, with the cessation of the extraordinary demand brought about by the war, to 2,849 tons in 1922. Of the total production of 1922, 2,789 tons, valued at $75,754, were in the form of calcined and dead burned magnesite, and only 60 tons, valued at $540, in the crude form.

Mica

Canada is one of the three principal mica producing countries of the world, the other two being India and the United States. The product of the Dominion is practically all phlogopite, or amber mica, as distinguished from muscovite, or white mica. Amber mica being softer, more flexible, and more suitable generally for insulating purposes than the latter, commands a somewhat higher price. So far, Canada has furnished much the greater part of the world's supplies of amber mica. Muscovite is also found in Canada but has not been mined to any great extent.

The productive amber mica deposits of Canada consist mainly of aggregates of phlogopite, apatite, pyroxene, and calcite in widely varying proportions, occurring in, or closely associated with pyroxenite rocks. They are believed to have been formed by the action of pegmatitic solutions given off by igneous intrusives. The chief productive areas, one of about 1,200 square miles in the province of Quebec and the other of about 900 square miles in Ontario, are separated from each other, geographically, by a belt of sedimentary rocks about 40 miles wide. The city of Ottawa, lying between the two areas, is the centre of the mica industry in Canada, all the more important works engaged in preparing that mineral for the market being located there.

In Quebec, amber mica deposits are being exploited chiefly in the districts adjacent to the Lievre and Gatineau rivers, in Hull and Pontiac counties, but the limits of the mica bearing zones are practically unknown, as active search for workable bodies of mineral is confined to localities within easy reach of railway or other good means of transport.

In Ontario, the amber mica mining district is included in the counties of Frontenac, Lanark, and Leeds, north of

the city of Kingston. The Lacey mine of the General Electric Company, near Sydenham, in Frontenac county, is probably the largest mica mine in the world.

Most of the mines are in the hands of small operators, who mine intermittently, trim the mica sheets roughly, and

PLATE XXV.

The world's largest amber mica mine, Lacey mine, Loughborough, Ont.

sell them to regular dealers, who further trim, split, and cut them to the thicknesses and dimensions required by the trade. The larger operators conduct all these operations themselves and sell directly to the trade. The mica is marketed either as trimmed sheet or as splittings, the latter being very thin sheets which are built up with shellac to

form mica board. The waste from the trimming shop goes to grinding mills, where it is ground to powder for use in roofing papers and felts, rubber, and other products. The bulk of the output is exported to dealers and manufacturers of electrical goods in the United States and Great Britain.

Occurrences of white mica, or muscovite, some few of which have been worked at different times, are known from Cape Breton, in the east, to British Columbia, in the west; and Arctic expeditions have brought back good shipments from the far north. Perhaps the best of these white mica deposits are those of the Saguenay district, on the lower St. Lawrence, in the province of Quebec. Others, however, are reported from the region north of Hull, in Quebec, from several places in Ontario, and from the Yellowhead pass, in British Columbia. One deposit of lepidolite, or lithia mica, is also known.

The production of mica in Canada, in 1922, totalled 3,349 tons, valued at $152,263, as against 702 tons, valued at $70,063, in 1921. The output is marketed as trimmed sheet, splittings, mica plate, and scrap.

Exports in 1922 were valued at $464,512.

A detailed monograph on "Mica" (No. 118), has been published by the Mines Branch, and copies may be obtained on application to the Director, Mines Branch, Ottawa.

Mineral Waters

Spring waters containing minerals in solution, or as they are usually termed, mineral waters, occur in very many sections of the country. Many of them are being utilized commercially, both as potable waters and for bathing purposes. At several of the springs, where the water has curative properties, hotels and sanitariums are being operated. Some of these are thermal or hot springs and are principally used for baths.

Natural Gas

Natural gas is found in the Canadian provinces of Ontario, Alberta, New Brunswick, Quebec, Manitoba, and Saskatchewan, but production is confined chiefly to Ontario and Alberta, with a much smaller output from New Brunswick and Manitoba.

The oldest gas field in Canada lies north of lake Erie, in southwestern Ontario, in the counties of Haldimand, Welland, Norfolk, Elgin, Essex, and Kent. It has been producing gas for over 30 years, the output being piped to neighbouring towns for domestic and industrial use. Single wells produce from 100,000 to 1,000,000 cubic feet of gas per day, but the output of the field as a whole is declining, and recent borings have not met with any marked success. To conserve the supply the production and use of natural gas in Ontario is now strictly regulated by the provincial government.

In Alberta, Medicine Hat in the southern part of the province is the centre of an important gas producing area, and from Bow Island 40 miles farther west, natural gas is piped to Calgary, Lethbridge, McLeod, and other towns. Farther north there are other smaller productive gas fields, to the south and east of Edmonton.

Recently several important new gas fields have been found in Alberta as a result of the boring for oil now being carried on in different parts of the province. Some of these, however, are in such sparsely settled districts that they cannot at present be utilized. One new gas well near Irma, southeast of Edmonton, is credited with a flow of 30,000,000 cubic feet per day, and another in the far north at Pouce Coupe in the Peace River district, is said to flow at an equal rate.

The productive gas wells of New Brunswick are found near Moncton, to which city the gas is piped for use.

The natural gas production of Manitoba is little more than nominal.

Production of Natural Gas in Canada, in 1922, by provinces

	Thousand cubic feet
Ontario	8,060,114
Alberta	5,867,459
New Brunswick	753,898
Manitoba	200

In Quebec a small quantity of natural gas was obtained for a short time from wells near Three Rivers, and gas is reported to have been encountered in wells drilled at Estevan, in southern Saskatchewan.

Natural Magnesium Sulphate (Epsomite)

In British Columbia crude crystalline magnesium sulphate is excavated from the bottoms of a series of five lakes situated fifteen miles west of Ashcroft and the product shipped to Vancouver to be refined, for use in tanning, and for medicinal purposes. It has also been obtained from a lake near Clinton, and is known to occur in another lake near Kruger mountain, in southern British Columbia.

In Saskatchewan magnesium sulphate is being produced from the natural brines of Muskiki lake, near Dana, where a large plant has been erected by Salts and Chemicals, Limited, who also have a refining plant at Kitchener, Ontario.

It is quite possible that some of the other numerous alkali deposits of Saskatchewan, Alberta, and British Columbia will also become commercial sources of magnesium sulphate.

The production of this material in Canada in 1922 was 1,021 tons, valued at $24,107, as against 2,029 tons, valued at $39,506, in 1921.

Natural Sodium Carbonate

In the vicinity of Meadow lake, 50 miles north of Clinton, British Columbia, the Lillooet Soda Company operates a plant for the production of natural sodium carbonate. The output is shipped to Vancouver and sold to soap makers.

This is the only deposit of this nature that has yet been worked in Canada.

Production in 1922 was 202 tons, valued at $3,027.

Natural Sodium Sulphate (Glauber's Salt)

Natural sodium sulphate (Glauber's salt, or salt cake) is obtained in the form of almost pure crystals from the bottom of a small lake five miles north of Fusilier, Saskatchewan. It is also recovered from the bottom deposits and brines of Muskiki lake in the same province, and a plant for its recovery has been erected at Frederick lake, near Dunkirk, also in Saskatchewan.

There are many other lakes and sloughs in the prairie provinces that could produce sodium sulphate, but the chief

consumption of this material in Canada is in the pulp and paper industries of the eastern provinces, so that only those deposits that are close to the railway, and whose product can be cheaply prepared for the market, can be profitably worked at present.

The production of natural sodium sulphate in Canada was 504 tons, valued at $11,980, in 1922, as against 623 tons, valued at $18,850, in 1921. All of it comes from the province of Saskatchewan.

Oil Shale

The existence in Canada of petroliferous shales, commonly called oil shales, has been known for many years, and for a short time an attempt was made to utilize them, first near Collingwood, Ontario, in 1859, and then, in 1862, near Baltimore, New Brunswick; but the competition of well petroleum from the then newly discovered oil fields in southwestern Ontario and in Pennsylvania rendered both these early attempts abortive. Within recent years, however, changing economic conditions have again directed attention to the possibility of using Canadian shales for the production of petroleum. Where the shale yields a high recovery of petroleum and of ammonium sulphate, and can be cheaply mined in open cast workings, competition with well petroleum may be possible now, but where it is necessary to adopt underground methods of mining the possibility of successful competition at present is more doubtful.

So far as known, the most important deposits of oil shales in Canada are those in Albert and Westmorland counties, New Brunswick, a district adjacent to tidewater and supplied with railway facilities. From borings, and measurements of incomplete surface exposures, it appears that the petroliferous bands in this area vary in thickness from a few inches to more than 25 feet, and analyses indicate a petroleum yield of 24·2 to 100 Imperial gallons (29·0 to 120 U.S. gal.) per ton of shale. The yield of ammonium sulphate varies from 26 to 100 pounds per ton.

Extensive bodies of oil shale are also found adjacent to railways, in rocks of Carboniferous age, in Pictou and in Antigonish counties, Nova Scotia. Those in Pictou county are the more important, having a petroleum content ranging from 15 to 170 Imperial gallons (18 to 204 U.S. gallons)

and an ammonium sulphate yield of 35 to 41 pounds per ton of shale. The petroleum content of the Antigonish shale ranges from 9 to 20 Imperial gallons (10·8 to 24 U.S. gallons) with a yield of 19·5 to 33·8 pounds of ammonium sulphate per ton of shale.

In Quebec, oil shales carrying 20 to 36 Imperial gallons (24·0 to 43·2 U.S. gal.) of petroleum and yielding ammonium sulphate at the rate of 22 to 59·5 pounds per ton occur in Gaspé county, on the York and St. John rivers. The shale bands, however, are irregular in thickness and lacking in continuity.

Oil shales that have a petroleum content of 7·8 to 10 Imperial gallons (9·3 to 12 U.S. gal.) per ton and that yield from 10 to 20·6 pounds of ammonium sulphate per ton, are widely distributed over southwestern Ontario, particularly in Lambton and Grey counties; while in northern Ontario, at present beyond the reach of transportation, bodies of shale yielding 7 to 16 Imperial gallons (8·4 to 19·2 U.S. gal.) of petroleum and 18·8 to 38·6 pounds of ammonium sulphate per ton have been found in the country adjacent to the Mattagami and Abitibi rivers.

Extensive deposits of petroliferous shales also occur in northern parts of the provinces of Manitoba and Saskatchewan, but so far as present information goes, could not be expected to yield, as a maximum, more than 10·9 Imperial gallons (13·1 U.S. gal.) of petroleum and 3 pounds of ammonium sulphate per ton.

Oil shales have also been reported from the Cariboo district and from the Queen Charlotte islands, in British Columbia.

Some of these Canadian oil shale deposits, especially those of Nova Scotia and New Brunswick, are worthy of careful investigation. They represent a large aggregate tonnage of valuable shale that it is reasonable to believe will eventually form the basis of a lucrative industry.

Peat

The peat deposits of Canada are quite extensive and constitute a reserve of fuel that has as yet been but little utilized. The most important areas so far as known are those found in the provinces of Quebec and Ontario. A number of these have been systematically examined and

surveyed by the Dominion Department of Mines with a view to determining their character and extent. The Mines Branch has carried out also a comprehensive investigation of fuel values of peat, having built a plant in Ottawa for demonstrating the feasibility of the manufacture and use of peat gas in gas engines.

From 1919 to 1922, both years inclusive, the Dominion government jointly with the provincial government of Ontario operated an experimental plant for the production of air dried machine peat on a bog at Alfred, Ontario, with a view to determining definitely the commercial feasibility of producing this class of fuel in Canada. The Joint Committee in charge of these experiments have not yet published their final report but have intimated that the results were on the whole satisfactory.

Reports giving the area, depth, composition and fuel value of a number of individual peat bogs in Canada have been published and may be obtained on application to the Director, Mines Branch, Ottawa.

Petroleum

The petroleum production of Canada is not as yet very large, so that most of the mineral oils and petroleum products at present used in the Dominion have to be imported. There is ground for hope, however, that an extensive drilling campaign now being carried on in the vast untested areas of western Canada will result in the discovery of large new oil fields. Meantime, most of the domestic production is obtained in Ontario, with small additional amounts from New Brunswick and Alberta.

The most productive district in Canada at present is the peninsula of southwestern Ontario, lying between lakes Huron and Erie, a district that has been producing oil continuously for about 60 years. For a long time Lambton county, on lake Huron, supplied nearly all the output, but now there is also a large production from wells in the adjoining counties of Middlesex and Essex.

A few thousand barrels of oil produced annually in New Brunswick come from the oil and gas field near Moncton in the southeastern part of the province.

The only commercial oil field yet developed in Alberta is on Sheep river, southwest of Calgary, where an oil of

very low specific gravity is obtained in small quantities, but showings of oil have been obtained in bore holes at a number of other places.

There is still a vast amount of possibly oil bearing territory in Canada that has yet to be drilled, chiefly in the prairie provinces and in the Mackenzie River basin, and it will be years before the possibilities of these large untested areas are fully determined. An active drilling campaign in search of oil has been carried on in western Canada for some years, both in the south near the international boundary and in the far north, and in 1920 a flow of oil was struck in a boring 45 miles below Fort Norman on the Mackenzie river. Active exploration is still in progress, not only in this district but at Pouce Coupe, in the Peace River country, at Irma, southeast of Edmonton, where a heavy flow of gas has been struck, and in the Sweetgrass-Coutts district of southern Alberta.

The production of crude petroleum in Canada in 1922 was, by provinces:—

	Barrels of 35 Imp. gals.	Valued at
Ontario	164,732	$ 526,316
New Brunswick	7,778	32,732
Alberta	5,608	52,128

The Dominion Government pays a bounty of 1½ cents per Imperial gallon on all petroleum produced in Canada, but this bounty ceases on July 1, 1925, and in the meantime is payable on a yearly diminishing scale only to those wells now producing.

There are a number of petroleum refineries operating in different parts of the Dominion, manufacturing illuminating oil, lubricating oil, gas and fuel oil, benzine, naphtha, gasoline, paraffin wax and candles, and tar, mostly from imported crude petroleum.

The imports of crude petroleum in its natural state in 1922 amounted to 419,559,952 gallons, and the total imports of petroleum and petroleum products had a value of $36,816,724.

Phosphate

Canada at one time produced considerable quantities of mineral phosphate, or apatite, the output in 1890 amounting to nearly 32,000 tons, but since that year the competition of less pure, but cheaper foreign phosphates of sedimentary

origin, present day workable deposits of which are not known to occur in Canada, has practically driven the pure, crystalline, Canadian hard rock phosphate off the market.

The small production of apatite in Canada in recent years is practically all obtained as a by-product of mica mining, mostly from the province of Quebec, crystalline apatite being found in the same pegmatitic dikes, or veins, as amber mica. It follows, therefore, that the phosphate producing districts are practically coterminous with the mica mining districts, that is to say, they are included in the counties of Frontenac, Lanark, and Leeds, in Ontario, and in Labelle and Hull counties, in Quebec. Sedimentary beds of low grade phosphate rock are found in the province of Alberta but are of no immediate economic importance.

There is little doubt that large quantities of apatite still remain in formerly exploited Canadian deposits, especially in those in the country bordering the Lievre river, in Quebec. When the deepest mine in this district was shut down it still had large bodies of apatite in sight, at a depth of 600 feet, and there is every reason to believe that many other of the larger mines were far from being worked out when they were abandoned.

Phosphate is used at Buckingham, Quebec, in the manufacture of phosphorus and ferro-phosphorus, in various fertilizer works in other parts of the country, and in the baking powder trade; the main source of supply is in the United States.

No phosphate was mined in Canada in 1922, though shipments of 190 tons, valued at $1,796, were made from stocks. In 1921, 30 tons were mined, all in the province of Quebec.

A monograph on " Phosphate in Canada " (No. 396) has been published and may be obtained on application to the Director, Mines Branch, Ottawa, Canada.

Pyrites

Until three or four years ago large quantities of pyrites were mined in Canada, much of it for export to United States sulphuric acid plants, but the substitution for pyrites of cheap native sulphur from Louisiana and Texas, in the manufacture of sulphuric acid, has seriously interfered with the Canadian production of late years.

In Canada, pyrites is mined in the provinces of Ontario, Quebec, and British Columbia.

In Ontario, the largest shippers for export are the General Chemical Company's mines at Goudreau, in the Michipicoten district, and at Northpines, on the Canadian National railway, 200 miles northwest of Port Arthur. The same company has also proved, but not developed, large deposits at Mokomon, 31 miles from Port Arthur.

Ontario mines shipping for domestic consumption are the Sulphide, Clyde Lake, and Queensboro, all of which are in east central Ontario. The first of these belongs to the Nicholls Chemical Company, a subsidiary of the General Chemical Company of New York, who operate an acid plant at the mine. The Clyde Lake mine is owned by the Grasselli Chemical Company, who have an acid plant at Hamilton, Ontario, to which the output is shipped. The Queensboro is a merchant mine the output of which also went to the Grasselli Chemical Company's plant at Hamilton.

The producing mines in British Columbia are the Sullivan, at Kimberley, shipping to the sulphuric acid plant at Trail, B.C., and the Hidden Creek at Anyox, whose output goes to acid works at Barnet, B.C.

The output of the Eustis and Weedon mines in the Eastern Townships, Quebec, neither of which are at present in operation, went in part to the United States, in part to the Nicholls Chemical Company's plant at Capelton, Quebec. The Quebec pyrites contains additional constituents of value in the form of small amounts of copper, gold, and silver that are recovered from the residues left when the sulphur is burned off.

Besides productive mines, many large bodies of pyrites, some of which are pure enough to be shipped as mined, others of which would require concentration, are known to occur throughout Canada and constitute a large future reserve. Thousands of tons of sulphur from the roasting and smelting of sulphide ores at large metallurgical works in Canada, also, are poured into the air and wasted annually in the form of noxious sulphur dioxide gas, because it has so far been found more economical to waste them, and even to pay for the damage they cause, than to turn them into sulphuric acid in localities too far from a profitable market for this commodity.

The output of pyrites in Canada reached a maximum in 1917, when shipments aggregating 416,649 short tons were recorded and exports amounted to 279,646 tons. In 1922 production had fallen to 18,143 tons, valued at $74,303, all for domestic consumption. To this total Ontario contributed about 11,000 tons and British Columbia 7,000 tons. There was no production in Quebec in 1922.

Salt

Salt, either in the form of natural brines or in beds of rock salt, is found in nearly every province of Canada. Production at present, however, is confined to Ontario and Nova Scotia.

In Ontario, the production of salt has long been a most important industry in the southwestern part of the province, in the counties adjacent to lake St. Clair and the southern part of lake Huron, the principal producing plants being situated at the towns of Windsor, Sarnia, Sandwich, Goderich, Clinton, and Kincardine. The salt of this district, which is remarkable for its purity, is recovered by evaporating artificial brines obtained by forcing water, by means of powerful pumps, down bore holes to the salt beds and then back again to the surface after it has become saturated with salt.

The salt beds of which as many as six were passed through by one bore hole at Goderich, lie at depths varying from 900 to 1,800 feet, according to location, and some of them are more than 100 feet thick. Part of the product of this, the most important salt producing area in Canada, forms the basis of a local chemical industry.

In Nova Scotia, attempts have been made from time to time to turn to commercial use some of the numerous salt springs found in various parts of the province, but until the discovery of valuable salt beds near Malagash, in Cumberland county, no important salt industry had been developed. Since 1919 there has been an important and growing production of rock salt from the Malagash mine, which finds a ready market in the fish curing industry of Nova Scotia and Newfoundland. The discovery and successful exploitation of the Malagash deposits has stimulated the search for salt beds in other parts of Nova Scotia, and recent reports, if correct, would indicate the presence of valuable deposits in Hants county also.

In New Brunswick, no salt beds have been found as yet, but salt springs occur in the vicinity of Sussex and at Saltspring brook, in Kings county, and on the Tobique river in Victoria county. Long ago a little salt was obtained for local use by evaporating the brine from springs near Sussex.

In Manitoba, numerous brine springs are found in the district west of lake Winnipegosis, and brine has been encountered in numerous drill holes in the district between the city of Winnipeg and the boundary of Saskatchewan. Formerly, salt for local use was obtained from the springs in the lake Winnipegosis district, but there has been no production for many years.

In the provinces of Saskatchewan and Alberta saline springs are numerous and, in 1920, an important discovery of rock salt was made in a drill hole at McMurray, in northern Alberta. At a depth of 648 feet, a bed of transparent rock salt 14 feet thick was penetrated by the core drill, below which intercalated salt and gypsum continues to a depth of 685 feet, at which point the drilling was stopped. In 1919 a small quantity of salt was made from springs near Senlac lake, in Saskatchewan, and this locality may become productive in the future.

In British Columbia, a number of saline springs are reported from various places.

The production of salt in Canada, in 1922, was 181,794 tons, having a selling value of $1,628,323. Of this total, 4,763 tons were rock salt and 290 tons land salt, from the Malagash mine, in Nova Scotia, the remainder, which includes the great bulk of the production, was obtained from brines in southwestern Ontario.

A report on "The Salt Deposits of Canada" (No. 325) was published by the Mines Branch in 1915 and may be obtained on application to the Director, Mines Branch, Ottawa, Canada.

Talc and Soapstone

Canada is the chief talc producer within the Empire. Talc, and talcose rocks popularly called soapstone, are found at many places in the Dominion—in the provinces of Ontario, Quebec, British Columbia, and Nova Scotia.

The centre of the talc mining industry in Canada is Madoc, in Hastings county, Ontario, though small amounts

of impure talc and soapstone have also been produced from deposits in the Eastern Townships, Quebec, in Leeds county, Ontario, in British Columbia and in Nova Scotia.

The talc deposits in the Madoc district, the only ones of their kind known in Canada, and the largest on the American continent, yield a fine, white, foliated talc that has probably no superior for certain purposes. It is used extensively in the paper, textile, and toilet powder trades, in which only the highest grades of talc are in demand. Two talc grinding mills are in operation at Madoc, where ground talc has been produced continuously since 1906. A third mill at Eldorado, a few miles away, has been idle for several years.

Near Wabigoon, Ontario, a promising deposit of soapstone, apparently well suited for linings for the alkali recovery furnaces of sulphate pulp mills, is now being opened up. Other talc localities in Ontario are in Pittsburgh township Frontenac county, Grimsthorpe township Hastings county, Lavant township Lanark county, Rideau lake in Leeds county, and May township in the Sudbury district.

In Quebec the principal talc deposits are found in the townships of Bolton and Potton in Brome county, Wolfestown in Wolfe county, and Broughton, Thetford, Ireland, and Inverness in Megantic county. Most of the material produced from the Quebec deposits appears to be used in the manufacture of roofing materials, but soapstone blocks for linings for the alkali recovery furnaces used at Kraft paper mills were produced in 1922, from a deposit at Robertson, Quebec.

In British Columbia, talc, mostly of the massive, or steatite variety, is found at the base of Mount Whymper in the Windermere mining division, near Keefers station in Yale mining division, near D'Arcy in the Lillooet mining division, and on Wolfe Creek, about 33 miles from Victoria, on Vancouver island. The very small production from this province has practically all been used in the roofing trades.

In Nova Scotia a small occurrence of steatite was worked many years ago near Whycocomagh, in Inverness county.

The production of ground talc in Canada (all from Madoc, Ontario) in 1922 amounted to 13,195 tons, valued at $188,458, as against 10,124 tons, valued at $144,565, in

1921. A small amount of block soapstone, for which no figures are available, was also produced. Increasing quantities of Canadian talc are being exported to the European market, where it competes successfully with the Italian, French and Spanish talcs.

A report on "Talc and Soapstone in Canada" (No. 583) published by the Mines Branch may be obtained on application to the Director, Mines Branch, Ottawa.

CLAYS AND QUARRY PRODUCTS

The clay working industry in Canada is engaged chiefly in the manufacture of structural materials such as brick and hollow building blocks, and of drain tile, from the surface clays of glacial origin which are widespread over the country, and, at a few places, from shale.

Stoneware clays and fireclays, also, are mined to some extent, and, at one place, kaolin, or china clay, but so far as we know at present these materials are of somewhat rare occurrence in the Dominion, and they and their products are largely imported.

Some of the ordinary brick clays of glacial origin that are found widely distributed over Canada are smooth enough to be used on the potter's wheel without any preliminary treatment, but usually they must be prepared by washing and screening. In either case they can be used only for low fired wares, which, however, can be covered with coloured glazes and sold as ornamental pottery.

Pottery Clays

Abundant supplies of valuable pottery clays are known to occur in Canada only in the southern part of the province of Saskatchewan, where white and grey clays, varying from low grade stoneware clays to fireclays, cover a large area and are mined at two places, East End and Willows. These Saskatchewan clays, which are now being shipped to a pottery and sewer pipe plant at Medicine Hat, Alberta, are suitable for the manufacture of various kinds of pottery, including the heavy tableware called white granite, or ironstone china.

The only white burning kaolin, or china clay, so far found in Canada occurs at St. Remi d'Amherst, in Argenteuil county, Quebec, where it is mined and prepared for

the market by the Canadian China Clay Company. There is also in this deposit a great deal of discoloured kaolin that can be used as a fireclay, or which, if washed, would be suitable in a mixture for making coloured pottery. Vitrifying shales that could probably be used for the manufacture of paving brick and sewer pipe are found near Levis, on the south shore of the St. Lawrence river opposite Quebec city, and at St. Charles de Bellechasse, on the north side of the river.

In Nova Scotia, brick clays that can also be used on the potter's wheel as they come from the bank are found at Avonport, Middletown, Bridgetown, and Annapolis, in the Annapolis valley, and at Shubenacadie and Elmsdale on the railway between Halifax and Truro. Stoneware clays occur at Middle Musquodoboit and at Shubenacadie.

Red brick clays suitable for making coloured earthenware without much preparation are found in New Brunswick at a number of places, including the vicinity of St. John, Albert Mines, and Bathurst. Certain clay beds in the coal measures of the Grand Lake district are suitable for stoneware pottery and saggers.

In Prince Edward Island, a red clay found at Richmond is exceptionally plastic, and parts of the deposit are very smooth. It is a good clay for wheel work, built pottery, or for casting and burns to a hard body of fine red colour that takes glazes well.

Some of the widely distributed red and buff burning brick and tile clays in Ontario have the requisite properties for making the cheaper grades of earthenware, but all require washing before being used. The only known deposits of stoneware clay and fireclay in this province are found in the far north, at present beyond the reach of transportation.

In Manitoba, some of the clays used for making brick at Winnipeg, Morris, Portage la Prairie, and Gilbert Plains are plastic enough for pottery making, and stoneware clay of the sandy type, overlain by very fine quartz sand, is found near Swan river. These last materials could be used for making ornamental tiles or for saggers.

A clay that can be used for the manufacture of whiteware occurs near Williams lake, in British Columbia, and a white burning plastic clay of the stoneware type at Quesnel, in the same province.

The only stoneware clays suitable for pottery making in Alberta occur in the northern part of the province beyond the reach of transportation.

At present stoneware and other heavy domestic pottery are made in Canada at St. John, New Brunswick, from Nova Scotia clays, at Medicine Hat, Alberta, from Saskatchewan clays, and at Iberville in Quebec, and Hamilton in Ontario, from imported clays.

Semi-vitreous tableware is now being made at Oshawa, Ontario, and experiments with a view to the manufacture of whiteware from local clays are being carried on in some of the potteries in the western provinces. That white tableware has not previously been made in Canada is probably due to the fact that the market was small and raw materials of domestic origin scarce. The domestic supply of kaolin, or china clay, is limited to the output of one mine, in Quebec, and clays suitable for use as ball clays have only recently been made available, in southern Saskatchewan, though quartz that can be used to replace flint in pottery and high grade feldspars for use in pottery bodies and glazes are plentiful in eastern Canada. At present there is a very considerable market in Canada for tableware of all kinds.

Sanitary porcelain is made at St. John, New Brunswick, electric porcelain at Peterboro and Hamilton, Ontario, and white and coloured vitrified floor tile at Kingston, Ontario, all from imported clays.

Heavy red floor tile and roofing tile are made at Mimico, Ontario, from ground shale obtained locally.

The total value of clay products manufactured and sold in Canada in 1922 amounted to $11,438,456, including $7,458,418 worth of brick, $1,767,054 of sewer pipe, $436,551 of drain tile, and $791,842 of other clay products.

Clay and clay products imported into Canada in 1922 had a total value of $6,664,503, of which $3,931,943 was for earthenware and chinaware, chiefly from England, Japan, United States, France and Czecho-Slovakia. Clays are imported from England and the United States.

Fireclay and Firebrick

The most important Canadian source of refractory clays at present known is in British Columbia, where, in Sumas mountain, some 15 feet of hard fireclay is found inter-

bedded with semi-refractory shales and some vitrifying shales. This district contains on the whole the best materials known in Canada for the manufacture of a wide range of clay products. Refractory shales similar to those at Sumas mountain occur also near Whonnock, on the Canadian Pacific railway, and a residual fireclay is shipped from Kyuquot to Victoria for the manufacture of stove linings and sewer pipe. It is quite possible that kaolin deposits, also, will ultimately be discovered in the interior plateau region of British Columbia.

PLATE XXVI.

Digging fireclay at Willows, Sask.

The southern part of the province of Saskatchewan is rich in refractory and semi-refractory clays. A plant at Claybank, in the Dirt hills south of Moosejaw, manufactures standard firebrick and special shapes, as well as a regular line of face brick, from local clays, and clays similar to those used at Claybank are also found near Michellton, at Willows, south of Twelve Mile lake, and along the Frenchman River valley in the Cypress hills. Those of the Cypress hills are less refractory than those found far-

ther east, and are more suited to the manufacture of vitrified clay ware, such as sewer pipe and stoneware.

No fireclays have yet been found in southern Alberta, but high grade clays occur in the north associated with the tar sands along the Athabaska river near McMurray. Most of these are only semi-refractory, but one bed at least is known to meet the requirements of a fireclay.

No good refractory clays are reported from Manitoba, but semi-refractory shale that may have a local value for medium temperature work—it withstands a temperature of 2600° F. before deforming—outcrops in Turtle mountain, at La Rivière, and in the Assiniboine valley near Virden.

There is a heavy annual importation of refractory goods into Ontario, but a preliminary survey of that province has resulted in the finding of fireclay in only two localities, at neither of which has it been worked. One of these is at the Helen iron mine in the Michipicoten district, where a diabase dike has weathered into a residual clay, the other, on the Missinaibi river about 40 miles north of the Canadian National railway, appears to be quite extensive but is too remote to be of present commercial importance. The prospect of finding new deposits of refractory materials in northern Ontario appears to be good.

The only important source of refractory clay in Quebec is the kaolin mine at St. Remi d'Amherst, 70 miles north of Montreal, where there are large quantities of discoloured kaolin suited for the manufacture of firebrick.

In the Maritime Provinces, the most refractory clay yet found is an unconsolidated Cretaceous clay at Shubenacadie, in Nova Scotia, which tests show to be a No. 2 refractory, deforming at 3,100°F. A clay of the same geological age and character is also found at Middle Musquodoboit, 16 miles to the east of Shubenacadie. The only clay or shale beds associated with the coal seams in these provinces that can be classed as even semi-refractory are: a bed of plastic clay overlying the 13 foot coal seam at Inverness, Cape Breton, a four foot bed of hard shale at the Drummond colliery, Westville, Pictou county, Nova Scotia, and a clay underlying a coal seam at Flower Cove in the Grand Lake coal area of New Brunswick. The Drummond colliery clay makes a good firebrick for lining ladles used

in handling molten metal and for lining slag cars. It is used for both these purposes by the Nova Scotia steel companies. A felsite rock found at Coxheath, near Sydney, Cape Breton, is refractory but not plastic. Crushed and bonded with plastic fireclay it makes good firebrick.

The most important plant producing refractory clay goods in Canada is at Clayburn, British Columbia, the output of which includes standard firebrick, special shapes, and retorts. There are also plants at Claybank, Saskatchewan, at Sydney, Nova Scotia, and at Montreal and St. John, in Quebec. Most of the industries using clay refractories in Canada, however, are dependent for their supply of clay on importations from the United States and Europe.

The total production of fireclay in Canada in 1922 was 9,832 tons, valued at $50,408. In the same year 615,830 cwt. of fireclay, valued at $138,995, and firebrick to the value of $972,902, were imported.

Cement

Occurrences of cement-making materials are so common in practically all parts of Canada that the question of their utilization is almost entirely one of commercial profit, depending on the availability of markets and the cost of fuel and transportation.

At the present time there are in Canada some 28 cement mills, having a total rated daily capacity of over 58,000 barrels:—in Ontario, eleven, in Quebec, eight, in Alberta, four, Manitoba and British Columbia each have two, and Nova Scotia, one. Not all of these are in operation, however.

One plant in Manitoba makes puzzolan, or natural rock cement, and the plant in Nova Scotia, at Sydney, uses blast furnace slag as raw material. The others all make ordinary Portland cement out of clay and ground limestone, or, in the case of two mills in Ontario, clay and marl.

The production of cement in Canada in 1922 amounted to 6,943,972 barrels, valued at $15,438,481, as against 5,752,885 barrels, including 4,761 barrels of puzzolan, valued at $14,195,143, in 1921. No puzzolan was made in 1922.

Ontario and Quebec being the most populous provinces naturally furnish most of the output. In 1922, Ontario provided 3,104,386 barrels and Quebec 2,660,935.

Exports of cement from Canada in 1922 amounted to the equivalent of 425,137 barrels of 350 pounds each, valued at $699,738, as against the equivalent of 242,345 barrels, valued at $650,658, in 1921, while imports of cement and manufactures thereof amounted to $96,310, as against $82,-615 in 1921.

Cement Products

In addition to cement used directly for building and kindred purposes, cement brick, building blocks, tile, sewer-pipe, etc., to an estimated value of perhaps one and one-half million dollars were manufactured in Canada in 1922. Most of these goods were made in Ontario, but makers in Quebec and New Brunswick report an output also.

Quarried Stone

Canada possesses, widely distributed and in great abundance, nearly every kind of stone, useful or decorative, that is used for building purposes, but their utilization is restricted to localities where conditions are favourable to economic working and marketing. With so many excellent building stones available in Canada, it is to be regretted that much sandstone, limestone, and marble is still imported from the United States for this purpose.

In addition to building stone, many quarries in Canada are operated for the production of crushed stone, for use in concrete aggregates, for road metal, and for other purposes; in fact the value of the crushed stone now produced is greater than that of ordinary or dimension stone.

Limestone is quarried for cement making, for lime burning, and for smelter flux, and quartz or quartzite for flux and for the production of ferrosilicon.

Marble, including all the standard varieties used for ornamental purposes in the building trades, are to be found in Quebec, Ontario, and British Columbia.

Roofing slates have been quarried in Quebec and in British Columbia, and large quantities apparently of good quality occur in Ontario.

Granite has been quarried for monumental purposes, and at many places throughout the country types of this and other allied igneous rocks that would take a good polish and produce extremely handsome monumental stone are found.

Detailed reports, by provinces, on "Building Stones in Canada" have been published and may be obtained on application to the Director, Mines Branch, Ottawa, Canada.

A great Nova Scotia coal mine. The Dominion Coal Company's Nos. 2 and 9 collieries, Glace Bay.

NOVA SCOTIA

Area 21,428 square miles. Population 1921, 523,837

Mineral Production 1921 and 1922

Product	1921		1922	
	Quantity	Value	Quantity	Value
		$		$
Metallic—				
Gold*.....fine oz.	464	9,091	1,128	21,598
Non-metallic—				
Barytes..... tons	270	9,567	289	9,537
Coal..... "	5,734,928	27,782,050	5,569,072	24,629,921
Feldspar..... "	16	117	.....	.....
Grindstones..... "	183	6,990	102	3,692
Gypsum..... "	206,831	511,883	332,404	580,148
Manganese..... "	68	3,400	73	2,044
Salt..... "	2,638	23,269	5,053	54,666
Tripolite..... "	341	11,268	219	5,781
Structural Materials—				
Lime.....bush.	25,914	6,085	.....	.....
Stone..... tons	58,923	116,602	87,955	119,492
Other products.....	.....	431,789	.....	496,620
Total.....	.....	28,912,111		25,923,499

*Includes small quantities and values of silver.

Nova Scotia though one of the smallest of the Canadian provinces was among the first portions of the North American continent to be settled and has always been an important mining centre. Situated on the Atlantic seaboard, the facilities for water shipment are unexcelled and naturally among the first products to be exported were those for which a foreign market could be found. Thus we find an early mining of coal, gold, iron ore, and gypsum. The coal fields, though not so extensive as those of some of the western provinces, are more highly developed, the annual production being a little more than one-third the total Canadian output. The product is an excellent grade of bituminous steam and coking coal.

A large industrial development has taken place in the iron and steel industry at Sydney and New Glasgow, based on the locally available fuels and fluxes and iron ores from Newfoundland. The gold production though not large remained fairly constant for many years. Recently the production has fallen off. The numerous occurrences of

free milling gold quartz ores may, however, long continue to reward the prospector.

Ores of manganese and barytes are being mined, and there have been important recent developments in the discovery and exploitation of valuable beds of rock salt, while there is also a fairly steady production of grindstone abrasives. Tripolite and infusorial earth deposits have been worked since 1896. From the widely distributed clays of the province there is an annual production of brick, tile and semi-refractory clay products. Marbles, granites, and sandstones of excellent quality for building and ornamental purposes are found in abundance, as well as limestone for building, fluxing or lime making. Cement and brick are made from blast furnace slag, and slag is also used for the manufacture of fertilizer. The manufacture of coke is accompanied by the recovery of the by-products, sulphate of ammonia and tar.

In addition to the mineral products mentioned in the table, ores of tungsten, antimony, and arsenic have been mined, and tin, lead, and copper ores have been found.

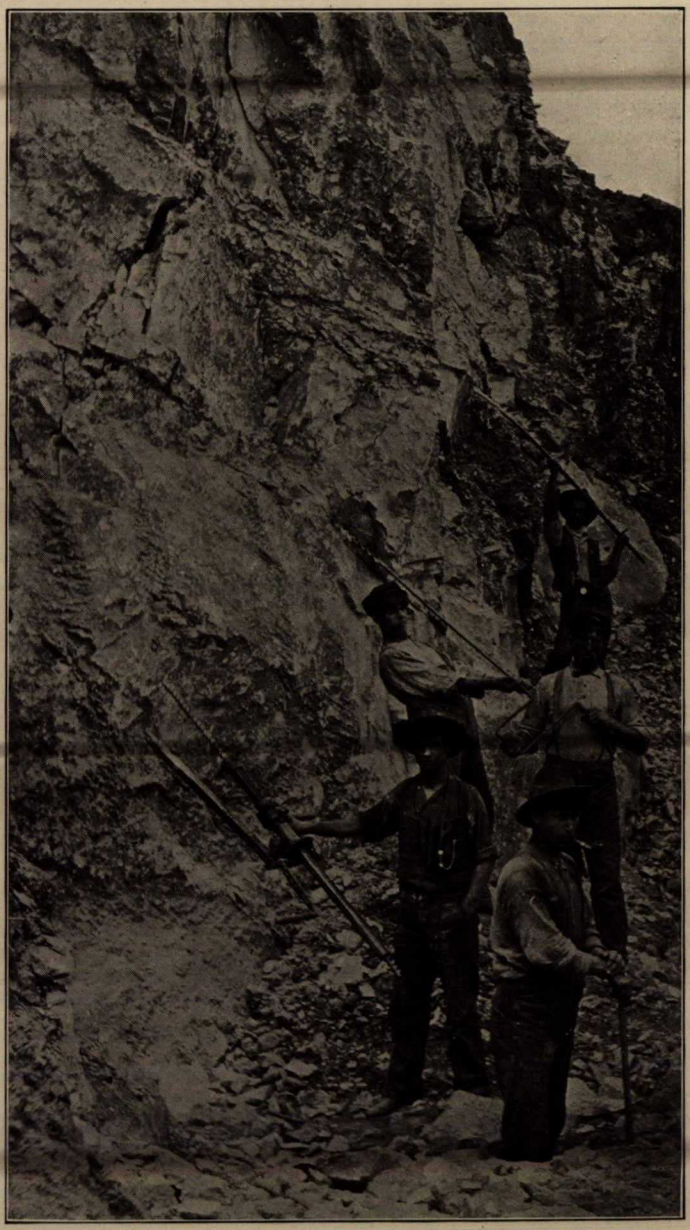
Nova Scotia furnishes encouragement and assistance to the mining industry by providing core drills owned by the Provincial Department of Mines, which are made available to applicants under certain conditions and regulations for the prospecting or development of mining lands.

Copies of the mining laws, regulations, mine reports, maps, and other literature, may be obtained from the Deputy Minister of Public Works and Mines, Halifax, Nova Scotia.

PRINCE EDWARD ISLAND

Area 2,184 square miles. Population 1921, 88,615

This little province, consisting of the island of the same name in the gulf of St. Lawrence, has practically no mineral industries. It is uniformly fertile and well peopled and has important fisheries. Red sandstones suitable for masonry may be quarried in some places, and clays occur that may be used for brick making. It may be that coal seams underlie the island or some part of it, but if so, they appear to be at a depth too great for utilization at the present time.



A New Brunswick gypsum quarry.

NEW BRUNSWICK

Area 27,985 square miles. Population 1921, 387,876

Mineral Production 1921 and 1922

Product	1921		1922	
	Quantity	Value	Quantity	Value
		$		$
Non-metallic—				
Coal..... tons	187,192	920,666	287,513	1,107,643
Grindstones..... "	1,098	57,077	903	40,050
Gypsum..... "	54,030	360,220	82,462	517,668
Natural gas.....M. cu. ft.	708,743	139,375	753,898	148,040
Petroleum..... bbl.	7,479	33,022	7,778	32,732
Structural Materials—				
Clay products.....	.....	66,600	.....	75,425
Lime..... bush.	562,447	203,084	560,834	187,895
Stone.....tons	15,125	97,290	12,027	104,730
Sand and gravel..... "	239,192	24,171	448,332	49,509
Total.....	.....	1,901,505	.....	2,263,692

Gypsum, coal, iron ore, manganese ore, sandstone abrasives, natural gas, petroleum, oil shales, together with limestone and building ornamental stones of granite and sandstone, form the principal mineral resources of this province, although the occurrence of many other minerals has been noted. Coal and gypsum are the chief mineral products, and there is an important production of cut and polished granite at St. George, from both imported and local stone.

Information respecting mining licenses, mining regulations, royalties, etc., may be had from the Minister of Lands and Mines, Department of Lands and Mines, Fredericton, New Brunswick.

A Quebec asbestos mine, Thetford Mines, Que.

QUEBEC

Area 706,834 square miles. Population 1921, 2,361,199

Mineral Production 1921 and 1922

Product		1921		1922	
		Quantity	Value	Quantity	Value
			$		$
Metallic*—					
Copper	lb.	352,308	44,045	.....	.....
Gold	oz.	635	13,127	.....	.....
Iron ore, sold for export	tons	.....	.....	526	1,410
Lead	lb.	595,881	34,215	.....	.....
Silver	oz.	38,084	23,861	.....	.....
Non-metallic—					
Asbestos and asbestic	tons	92,761	4,906,230	163,706	5,552,723
Chromite	"	2,798	55,696	767	11,503
Feldspar	"	9,737	80,180	12,472	127,826
Graphite	"	38	2,423	24	1,500
Magnesite	"	2,927	74,109	2,849	76,294
Mica	"	484	41,172	1,360	97,748
Mineral water	gal.	19,626	7,278	12,161	3,692
Iron oxides	tons	8,879	92,765	7,282	110,488
Phosphate	"	30	450	131	1,320
Pyrites	"	1,986	10,463	.....	.....
Quartz	"	5,994	29,824	10,994	53,023
Talc	"	.....	.....	150	4,950
Structural Materials—					
Cement	bbl.	2,135,631	5,410,275	2,660,935	5,907,300
Clay products		.....	1,742,872	.....	2,476,370
Kaolin	tons	124	1,888	1,197	17,866
Lime *a*	bush.	2,040,451	790,503	2,108,513	634,157
Slate	tons	.....	22,325	*b*1,899	14,871
Stone	"	719,499	1,662,641	987,355	2,342,316
Other products		*b*700,669	110,752	.....	212,582
Total		.....	15,157,094	.....	17,647,939

*There is also an important production of aluminium from imported ores.
a Quick and hydrated in 1921; quick only, 1922. *b* tons.

This province, whose boundaries include the great north country reaching to the shores of Hudson bay and Hudson strait, is now geographically the largest province in Canada, but as in all of the central and western provinces, the settled or populated section is confined to a comparatively narrow fringe of territory along the southern border, and the greater part of the northern area is scarcely even explored. Of the 706,834 square miles, or over 452,000,000

acres, comprised within the province of Quebec, 90 per cent is underlain by rocks of pre-Cambrian age, and only an insignificant portion of this immense area has been touched by the prospector.

Quite a wide variety of mineral products are obtained as will be noted in the above table. In the southeastern portion of the province, south of the St. Lawrence river, in an area usually referred to as the Eastern Townships, are found alluvial gold, copper pyrites, asbestos, and chromite deposits, bog iron ores, and large marble and granite quarries, and, in Gaspe peninsula, zinc, lead and other minerals.

North of the St. Lawrence are titanium ores north of Montreal and Baie St. Paul, while farther west, north of the Ottawa river, are found magnesite, graphite, kaolin, phosphate, feldspar, mica, barytes, iron ore, molybdenite, and lead and zinc at Notre-Dame-des-Anges, Calumet island, and near lake Timiskaming.

The asbestos deposits of the Eastern Townships, which supply most of the world's requirements of this product, are at present the most important of the province's mineral resources. The pyrites ores are mined chiefly for sulphur, but carry important copper values, with some gold and silver. The alluvial gold deposits have not been productive for some years, but recent discoveries of lode gold in the northwestern part of the province, south of James bay, show that the rich gold fields of Ontario extend across the interprovincial boundary into northern Quebec.

The production of both chromite and phosphate have been limited only by the availability of more cheaply mined products in other countries. It will be noted that quite a wide variety of mineral products are mined, many of which are found widely distributed and constitute important mineral reserves.

Natural gas is not included in the table of production, but is found in the vicinity of Three Rivers. Barytes, also, has been mined. The limestones and igneous rocks of the province furnish an inexhaustible source of supply for cement, building, and ornamental stone, and other materials of construction.

Clays are extensively employed for the manufacture of brick, sewerpipe, etc.

Phosphorus is manufactured in electric furnaces at Buckingham, and occasionally ferro-alloys, such as ferro-phosphorus, and ferro-chrome. Aluminium is manufactured in electric furnaces at Shawinigan Falls, from imported bauxite ores.

Any desired information respecting the mines, mineral resources, and mining laws of the province may be obtained on application to the Superintendent of Mines, Bureau of Mines, Department of Colonization, Mines and Fisheries, Quebec City, Quebec.

An Ontario waterpower harnessed for mining purposes. The general use of hydro-electric power is characteristic of Ontario's mining districts.

ONTARIO

Area 407,262 square miles. Population 1921, 2,933,662
Mineral Production 1921 and 1922

Product		1921		1922	
		Quantity	Value	Quantity	Value
			$		$
Metallics—					
Cobalt, metallic and in oxide	lb.	251,986	755,958	569,960	1,852,370
Copper	"	12,821,385	1,602,930	10,943,636	1,464,477
Gold	oz.	708,213	14,640,062	1,000,340	20,678,862
Iron ore, sold for export	tons	48	242	.....	.....
Iron, pig from Canadian ore	tons	56,564	1,873,682	8,095	178,980
Lead	lb.	3,312,493	190,203	2,890,397	180,216
Nickel	"	19,293,060	6,752,571	17,597,123	6,158,993
Platinum.....Crude	oz.	269	20,184	458	44,709
Palladium	"	591	38,267	724	47,060
Rhodium, ruthium, osmium	oz.	57	9,690	391	31,280
Silver	"	9,761,607	6,116,037	10,811,903	7,300,305
Non-metallics—					
Actinolite	tons	78	975	50	575
Arsenious oxide	"	1,491	233,763	2,058	299,940
Corundum	"	403	55,965	.....	.....
Feldspar	"	20,115	150,457	15,255	120,576
Fluorspar	"	116	1,744	284	3,905
Graphite	"	899	63,439	573	29,853
Gypsum	"	84,790	433,053	110,227	621,668
Mica	"	218	28,891	1,989	54,515
Mineral water.....imp.	gal.	308,647	14,438	209,072	10,528
Natural gas.....M.	cu. ft.	8,422,774	3,080,130	8,060,114	4,076,296
Peat	tons	1,666	6,664	3,000	14,500
Petroleum	bbl.	172,859	559,198	164,732	526,316
Phosphate	tons	.....	.....	59	476
Pyrites	"	27,785	101,306	11,233	39,763
Quartz	"	72,068	220,806	81,528	118,054
Salt	"	161,987	1,649,626	176,741	1,573,657
Talc	"	9,967	140,390	12,854	178,728
Structural Materials—					
Cement	bbl.	2,723,071	6,424,356	3,104,386	3,393,566
Clay products		.....	5,183,125	.....	6,944,218
Lime (*a*)	bush.	3,530,547	1,344,188	3,939,954	1,311,563
Stone	tons	2,716,080	4,167,582	2,317,265	2,969,926
Other products	"	6,273,173	1,496,729	.....	2,640,154
Total		.....	57,356,651	.....	65,866,029

a Quick lime only, in 1922; both quick and hydrated in 1921.

As shown in the tabular statement given above, Ontario now produces the largest output as well as the greatest variety of mineral products of any of the Canadian

provinces, being credited with nearly 36 per cent of the total Canadian mineral production in 1922. Comprised within its 407,262 square miles are many millions of acres in which the geological formations are favourable for the occurrence of minerals, 70 per cent of its area being underlain by rocks of pre-Cambrian age. The phenominally rich silver mines of Cobalt occur in these rocks, so also do the far famed nickel-copper deposits of Sudbury, the gold of Porcupine and Kirkland Lake, and the iron ore of Magpie and Moose Mountain mines.

The principal metalliferous ores are the nickel-copper deposits of the Sudbury district, the silver-cobalt-nickel arsenides of Cobalt and surrounding areas, and the gold fields of Porcupine.

The nickel deposits of the Sudbury district are the most important of the known sources of nickel and supply a very large portion of the world's requirements of that metal. They furnish in addition, as by-products, very considerable amounts of copper and small, but, in the aggregate, important amounts of platinum, palladium, gold, and silver. The proved ore reserves are known to be very large. The Cobalt district, in which the occurrence of silver first became known in 1903, has since that date produced over 325,000,000 ounces of silver, and dividends and bonuses paid by silver mining companies to the end of 1922 amounted to $86,238,185. Important by-products obtained include arsenic, cobalt, and nickel, white arsenic, cobalt oxide, nickel and nickel oxide being recovered in refining plants at Thorold, Deloro and other points. The Porcupine gold camp, with its large proved ore reserves and its possibilities of a rapidly increasing output, is now producing at the rate of over $25,000,000 annually, and Ontario gold mining companies have paid in dividends and bonuses to the end of 1922, $28,096,699.

In addition to the above, practically all the economic minerals (coal and tin excepted) are found in Ontario:—actinolite, apatite, arsenic, asbestos, cobalt, corundum, feldspar, fluorspar, graphite, gypsum, iron pyrites, lead, mica, molybdenite, natural gas, palladium, petroleum, platinum, quartz, salt, talc, and zinc. This province has the largest deposits on the continent of talc, feldspar, mica, and graphite.

Building materials, such as ornamental marble, limestone, sandstone, granite, trap, sand and gravel, lime, Portland cement, brick and tile, meet every demand.

The following figures show the rapid growth of Ontario's mineral industry by five year periods since 1891:*

Year	Value	Year	Value
1891	$ 4,705,673	1906	$ 22,388,383
1896	5,235,003	1911	41,976,797
1901	11,831,086	1916	65,303,822
		1921	48,128,387

Iron blast furnaces have been built at Hamilton, Deseronto, Port Colborne, Midland, Parry Sound, Sault Ste. Marie, Port Arthur, and Ojibway, while metallurgical works for the reduction of nickel, copper, silver, and lead ores are found at Copper Cliff, Coniston, Thorold, Deloro, and Galetta.

A miner's license, which costs $5 per annum, entitles the holder to stake out in any or every mining division three claims of 40 acres each. After performing 200 days' assessment work on a claim, patent may be obtained from the Crown on payment of $2.50 or $3 per acre, depending on location in unsurveyed or surveyed territory.

The Provincial Assay Office at No. 5 Queen's Park, Toronto, is maintained by the Ontario Department of Mines for the free identification of minerals, free assays under the provisions of the Mining Act of Ontario, and also for general assay work as per the schedule of charges which may be obtained on application.

The Department also maintains, at Cobalt, an ore sampling and testing laboratory which is now prepared to receive parcels of gold ore from 100 pounds upward, and after sampling and assaying the same to pay to the shipper the value thereof, less treatment charges. The purpose is to afford a market for ores extracted by prospectors and others in developing their mining claims, thus enabling them to obtain funds which they can use for further work, and to report on the most satisfactory method of treatment.

Information respecting miners' licenses, mining laws, annual reports of the Bureau of Mines, etc., may be had on application to the Deputy Minister of Mines, Department of Mines, Toronto, Ontario.

*Ontario Bureau of Mines figures.

A Manitoba gypsum quarry, Gypsumville, Man.

MANITOBA

Area 251,832 square miles. Population 1921, 610,118

Mineral Production 1921 and 1922

Product	1921		1922	
	Quantity	Value	Quantity	Value
		$		$
Metallic—				
Gold..... oz.	207	4,279	156	3,225
Silver..... "	33	20	20	14
Non-metallic—				
Gypsum, calcined..... tons	40,859	480,282	34,072	440,914
Natural gas.....M. cu. ft.	200	60	200	60
Structural Materials—				
Clay products.....	.....	208,982	.....	210,740
Lime..... bush.	413,283	136,375	382,184	163,799
Stone..... tons	16,868	56,666	34,359	106,638
Other products.....	.....	1,047,453	.....	1,333,552
Total.....	.....	1,934,117	.....	2,258,942

Approximately two-fifths of the total area of Manitoba, in the southern and southwestern sections of the province, is agricultural and is the main source of the non-metallic minerals. The remaining three-fifths is underlain by pre-Cambrian rocks, and in it copper, gold, and other metallic products have been mined. The mining districts are new and there are exceptional opportunities for the prospector and the mining company.

Gold is found widely distributed in the Rice Lake field, at Star lake, and at Knee lake, and in the Pas mineral belt the Rex mine at Herb lake has reached the producing stage. Copper has been mined in the Pas mineral belt, where the Mandy mine produced over $2,000,000, and the Flin Flon is one of the largest bodies of low grade copper ore yet found in Canada. In the Maskwa River district copper is found with nickel in associations suggestive of the Sudbury nickel deposits, in Ontario. Lead and zinc are associated with the copper in the deposits at the Pas, as is silver also. Argentiferous galena occurs in the Herb Lake district, and tungsten and molybdenum have been found in the Falcon Lake district, near the Ontario boundary.

A mottled limestone of a very handsome variety, quarried at Tyndall, is in wide demand as a building stone; gypsum is mined at Gypsumville; Portland cement is manufactured from limestone outcroppings at lake Manitoba and natural cement at Babcock; brick and clay products are obtained from widely distributed surface clays and shales; oil shales that may yet prove to be of commercial value occur throughout the Manitoba escarpment; lignite is found at Turtle mountain; and sand for glass and foundry purposes is available at Black island, in lake Winnipeg.

The Crown lands, including mining rights in the provinces of Manitoba, Saskatchewan, Alberta, and in the Yukon and Northwest Territories are owned and controlled by the Dominion Government, and reference to the laws in force regarding the disposal of mining lands will be found under Northwest Territories.

For map, publications, and information generally, application may be made to the Commissioner of Northern Manitoba, the Pas, Manitoba.

White fireclay beds in Saskatchewan, Twelve Mile lake.

SASKATCHEWAN

Area 251,700 square miles. Population 1921, 757,510

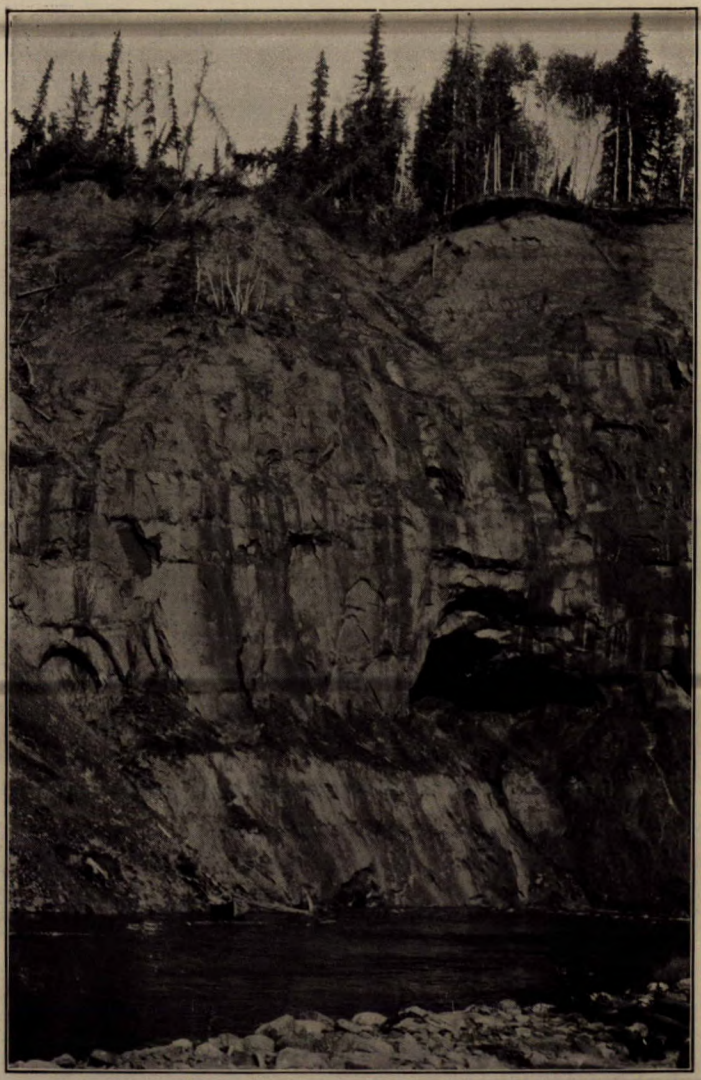
Mineral Production 1921 and 1922

Product		1921		1922	
		Quantity	Value	Quantity	Value
			$		$
Non-metallic—					
Coal	tons	335,632	823,180	382,437	802,053
Magnesium sulphate	"	2	120	.....	.....
Salt	"	33	790	.....	.....
Sodium sulphate	"	624	18,850	504	11,980
Structural Materials—					
Clay products		.....	166,244	.....	134,704
Other products		.....	105,036	.....	306,733
Total		.....	1,114,220	.....	1,255,470

The province of Saskatchewan, embracing an enormous area of level prairie land, is popularly known as a " prairie province " and essentially agricultural. There is, nevertheless, an appreciable, and growing output of non-metallic minerals from the southern part of the province, and very large areas of unprospected territory in the north are underlain by the same pre-Cambrian rocks that have proved mineral bearing in other parts of Canada.

Lignites are mined in the southern part of the province, at Estevan, Roche Percee, Pinto, Bienfait, and the Dirt Hills district; brick clays are widely utilized, and, to the south of Moosejaw, there are extensive beds of refractory clays that are used in the manufacture of firebrick, stoneware, pottery, sewerpipe, etc., and that are also suitable for use as ball clays; soluble natural salts of the alkalis are obtained from the numerous alkali lakes and sloughs of the province; and natural gas has been found, though not yet in commercial quantities. In the northern part of the province lode gold has been reported in the pre-Cambrian rocks near Beaver lake, and iron and other metallic minerals near lake Athabaska.

While the disposal of coal lands, and mining rights generally, is made by the Dominion Government (see under Northwest Territories), mining operations are carried on under the regulations and inspection of the Provincial Government of Saskatchewan.



Alberta's bituminous sands. A bed 85 feet thick on the Steepbank river.

ALBERTA

Area 255,285 square miles. Population 1921, 588,454
Mineral Production 1921 and 1922

Product	1921		1922	
	Quantity	Value	Quantity	Value
		$		$
Metallic—				
Gold, alluvial..... oz.	49	1,013	.....	.....
Non-metallic—				
Coal..... tons	5,909,217	27,246,514	5,990,911	24,351,913
Natural gas.....M. cu. ft.	4,945,884	1,374,599	5,867,459	1,622,105
Petroleum..... bbl.	7,203	49,313	5,608	52,128
Structural Materials—				
Clay products.....	.....	710,477	.....	700,063
Lime..... bush.	107,083	48,332	130,627	71,328
Stone.....tons	2,962	13,750	554	7,300
Other products.....	.....	1,118,231	.....	1,067,299
Total.....	.....	30,562,229	.....	27,872,136

The mineral resources of this province that are being actively exploited are: coal, natural gas, petroleum, alluvial gold, and clay and quarry products. The coal fields of Alberta include lignite, bituminous, semi-bituminous, and anthracite, and are the most extensive and valuable in Canada. The output of the coal mines is now the largest of any province in the Dominion. Natural gas is found over wide areas and is being put to extensive industrial use. Petroleum is produced commercially in one locality, and showings of oil have been obtained in a number of bore holes in different parts of the province. In the north there are large areas of bituminous sands, valuable beds of salt and gypsum, and refractory clays, none of which have yet been exploited.

As in the other prairie provinces, the disposal of mining lands or leases is made by the Dominion Government at Ottawa (see under Northwest Territories), while mining is carried on under the laws and regulations of the Provincial Government of Alberta.

Enquiries regarding the mining laws, etc., may be addressed to the Chief Inspector of Mines, Edmonton, Alberta.

A British Columbia metallurgical plant. The Consolidated Mining and Smelting Company's plant at Tadanac, B.C.

BRITISH COLUMBIA

Area 355,855 square miles. Population 1921, 524,582

Mineral Production 1921 and 1922

Product		1921		1922	
		Quantity	Value	Quantity	Value
			$		$
Metallic—					
Copper (a)	lb.	34,447,127	4,306,580	31,936,182	4,273,700
Gold	oz.	150,792	3,117,147	207,370	4,286,718
Iron ore sold for export	tons	1,010	3,030	1,255	3,528
Lead	lb.	60,298,603	3,462,346	87,093,266	5,430,265
Platinum	oz.	23	1,726	12	1,154
Silver	"	3,350,357	2,099,133	7,105,937	4,828,384
Zinc	lb.	53,089,356	2,471,310	56,290,000	3,217,536
Non-metallic—					
Arsenic	tons	.....	.....	518	21,097
Coal	"	2,890,291	15,676,774	2,927,033	14,622,317
Fluorspar	"	5,403	134,523	4,219	98,233
Gypsum	"	40	100	100	500
Manganese	"	.....	.....	.....	.....
Magnesium sulphate	"	2,027	39,386	1,021	24,017
Magnesite	"	803	7,211	.....	.....
Mineral water		.....	.....	.....	.....
Natro-alunite		30	1,500	50	2,500
Oxides (iron)		169	845	3	120
Pyrites	tons	3,597	4,557	6,908	34,540
Quartz	"	22,288	62,317	17,425	37,521
Sodium carbonate	"	197	14,775	202	3,027
Talc	"	167	4,175	191	4,780
Structural Materials—					
Clay products		.....	415,869	.....	447,452
Lime (b)	bush.	199,341	252,630	433,716	254,320
Stone	tons	142,041	229,165	197,670	324,591
Other products		.....	925,361	.....	1,507,662
Total		.....	33,230,460	.....	39,423,962

(a) Smelter recoveries of copper. (b) Quick lime only, in 1922; both quick and hydrated lime in 1921.

For many years British Columbia was the premier mining province of Canada, and was only displaced in so far as magnitude of output is concerned in 1907, when Ontario forged ahead. In a certain sense, this province is still the premier, since mining is probably its most important industry. Physiographically the province embraces a series of mountain ranges beginning at the Rocky mountains, which forms the eastern border, and extending to the Pacific coast. Its principal features have already been described in the introductory chapter. Much of this vast mountainous area

is still virtually unprospected. Exclusive of placer gold, practically the entire mineral production is obtained from that portion of the province near its southern boundary or along the coast, that is to say, within those areas that are provided with transportation facilities.

Coal, metalliferous ores, including gold, silver, copper, lead and zinc, together with clay and quarry products, constitute the bulk of the mineral output. Antimony, platinum, molybdenum, mercury and numerous other useful minerals are also found. To the end of December, 1922, British Columbia had produced minerals as follows:* placer gold, $76,542,203; lode gold, $109,647,661; silver, $59,814,-266; lead, $51,810,891; copper, $170,723,242; zinc, $24,625,-853; miscellaneous minerals, $1,358,839; coal and coke, $238,289,565; building stone, brick, cement, etc., $36,605,-942, making the aggregate value of its recorded mineral production to that date, $769,418,462.

Among the chief centres of activity are included the coal mines of the Crowsnest Pass and East Kootenay and those on Vancouver island. Silver-lead and zinc ores have been extensively mined at Marysville, Moyie, Ainsworth, Slocan, Sandon, Silverton, Kimberley, and other points in East and West Kootenay, while to the south, at Nelson and Rossland, gold and copper are the principal values in the ores mined. Sheep Creek is an important gold camp, in which the ores are mainly free milling. Farther west, in the area known as Boundary district, low grade copper ores, carrying gold and silver values, have been found in very large deposits. On the coast, copper ores are mined at Britannia bay, and at Granby bay, or Anyox. Vancouver island possesses the oldest and most important coal mines, as well as important metalliferous deposits. Recently, remarkably rich gold and silver ores are being mined near Stewart, on the Portland canal, in the northwestern coast district.

Important smelting industries have been established at Trail, in the southern interior, the fuel for which is provided by the coal mines of the Crowsnest Pass, and a large copper smelting plant, drawing fuel from its own coal mine on Vancouver island, is in operation at Anyox, or Granby bay.

---

*British Columbia Bureau figures.

Mineral locations are granted to discoverers, for nominal fees, and absolute titles are obtained by developing the properties, the security of which is guaranteed by Crown grants. Full information, together with reports, maps, etc., may be obtained by addressing the Hon. the Minister of Mines, Victoria, British Columbia.

Gold dredge operating in Yukon.

YUKON TERRITORY

Area 207,076 square miles. Population 1921, 4,157

Mineral Production 1921 and 1922

Product		1921		1922	
		Quantity	Value	Quantity	Value
			$		$
Metallic—					
Gold	oz.	65,994	1,364,217	54,456	1,125,705
Silver	"	393,092	246,288	663,493	447,997
Lead	lb.	2,472,615	141,978	3,323,508	207,221
Non-metallic—					
Coal	tons	233	2,472	465	4,650
Total		.....	1,754,955	.....	1,785,573

This district, which geographically is a continuation of the great Rocky Mountain belt, extending northwesterly from the 60th degree of latitude, the northern boundary of British Columbia, to the 141st meridian, the Alaskan boundary, has already become famous on account of the Klondike gold fields, situated in the vicinity of Dawson, on the Yukon river. Placer gold is still the principal mineral product, although there was formerly an output of copper, and that of silver-lead ores and coal is increasing. The district also possesses important coal fields. Gold ores and ores of copper, silver, lead, and antimony are found widely distributed, and the region undoubtedly possesses enormous mining possibilities.

The Crown lands and mining rights are controlled by the Dominion Government at Ottawa and disposed of or leased according to the regulations in force and referred to under Northwest Territories.

NORTHWEST TERRITORIES

Area 1,242,224 square miles. Population 1921, 7,988

The Northwest Territories, as at present constituted, include all that northern portion of Canada above the 60th parallel of latitude and extending from Hudson bay on the east to the Yukon district on the west, and including all of the northern Arctic islands that belong to Canada. It is practically unpopulated, except for a few Indians and fur traders.

Little is known of the country beyond what has been learned from explorations of some of the principal rivers. In respect to its mineral resources, the occurrence of coal and petroleum in the Mackenzie basin and of native copper in the Coppermine River district has long been known. Alluvial gold is found on many of the streams, and the occurrence of iron ores, mica, graphite, salt, and gypsum have been noted. The northern part of North America, and the great Arctic archipelago to the north of the continent, contain large areas of the older rocks in which deposits of metalliferous and other minerals will no doubt eventually be developed, but in regard to which little is yet known.

The ownership of Crown lands and mining rights in the Northwest Territories and the Yukon Territory, and in the provinces of Manitoba, Saskatchewan, and Alberta, are still retained under the control of the Dominion Government at Ottawa, and full information regarding the Dominion mining laws and regulations under which these are administered may be obtained from the Director, Northwest Territories and Yukon Branch, or from the Superintendent, Mining Lands Branch, Department of the Interior, Ottawa, Canada, or locally from any Dominion Lands Agent.

EXPLANATORY REMARKS AND GENERAL INFORMATION

In order that the present handbook outlining Canada's mineral resources and mining industries should not become too large and cumbersome for a convenient pocket reference, it has been necessary to omit all but a few of the most salient facts concerning them, and the information conveyed is, therefore, fragmentary and very incomplete. For further enlightenment regarding the location, character, and extent of the mineral resources of the Dominion recourse should be had to the vast fund of information contained in the records, reports, and maps of the Dominion Department of Mines, and of the various Provincial Departments or Bureaus of Mines, all of which is available to those interested. In this connection the following may be consulted:—

Canada, Department of Mines:

The Deputy Minister of Mines, Department of Mines, Ottawa, Canada.

The Director, Mines Branch, Department of Mines, Ottawa, Canada.

The Director, Geological Survey, Department of Mines, Ottawa, Canada.

Nova Scotia:

The Deputy Minister of Public Works and Mines, Halifax, N.S.

New Brunswick:

The Deputy Minister of Lands and Mines, Department of Crown Lands, Fredericton, N.B.

Quebec:

The Superintendent of Mines, Department of Colonization, Mines and Fisheries, Quebec, Que.

Ontario:

The Deputy Minister of Mines, Department of Mines, Toronto, Ontario.

Manitoba:

The Commissioner of Northern Manitoba, The Pas, Manitoba.

67478—10

Saskatchewan:
The Commissioner of Labour and Industries, Bureau of Labour and Industries, Regina, Sask.

Alberta:
The Chief Inspector of Mines, Edmonton, Alberta.

British Columbia:
The Provincial Mineralogist, Department of Mines, Victoria, B.C.

The functions of the Dominion Department of Mines are broadly scientific and are primarily concerned with geological and mineralogical studies, and with investigations of mineral resources and their technology. Dominion wide explorations and investigations are conducted and elaborate reports furnished to the public as to the natural resources of the Dominion in respect to mineral, forest, fuel, water supply, etc.

Test and research investigations are carried on in experimental stations and laboratories equipped for the purpose. These include an ore testing station, a fuel testing station, a ceramic laboratory, a road materials testing laboratory, equipment for the testing of sands and structural materials, and a general Departmental chemical laboratory, all at Ottawa. The Department also maintains at Vancouver, B.C., the Dominion of Canada assay office for the purchase of gold. At Ottawa, in addition to an Economic Mineral Museum the Department has under its jurisdiction the Victoria Memorial Museum containing exhibits in geology, mineralogy, and natural history of both utilitarian and cultural values.

Applications for reports and particulars relative to technological investigations and mineral resources should be made to the Director of the Mines Branch, Department of Mines, Ottawa, and for information on subjects relating to general and economic geology, to the Director of the Geological Survey, Department of Mines, Ottawa.

The control of mining lands, the granting of mineral rights, and the administration of mining laws come under the jurisdiction of the individual provinces, except in the newer provinces of Manitoba, Saskatchewan, and Alberta, and in the Yukon and Northwest Territories, where the mineral rights are still vested in the Federal government

and are administrated under the direction of the Mining Lands Branch of the Department of the Interior at Ottawa.

Besides administrative officials, a number of the provinces also maintain highly trained scientific and technical officers on their staffs and publish exceedingly valuable reports.

Mineral Statistics.—The figures for production used throughout this handbook were, except where otherwise stated, obtained from the Dominion Bureau of Statistics, and at the time of writing were the latest available. Some of the figures for 1922, however, are still subject to final revision and, while it is not thought that this will result in any changes that would affect their value for the illustrative purpose they have been used for here, the fact that they are not necessarily final should be kept in mind, and, where final figures are desired, later authoritative publications of the Bureau of Statistics should be consulted.

At one or two places that have been marked by foot notes, Provincial instead of Dominion figures have been used, and there may be some apparent discrepancies between production as reported by the Dominion and by the several Provincial Governments. This is to be accounted for by the different points of view that have been held as to methods of procedure, with the result that questionnaires from the several offices have called for different information, and even when the same data have been asked for, different methods of compilation have been used in order to present to the reader the particular points of view held by the different offices.

In this handbook the term "production" means, generally speaking, the quantity sold or shipped. Products mined or manufactured but not sold or shipped at the end of the year are not included in the "production" for that year. The values of the metallic minerals, whether refined in Canada or not, is calculated on the basis of the average price of the metal in some recognized market, the value of non-metallic products is that at the mine or place of shipment.

The ton used throughout is the short ton of 2,000 pounds.

INDEX

A

PAGE

Actinolite.. .. .. 57, 114
Aluminium.. .. .. 17, 111
Alunite.. 53
Antimony.. .. ..18, 104, 126, 129
Apatite.. .. ..80, 88, 114
Argentiferous galena ore.. .. .. 33, 34
Argentite.. 46
Arsenic.. .. ..18, 46, 104, 114
Asbestos.. .. ..57, 110, 114

B

Barytes.. .. ..59, 72, 104, 110
Bauxite.. 17
Bentonite 60
Bituminous sand.. .. .. 61, 123
Bog manganese.. 35
Bog ore.. .. .. 78, 110
Bornite.. 20

C

Calcite.. 80
Cassiterite.. 49
Celestite.. 63
Cement-making materials.. .. ..99, 104, 126
Chalcopyrite.. .. ..20, 21, 23, 39
China clay.. .. ..78, 94, 96
Chromite.. .. .. 64, 110
Chromium.. 20
Cinnabar.. .. .. 36, 37
Clays.. .. ..94, 104, 105, 110, 118, 121, 123, 126
Clays, ferruginous.. 78
Coal.. .. ..64, 103, 107, 123, 126, 129, 130
Cobalt.. .. ..19, 46, 114
Cobaltite.. 19
Copper.. .. ..20, 38, 48, 90, 104, 110, 114, 117, 126, 129, 130
Corundum.. .. .. 53, 114

D

Diamonds.. 64
Diatomaceous earth.. 55
Dyscrasite.. 46

E

Emery.. 54
Epsomite.. 84
Erythrite.. 19

F

PAGE
Feldspar..17, 69, 110, 114
Fireclay.. 96
Fluorite.. 72
Fluorspar.. 72, 114
Fossil flour.. 55

G

Galena..34, 48, 51, 52, 117
Garnet.. 53, 55
Glauber's salt.. 84
Gold..21, 24, 33, 34, 38, 43, 44, 90, 103, 110, 114, 117, 121, 123, 126, 129, 130
Granite..101, 104, 107, 110, 115
Graphite..73, 110, 114, 130
Gypsum..75, 92, 103, 107, 114, 118, 123, 130

H

Hematite..21, 30, 31, 32
Hornblende.. 57

I

Ilmenite.. 49, 50
Infusorial earth.. 55, 104
Iridium..38, 43, 44
Iron..29, 103, 107, 110, 114, 121, 130
" carbonate.. 30
" oxides.. 78
" pyrites.. 114

K

Kaolin.. 78, 94, 96, 110
Kieselguhr.. 55

L

Lead..35, 52, 104, 110, 114, 117, 126, 129
Lead-zinc ore.. 34, 52
Lepidolite (lithia mica).. 82
Lignite.. 118, 121
Limestone..100, 104, 107, 110, 115, 118
Limonite.. 31

M

Magnesite.. 79, 110
Magnesium sulphate.. 84
Magnetic iron sands.. 29
Magnetite..29, 31, 35
Manganese..35, 36, 104, 107
Manganite.. 35
Marble..100, 104, 110, 115
Mercury..36, 37, 46, 126
Mica..80, 110, 114, 130

PAGE

Mineral waters.................. 82
Mispickel..................18, 19, 51
Molybdenite..................37, 110, 114
Molybdenum..................37, 117, 126
Muscovite (white mica).................. 80

N

Natural gas..................82, 107, 114, 121, 123
Niccolite.................. 46
Nickel..................22, 38, 39, 46, 114, 117

O

Ochres.................. 78
Oil shale..................85, 107, 118
Osmium..................38, 43, 44

P

Palladium.................. 38, 43, 44, 114
Peat.................. 86
Pentlandite.................. 38
Petroleum..................87, 107, 114, 123, 130
Phlogopite (amber mica).................. 80
Phosphate.................. 88, 110
Phosphorus.................. 111
Platinum..................38, 43, 44, 114, 126
Plumbago.................. 73
Psilomelane.................. 35
Puzzolan.................. 99
Pyrargyrite.................. 46
Pyrite.................. 21, 23
Pyrites.................. 89, 110
Pyrolusite.................. 35
Pyroxene.................. 80
Pyrrhotite..................21, 38, 39, 40

Q

Quartz.................. 114
Quartz sand.................. 56

R

Rhodium..................38, 43, 44
Rhodonite.................. 35
Ruthenium..................38, 43, 44
Rutile.................. 49, 50

S

Salt..................91, 104, 114, 123, 130
Salt cake.................. 84
Salts of alkali.................. 121
Sand.................. 118
Sandstones.................. 53, 54, 104, 105, 107, 115
Scheelite.................. 51

PAGE

Shales.. 118
Silver.. .. ..21, 26, 33, 34, 38, 44, 46, 47, 48, 90, 110, 114, 117, 126, 129
Silver-lead.. .. .. 33, 34
Slates.. 100
Smaltite.. .. .. 19, 46
Soapstone.. .. .. 57, 92
Sodium carbonate.. 84
Sodium sulphate.. 84
Spelter.. 53
Sperrylite.. .. .. 43, 49
Sphalerite.. .. .. 51, 52
Steatite.. 93
Stellite.. 20
Stibnite.. .. .. 18, 36
Stone.. 100
Strontium.. 63

T

Talc.. .. ..57, 92, 114
Tar sand.. 61
Tin.. .. .. 49, 104
Titaniferous magnetite.. .. .. 49, 50
Titanium.. .. ..49, 50, 110
Trap.. 115
Tremolite.. 57
Tripolite.. .. ..53, 55, 104
Tungsten.. .. ..20, 49, 51, 104, 117
Tungstite.. 51

V

Volcanic ash.. .. .. 53, 56

W

Wad.. .. .. 35, 78
Wolframite.. .. .. 49, 51

Z

Zinc.. .. ..51, 52, 53, 110, 114, 117, 126
" blende.. .. ..21, 23, 34, 48, 51, 52
" lead ore.. .. .. 33, 48

Canada
Department of Mines

HON. CHARLES STEWART, MINISTER; CHARLES CAMSELL, DEPUTY MINISTER

MINES BRANCH

JOHN McLEISH, Director

1924

LEGEND

- Antimony
- Arsenic
- Asbestos
- Barite
- Bentonite
- Bituminous Sand Area
- Cement
- Chromium
- Coal District
- Coal
- Copper
- Cobalt
- Corundum
- Feldspar
- Garnet
- Gold District
- Gold (Quartz)
- Gold (Placer)
- Graphite
- Grindstones
- Gypsum
- Iron
- Kaolin
- Kieselguhr
- Lead
- Lignite
- Manganese
- Magn Sulphate
- Magnesite
- Marble
- Mercury
- Mica & Phosphate
- Molybdenum
- Natural Gas
- Nickel
- Ochre
- Oil-Shales
- Petroleum (Producing wells)
- Petroleum
- Peat
- Platinum
- Pyrite
- Salt District
- Salt
- Silver District
- Silver
- Silver-Lead District
- Silver-Lead
- Slate
- Sodium Carbonate
- Sodium Sulphate
- Talc & Soapstone
- Tin
- Tungsten
- Volcanic Ash
- Zinc

Base map from plate of the Department of the Interior

MINERAL MAP
OF THE
DOMINION OF CANADA

Natural Scale $\frac{1}{6336000}$

Scale 100 miles to one inch

BRITISH EMPIRE EXHIBITION EDITION 1924

613