CANADA
DEPARTMENT OF MINES
HON. W. A. GORDON, MINISTER; CHARLES CAMSELL, DEPUTY MINISTER

MINES BRANCH
JOHN MCLEISH, DIRECTOR

The Mineral Industries of Canada

1933

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A. H. A. Robinson
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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 possibilities for the development of mineral wealth, compared with which the present production, important though it may be, is but a small beginning.

This is the fourth edition of this report, which was first issued under the title "Economic Minerals and Mining Industries of Canada" in 1913 (Mines Branch Report No. 230). A revised second edition (Report No. 322) was distributed at the Panama Pacific Exposition at San Francisco in 1914; the third edition was distributed at the British Empire Exhibition at Wembley, England, in 1924.

The present handbook has been prepared under the supervision of Dr. A. W. G. Wilson, Chief of the Division of Mineral Resources, most of the compilation having been done by Mr. A. H. A. Robinson, assisted by other members of the Mines Branch staff who have specialized in particular subjects. These include: Messrs. H. S. Spence, L. H. Cole, S. C. Ells, M. F. Goudge, V. L. Eardley-Wilmot, A. Buisson, and J. M. Casey, of the Mineral Resources Division; H. A. Leverin, Chemical Division; R. E. Gilmore, Fuels and Fuel Testing Division; and H. Frechette, Ceramic Division.

The data, both technical and statistical, have all been compiled from official sources, either Federal or Provincial; a number of the illustrations used were furnished by Canadian mining or metallurgical companies, to whom a general acknowledgment is here made of the many courtesies extended to members of our staff over a long term of years. An index map showing the principal mining localities in Canada is included.

The Mines Branch has issued an important series of monographs and other reports dealing with individual products, to which some reference will be found in the text. More detailed information about any particular mineral, ore, product, district, or industry may be obtained from the proper official department of the various Provincial Governments, as indicated in this report, or from the Dominion Department of Mines at Ottawa, Canada.

JOHN MCLEISH,
Director.

Mines Branch,
Department of Mines,
Ottawa, Canada,
December, 1933.

The Mineral Industries of Canada

INTRODUCTORY

The history of the mineral industry in Canada extends back to the establishment of the first permanent settlements in the country, but for very many years practically the sole incentive to search for useful minerals was the necessity of supplying as far as possible from local sources the simple requirements of the isolated communities and its growth was slow. Later, as the country became more populous the search for minerals became more general and discoveries of importance were made with increasing frequency in many widely separated localities, but until the beginning of the present century interest in mining was largely local or transitory; there was no general realization of the tremendous possibilities of the country's mineral resources and the importance of the part they were to play in its development. It is only within the last 30 or 35 years that mining has come to be recognized as one of the greatest and most stable of the basic industries of the Dominion.

The first mining in Canada of which we have any record is the digging of coal from seams outcropping on the Atlantic coast. In 1677 a royalty was being levied by Monsieur Duchesneau, the Intendant of New France, on all coal taken from Cape Breton; and pits from which coal was dug in 1720 to supply the workmen engaged in building the fortress of Louisburg may still be seen. By 1737, the making of charcoal iron from bog ores was established at Three Rivers, in Quebec—an industry that remained in practically continuous operation in that vicinity for the next 145 years. Though insignificant as compared with modern iron-works, those at Three Rivers were, in their time, of more than mere local importance. For some years they were operated in the King's name and it is very probable that cannon-balls cast in the valley of the St. Maurice were used in the defence of Quebec in 1759. In addition to coal and iron, the occurrence of metals such as silver, lead, and copper was also noted by early French explorers, but to these adventurous spirits the arduous labour and uncertain outcome of seeking mineral wealth had little attraction as compared with the promise of large profits and quick returns offered by the fur trade.

Following the ceding of Canada to the British in 1763, the history of the mineral industry continued, for many years, to be uneventful. The Nova Scotia coalfields were gradually opened up as settlement expanded; charcoal iron continued to be made at Three Rivers, in Quebec; and during the first half of the nineteenth century, a number of small iron furnaces built in different parts of eastern Canada to supply the local inhabitants with such articles as stoves, pots, and potash kettles ran short and checkered careers. In addition, an unsuccessful attempt was made to mine copper at Point Mamainse, on Lake Superior, in 1770; a discovery of alluvial gold, which attracted little attention at the time, is reported to have been

made in the valley of the Chaudière River, in Quebec, in 1823 or 1824; and coal was found at Fort Rupert, in what is now the Province of British Columbia, in 1835. It was not until the middle of the nineteenth century, however, that any marked activity in the search for minerals became evident in Canada.

The discovery of gold placers in California in 1848 and in Australia in 1851, sent men seeking easily won wealth in all the newer parts of the world. As a result rich deposits of alluvial gold were found in the Fraser River, in British Columbia, about 1857, and gold-bearing lodes in Nova Scotia about 1860. The mining industry in Canada thus received an impetus that it never afterwards entirely lost, though interest in it waxed and waned and it was nearly another 50 years before it became firmly established as one of the most important industries in the Dominion. The Chaudière placers, in Quebec, were actively worked and are said to have yielded some $2,000,000 in gold between 1860 and 1876. Copper was mined with more or less success at Bruce Mines, on the north shore of Lake Superior, for several years following 1853; and the Acton copper mine in the Eastern Townships of Quebec is said to have made large profits for its holders during the American Civil War. From Silver Islet, a mere speck in the vast expanse of Lake Superior, over $3,000,000 worth of silver was taken between 1870 and 1884; and in 1878, commercial production started in Quebec's now famous asbestos fields, discovered some fifteen years before.

The building of the Canadian Pacific railway across the continent brought with it a crop of new discoveries. The nickel-copper deposits of Sudbury, Ontario, were first uncovered in 1883; and the mining of rich silver-lead ores in the Slocan district of British Columbia began in 1887. Silver-lead mining in Slocan was quickly followed by that of copper-gold ores at Rossland and in its vicinity, where a smelter at Trail, later to develop into the present mammoth metallurgical plant of the Consolidated Mining and Smelting Company of Canada, first went into operation, in 1896. The famous Klondike gold-rush, to Yukon, took place in 1897-98.

The latest, and most remarkable, series of discoveries in the history of Canadian mining—the discoveries that were to establish the industry as one of the most important in the economic life of Canada, and Canada as one of the greatest mineral-producing countries of the world—began with the finding of silver at Cobalt during the construction of the Temiskaming and Northern Ontario railway in 1903. Prospectors trained in the Cobalt camp later spread out and discovered gold at Porcupine in 1909, at Kirkland Lake in 1912, and at Red Lake, in Ontario, in 1925; large bodies of copper-zinc-gold in Manitoba—at Flin Flon in 1915 and at Sherridon in 1923; copper and gold deposits at Rouyn in Quebec in 1924; and, lastly, in addition to a number of less important finds, rich ores of silver and radium at Great Bear Lake, in the far northwest of the Dominion, in 1930. Meanwhile, important developments had also been taking place in British Columbia. Here, the Britannia copper mine came into production about 1905; that at Anyox in 1914; and Copper Mountain in 1925. The famous Premier gold-silver mine was also discovered and developed during this period; and the still more famous Sullivan mine was transformed by the skill of Canadian metallurgists from a lead mine of no great prominence to the world's largest producer of lead and zinc.

Another important development in connexion with the mineral industry that has come about within the present century, is the establishment in Canada of plants for the refining of Canadian metals—a development largely due to abundant and widespread sources of hydro-electric energy. At one time all Canadian metals were shipped abroad for the final treatment necessary to fit them for the use of the manufacturer, but now Canadian gold, silver, copper, lead, zinc, and nickel, as well as minor metals, are practically all marketed in highly refined form and go forth to the metal-consuming countries of the world, bearing brands clearly identifying them with their place of origin, and thus adding to Canada's prestige abroad as a mining country.

MINERAL PRODUCTION OF CANADA

Definite figures illustrative of the present importance of the primary mineral industries to Canada are given in the following table, which, however, takes no account of the many indirect benefits conferred by the purchase of supplies, furnishing of traffic to the railways, etc.

General Statistics on the Mineral Producing Industries in Canada, 1932[1]

—	No. of mines, quarries, smelters, gas wells, etc.	Capital employed	No. of employees	Salaries and wages	Income from sales
INDUSTRIES		$		$	$
Metal Mining—					
Alluvial gold	120	7,306,130	373	665,711	1,211,018
Auriferous quartz	100	58,167,335	10,442	17,686,584	58,645,772
Copper-gold-silver	30	14,793,372	3,076	3,770,627	11,143,759
Silver-cobalt	20	3,005,872	369	551,255	1,735,708
Silver-lead-zinc	36	11,921,067	1,084	1,719,186	5,156,365
Nickel-copper	6	23,137,628	1,210	1,776,190	3,174,208
Miscellaneous	5	1,140,200	34	35,181	1,113
Smelting and refining	13	149,708,860	5,343	8,778,970	*38,722,129
Total	**330**	**269,180,464**	**21,931**	**34,983,704**	**119,790,072**
Non-Metal Mining including Fuels—					
Coal	493	131,879,671	26,960	25,042,769	34,984,922
Natural gas	2,418	75,187,066	1,351	1,738,949	8,188,966
Petroleum	2,210	48,568,562	655	776,163	3,467,538
Abrasives	10	679,865	36	26,471	48,844
Asbestos	8	30,081,362	1,409	1,156,315	3,039,721
Feldspar and quartz	33	936,177	120	91,603	358,129
Gypsum	17	8,054,148	478	368,484	1,080,379
Iron oxides	4	206,863	26	22,909	46,161
Mica	5	119,670	9	7,864	6,828
Salt	8	3,805,008	345	455,049	1,947,551
Talc and soapstone	5	703,532	83	76,577	159,038
Miscellaneous	35	2,072,913	182	155,166	1,061,779
Total	**5,246**	**302,294,837**	**31,654**	**29,918,319**	**54,389,856**

[1] As published by Dominion Bureau of Statistics.

* Value added by smelting.

General Statistics on the Mineral Producing Industries in Canada, 1932—Con.

——	No. of mines, quarries, smelters, gas wells, etc.	Capital employed	No. of employees	Salaries and wages	Income from sales
Clay Products and Other Structural Materials—		$		$	$
Brick, tile and sewer pipe	159	24,910,020	1,622	1,469,270	3,405,295
Stoneware and pottery	5	437,562	118	107,316	244,923
Cement	12	55,294,814	1,216	1,344,772	6,930,721
Lime	60	6,823,949	677	575,072	2,394,537
Sand and gravel	2,249	9,542,446	1,743	1,322,201	4,480,596
Stone	319	16,727,481	2,509	2,051,395	4,942,211
Total	**2,804**	**113,736,272**	**7,885**	**6,870,026**	**22,398,283**
Grand Total	**8,380**	**685,211,573**	**61,470**	**71,772,049**	**196,578,211**
PROVINCES					
Nova Scotia	495	63,415,735	13,706	11,302,801	15,049,226
New Brunswick	563	4,998,656	1,480	1,123,080	2,185,174
Quebec	487	121,200,895	7,694	8,198,379	32,834,588
Ontario	5,196	244,250,088	16,376	24,412,126	85,868,259
Manitoba	133	21,349,000	1,730	2,106,017	11,396,818
Saskatchewan	115	6,013,271	924	748,782	1,626,307
Alberta	567	124,484,909	9,692	10,476,449	20,701,075
British Columbia	819	91,469,101	9,582	12,642,830	25,081,413
Yukon	5	8,029,918	286	761,585	1,835,351
Canada	**8,380**	**685,211,573**	**61,470**	**71,772,049**	**196,578,211**

Interesting figures regarding the secondary, or manufacturing, industries in Canada based on the use of materials of mineral origin are given in "The Canada Year Book, 1932."

In the year 1929 the net value of the products of the mineral group of manufacturing industries was 35·7 per cent of the total, as compared with 27·7 per cent for the farm, and 20·5 for the forest origin groups. These three principal groups stood in the same order of importance with regard to employees engaged and salaries and wages paid. In the matter of capital invested the mineral group also led with 30·5 per cent of the total, followed by the forest group with 22·6 per cent, central electric stations with 20·8 per cent, and the farm group with 19·6 per cent.

A considerable portion of the raw material used in the mineral group of manufacturing plants in Canada is of foreign origin, nevertheless the importance attained by this branch of industry is largely due to the development of metallurgical plants in Canada and to increasing appreciation and utilization of the wealth of the mineral resources of the Dominion. Not only have mining activities made raw materials more readily available, but those same activities also consume large quantities of finished products in whole or in part of mineral origin.

The growth and present extent of Canada's mineral production is summarized in the following tables:—

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	1910	$106,823,623	$14·93
1887	10,321,331	2·23	1911	103,220,994	14·32
1888	12,518,894	2·67	1912	135,048,296	18·33
1889	14,013,113	2·96	1913	145,634,812	19·35
1890	16,763,353	3·50	1914	128,863,075	16·75
1891	18,976,616	3·92	1915	137,109,171	17·44
1892	16,623,415	3·39	1916	177,201,534	22·05
1893	20,035,082	4·04	1917	189,646,821	23·18
1894	19,931,158	3·98	1918	211,301,897	25·37
1895	20,505,917	4·05	1919	176,686,390	20·84
1896	22,474,256	4·38	1920	227,859,665	26·40
1897	28,485,023	5·49	1921	171,923,342	19·56
1898	38,412,431	7·32	1922	184,297,242	20·66
1899	49,234,005	9·27	1923	214,079,331	23·76
1900	64,420,877	12·04	1924	209,583,406	22·92
1901	65,797,911	12·16	1925	226,583,333	24·38
1902	63,231,836	11·36	1926	240,437,123	25·44
1903	61,740,513	10·83	1927	247,356,695	25·67
1904	60,082,771	10·27	1928	274,989,487	27·97
1905	69,078,999	11·49	1929	310,850,246	31·00
1906	79,286,697	12·81	1930	279,873,578	27·42
1907	86,865,202	13·75	1931	228,029,018	21·92
1908	85,557,101	13·16	1932	182,681,915	.....
1909	91,831,441	13·70			

Annual Value of the Mineral Production of Canada by Classes, 1907-1932

Year	Metallics	Non-metallics including fuels	Clay products and other structural materials	Total
Canada—	$	$	$	$
1907	42,426,607	31,275,546	12,863,049	*(a)* 86,865,202
1908	41,774,362	32,142,784	11,339,955	*(a)* 85,557,101
1909	44,156,841	31,141,251	16,533,349	91,831,441
1910	49,438,873	37,757,158	19,627,592	106,823,623
1911	46,105,423	34,405,960	22,709,611	103,220,994
1912	61,172,753	45,080,674	28,794,869	135,048,296
1913	66,361,351	48,463,709	30,809,752	145,6 4,812
1914	59,386,619	43,467,229	26,009,227	128,863,075
1915	75,814,841	43,373,571	17,920,759	137,109,171
1916	106,319,365	53,414,983	17,467,186	177,201,534
1917	106,455,147	63,354,363	19,837,311	189,646,821
1918	114,549,152	77,621,946	19,130,799	211,301,897
1919	73,262,793	76,002,087	27,421,510	176,686,390
1920	77,939,630	108,027,947	41,892,088	227,859,665
1921	49,343,232	87,842,682	34,737,428	171,923,342
1922	61,785,707	82,976,794	39,534,741	184,297,242
1923	84,391,218	91,936,732	37,751,381	214,079,331
1924	102,406,528	71,796,009	35,380,869	209,583,406
1925	117,082,298	71,851,801	37,649,234	226,583,333
1926	115,237,581	85,240,144	39,959,398	240,437,123
1927	113,561,030	88,986,246	44,809,419	247,356,695
1928	132,012,454	93,239,85 ·	49,737,181	274,989,487
1929	154,454,056	97,861,350	58,534,834	310,850,246
1930	142,743,764	83,402,349	53,727,465	279,873,578
1931	118,524,439	65,346,284	44,158,295	228,029,018
1932	103,495,453	56,788,179	22,398,283	182,681,915

(a) Total includes $300,000 allowed for products not reported.

Values of the Mineral Production of Canada by Provinces, 1899-1932

Year	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon
	$	$	$	$	$	$	$	$	$
1899	6,817,274	420,227	2,585,635	9,819,557		17,108,707		12,482,605	Included
1900	9,208,479	439,060	3,202,383	11,258,099		23,452,330		16,680,526	with
1901	7,770,159	467,985	3,759,984	13,970,010		19,297,940		20,531,833	Mani-
1902	10,686,549	607,129	3,743,636	14,619,091		16,127,400		17,448,031	toba,
1903	11,431,914	580,495	3,585,938	14,160,033		14,082,986		17,899,147	Saskat-
1904	11,212,746	559,913	3,688,482	12,582,843		12,713,613		19,325,174	chewan
1905	11,507,047	559,035	4,405,975	18,833,292		11,387,642		22,386,008	and
1906	12,894,303	646,328	5,242,058	25,111,682		10,092,726		25,299,600	Alberta
1907	14,532,040	664,467	6,205,553	30,381,638	898,775	533,251	4,657,524	25,656,056	3,335,898
1908	14,487,108	579,816	6,372,949	30,623,812	584,374	413,212	5,122,505	23,704,035	3,669,290
1909	12,504,810	657,035	7,086,265	37,374,577	1,193,377	456,246	6,047,447	22,479,006	4,032,678
1910	14,195,730	581,942	8,270,136	43,538,078	1,500,359	498,122	8,996,210	24,478,572	4,764,474
1911	15,409,397	612,830	9,304,717	42,796,162	1,791,772	636,706	6,662,673	21,299,305	4,707,432
1912	18,922,236	771,004	11,656,998	51,985,876	2,463,074	1,165,642	12,073,589	30,076,635	5,933,242
1913	19,376,183	1,102,613	13,475,534	59,167,749	2,214,496	881,142	15,054,046	28,086,312	6,276,737
1914	17,584,639	1,014,570	11,836,929	53,034,677	2,413,489	712,313	12,684,234	24,164,039	5,418,185
1915	18,088,342	903,467	11,619,275	61,071,287	1,318,387	451,933	9,909,347	28,689,425	5,057,708
1916	20,042,262	1,118,187	14,406,598	80,461,323	1,823,576	590,473	13,297,543	39,969,962	5,491,610
1917	21,104,542	1,435,024	17,400,077	89,066,600	2,628,264	860,651	16,527,535	36,141,926	4,482,202
1918	22,317,108	2,144,017	19,605,347	94,694,093	3,120,600	1,019,781	23,100,987	42,935,333	2,355,631
1919	23,445,215	1,770,945	21,267,947	67,917,998	2,868,378	1,521,964	21,087,582	34,865,427	1,940,934
1920	34,130,017	2,491,787	28,886,214	81,715,808	4,223,461	1,837,468	33,586,456	39,411,728	1,576,726
1921	28,912,111	1,901,505	15,157,094	57,356,651	1,934,117	1,114,220	30,562,229	33,230,460	1,754,955
1922	25,923,499	2,263,692	17,647,939	65,866,029	2,258,942	1,255,470	27,872,136	39,423,962	1,785,573
1923	29,648,893	2,462,457	20,308,763	80,825,851	1,768,037	1,047,583	31,287,536	43,757,388	2,972,823
1924	23,820,352	1,969,260	19,136,504	86,398,656	1,534,249	1,128,100	22,344,940	52,298,533	952,812
1925	17,625,612	1,743,858	24,284,527	87,980,436	2,276,759	1,076,392	25,318,866	64,485,242	1,791,641
1926	28,873,702	1,811,104	25,956,193	84,702,296	3,073,528	1,193,394	26,977,027	65,622,976	2,226,813
1927	30,111,221	2,148,535	28,870,403	89,982,962	2,888,912	1,455,225	29,309,223	60,801,170	1,789,044
1928	30,524,392	2,198,919	37,037,420	99,584,718	4,186,853	1,719,461	32,531,416	64,496,351	2,709,957
1929	30,904,453	2,439,072	46,358,285	117,662,505	5,423,825	2,253,506	34,739,986	68,162,878	2,905,736
1930	27,019,367	2,383,571	41,215,220	113,530,976	5,453,182	2,368,612	30,427,742	54,953,320	2,521,588
1931	21,080,746	2,176,911	35,696,563	96,113,235	9,965,854	1,931,880	23,580,727	35,337,756	2,145,347
1932	16,198,573	2,223,505	24,512,470	79,509,239	8,714,459	1,681,697	21,183,079	26,767,522	1,891,371

Details of the mineral production of the Dominion for 1931 and 1932 are as follows:—

Quantities and Values of Mineral Products from Canadian Sources, 1931 and 1932

		1931		1932	
		Quantity	Value	Quantity	Value
Metallics			$		$
Arsenic (As_2O_3)	lb.	3,575,936	135,170	2,424,342	98,714
Bismuth	"	118,207	157,650	16,855	7,340
Cadmium		.....	180,958	.....	26,824
Chromite	tons	.....	.....	78	1,113
Cobalt	lb.	521,051	651,179	490,631	587,957
Copper	"	292,304,390	24,114,065	247,679,070	15,294,058
Gold	fine oz.	2,693,892	55,687,688	3,044,387	62,933,063
Lead	lb.	267,342,482	7,260,183	255,947,378	5,409,704
Manganese ore	tons	117	2,893	.....	.....
Molybdenite (concentrates)	lb.	1,222	280	.....	.....
Nickel	"	65,666,320	15,267,453	30,327,968	7,179,862

Quantities and Values of Mineral Products from Canadian Sources, 1931 and 1932
—Continued

		1931		1932	
		Quantity	Value	Quantity	Value
Metallics—Con.			$		$
Palladium, rhodium, iridium, etc	fine oz.	46,918	1,217,717	37,613	901,890
Platinum	"	44,775	1,596,900	27,343	1,099,393
Selenium	lb.	21,500	40,850	.....	.....
Silver	fine oz.	20,562,247	6,141,943	18,347,907	5,811,081
Titanium ore	tons	1,509	10,261	.....	.....
Zinc	lb.	237,245,451	6,059,249	172,283,558	4,144,454
Total		.....	**118,524,439**	.....	**103,495,453**
Non-Metallics—Fuels					
Coal	tons	12,243,211	41,207,682	11,738,913	37,117,695
Natural gas	M. cu. ft.	25,874,723	9,026,754	23,420,174	8,899,462
Peat	tons	1,674	7,033	3,248	7,593
Petroleum, crude	brls.	1,542,573	4,211,674	1,044,412	3,022,592
Total		.....	**54,453,143**	.....	**49,047,342**
Other Non-Metallics					
Actinolite	ton	35	456	.....	.....
Asbestos	"	164,296	4,812,886	122,977	3,039,721
Barytes	"	16	363	.....	.....
Bituminous sands	"	1,015	4,060	343	1,372
Diatomite	"	1,610	32,789	1,496	29,509
Feldspar	"	18,343	186,961	7,047	81,982
Fluorspar	"	40	620	32	464
Graphite	"	548	32,149	346	18,483
Grindstones	"	621	38,103	328	15,735
Gypsum	"	863,752	2,111,517	438,629	1,080,379
Iron oxides (ochre)	"	5,520	49,205	5,240	46,161
Magnesitic dolomite	"	11,411	295,579	.....	262,860
Manganese (bog)	"	77	462	.....	.....
Mica	"	1,339	54,066	618,349	6,829
Mineral waters	Imp. gals	217,408	13,324	76,714	7,170
Phosphate	tons	.....	.....	1,316	12,333
Quartz	"	195,724	303,158	189,132	276,147
Salt	"	259,047	1,904,149	263,543	1,947,551
Silica brick	M	900	35,746	93	4,304
Soapstone		.....	34,439	.....	46,751
Sodium carbonate	tons	712	7,351	495	5,450
Sodium sulphate		.....	421,097	.....	271,736
Sulphur*	tons	50,107	429,457	53,172	470,014
Talc	"	11,836	122,644	12,103	112,287
Volcanic dust	"	128	2,560	180	3,600
Total		.....	**10,893,141**	.....	**7,740,837**

* Sulphur content of pyrites shipped and estimated sulphur contained in sulphuric acid made from waste smelter gases.

Quantities and Values of Mineral Products from Canadian Sources, 1931 and 1932
—Concluded

		1931		1932	
		Quantity	Value	Quantity	Value
Clay Products and Other Structural Materials			$		$
CLAY PRODUCTS					
Brick—					
Soft-mud process	Face	M	5,476	116,316	6,188	108,582
	Common	M	41,177	619,357	12,801	182,372
Stiff-mud (wire cut)	Face	M	77,135	1,752,947	30,197	664,756
	Common	M	81,930	1,205,464	40,753	638,922
Dry press	Face	M	20,149	423,357	5,522	119,547
	Common	M	8,688	107,213	4,248	46,762
Fancy or ornamental brick		M	335	20,773	125	6,237
Sewer brick		M	2,253	43,692	643	12,156
Paving brick		M	19	682	6	155
Firebrick		M	2,248	107,597	1,580	71,757
Fireclay		tons	1,233	14,857	990	11,826
Fireclay blocks and shapes			.....	83,039	.....	75,209
Structural Tile—						
Hollow blocks		tons	105,635	1,046,634	48,118	421,672
Roofing tile		No.	6,935	720	48,939	3,900
Floor tile (quarries)		sq. ft.	107,499	31,415	94,316	21,502
Drain tile		M	12,518	328,410	7,385	186,670
Sewer pipe, copings, flue linings, etc			.....	1,508,803	.....	813,224
Pottery, glazed or unglazed			.....	257,125	.....	244,861
Bentonite		tons	187	935	7	176
Other clay products			.....	171,952	.....	19,932
Total			.....	**7,841,288**	.....	**3,650,218**
OTHER STRUCTURAL MATERIALS						
Cement		brls.	10,161,658	15,826,243	4,498,721	6,930,721
Lime		tons	344,785	2,764,415	320,650	2,394,537
Sand and gravel		"	21,748,586	6,651,165	14,469,942	4,480,596
Slate		"	250	5,000	250	3,750
Stone		"	8,397,860	11,070,184	4,690,922	4,938,461
Total			.....	**36,317,007**	.....	**18,748,065**
Grand Total			.....	**228,029,018**	.....	**182,681,915**

MINERAL PRODUCTS

ALUMINIUM

Canada, since 1927, has been the second largest producer of aluminium metal in the world; but Canada's aluminium industry, like its iron industry, is based entirely on foreign ores. Bauxite, the commercial ore of aluminium, is not known to occur in Canada; on the other hand very large quantities of cheap hydro-electric power, which, in practice, is essential for the reduction of aluminium ores to the metal, are available in many parts of the Dominion. Consequently, plants for the treatment of ores, imported mainly from British Guiana and the United States, have been built near large hydro-electric power generating plants at Arvida and at Shawinigan Falls in the Province of Quebec. The plant at Arvida, which is one of the largest of its kind in the world, in addition to having a supply of electricity developed locally, has the further advantage of being situated virtually on tidewater at the head of navigation on the Saguenay River, so that raw materials can be brought to it and finished products shipped out either by ocean-going vessels or by rail.

In 1932, Canada exported aluminium and its products to the value of $3,903,386.

USES

Until the beginning of the present century aluminium was of not great importance as an industrial material, but during recent years its use has been increasing at a relatively faster rate than that of any of the other principal metals. In amount consumed it now ranks fifth, being surpassed only by iron, copper, lead, and zinc. Either mixed with other metals to form alloys or as the simple metal, it finds important uses in the manufacture of automobile and airplane parts, of cooking utensils, of electric transmission cables, of numerous articles of household equipment, as foil for wrappings, and as aluminium paint. Very large quantities are also used in the deoxidation of steel, and the strong affinity of aluminium for oxygen is also made use of in a process of reducing rare metals from their oxides and in the related process of thermit welding. Among the more recently developed uses are: for roofing, exterior trim, etc., in building construction; for the framework of certain types of furniture; and for the production of high-strength alloys that can be rolled into large structural shapes.

ANHYDRITE

Canada possesses large deposits of anhydrite,[1] anhydrous calcium sulphate, the larger occurrences so far known being in the Provinces of Nova Scotia, New Brunswick, Ontario, Manitoba, Alberta, and British Columbia. The deposits, as a rule, occur associated with gypsum and limestone.

In Nova Scotia, the principal districts in which anhydrite is found are in Hants County, near Windsor, and also near Cheverie; in Victoria County near Ottawa Brook, Cain Mountain, Baddeck, St. Ann, and Ingonish; and near Mabou in Inverness County. There are also many other localities in this province which, however, have not as yet been developed.

[1] See also Gypsum.

Plant of Aluminium Company of Canada, Arvida, Quebec.

In New Brunswick, the principal occurrences are found in Albert County, near Hillsborough, and the material is also known to occur, associated with gypsum, at a number of other localities.

In Ontario, anhydrite occurs, associated with gypsum, at depth and has been encountered in many drill holes throughout the province.

In Manitoba, in the Gypsumville district as well as in the gypsum mine at Amaranth, anhydrite in commercial quantities exists associated with the gypsum.

At McMurray, in Alberta, anhydrite was encountered at depths of 500 to 685 feet in several drill holes drilled for salt.

In British Columbia, anhydrite in commercial quantities occurs at Falkland in the gypsum deposits of that place.

USES

Anhydrite as a mineral of commerce is becoming better known each year, and as new uses are found it will probably become of increasing importance as time goes on.

In Europe already it finds a market for the manufacture of ammonium sulphate, cement, and sulphuric acid, and the demonstration of the possibility of its preparation into a commercial plaster is attracting increasing interest.

The production of anhydrite in Canada will average around 40,000 tons per year, the product being shipped to the southern areas of the United States which border on the Atlantic seaboard, where it is ground and used as a fertilizer, as well as a retarder in cement.

The Mines Branch has published a report (No. 732) on "Anhydrite in Canada, its Occurrence, Properties, and Utilization," copies of which may be obtained on application to the Director, Mines Branch, Ottawa, Canada.

ANTIMONY

Antimony minerals are known to occur in the Provinces of Nova Scotia, New Brunswick, Quebec, Ontario, and British Columbia, and in Yukon; and antimony in one form or another has been produced intermittently in small quantity in Canada for many years. At various times between 1884 and 1917, antimony ore carrying stibnite (sulphide of antimony), native antimony, and gold was mined and shipped from deposits at West Gore, in Hants County, Nova Scotia. In New Brunswick also, deposits of stibnite and native antimony were worked in a small way for short periods previous to 1917, the metal being in part shipped in the ore, in part smelted and refined at the mine. Most of the refined antimony so far produced in Canada, however, has been obtained as a by-product of the treatment of silver-lead ores at Trail, British Columbia, during the years 1907, 1909, 1915, and 1916. In 1925 and 1926, a little antimony was recovered from silver-lead-bismuth bullion produced in the course of treatment of ores from the Cobalt district in Ontario, and shipped to the United States to be refined. No production of antimony in Canada is recorded from 1918 to 1924, or since 1926, but a certain amount of antimonial lead not shown separately in statistical returns is regularly produced in the course of lead refining at Trail, B.C.

The world's total production of antimony amounts to about 20,000 tons annually, by far the greater part of which comes from China. Antimony imported into Canada in 1932 amounted to 316 tons valued at $37,180.

USES

The chief uses of antimony are in the manufacture of storage battery plates, bearing and babbitt metals, type metal, solder, rubber goods, and pigments.

ARSENIC

Arsenical minerals are of widespread occurrence in Canada, but all Canada's output of arsenic, like nearly all the world's output, is recovered as a by-product of smelting ores for other metals. The chief Canadian source at present is the silver-cobalt-arsenic ores of Cobalt, Ontario. These, or residues obtained from their preliminary treatment, are shipped abroad and to Deloro, Ontario, where the arsenic they contain is recovered in the form of white arsenic (As_2O_3), as a by-product of their final treatment. The Deloro Smelting and Refining Company also manufacture some of their arsenic into Paris green, lead arsenate, and arsenate of lime before marketing it.

Numerous other arsenic-bearing deposits, many of which are auriferous and some of which were formerly worked, are known in Canada, especially in the Provinces of Nova Scotia, Ontario, and British Columbia. Mispickel ores were at one time mined at Deloro, Ontario, and treated locally for the production of white arsenic. The Hedley gold mine in British Columbia was formerly an important source of gold-bearing arsenical concentrates; and the Bralorne gold mine in the same province is at present a small producer of this material. The Beattie gold mine in Quebec exports all its output in the form of auriferous arsenical concentrates. For several years some of the gold mines in Nova Scotia exported small quantities of auriferous mispickel concentrate for treatment abroad.

In 1931, Canada produced some 1,788 tons of arsenic (calculated as white arsenic) valued at $135,170, and exported some 1,546 tons valued at $116,044. In 1932, 1,212 tons of white arsenic valued at $98,714 was produced.

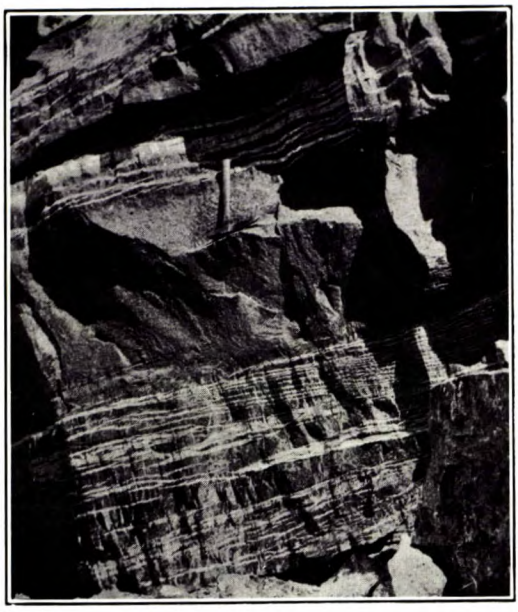
USES

The largest part of the world's consumption of arsenic is in the agricultural industries in the form of insecticides, weed killers, cattle dips, etc. The only other large use of arsenic is in the glass industry, to purify and decolorize the product. Small quantities, however, are used as a wood preservative and in the preparation of drugs and dyes. Metallic arsenic is used for hardening shot.

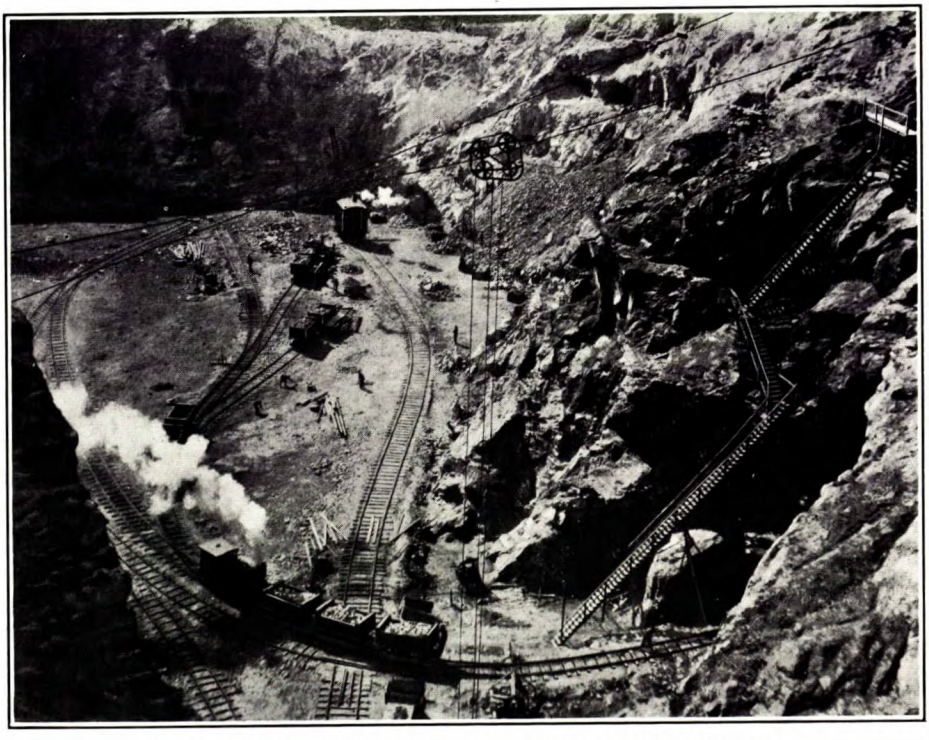
The Dominion Department of Mines has published a report on "Arsenic-bearing Deposits in Canada" (Economic Geology Series No. 4) which may be obtained by applying to the Director, Geological Survey of Canada, Ottawa, Canada.

ASBESTOS

Asbestos is a name applied to a group of minerals of differing chemical compositions, but having in common a fibrous structure, on which their commercial value depends. Asbestos may be spun into yarn or thread, woven into cloth, or felted into sheets or packings, just as vegetable fibre may be so treated, but unlike vegetable fibre it is fireproof, weatherproof, and highly resistant to chemical action. Commercially, it is divided into two general classes—spinning fibre and non-spinning fibre. The chief spinning



A. Ribbon fibre, Quebec; Vimy mine, Asbestos Corporation, Limited.



B. Pit of Bell Asbestos Company, Thetford Mines, Quebec.

fibre is chrysotile, a hydrous magnesium silicate of the same composition as serpentine, with which it is always associated. Other spinning fibres are crocidolite, or " blue " asbestos, a soda-bearing amphibole; and amosite, a long-fibred variety of anthophyllite. The chief non-spinning variety is also anthophyllite. Its fibre is usually brittle and of low tensile strength but it is more resistant to acids and to heat than chrysotile. All the asbestos produced in Canada is of the chrysotile or serpentine variety; crocidolite and amosite are varieties peculiar to the South Africa deposits.

Though asbestos is known to occur in a number of places in Canada—in the Provinces of Quebec, Ontario, and British Columbia—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 (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 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 2½ inches, and usually less than one-half 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.

A wide variety of grades is produced. The highest grades are known as " crudes ". These consist of long fibre which has been separated from the accompanying rock by hand cobbing. Spinning fibre consists of crudes and of the highest grade of mill fibre. Mill fibre is obtained by crushing the asbestos-bearing rock, passing it through beaters, and removing the fibre by screening and air separation. Below the spinning grades come shingle fibres, paper fibres, plaster fibres, and refuse, or shorts. The proportion of crude fibre—much the most valuable grade—to short fibre is very small in the Canadian deposits, probably less than one per cent.

Production of asbestos, of all grades, in Canada in 1932 amounted to 122,977 tons, valued at $3,039,721; as against a maximum production of 306,055 tons valued at $13,172,581 in 1929.

Complete data on which to base an estimate of world production in 1932 are not yet available; in 1930 the production was approximately 424,480 tons.

The chief producing countries are: Canada, Russia, Rhodesia, and the Union of South Africa. Canada is much the most important producer as regards tonnage but most of its output is of the shorter non-spinning grades. Rhodesia and South Africa, on the other hand, both produce chiefly spinning grades. Russia is rapidly becoming of increasing importance as a producer.

USES

Most of the uses of asbestos are based on its resistance to heat and its heat-insulating properties. The chief single use of high-grade fibre is in the manufacture of brake-band linings and clutch facings for automobiles. Spinning fibres also find use in the manufacture of asbestos cloth for fireproof curtains, gloves, clothing, packing, gaskets, etc. Chrysotile fibre of shorter grades than those used for spinning is used for compressed sheets, asbestos paper, shingles, and millboard. The shortest grades are used for asbestos cement, fireproof paint, packing, and insulating materials. A complete list of articles into the manufacture of which asbestos enters would occupy several pages.

A detailed report (No. 707), on "Chrysotile Asbestos in Canada," has been published and may be obtained by applying to the Director, Mines Branch, Department of Mines, Ottawa.

BARITE

Barite, also known as barytes or heavy spar, is widely distributed in Canada, and small amounts have been mined at various times in the Provinces of Nova Scotia, Quebec, and Ontario. For many years production has been entirely from Nova Scotia.

The first recorded production of barite in Canada was from Five Islands, in Colchester County, and from Brookfield, in Hants County, *Nova Scotia,* where deposits were worked between 1865 and 1880. From 1900 to 1903, barite was mined at Cap Rouge, in Cape Breton Island; and since 1904, practically all the Canadian production has come from large deposits at Lake Ainslie in Cape Breton Island.

In *New Brunswick,* a small amount of barite is reported to have been dug from pits at Gouldville, in Westmorland County, many years ago.

In *Quebec,* a considerable tonnage of barite was shipped from near Ironside, in Hull County, previous to 1900; and other occurrences are known in Hull, Labelle, and Pontiac Counties.

In *Ontario,* a deposit of barite on McKellar Island in the Thunder Bay District was worked previous to 1894; and scattered small deposits in southeastern Ontario, within a radius of about 100 miles of Ottawa, have been worked at various times in the last forty years. In northeastern Ontario, large deposits of barite have been discovered; in 1910, in Langmuir Township, near Porcupine; later, in Cairo, Lawson, and Yarrow Townships in the vicinity of Elk Lake and Matachewan; and, in 1917, at Tionaga, in Penhorwood Township, west of Sudbury. None of these deposits has as yet been productive, except for a shipment of 60 tons from Langmuir Township in 1918, and of 200 tons from Tionaga in 1923; though considerable development work was done and a mill built on that in Langmuir Township, and more recently a modern milling plant has been built on that at Tionaga.

In *British Columbia,* the best known deposits are those at the Giant Mine, near Spillimacheen, in the Golden mining division, which attracted some attention about 1921.

In 1931, Canada produced only 16 tons of barite, worth $363, all of it from Lake Ainslie in Nova Scotia; no production is recorded for 1932;

maximum production was 4,312 tons valued at $19,021 in 1908. Imports of barite into Canada in 1931 amounted to 1,686 tons valued at $32,712; in 1932, 1,292 tons worth $22,989 were imported.

The world's chief producers of barium minerals are: Germany, United States, Great Britain, Italy, and France. The world's requirements of barium minerals amount to about 750,000 tons annually.

USES

The chief use of barium is in the form of compounds. These in their probable order of importance are: lithopone—a mixture of barium sulphate, zinc sulphide, and zinc oxide—used extensively in white paint and as a filler in rubber, paper, linoleum, etc.; blanc fixe, precipitated barium sulphate, used like lithopone largely as a paint pigment and a filler; ground barite, also used as a white pigment and as a filler. Barium carbonate is used largely in the ceramic industries to prevent scumming in brick and tile; in pottery glazes; in optical glass; and in certain rat poisons. Barium chloride is used as a mordant in dyeing; in the purification of salt; as a water softener; in the leather, ceramic, and photographic industries; and in rat and vermin destroyers. A number of other chemical compounds of barium find use, in minor quantities, in a variety of other industries. Barium metal has been used tentatively as a hardening agent, in radio tubes, and in combination with calcium as a constituent metal for bearings.

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

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 been extensively employed as a bonding ingredient in moulding and core sands and as a suspending agent in core and mould washes in the foundry industry; and also for the refining of oils and gasoline. It has been successfully used for de-inking old newsprint, to increase the retention of china clay in the manufacture of paper, in the manufacture of refractory and other ceramic products, and for a variety of other purposes.

Bentonite in thin seams and beds is of widespread occurrence in the Provinces of Alberta, Saskatchewan, and British Columbia, but with the exception of some small test shipments there has as yet been little Canadian production of this material—in 1932, 7 tons valued at $176.

Two reports on bentonite (Nos. 626 and 723-2) have been published by the Mines Branch, Department of Mines, Ottawa, and may be obtained on application to the Director.

BISMUTH

No ores of bismuth are mined in Canada, the small amounts of the metal produced all being recovered as a by-product of the treatment of other ores. Some of the silver-cobalt-arsenic ores of the Cobalt district in Ontario carry bismuth chiefly in the form of native metal, but also as sulphide, and in the course of treatment of these ores a certain amount of metallic bismuth, and lead bullion containing bismuth is obtained. The latter is exported to the United States for refining, in the course of which the contained bismuth is recovered. In British Columbia, the Consolidated Mining and Smelting Company of Canada built a plant at Trail, in 1928, for the refining of bismuth residues obtained in the course of the electrolytic refining of lead. These are at present the only commercial sources of bismuth in Canada.

In 1929, Canada produced 194,329 pounds of bismuth valued at $307,-114, part of it as metallic bismuth, part in silver-lead-bismuth bullion exported for refining. In 1932, production fell to 16,855 pounds, valued at $7,304. In the same year Canadian imports of metallic bismuth amounted to 5 pounds valued at $9.

World consumption of bismuth is very small, amounting to only a few hundred tons annually, and is considerably exceeded by potential supplies.

USES

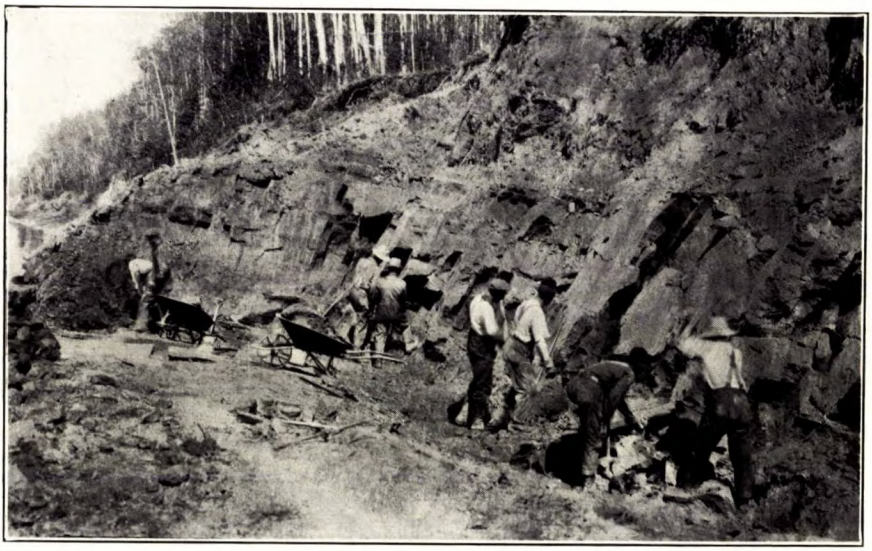
The chief use of bismuth is in pharmaceutical preparations, especially those used in intestinal disorders. It is also used as a constituent of so-called fusible alloys such as those employed in automatic fire sprinklers, safety plugs for boilers, electric fuses, solders, and dental amalgams, and in some type and bearing metals.

BITUMINOUS SAND

An extensive deposit of bituminous sand, commonly called tar sand—probably the largest occurrence of solid asphaltic material known—outcrops at frequent intervals along the Athabaska River and its tributaries for an aggregate distance exceeding 200 miles, in the district centering about McMurray in the Province of Alberta. The total estimated volume of the sand is 500 billion cubic yards, and analyses have shown that the bitumen content varies from less than one per cent to 20 per cent, many large portions of the deposit averaging 10 per cent or more.

For a number of years experiments have been carried on by the Mines Branch of the Federal Department of Mines, by the Provincial Government of Alberta, and by private investigators, with a view to utilizing McMurray bituminous sand as a surfacing material for roads and walks and as a source of bitumen and of petroleum and its products. Gratifying success has attended these efforts but up to the present attention has been directed chiefly to field explorations, laboratory studies, and demonstration work. Production of bituminous sand and separated bitumen is as yet small, total shipments of sand to date, all for experimental or demonstration purposes, amounting to approximately 8,000 tons. In 1932, 343 tons valued at $1,372 were produced.

PLATE III



A. A bituminous sand quarry, McMurray, Alberta.

B. A magnesian dolomite quarry in Quebec.

In view of Canada's present dependence on foreign sources for practically all its requirements of asphaltic materials and much the greater part of its petroleum products, Alberta's vast resources of bituminous sand promise to become of great future value to the Dominion.

A number of reports, maps, etc., dealing with the occurrence and utilization of the McMurray bituminous sand have been published by the Mines Branch, Department of Mines, Ottawa, and copies of these may be obtained on application to the Director.

CADMIUM

No ores are mined for cadmium; the entire world's production being obtained as a by-product chiefly of the zinc industry, as nearly all zinc ores contain cadmium.

Since 1928, refined metallic cadmium has been produced by the Consolidated Mining and Smelting Company of Canada in their plant at Trail, British Columbia, from precipitates obtained in the purification of zinc solutions prior to electrolysis in the zinc refinery. Small quantities of cadmium in the form of "cadmium sponge" are being recovered also by the Hudson Bay Mining and Smelting Company at their electrolytic zinc plant at Flin Flon in northern Manitoba.

The world's consumption of cadmium is small, between 1,000 and 2,000 tons annually, and all productive demands can be more than met from present sources, of which the chief are the zinc refineries of the United States, Canada, and Australia.

In 1932 cadmium to the value of $26,824 was reported as produced in Canada.

USES

The chief use of cadmium is as a protective or ornamental coating for articles made from other metals, to which it may be applied either by the metal-spray process or by electro-plating. A considerable amount also is used in alloys, such as the fusible metals used in automatic fire-extinguishers; and in copper transmission wire, to which it adds strength without seriously lowering the conductivity. Cadmium compounds are also used as pigments and as medicines.

CEMENT

The only rock cement which is manufactured in large quantity in Canada is Portland cement, the raw materials for the production of which—viz. limestone or marl, clay, and gypsum—are of widespread occurrence in the Dominion.

There are at present 12 plants having an aggregate capacity for the production of about 14,000,000 barrels of Portland cement a year in Canada, distributed over the Provinces of Quebec, Ontario, Manitoba, Alberta, and British Columbia.

The maximum annual production was 12,284,081 barrels valued at $19,337,235, or about 82 per cent of the total rated capacity, in 1929. In 1932, production was 4,498,721 barrels valued at $6,930,721, of which Quebec mills produced 49 per cent of the total; Ontario, 35·5 per cent; Manitoba, 5·4 per cent; Alberta, 4·3 per cent; and British Columbia, 5·6 per cent.

CHROMITE

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, Mégantic, Richmond, and Wolfe, the most productive locality being the Township of Coleraine, in Mégantic County. Some of the ores are pure enough to be merchantable as mined, but most of them would have to be concentrated to raise their chromium content to the minimum demanded by buyers. Commercial ores of chromium commonly carry 45 to 55 per cent of the oxide (Cr_2O_3).

Occasional small shipments of chromite have been made in the past from points in *British Columbia*, notably from Cascade, near Grand Forks.

In 1928, apparently extensive deposits of chromite were discovered in northwestern *Ontario*, at Obonga Lake, which is west of Lake Nipigon, and 26 miles south of Collins Station on the Canadian National railway. A considerable amount of development work done on the Obonga deposits indicates that they are low grade—13 to 36 per cent chromite (Cr_2O_3)—hence concentration would be necessary to produce a saleable product.

Practically all the chromite as yet produced commercially in Canada has come from the Province of Quebec, and with the exception of a shipment of 126 tons from British Columbia in 1929, and of 78 tons from Quebec in 1932, there has been no production since 1923, when 3,558 tons of 48 per cent Cr_2O_3 concentrate was produced. Maximum production of chromite in Canada was 23,713 tons of ore and concentrate valued at $581,796, in 1917.

Consumption of chromium has increased rapidly during the last few years and the world demand for chromite now amounts, normally, to 600,000 or 700,000 tons a year. Nearly half the world's supply comes from Rhodesia, the remainder from Union of South Africa, New Caledonia, Cuba, India, Jugloslavia, Russia, Greece, and Turkey (Anatolia).

USES

Chromite is the ore of the metal chromium, a prime constituent of chrome steels, which are used for armour plate, high-speed cutting tools, and many other purposes where hardness and resistance to shock are important properties. Chromium also constitutes 12 to 14 per cent of stainless steels. The metal is now used in considerable quantity for electro-plating. Chromite, without reduction to the metal, is largely employed in the manufacture of high-grade refractory bricks and furnace linings.

CLAYS AND CLAY-WORKING INDUSTRY

HEAVY CLAY PRODUCTS

The clay-working industry in Canada is engaged chiefly in the manufacture of heavy clay products such as brick, structural tile, drain tile, and sewer pipe. With the exception of Prince Edward Island all the provinces contribute to the production of these products which are manufactured from domestic clays and shales, except in the case of sewer pipe made in Quebec which is manufactured from a mixture of domestic and imported clays.

Aerial view of a cement plant at Montreal East, Canada.

In the manufacture of building brick and structural and drain tile, common surface clays and shales are used and, to a small extent, low-grade fireclays. Canada has immense resources of such clays and shales suitable for making good quality building brick of a wide range of texture and colour, distributed throughout the nine provinces. Their distribution is so general that mention of any particular occurrences in a brief résumé would be rather misleading. For detailed information reference should be made to Departmental reports.

Maritime Provinces. Building brick, structural tile and drain tile are produced at a number of points in Nova Scotia and New Brunswick. Before transportation facilities rendered the small plants unprofitable there were a number of small brick plants in Prince Edward Island.

The principal brick and tile plants on the mainland are at New Glasgow, Pugwash, Avonport, and near Elmsdale, Nova Scotia, and at Chipman and Fredericton, New Brunswick.

Sewer pipe and salt-glazed wares are made from domestic clay at New Glasgow.

Quebec. Quebec is the second largest producer of brick and tile in Canada. The main producing centres are Laprairie and Delson to the southwest of Montreal, Deschaillons, and along the Quebec Electric railway to the east of Quebec. Other important plants are situated at Lakeside, East Angus, Ascot, and Scott.

Sewer pipe and salt-glazed wares are made from a mixture of domestic and imported clays at St. Johns.

Ontario. The greatest output of brick and structural tile is from Ontario, the main producing centres being Toronto, Hamilton, and the district lying immediately to the west and north of these cities, with Ottawa, London, Chatham, and Fort William among the other important points of production.

Drain or farm tile is manufactured at many brick plants throughout the province. The flat-lying farm lands of the southwestern counties of Ontario require special drainage and as a consequence there are in that district a number of small plants specializing on drain tile, which in the aggregate make a considerable contribution to the output of the province.

The only production of red quarry tiles (promenade tiles) and roofing tile in Canada is from the immediate neighbourhood of Mimico where a red-burning shale is used.

Sewer pipe and allied salt-glazed products are manufactured at Toronto, Hamilton, and Aldershot from clay obtained from near Aldershot.

Prairie Provinces. During the years when most active building was in progress in the Praire Provinces there were many small brick and tile plants in operation. The number of plants has been materially reduced and now the points of production are in the neighbourhood of the larger towns, where particularly desirable clays may be obtained or where natural gas is available for the burning operations. The plants at Redcliff and Medicine Hat, Alberta, fall into this latter class and, although having to contend with a type of clay which is difficult to process, are able to meet competition on account of the cheap natural gas at their disposal. A firebrick plant at Claybank, Saskatchewan, to the southeast of Moose Jaw,

produces a very desirable building brick which on account of its colour and quality enjoys a wide market. Other producing centres are at Winnipeg, Portage la Prairie, and Edrans, Manitoba; Bruno, Prince Albert, and Estevan, Saskatchewan; and Edmonton and Calgary, Alberta.

Sewer pipe is manufactured at Medicine Hat, Alberta, from clay obtained from southern Saskatchewan. Natural gas is used for fuel, which accounts for the building of the plant remote from the source of clay of the necessary quality and from its main markets.

British Columbia. With the exception of a few small plants which operate intermittently, the brick and tile plants of British Columbia are situated in the neighbourhood of Vancouver and Victoria.

Sewer pipe is manufactured at one plant at Kilgard.

REFRACTORIES

Fireclays are graded according to their refractoriness, or the temperature which they can withstand in service, ranging from low-heat duty to medium- and high-heat duty. The high-heat duty or high-grade fireclays are of rare occurrence in Canada but the lower grades are of broader distribution. With the exception of Prince Edward Island and Manitoba all the provinces are known to possess deposits of fireclay, though some of the deposits are too remote from markets to be of immediate value.

The paucity of fireclays in the neighbourhood of industrial centres has been a deterrent to the development of the refractories industry in Canada.

Firebricks and fireclay shapes are manufactured from domestic clays in Nova Scotia, New Brunswick, Saskatchewan, and British Columbia, while in Quebec and Ontario imported clays are used exclusively.

Some of the clay beds occurring in conjunction with the coal seams of Nova Scotia may be classed as low- and medium-heat-duty fireclays, and have been used to a small extent for the production of refractory bricks and stove linings. The most refractory known clays of the province occur at Middle Musquodoboit and Shubenacadie. This fireclay is used by the steel plants at Sydney and at one time was used there for the manufacture of firebrick.

The so-called fireclays of the Minto district, New Brunswick, are of comparatively low refractoriness and though of little value for manufacturing firebricks might be used for making stove linings and similar ware.

The only known refractory clays in Quebec are found at St. Rémi d'Amherst, Labelle County, where a kaolin of good quality and an associated discoloured kaolin occurs in sufficient quantity to be worthy of consideration as a raw material for the manufacture of firebrick.

In recent years considerable attention has been given to beds of Cretaceous clays occurring along the Mattagami, Abitibi, and Missinaibi Rivers in northern Ontario. Some of these clays are very refractory and are apparently suitable for the production of high-grade firebrick.

In the southwestern part of Saskatchewan there is a series of exposures of refractory clays belonging to the Whitemud and Ravenscrag formations. Some of these, particularly those of the Whitemud series occurring in the vicinity of Bengough, Claybank, and Willows, are highly refractory. The refractory clays of the Ravenscrag (termed Willowbunch member) are not

so widely distributed as the Whitemud nor are they generally as refractory. The Whitemud clays occurring in the neighbourhood of Claybank have been used for a number of years for the manufacture of a good quality firebrick and special shapes.

POTTERY AND CHINA CLAY

Clays suitable for the manufacture of stoneware and the better grades of pottery have been found in only a few places in Canada. Stoneware clays of good quality occur at Shubenacadie, Middle Musquodoboit, and Inverness in Nova Scotia and in the Whitemud series in southern Saskatchewan, already referred to under refractory clays. Ball clay of excellent bonding power also occurs in this same series.

The only locality where china clay has been produced commercially is at St. Rémi d'Amherst, Quebec. There is no production at present. Deposits of high-grade, white-burning clays occur at the Mattagami, Abitibi, and Missinaibi Rivers in Ontario. Some of these clays are very plastic and might be classed as ball clays.

A deposit of white-burning clay occurs at Punk Island, Lake Winnipeg, Manitoba; and at Williams Lake, British Columbia, there is a deposit which has been referred to in the report of the Minister of Mines of British Columbia as consisting of "silicate of alumina." This material, if not a true kaolin, is closely allied to it.

Stoneware is manufactured at Saint John, N.B., from Nova Scotia clay and at Medicine Hat from Saskatchewan clay.

Art pottery is made at Oshawa and Hamilton in Ontario and at a few small plants in New Brunswick, Ontario, and British Columbia, as well as at the stoneware potteries.

Sanitary ware is manufactured at two plants at St Johns, Quebec, and electrical porcelain at Hamilton, Niagara Falls, Peterborough, and Georgetown, Ontario.

One plant at Kingston, Ontario, manufactures floor and wall tile.

A number of reports on clays and shales have been published by the Mines Branch and by the Geological Survey, and copies may be obtained on application to the Directors of the Mines Branch and the Geological Survey respectively.

COAL

The coal situation in Canada is somewhat anomalous inasmuch as, in spite of enormous resources, about one-half of the country's consumption is of imported coal. This arises from the fact that Canada's important coalfields are all situated either in the extreme eastern or far western portions of the Dominion, while the chief consuming centres are in the more thickly populated and more highly industrialized central provinces of Ontario and Quebec, which can be more cheaply supplied from foreign than from domestic sources.

The actual mining of coal is carried on in Nova Scotia, New Brunswick, Saskatchewan, Alberta, British Columbia, and Yukon.

Nova Scotia's entire production is bituminous coal, most of which comes from undersea workings in the Sydney, Cape Breton coalfields—the largest in the province and the most extensively exploited in the Dominion. Much of the output of this field is consumed in iron and steel works at the city

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Canada's largest coal mine: No. 1 B Colliery, Glace Bay, Cape Breton, N.S.

of Sydney. There are also smaller coalfields in Pictou and Cumberland Counties, on the mainland, and in Inverness County, in Cape Breton Island.

All the coal produced in *New Brunswick* is bituminous. Here it occurs in thin flat seams that are rendered workable by the shallow depths at which they lie. In some cases they are worked open-cast after the surface soil has been stripped from them.

In *Saskatchewan* only lignite coal is mined, some of it by stripping and open-cast methods. A part of the output is carbonized and briquetted before use.

In *Alberta* both bituminous and lignite coals are mined. The bituminous coalfields of this province are the largest in the Dominion and some of them produce coals of the highest grade; but the output is restricted by lack of consumers within the range of economical transportation.

In *British Columbia* bituminous coal is being mined, the chief collieries being located on Vancouver Island and in the Crowsnest Pass district, in the southeastern part of the province.

There is also a very small production of bituminous coal in *Yukon*.

The coalfields of the *Northwest Territories* and the *Arctic Islands* are as yet entirely unprospected, and the recently discovered lignite beds of northern *Ontario* have been subjected to a preliminary examination only.

Output and Value of Coal in Canada by Kinds and by Provinces, 1931 and 1932*

Province	1931		1932	
	Quantity	Value	Quantity	Value
	Short tons	$	Short tons	$
Nova Scotia (Bituminous)	4,955,563	19,016,720	4,084,531	15,123,094
New Brunswick (Bituminous)	182,181	743,196	211,055	789,617
Manitoba (Lignite)	1,306	3,797	3,300	9,259
Saskatchewan (Lignite)	662,836	945,259	875,432	1,211,539
Alberta—				
Bituminous	1,846,306	6,249,779	1,734,705	5,714,682
Sub-bituminous	471,343	1,211,197	560,902	1,330,316
Lignite	2,246,366	5,881,699	2,571,663	6,472,862
Total	**4,564,015**	**13,342,675**	**4,867,270**	**13,517,860**
British Columbia (Bituminous)	1,876,406	7,150,996	1,681,015	6,390,412
Yukon (Bituminous)	904	5,039	808	3,491
Canada—				
Bituminous	8,861,360	33,165,730	7,712,114	28,021,296
Sub-bituminous	471,343	1,211,197	560,902	1,330,316
Lignite	2,910,508	6,830,755	3,450,395	7,693,660
Total	**12,243,211**	**41,207,682**	**11,723,411**	**37,045,272**

* Preliminary figures subject to some slight revision.

COBALT

All the cobalt produced in Canada is derived from the silver-cobalt-arsenic ores of Cobalt and the outlying districts of Gowganda and South Lorrain, in northern Ontario, where it occurs closely associated with silver in the minerals smaltite and cobaltite—the arsenide and sulpharsenide respectively of cobalt. For a number of years much the greatest part of the world's demand for cobalt was supplied by Ontario mines but the production of the Belgian Congo now surpasses that of Canada. At first, the Canadian metal was obtained entirely as a by-product of silver production, but latterly, with the gradual exhaustion of the high-grade silver ore, portions of the deposits that were formerly passed by as too low grade to be payable were being mined primarily for their cobalt content.

Ore and residues from silver-producing plants at the mines are in part sold for export to foreign refineries and in part shipped to the Deloro Smelting and Refining Company's plant at Deloro, in southern Ontario, where they are treated for the recovery of cobalt as refined metal, oxide, and salts.

Canada's production of cobalt reached a maximum of 1,533 tons in 1909. Production in 1932 was 245 tons valued at $587,957.

The world's chief producing countries in the order of their importance are: Belgian Congo, Canada, and India.

USES

The chief use of metallic cobalt is in the production of special alloys, notably stellite, an alloy of cobalt and chromium much used for high-speed cutting tools; cobalt magnet steel, for permanent magnets; and in cobalt-tungsten carbides such as carboloy, an alloy even harder and more heat-resisting than stellite. Cobalt oxide finds its chief use as a pigment in the ceramic industries, where it is the essential constituent of the well-known refractory colouring material, cobalt blue. Cobalt salts are used in the paint and varnish industries.

COPPER

Canada supplies nearly 9 per cent of the world's production of copper, entirely from sulphide ores—chiefly chalcopyrite—which are mined in large quantities in four provinces, namely, in the order of their importance: Ontario, Quebec, British Columbia, and Manitoba. A certain amount of copper has also been mined in Yukon, but there has been little production from this source for some years past. Mention should also be made of the large areas of copper-bearing rock, similar to those in the famous copper-producing state of Michigan, which occur in the vicinity of Bathurst Inlet and Coronation Gulf on the Arctic coast of the Dominion. These areas which give promise of containing large quantities of copper constitute an important future source of supply.

In *Ontario*, which furnished about 31·0 per cent of Canada's copper in 1932, most of the metal is derived from the nickel-copper ores of the Sudbury district by the International Nickel Company of Canada and Falconbridge Nickel Mines, Ltd. The nickel-copper ores, with or without previous concentration, are smelted at, or near, the mines to nickel-copper matte—

Copper stored for shipment at plant of Ontario Refining Company, Sudbury, Ontario.

a mixture of nickel, copper, sulphur, and iron—from which the copper is afterwards separated. Most of the copper produced by the International Nickel Company is separated from the other constituents of the matte and refined electrolytically at Copper Cliff, by the Ontario Refining Company, which operates a plant capable of producing 120,000 tons of refined copper a year; some of the International Company's matte, however, is sent to the company's plant in England for separation of the contained metals and for final treatment; and a third portion is shipped to the United States to be converted, without separation of the nickel and copper, into Monel metal—a so-called natural alloy of copper and nickel. The matte made by Falconbridge Nickel Mines is all shipped to that company's refinery in Norway for final treatment. In 1932 the International Nickel Company produced (sold) 28,831 tons of copper and Falconbridge Nickel Mines, 1,197 tons.

Small amounts of copper ore or concentrate have also at different times been shipped from other mines and prospects in the province, and a certain amount of copper, in the form of copper sulphate, is recovered from the Cobalt silver ore of Cobalt; but the aggregate production from sources other than the nickel-copper ores of the Sudbury district has been inconsiderable.

Quebec furnished about 27·2 per cent of the total copper output of the Dominion in 1932; most of it coming from the rich copper-gold ore of the Horne mine of Noranda Mines, Ltd., situated in the northwestern part of the province. Ore and concentrate from the Horne mine are smelted on the mine, at Noranda, to blister copper. This is then sent to the plant of Canadian Copper Refiners, Ltd., at Montreal East, which is capable of refining 75,000 tons of copper a year, where it is refined electrolytically. In addition to its own ore from the Horne mine, Noranda Mines, Ltd. also smelts custom ores and concentrates from a number of other mines in the surrounding district, chief among which are the Waite-Ackerman-Montgomery, Aldermac, and Amulet mines. In 1932 the output of Noranda smelter was 30,294 tons of copper.

A small amount of copper concentrate in also produced near Sherbrooke, in the Eastern Townships, in southwestern Quebec—one of the oldest mining districts in Canada—where cupriferous pyrites from the Eustis mine is treated by flotation. The copper concentrate obtained at this mine is shipped to the United States for treatment.

British Columbia's copper production, which amounted to 20·4 per cent of that of all Canada in 1932, is now obtained almost entirely from three large mines or groups of mines, viz., the Britannia mine of the Britannia Mining and Smelting Company, Ltd., situated on Howe Sound, on the coast near Vancouver; the Hidden Creek mines of the Granby Consolidated Mining and Smelting Company, Ltd., at Anyox, on Observatory Inlet, on the northwest coast; and the Copper Mountain mine, at present idle, also owned by the Granby Consolidated Mining and Smelting Company, situated near Allenby in the southern interior of the province. The ores on all these mines are low-grade disseminated mixtures of iron and copper sulphides, which have to be concentrated before being smelted. The copper concentrate from the Britannia mine is sent to the United States for smelting and refining; that from the Hidden Creek mine is smelted at Anyox and the resulting blister copper sent for refining, in part to the United States and, in

part, to the Ontario Refining Company's plant at Sudbury, in Ontario. The ore from Copper Mountain mine, until the mine was forced to close down on account of the low price of copper, was concentrated at Allenby and the concentrate shipped, like that from Britannia, to the United States to be smelted and refined.

Formerly most of British Columbia's copper was derived from the rich gold-copper ores of Rossland and the low-grade ores of the adjoining Boundary district in the southern interior, but production from these virtually ceased a number of years ago. The Belmont-Surf Inlet mine on Princess Royal Island also at one time produced considerable copper in the form of rich auriferous concentrate.

Among the many undeveloped or partly developed copper prospects of the province one of the best known is the Coast Copper mine of the Consolidated Mining and Smelting Company of Canada, on the west coast of Vancouver Island.

Manitoba, which furnished about 21·3 per cent of the Canadian output of copper in 1932, is the most recent addition to the list of Canada's copper-producing provinces. Its chief source is the Flin Flon mine of the Hudson Bay Mining and Smelting Company, Ltd., situated on the Manitoba-Saskatchewan boundary, 91 miles by rail northwest of The Pas. The output of this mine, which became productive in 1930, was supplemented in 1931 by that of the Sherritt-Gordon mine[1] at Sherridon, about 40 miles farther north. The ores on both these mines are low-grade mixtures of copper-zinc-iron sulphides that are worked for both copper and zinc. At Flin Flon the ore is concentrated and the resulting copper concentrate is smelted on the mine, the blister copper produced being sent to the Canadian Copper Refiners plant at Montreal, Quebec, for refining. At Sherridon the ore is concentrated on the mine, the concentrate being sent to the Flin Flon plant for smelting; and the blister copper produced there is sent to the Ontario Refining Company at Sudbury, Ontario, for refining. Both mines have known ore reserves large enough to keep them in operation for many years.

In Yukon there are important copper deposits near Whitehorse, from which about 3,000,000 pounds of copper were produced previous to 1921, when the mines were closed on account of high transportation costs and a slump in the price of the metal. Since 1925 there has been a very small occasional production reported of recoverable copper in silver-lead ore exported.

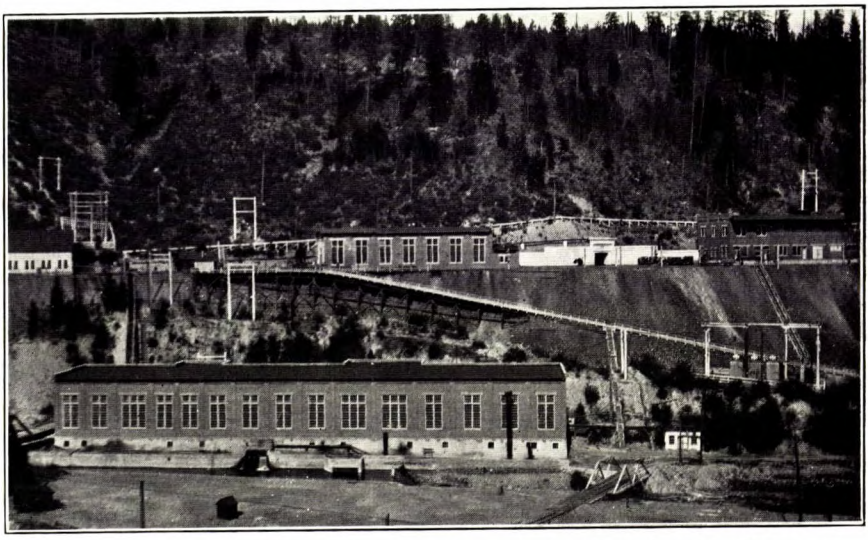
Canada's maximum production of copper for any one year was 151,739 tons valued at $37,948,359 in 1930; in 1932 it dropped to 123,839 tons, valued at $15,294,058. The present productive capacity, however, greatly exceeds the former amount.

World production of copper reached a maximum of 2,127,104 tons in 1929; but had dropped to 1,501,486 tons in 1931. The chief producing countries are, in the order of their importance, the United States (which now produces about one-half of the world's copper), Chile, Africa, and Canada. These are the only countries normally producing more than 100,000 tons annually.

[1] In June, 1932, the Sherritt-Gordon mine found it necessary to close down until copper prices improved.

PLATE VII

A. A concentrating mill at Britannia copper mine, British Columbia.



B. Tunnel portal at Sullivan mine, Kimberley, British Columbia.

USES

Copper is, next to iron, the most useful of all metals. Enormous quantities are used in the form of wires and cables for the transmission of electricity and for the operation of telegraphs, telephones, electric railways, electric lighting, etc.; also in the manufacture of electrical apparatus. Other large quantities go into the making of brasses and bronzes—alloys much used for the manufacture of hardware, and plumbing and electrical fixtures. The automobile industry also requires large quantities of copper in the form of nuts, screws, bolts, etc., and a wide variety of special fittings and mountings; the average car is said to contain about 50 pounds of copper in all forms. Copper is also much used for roofing, shop fronts, and other purposes in the building trades; for sheathing ships' bottoms; and for coinage.

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.

At one time Canada was the world's most important producer of corundum, a maximum output of 2,914 tons of grain corundum having been attained in 1906. With growing competition from artificial abrasives, however, production fell off and, in 1921, ceased entirely.

At present the Union of South Africa is the world's chief source of corundum.

USES

Natural grain corundum finds its chief use as an abrasive, in grinding wheels, etc. It is also used to some extent in the fused state in the manufacture of artificial abrasives. Demand for corundum is small and is decreasing.

The Mines Branch of the Department of Mines has published a report (No. 675) on "Corundum and Diamond" which may be obtained on application to the Director.

DIATOMITE

Diatomite, also known as diatomaceous silica, infusorial earth, tripolite, fossil flour, and kieselguhr, and by such trade names as "Celite," "Filter-Cel," "Calatom," "Pacatome," is, when pure, a white chalky substance made up of the minute siliceous skeletons of algæ. Due to its highly porous nature it finds a number of industrial uses particularly for heat insulation and for filtration purposes. In Canada diatomite is found at many places in Nova Scotia, New Brunswick, Quebec, Ontario, and British Columbia. Almost all the occurrences in eastern Canada are found under lakes or marshes; the most important British Columbia deposits, on the other hand, are massive beds high above the present lakes and rivers in their vicinity.

Prior to 1928 virtually all the diatomite produced in Canada came from *Nova Scotia*. Production started in 1895, at Silica Lake, west of Folly Lake, in Colchester County and at St. Ann in Victoria County, Cape Breton. Latterly the chief source has been New Annan in Colchester County. A

PLATE VIII

A. A diatomite prospect near Quesnel, B.C.

B. A sodium carbonate lake near Kamloops, British Columbia.

plant has also been erected recently on deposits at Little River in Digby County. Of the many known occurrences of diatomite in Nova Scotia, the greater part are confined to the lakes of the Cobequid Mountains in Colchester, Cumberland, and Pictou Counties.

In *New Brunswick*, the chief known deposits are at Pollet and Flood Lakes in Kings County; at Stannard Lake in Albert County; and at Fitzgerald Lake in Saint John County, all in the southern part of the province. In times past, a little diatomite was dug at Pollet Lake and at Fitzgerald Lake.

Of the few known occurrences of diatomite in *Quebec* the most important are those in Chertsey Township, Montcalm County and in Colbert Township, Portneuf County.

In *Ontario*, the known deposits are all confined to the Muskoka Lake region, and, like those in Quebec, are small. A plant capable of producing about 20 tons of diatomite a day has been built at Martin's Siding to treat material from Slocum Lake and another of 3½ to 5 tons capacity at a dry deposit four miles west of Novar.

The largest deposits of diatomite yet found in Canada are those at Quesnel, *British Columbia*, where the material is found in beds high above present drainage level. Small shipments, totalling 650 tons up to the end of 1932, have been made from these deposits.

Maximum production of diatomite in Canada amounted to 1,496 tons valued at $29,509 in 1932. Yearly imports, chiefly in the form of diatomite products from the United States, are estimated at 3,600 tons.

The demand for diatomite has been steadily increasing and world production is estimated to be now 280,000 tons annually. The chief producing countries are: United States, Denmark, Germany, Russia, Algeria, France, Japan, and Ireland.

USES

The three chief uses of diatomite are: as a filter medium, particularly in the sugar industry; as a heat and sound insulator; and as an admixture in concrete, to increase workability and strength. It is also used as a filler in the manufacture of hard asphaltum and rubber products, in metal polishes, absorbents, and other products. In many of its products the presence of diatomite is hidden under a trade name.

A comprehensive report "Diatomite: Its Occurrence, Preparation, and Uses," published by the Mines Branch, Department of Mines, Ottawa, is now out of print, but may be consulted at various libraries throughout the country.

FELDSPAR

Feldspar has been mined in Canada since 1890, most of the output being exported to grinding mills in the United States. There are two feldspar grinding mills in Canada, one at Kingston, Ontario, the other, at Buckingham, Quebec.

The feldspar mined in Canada is chiefly the high-potash variety known as microcline. Soda-feldspar (albite), for which there is less demand, is also produced in small amount.

Ontario and *Quebec* possess large feldspar resources, and there are also potential sources of this material, which have as yet received little attention,

A. Microcline feldspar from Villeneuve, Quebec.

B. Richardson mine, the largest feldspar mine in Canada.

in *Manitoba* and *British Columbia*. The principal producing localities have been Verona, Frontenac County, and Perth, Lanark County, Ontario; and Buckingham, Hull County, Quebec. Until recently Hybla, Hastings County, Ontario, was also an important producing centre; and there has been further small production in the past from deposits in the Sudbury and Parry Sound Districts, Ontario, and at Quetachu Bay, on the lower St. Lawrence River, Quebec. Canadian feldspar enjoys a well merited reputation as a high-grade raw material for use in the ceramic industries; some of that mined at Buckingham, Quebec, being of the special grade known as " dental spar," used in the manufacture of artificial teeth.

In 1932 Canada produced 7,047 tons of feldspar, valued at $81,982; as against a maximum production of 44,804 tons valued at $358,504 in 1924.

The world's normal requirements of feldspar amount to about 500,000 tons annually. The chief producing countries are: United States, Great Britain, Sweden, Canada, France, Czechoslovakia, and Norway.

USES

The chief use of feldspar is in the ceramic industries in the manufacture of pottery, porcelain, floor and wall tile, enamelware, and glass. The next largest use is probably in the manufacture of abrasive soaps and washing compounds. It is also used as a bonding agent in emery and carborundum wheels, in paints, and for other minor purposes.

A report on " Feldspar " (No. 731), has been published by the Mines Branch, Department of Mines, Ottawa, and may be obtained on application to the Director.

FLUORSPAR

Occurrences of fluorspar, or fluorite, are known in Canada in the Provinces of British Columbia, Ontario, Quebec, and New Brunswick, but the only localities in which fluorspar has been mined in important quantities are in the vicinity of Madoc, in Ontario and near Grand Forks, in British Columbia.

In *British Columbia*, the Rock Candy mine near Grand Forks is the largest known deposit of fluorspar in Canada. It was opened in 1918, since when it has been operated intermittently whenever a demand arose, in part to supply material for the production of hydrofluosilicic acid for use in electrolytic lead refining at Trail, B.C., and in part for export. The Grand Forks fluorite as mined contains considerable siliceous matter. It is, therefore, concentrated before shipment and marketed in the form of granular concentrates. There has been no production from the Rock Candy mine since 1929.

In *Ontario*, fluorspar has been mined intermittently, in small quantities, since 1905. It occurs near Madoc, in narrow veins cutting limestone, in part as massive crystalline fluorite, in part in the loose friable form known as " gravel spar." Some veins have yielded beautiful clear and flawless crystals suitable for optical purposes. A number of fluorspar mines were opened in the Madoc area during the war, but in recent years only desultory mining has been done on a few properties.

In 1932, Canada produced only 32 tons of fluorspar valued at $464, all from the Madoc area; as against a maximum production of 17,870 tons valued at $268,120 (practically all from British Columbia) in 1929.

The world's normal requirements of fluorspar amount to about 450,000 tons a year. The chief producing countries are: United States, Germany, France, and Great Britain.

USES

The chief use of fluorspar is as a flux in the making of open-hearth steel, and in other metallurgical industries. It is also used in the making of glass and of enamelled ware, and in refining of metals such as aluminium, lead, and antimony, where it aids in the electrolytic process. It is the source of hydrofluoric acid, and sections cut from clear transparent crystals are used in certain optical apparatus.

A report on "Fluorspar Deposits in Canada" (Economic Geology Series No. 6) has been published by the Geological Survey, Department of Mines, Ottawa, and may be obtained on application to the Director.

GARNET

Garnets are of widespread occurrence in Canada but only a few of the deposits are known to be of such quality as to have commercial value. These are all situated in Ontario and Quebec. The only recorded production of garnet was in 1923 and 1924, when a total of 1,610 tons was produced, all of which came from near Bancroft, in central Ontario. Since 1924 no garnet has been produced in Canada.

In *Ontario,* in addition to the deposits in Ashby Township, near Bancroft, some development work has been done on promising deposits on Parry Island, near the town of Parry Sound, in the district of the same name, and at River Valley, near North Bay.

In *Quebec,* the prospecting of garnet deposits has been carried on in Joly Township in Labelle County, about 100 miles north of Montreal and at Langlade, in Baudin Township, Abitibi County.

In *Nova Scotia,* some attention has been given to a deposit at Chegoggin Point, in Yarmouth County.

The production of garnet is confined largely to the United States, which in the peak year of 1923 produced 9,000 tons, but the output has gradually declined to about 2,200 tons in 1932. A small production has also been recorded in Spain and in the past very small amounts in India and Madagascar.

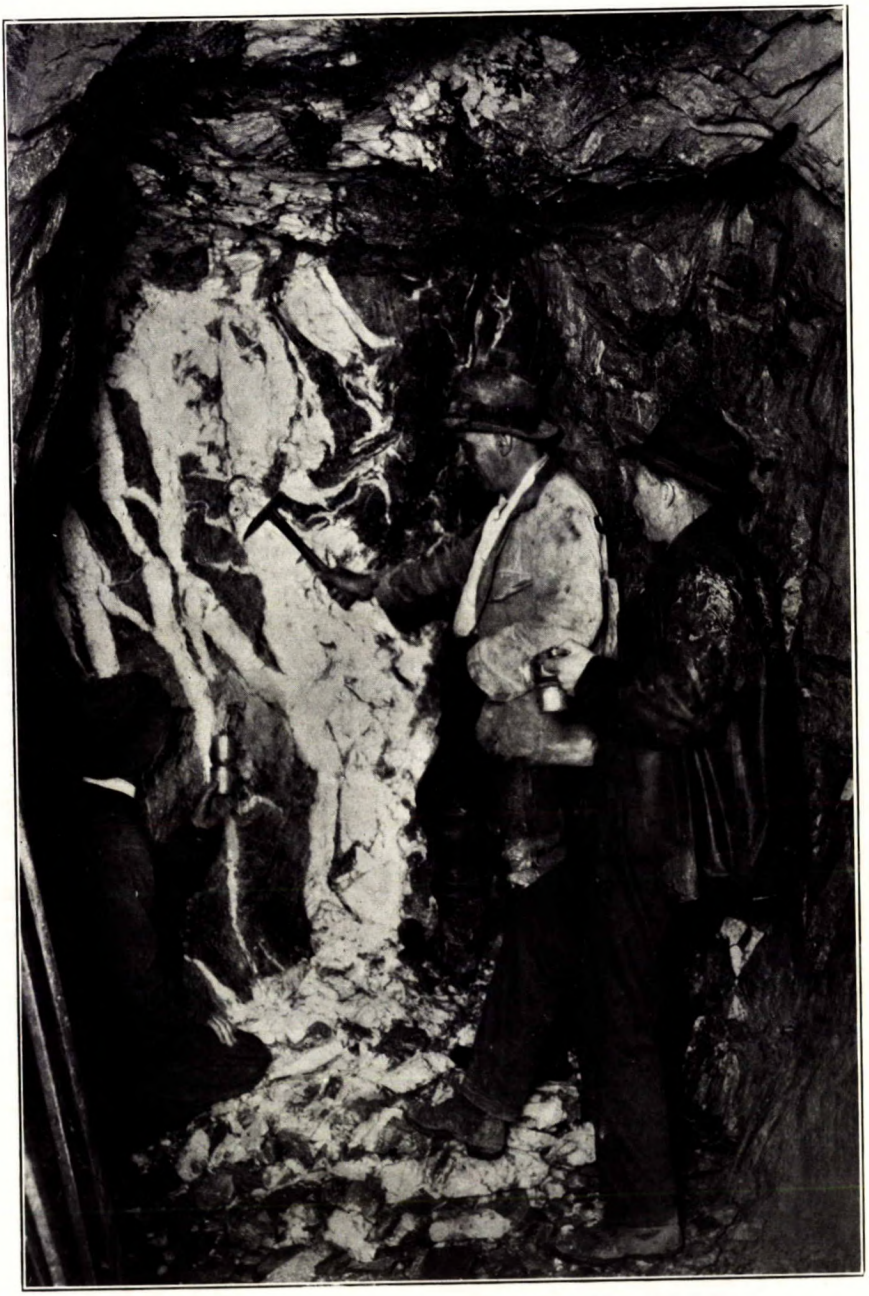
USES

Over 90 per cent of the garnet mined is used for the manufacture of abrasive-coated papers and cloths, for use in wood-working and shoe-manufacturing industries. Lower-priced, loose, fine-grained material is used for surfacing plate glass.

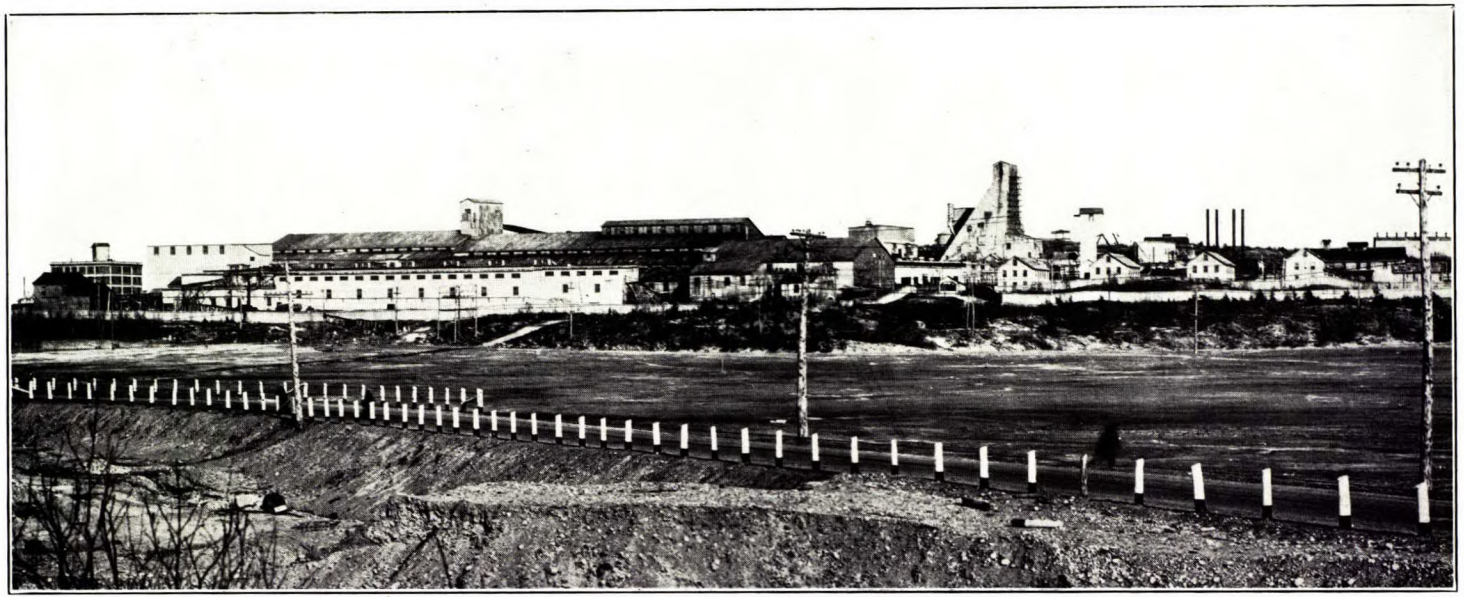
A report (No. 677) on "Garnet" has been published by the Mines Branch, Department of Mines, Ottawa, and may be obtained on application to the Director.

GOLD

Gold in some form has been found in every province of Canada except Prince Edward Island, and is, in point of value, now the most important mineral product of the Dominion. Ontario, by far the most productive province, furnished some 75·0 per cent of the total output in 1932; Quebec, about 13·2 per cent; British Columbia, about 6·5 per cent; Manitoba, 4·0



A gold quartz vein at Porcupine, Ont.



Panoramic view at Hollinger mine, Timmins, Ontario.

per cent; Yukon, about 1·3 per cent; and Nova Scotia, Alberta, and Saskatchewan combined, less than one-tenth of one per cent.

There has been continuous production of more or less gold in *Ontario* for over forty years and sporadic production goes back to 1866 when gold was found near Madoc in southeastern Ontario. In the eighteen-nineties the Lake of the Woods district in western Ontario was the scene of a gold-mining boom of considerable magnitude. It was not, however, until after the discovery of the Porcupine camp in 1908 that gold-mining became established as a profitable industry in this province. At present the Porcupine and Kirkland Lake camps—two small areas some 65 miles apart, situated in the northeastern part of the province—furnish between them over 95·0 per cent of Ontario's gold. The chief producing mines at Porcupine are the Hollinger, McIntyre, Dome, Coniaurum, and Vipond; and at Kirkland Lake, the Lake Shore, Teck-Hughes, Wright-Hargreaves, Sylvanite, and Kirkland Lake Gold. The total value of the production (gold and silver) of the Porcupine camp up to the end of 1932 is $308,037,795 and of the Kirkland Lake camp $125,421,455, or a grand total from these two areas of $433,459,250.

Outside the Porcupine and Kirkland Lake camps, the largest producing gold mine in Ontario is the Howey, in Patricia District in the northwestern part of the province. Other smaller gold mines are being worked at Boston Creek, about 12 miles south of Kirkland Lake; in the Michipicoten district, near Sault Ste. Marie; in Moss Township, 75 miles west of Port Arthur; and in the Matachewan district, about 40 miles southwesterly from Kirkland Lake. In addition to that produced by the gold mines a certain amount of by-product gold is recovered from the nickel-copper ores of the Sudbury district.

Ontario's annual production of 2,280,105 fine ounces of gold worth $47,133,952 in 1932 is the largest yet recorded; the total production to the end of that year is 21,313,060 fine ounces valued at $440,580,472.*

Alluvial gold was discovered in *Quebec* in the valley of the Chaudière River as early as 1835; and it is estimated that between 1846 and 1912 some $2,000,000 or $3,000,000 worth of gold was obtained from that source. The first recorded production of lode gold was in 1901, when by-product gold began to be recovered from the treatment of auriferous pyrites mined in the Eastern Townships. In 1915, zinc-lead ores mined at Montauban in Portneuf County also became a source of by-product gold. Gold production on a large scale, however, did not begin until 1927, when the Horne copper-gold mine in the northwestern part of the province started producing.

At present, the Horne mine, at Noranda in Rouyn Township, is by far the largest producer of gold in Quebec. Originally regarded as essentially a copper mine, the value of its gold output now exceeds that of the copper and, for the time being at least, it is being worked primarily for gold. In addition, there are now a number of gold-quartz mines in operation, chief among these being: the Beattie mine in Duparquet Township; the Siscoe mine in Dubuisson Township; the Granada mine in Rouyn Township; the O'Brien-Cadillac mine in Cadillac Township; and the

* Figures subject to revision.

Bussière, or Treadwell-Yukon mine in Louvicourt Township. Several others are in an advanced state of development and will probably be producing before long.

Quebec's gold output of 401,105 fine ounces valued at $8,291,576 in 1932—its largest annual output yet recorded—places it in second place among Canada's gold-producing provinces, a position occupied by British Columbia previous to 1931. The total recorded production of gold from Quebec, to the end of 1932, is 1,036,533 fine ounces having a value of $21,426,937.*

In *British Columbia*, where gold has been produced continuously, in quantity, since 1858, almost all the production up to 1893 was from placers. At present, however, placer gold forms only about 9 per cent of the annual output, the remainder coming from lode mines.

The most important of these is the famous Premier gold-silver mine near Stewart, at the head of Portland Canal on the north coast, which for a number of years has been the source of more than half British Columbia's output of gold. In the thirteen years from 1919 to the end of 1932 the Premier mine produced 1,280,206 ounces of gold and 32,728,182 ounces of silver; and paid $16,629,503.46 in dividends. The ore deposits on the Premier are now becoming depleted and production is dropping.

Next in importance to the Premier is the Pioneer, a gold-quartz mine, situated in the Bridge River district, in the southern interior of British Columbia. This is an old mine which was reopened a few years ago, with such promising results that it is expected that increasing production from the Pioneer will offset the decline in output from the Premier.

Other gold mines in the province producing considerable amounts of gold are the Bralorne, in the Bridge River district; the Reno, in the Sheep Creek camp, south of Nelson; and the Cariboo Gold Quartz mine in the Cariboo district.

In addition to that derived from gold placers and lode mines, considerable by-product gold is derived from the working of copper ores, chiefly those of the Hidden Creek and Britannia mines, and, to a small extent, from auriferous lead and zinc ores.

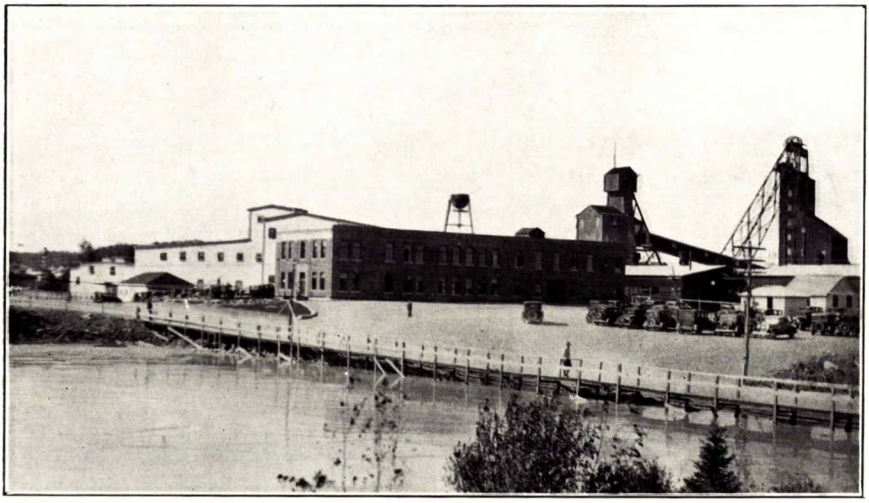
Gold production in British Columbia reached a maximum in 1913, when 297,459 fine ounces valued at $6,149,027 was produced; the output in 1932 was 199,004 ounces valued at $4,113,778. The total recorded production of the province, to the end of 1932, is 10,750,472 fine ounces valued at $222,232,018.*

Manitoba's record as a gold producer is a short one, production beginning only in 1917. Present output is chiefly by-product gold recovered from the copper-zinc ores of the Flin Flon mine, in the northwestern part of the province. Important additional amounts, however, have their source in gold-quartz mines situated in southeastern Manitoba, where the chief producers are the Central Manitoba and the San Antonio mines.

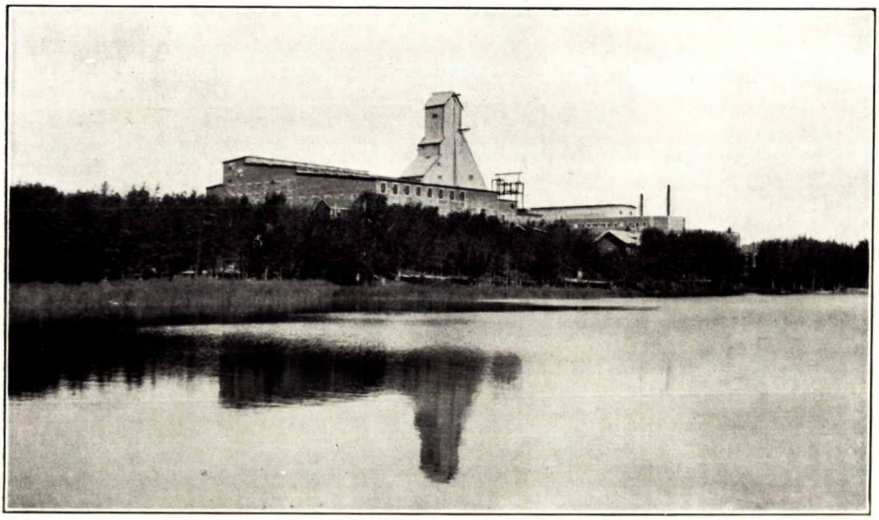
Production of gold in Manitoba in 1932 amounted to 122,507 fine ounces valued at $2,532,444, the maximum annual output to date. Total production to the end of 1932 is 301,172 fine ounces valued at $6,225,776.*

* Figures subject to revision.

PLATE XII



A. Lake Shore mine, Kirkland Lake, Ontario.



B. McIntyre mine and Pearl Lake, Timmins, Ontario.

In *Yukon,* where the once famous Klondike is situated, gold is obtained almost entirely from placers and production from these has long since passed its peak. It has been estimated, however, that there are still in the territory reserves of at least 268,000,000 cubic yards of gravel containing $54,500,000 worth of recoverable gold. Small, but recoverable, amounts of gold also are contained in copper and silver-lead ores which are mined in the Territory. Attempts to develop gold-quartz mines, however, have so far not been successful.

Production of gold in Yukon reached a maximum of 1,077,553 ounces valued at $22,275,000 in 1900; in 1932 it was 40,608 ounces, worth $839,442. The total recorded production to the end of 1932 is 9,014,869 ounces valued at $186,353,531.*

Lode gold mining has been carried on in *Nova Scotia* since 1862; the recovery of some gold being reported every year for the last 70 years. Production, never large, has dwindled latterly to almost insignificant proportions. In 1902, the year of maximum production, an output of 30,348 ounces valued at $627,357 is recorded; in 1932, 964 ounces worth $19,928. The total output of the province to the end of 1932 is 925,632 ounces valued at $19,134,594.*

From time to time for many years past small amounts of alluvial gold have been recovered from the sands of the Saskatchewan River in the Province of *Alberta;* and it is reported that dredging of extensive placers near Peers on McLeod River, in the northwestern part of the province, is now under way. No lode gold has yet been mined in Alberta.

In 1932, Alberta produced 83 ounces of gold valued at $1,716; total production to the end of 1932 is 15,502 ounces valued at $320,453.*

The first recorded production of gold from the Province of *Saskatchewan* was 11 ounces valued at $227, in 1932. Part of the gold recovered from copper-zinc ores at Flin Flon, in Manitoba, will ultimately be credited to Saskatchewan, as the Flin Flon deposits lie partly in the last-named province. Gold-quartz veins are known to occur in the northern part of the province.

Occurrences of gold have been reported in *New Brunswick*, but there has been no production from that province.

Canada's gold production reached its maximum in 1932, when 3,044,387 fine ounces valued at $62,933,063 were produced. The total production of the Dominion up to the end of 1932 is 43,356,920 fine ounces valued at $896,273,558.

World production of gold reached its previous maximum in 1915, when 22,737,520 fine ounces valued at $470,026,251 was produced; in 1932, world production is estimated at 24,014,307 fine ounces.[1]

Over one-half of the world's gold produced since 1920 has come from the Union of South Africa (48·1 per cent in 1932). Other large gold-producing countries in the order of their importance are: Canada, United States, Russia, Mexico, Rhodesia, Australia, British India, etc. Well over 75 per cent of the world's gold now comes from countries within the British Empire.

* Figures subject to revision.

[1] Am. Bur. of Met. Stat., Year Book, 1932.

PLATE XIII

A. Hydraulicking gold-bearing gravels, Cariboo area, B.C.

B. Kirkland Lake gold mine.

USES

By far the most important use of gold is for monetary purposes—as a basis of currencies and for the settlement of trade balances between countries. Outside its monetary use it is employed largely for ornamental purposes, as in jewellery and gilding. It is also used in dentistry, for fountain pens, and in photography.

New editions of two reports on gold mining in Canada have been issued by the Department of Mines; one on "Gold in Canada, 1933" may be obtained by application to the Director of the Mines Branch; the other on "Gold Occurrences of Canada" (Economic Geology Series No. 10) may be obtained by application to the Director of the Geological Survey.

GRAPHITE (NATURAL)

Graphite, in deposits of considerable size, occurs in Canada in the Provinces of Nova Scotia, New Brunswick, Quebec, Ontario, and British Columbia, and in the Northwest Territories. It has been produced commercially in Ontario, Quebec, and New Brunswick. The first graphite mining was done in Quebec as early as 1846, and for many years graphite mining and milling was an active, if small, Canadian industry; most of the producing properties being situated in the Provinces of Ontario and Quebec, within a radius of about 150 miles of the city of Ottawa. In recent years, however, increasing competition from Madagascar and Ceylon graphite in the foreign markets, in which the bulk of the Canadian production must find an outlet, has caused the industry in Canada to decline and at present only one graphite mine is operating—the Black Donald, in Renfrew County, Ontario.

Though there is no recorded production from *Nova Scotia,* occurrences of amorphous graphite have been known for many years—most of them in the Island of Cape Breton; where in 1931, a new and apparently large deposit was found at Glendale, Inverness County.

In *New Brunswick* amorphous graphite was mined intermittently from 1853 to 1908, at Split Rock and Marble Cove near the city of Saint John. Other occurrences of amorphous graphite are recorded at a number of points in Charlotte, Saint John, Westmorland, and Kings Counties. No graphite has been produced in the province since 1908.

Graphite mining in Canada started in *Quebec,* in 1846, on a deposit of crystalline graphite, or plumbago, in Argenteuil County, and intermittent operations were carried on in Argenteuil up to 1899. Disseminated flake graphite was first mined in Quebec, in 1866, in Labelle County; and the industry has centered chiefly in the Townships of Buckingham, Amherst, and Lochaber, in Labelle County. Occurrences of graphite are also known in Hull County and other parts of the province, but there is no record of their having been worked.

Much the larger part of Canada's total production of graphite has come from *Ontario.* Here mining and milling started in 1870 at Port Elmsley, near Perth, Lanark County, and until 1896, when the Black Donald mine, near Calabogie, Renfrew County, commenced operations, this mine was the sole producer in the province. The Black Donald mine, reputedly the largest known deposit of graphite in America, has been operated practically

continuously since 1896, and is at present the only producing graphite mine in Canada. Other properties in Ontario that have produced flake graphite are situated at Wilberforce and at Mumford, Haliburton County, and in North Burgess Township, Lanark County. There are also many prospects scattered over the eastern counties of Ontario, and a few in other parts of the province.

In *British Columbia,* occurrences of graphite are known but there is no record of any attempt having been made to develop them, though in 1930 some attention was directed to one found in 1929 at Mussel Inlet on the coast.

In 1917 and 1918, a few tons of crystalline graphite, said to equal the best Ceylon plumbago, was mined and shipped by the Hudson Bay Company from a deposit near Lake Harbour on the south shore of Baffin Island in the *Canadian Arctic Archipelago.*

Production of graphite in Canada in 1932 amounted to only 346 tons valued at $18,483; as against a maximum production of 3,955 tons valued at $325,362 in 1916.

World production of natural graphite amounts to about 165,000 tons a year. The chief producing countries are: Czechoslovakia, Austria, Chosen (Korea), Germany, Ceylon, Madagascar, and Mexico.

USES

Approximately in the order of their present importance, the chief uses of graphite are: for crucibles to be used in the melting of metals, for foundry facings, for paints, for commutator brushes, for pencils and crayons, for stove polishes, and in lubricants.

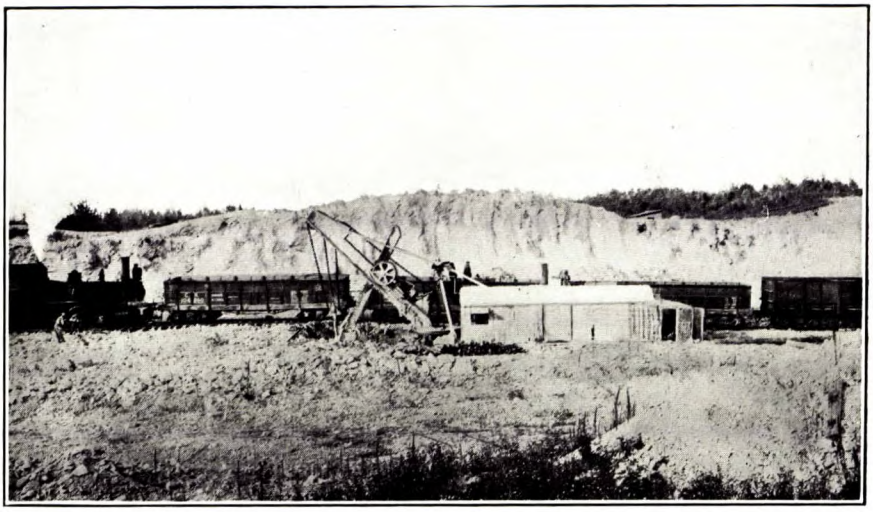
A report on "Graphite" (No. 511) has been published by the Mines Branch, Department of Mines, Ottawa, and may be obtained on application to the Director.

GYPSUM

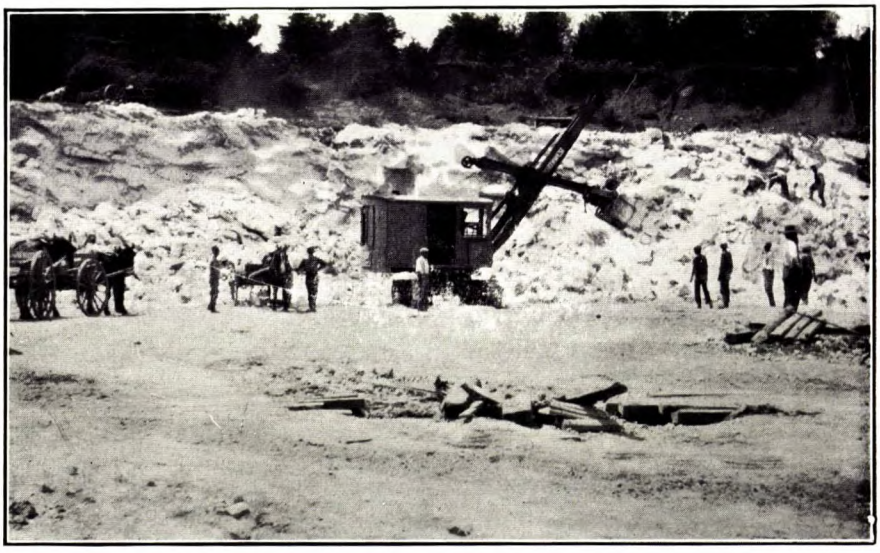
Many large deposits of gypsum are known in Canada distributed through the Provinces of Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba, Alberta, and British Columbia. Up to the present production has been confined to Nova Scotia, New Brunswick, Ontario, Manitoba, and British Columbia.

In *Nova Scotia,* gypsum was quarried and was a standard article of commerce in a small way as early as 1770. It occurs in ten of the eighteen counties into which the province is divided, and over 80 per cent of the gypsum production of the Dominion originates in Nova Scotia. The chief producing centres are Windsor, Cheverie, and Walton, in Hants County, on the mainland; and Iona, Ottawa Brook, Baddeck, Ingonish, and St. Ann, in Victoria County, and Cheticamp and Mabou, in Inverness County, on Cape Breton Island. About 80 per cent of Nova Scotia's output of gypsum is shipped in the crude state to the United States.

In *New Brunswick,* gypsum occurrences are known in Victoria, Saint John, Kings, Westmorland, and Albert Counties. The chief productive centre is Hillsborough, Albert County, where gypsum has been mined for over 80 years. There is also a small production at Plaster Rock, in Victoria County, in the northern part of the province, and from near Petitcodiac, Westmorland County.



A. A gypsum quarry at Gypsumville, Manitoba.



B. A gypsum quarry at Cheverie, N.S.

In *Quebec,* the only known gypsum deposits are on the Magdalen Islands in the Gulf of St. Lawrence. No attempt has yet been made to work these.

In *Ontario,* gypsum has been mined in the valley of the Grand River, north of Lake Erie, since 1822. The present productive centres are Caledonia, Lythmore, and Willow Grove, Haldimand County. Outside the Grand River area, gypsum is found in a number of localities in the country between James Bay and the trans-Canada line of the Canadian National railway, in the far north of the province, but these deposits are still undeveloped.

In *Manitoba,* large deposits of gypsum have been worked at Gypsumville, 170 miles north of Winnipeg, since 1901. At Amaranth, on the west shore of Lake Manitoba a new gypsum deposit has been opened up on the Oakland branch of the Canadian National railway, 54 miles northwest of Portage la Prairie. Gypsum has also been encountered in borings in the southern part of the province.

In *Alberta,* gypsum is known to occur in considerable quantity near McMurray on Athabaska River; along Peace River near Bonille Rapids; near the boundary of Jasper Park; and in other parts of the province. None of these occurrences has as yet been exploited.

In *British Columbia,* gypsum was first quarried in 1911. At present production is entirely from the Falkland quarries, situated about 40 miles from Kamloops by Canadian National railway. Other deposits are known at Spatsum, in the Ashcroft mining division; at Mayook, near Cranbrook; and at Wardner, Bull River, and a number of other points in the province.

In 1932, 438,629 tons of gypsum valued at $1,080,379 were produced in Canada; as against a maximum production of 1,246,368 tons valued at $3,743,648 in 1928.

Complete figures for world production of gypsum are not available, but it is probably in the neighbourhood of 10,000,000 tons annually. The chief producing countries are: United States, France, Canada, Great Britain, and Italy.

USES

Gypsum is the basis of a long list of materials used in the building trades, such as hard wall, cement, flooring and insulating plasters, wallboard, tile, roofing slabs and building blocks. It also has an important use as a retarder in the manufacture of Portland cement. Other uses are for paints and crayons; as a smelter flux, and under the name *terra alba* it has been used as a filler for paper, as an adulterant in foods, and in brewing. Formerly it was much used as "land plaster" or fertilizer but little is now employed for this purpose.

A report on "The Gypsum Industry in Canada" (No. 714) has been published and may be obtained on application to the Director, Mines Branch, Department of Mines, Ottawa.

IRON ORE

No iron ore for blast furnace use has been mined in Canada since 1921. Canadian furnaces now depend entirely on imported ore.

Up till 1895 all the pig iron produced in Canada was made from domestic ores; and a certain amount of iron ore was mined in Nova Scotia

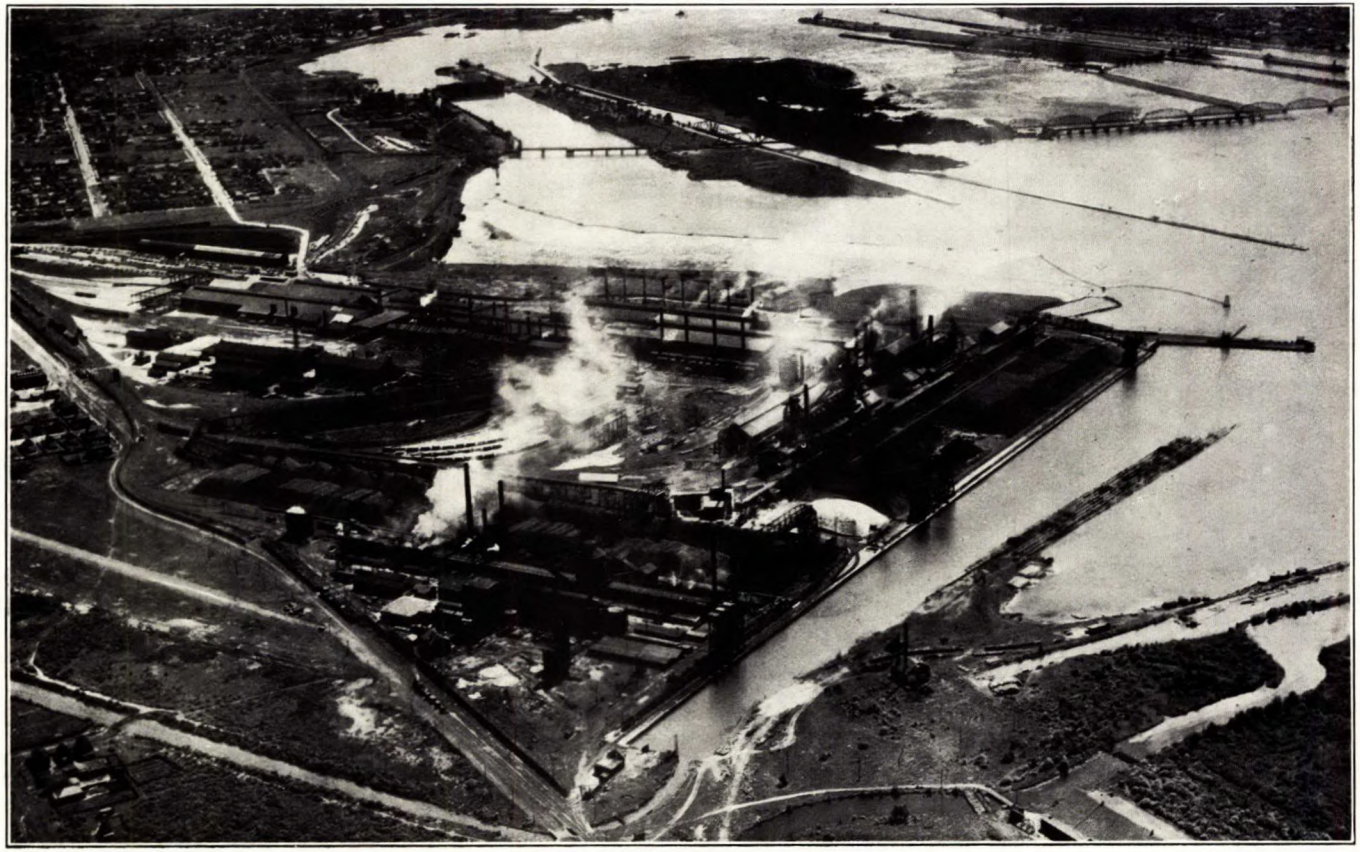
and New Brunswick as late as 1913 and in Ontario till 1921. The ready availability of abundant supplies of cheaper foreign ore, however, makes the use of domestic material uneconomical at present, in spite of the fact that occurrences of iron ore are numerous and widespread in the Dominion. No large bodies of high-grade material are known, but there are very considerable quantities of low-grade iron ore that under slightly more favourable economic conditions could be made commercially available.

In *Nova Scotia* there were at one time important iron-making industries based on local ores at Londonderry, in Colchester County, and at Ferrona, in Pictou County; and iron ore has been mined at various points in Annapolis, Kings, Hants, Cumberland, Colchester, Pictou, Antigonish, and Cape Breton Counties. Nova Scotia's present great iron and steel industry, however, at Sydney, in Cape Breton, is based entirely on ore from Wabana, Newfoundland, supplemented by small amounts of other foreign ores.

In *New Brunswick*, a large deposit of mixed magnetite and hematite ore was worked from 1910 to 1913. The product, some 181,000 long tons, was shipped for export.

In *Quebec*, from 1773 till 1911, small quantities of excellent charcoal iron was made from the bog ores of the St. Lawrence valley, in the vicinity of Three Rivers and of Drummondville. Also a number of attempts have been made in the past to work some of the hard rock deposits that occur scattered over the province, as well as the magnetic iron sands found on the shores of the St. Lawrence River. In northern Quebec, at present beyond the reach of transportation, there are large areas of iron-bearing formation geologically similar to that of the Lake Superior iron ranges.

Ontario has been the most productive of iron ore of any of the Canadian provinces. The Helen mine in the Michipicoten district, north of Lake Superior, yielded 2,875,299 tons of brown hematite of good grade before it was exhausted in 1918; and the Magpie mine in the same district shipped 1,193,480 tons of roasted siderite between 1913 and 1921. The Moose Mountain mine, near Sudbury, which was operated intermittently between 1908 and 1920 produced and shipped during that time nearly 400,000 tons of magnetite concentrates and high-grade sintered magnetite briquettes, obtained by beneficiating a low-grade magnetite ore. There still remains at what is known as the New Helen mine in Michipicoten district, some 80,000,000 or 100,000,000 tons of proved ore very similar in grade and composition to that formerly worked at the Magpie mine; and at the Josephine mine, probably 1,000,000 tons of hematite comparable in grade to that worked at the old Helen mine. Estimated reserves at Moose Mountain contain some 33,000,000 tons of low-grade siliceous magnetite carrying in its natural state about 35 per cent of iron, but which can be concentrated magnetically to a high-grade material carrying well over 60 per cent iron. During the three years 1909 to 1911, 90,680 tons of high-sulphur magnetite, obtained from large deposits at Atikokan, 125 miles west of Lake Superior, was roasted and smelted at Port Arthur; and it is estimated that between 1867 and 1888 there was mined and shipped from numerous small deposits in eastern (old) Ontario, in the aggregate some 500,000 tons of ore, mostly magnetite, that went direct to the furnace without any preliminary treatment except rough cobbing.



Plant of Algoma Steel Company at Sault Ste. Marie, Ontario.

Ontario's two great iron and steel plants—that of the Steel Company of Canada at Hamilton and that of the Algoma Steel Corporation at Sault Ste. Marie—both now obtain all their supplies of ore, as well as of fuel, from the United States.

British Columbia contains numerous undeveloped deposits of iron ore —magnetite, limonite, and hematite, but chiefly of magnetite. The establishment of an iron industry, based on the readily accessible magnetite deposits, and the fuel and flux available on the coast and islands of British Columbia, has often been discussed, but up to the present the prospects for the commercial success of such an undertaking have not been particularly encouraging.

In 1932, Canada imported only 67,567 tons of iron ore valued at $184,-363. In 1929, previous to the present industrial depression, imports of iron ore were 743,713 tons from Newfoundland, 1,640,500 tons from United States and 63,594 tons from other countries; or a total of 2,447,807 tons valued at $5,026,265. The United States ore is all consumed in Ontario furnaces, the remainder in Nova Scotia furnaces.

Three provinces in Canada offer bounties on pig iron produced in Canada from Canadian ore, viz. British Columbia, Ontario, and Quebec.

A detailed report on "Iron Ore Occurrences in Canada" (No. 217) has been published, and may be obtained by applying to the Director of the Mines Branch, Department of Mines, Ottawa, Canada. A more recent report on iron ore occurrences in British Columbia and Yukon (Economic Geology Series No. 3) may be obtained on application to the Director, Geological Survey, Department of Mines, Ottawa.

IRON OXIDES (OCHRES), ETC.

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.

Materials produced under this heading include: ochreous iron oxide, sold uncalcined, for the purification of illuminating gas; and calcined ochreous iron oxide (called metallic oxide), umber, calcined and uncalcined, and sienna, calcined and uncalcined, used in the manufacture of paints.

For many years production has been chiefly from near Three Rivers in *Quebec*. There has also been smaller production from a deposit near Ste. Anne de Beaupre, east of Quebec City and, in past years, from Lynch Township, Labelle County, and from Iberville Township, Saguenay County, also in Quebec. The present producing localities have met the requirements of the domestic pigment trade for the cheaper grades of material for many years; and there are other prospective producing localities, particularly in the low-lying land bordering the lower St. Lawrence River.

In *British Columbia*, small shipments of bog iron ore for the purification of illuminating gas have been made since 1923, from Alta Lake, in the Vancouver district, and from the Windermere district. In 1931, the building of a drying and grinding plant on an ochreous pigment deposit near the Big Bend of the Fraser River—about 8 miles from Quesnel—was in contemplation.

In *Ontario,* ochreous deposits are known in various parts of the province, including Algoma District and Norfolk, Leeds, and Halton Counties. Previous to 1911 there was a small intermittent production from Campbellville, Halton County, but since 1911, there has been no production recorded from this province.

In *Nova Scotia* and *New Brunswick* deposits apparently suitable for pigments are known. There has been some small production in the past from deposits in Colchester County, Nova Scotia.

In 1932, Canada produced 5,240 tons of iron oxides, ochres, etc., valued at $46,161 as against a maximum production of 19,128 tons valued at $157,909 in 1920.

LEAD

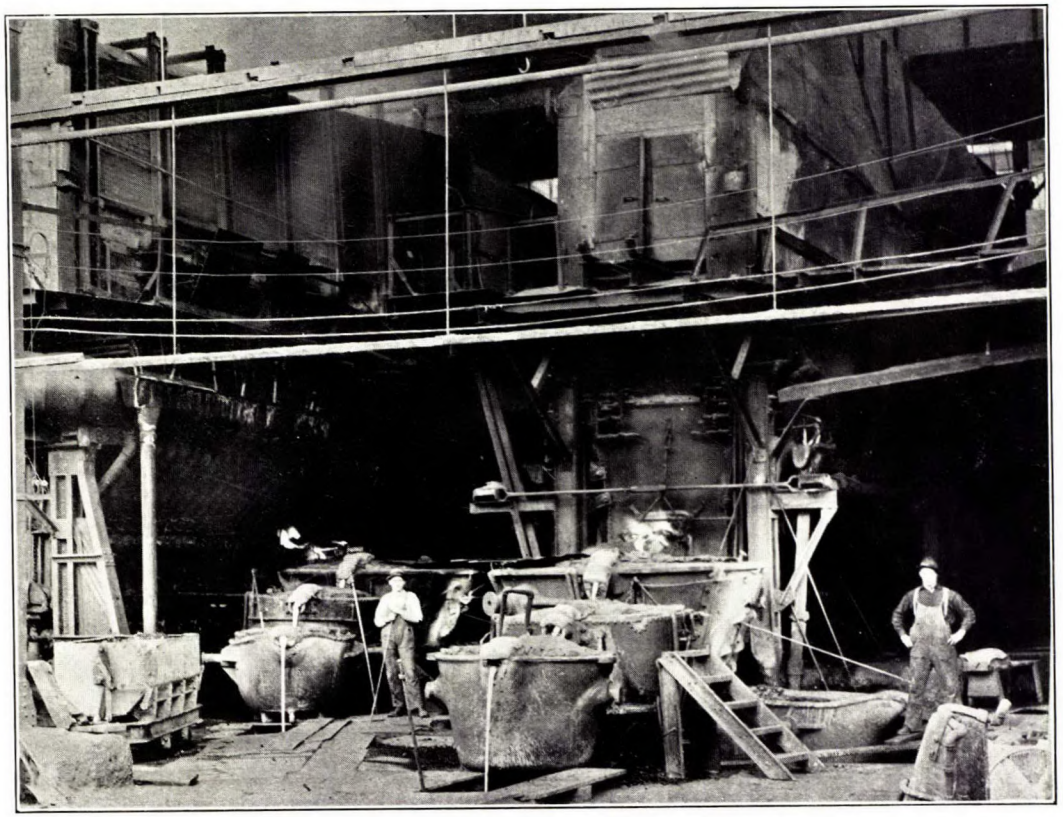
Canada now produces between 9 and 10 per cent of the world's lead. British Columbia, in turn, furnished over 98 per cent of Canada's output in 1932; Yukon and Ontario the remainder. Lead has also been produced in the past in Quebec and in Nova Scotia.

By far the greater part of the lead produced in *British Columbia* has its source in the Consolidated Mining and Smelting Company of Canada's famous Sullivan mine at Kimberley in the East Kootenay district; but many smaller mines scattered over the province—chiefly silver-lead mines in the Slocan and Ainsworth mining divisions in West Kootenay—also contribute to the total. Nearly all the ore shipped is smelted and the resulting lead refined electrolytically at the Consolidated Mining and Smelting Company's plant at Tadanac, near Trail, B.C.; though a few of the independent mines ship their ore or concentrate to the United States for treatment. In 1930, the year of maximum production, 160,902 tons of lead were produced in British Columbia; in 1932, 126,004 tons.

The lead production of *Yukon Territory* is that contained in silver-lead ores, which are mined chiefly in the Mayo district and shipped abroad for treatment. Maximum production of lead in Yukon was 4,448 tons in 1930; in 1932, it was 1,926 tons.

For the last sixteen years the chief source of lead in *Ontario* was the Galetta mine, on the Ottawa River, in Carleton County, which was closed down permanently in May, 1931. For a few years also a certain amount of lead concentrate was shipped from the Treadwell-Yukon lead-zinc-copper mine at Bradley, Sudbury district, but this mine also is now idle. Further small quantities of lead have been recovered as a by-product in the concentration and smelting of silver-cobalt ores. Previous to 1915 small amounts of lead were produced occasionally at various small mines in Frontenac and Hastings Counties. Ontario's lead production has been chiefly pig lead made on the mine at Galetta.

In *Quebec* lead concentrate was produced and shipped from the Tetreault mine at Notre-Dame-des-Anges from 1915 to 1929. Previous to that, small amounts of lead were produced at the Wright mine in Lake Timiskaming and on Calumet Island in the Ottawa River. Considerable work has been done on lead-zinc deposits, on the headwaters of the Cascapedia River, in the interior of Gaspe Peninsula, but so far there has been no production from this source.



A lead-smelting furnace, Trail, British Columbia.

In *Nova Scotia*, a few tons of lead concentrate was made at the Stirling zinc-lead-copper mine in Cape Breton, in 1930, but a sharp fall in the price of metals prevented a continuance of operations. Attempts have been made at various times in the past to develop occurrences of lead minerals at several other points in the province.

Occurrences of galena and zincblende are known in *New Brunswick*, but little work has been done on any of them.

Canada's maximum annual production of lead amounted to 168,974 tons valued at $15,553,231 in 1928; in 1932 it was 127,974 tons valued at $5,409,704.

World production of lead reached a maximum of 1,931,544 tons in 1929. The chief producing countries in the order of their importance in 1931 were: United States, Australia, Mexico, Canada, Spain, and Germany, each of which produced in excess of 100,000 tons.

USES

Large quantities of lead are consumed in the form of white lead, red lead, and litharge, the first two of which are largely used as paint pigments, the last, in rubber manufacture and in glass-making. Other large quantities go into the manufacture of storage batteries, cable covering, and such building material as plumbers' supplies. Somewhat smaller amounts are used in the manufacture of ammunition, lead foil, solder, bearing metal, type metal, terne plate, etc.

A detailed report on "Zinc and Lead Deposits of Canada" (Economic Geology Series No. 8) has been published by the Geological Survey, Department of Mines, Ottawa, and may be obtained on application to the Director.

LITHIUM MINERALS

Lithium minerals in deposits of such size as to be possibly of economic importance are known in Canada. Near Pointe-du-Bois, about 100 miles northeast of Winnipeg, in *Manitoba*, considerable work has been done, since 1925, in opening up a deposit in which the principal minerals are lepidolite, spodumene, and a variety of amblygonite. Other deposits of similar type occur in the same general region.

USES

The principal use of lepidolite is in the glass industry as an ingredient of heat-resistant flint and opal glasses. Spodumene and amblygonite, which contain more lithium than lepidolite, are generally used for the production of lithium salts and chemicals. Metallic lithium has been produced from its ores commercially in a small way by electrolysis and is said to add valuable hardening properties to lead and aluminium and some of their alloys.

MAGNESITE

Deposits of magnesite, magnesium carbonate, of workable size and grade are known in two Canadian provinces, viz: Quebec and British Columbia.

Practically all the Canadian production has come from one small area in the Townships of Grenville and Harrington, in Argenteuil County, *Que-*

bec, where quarrying has been carried on since 1908. The bulk of the material in the Quebec deposits, however, is not strictly speaking magnesite, but high magnesian dolomite.

In *British Columbia,* hydromagnesite deposits of considerable extent occur in the central part of the province and in the Atlin district. Some small shipments were made from the Atlin deposits in 1915 and 1916, and again in 1921; but there has been no production reported from this source since 1921. Also, hard-rock magnesite of good grade is reported to occur in the Bridge River area, in Lillooet mining division, and in the vicinity of Cranbrook in East Kootenay District.

The magnesite at present produced in Quebec is reported either as caustic calcined material or as dead-burned clinker; production in 1932 totalled 8,892 tons valued at $262,860 as compared with a maximum output of 58,090 tons valued at $728,275 in 1917.

World production of magnesite reached a total of well over 1,000,000 tons in 1929, the year of maximum production, the chief producing countries being Austria, United States, Russia, Czechoslovakia, and Greece.

USES

Dead-burned magnesite in grain form or as brick, is used in the metallurgical industries as a refractory material for the lining of furnaces, etc. Caustic calcined magnesite is calcined at a lower temperature than the dead-burned. In conjunction with a solution of magnesium chloride, it is used as a plastic material—oxychloride, or Sorel cement.

The magnesian dolomite quarried in Argenteuil County, Quebec, is used largely as a refractory lining for the bottoms of steel-making furnaces. British Columbia hydromagnesite is used in the preparation of oxychloride cement.

MAGNESIUM SULPHATE (EPSOMITE)

Saline lakes containing natural magnesium sulphate are found in the Provinces of British Columbia, Alberta, and Saskatchewan.

In *British Columbia,* small shipments of this material were made between 1915 and 1923 from Spotted Lake, near Kruger Mountain, in Osoyoos mining division; from a lake near Clinton, in Lillooet mining division; and from several lakes on Basque ranch, 15 miles west of Ashcroft.

In *Saskatchewan* a small amount of magnesium sulphate was produced in an experimental way from the natural brine of Muskiki Lake, near Dana.

The total recorded production of magnesium sulphate in Canada is 8,734 tons, valued at $138,314. There has been no production since 1923.

USES

The Canadian material shipped was refined for use in the drug trade and in the tanning industry.

MANGANESE ORE

There has been a small intermittent production of the manganese oxides—pyrolusite, manganite, psilomelane, and bog manganese—in the Provinces of Nova Scotia, New Brunswick, and British Columbia. Most

of the output has been material suitable for use in the manufacture of dry batteries and in the chemical industry. Deposits of commercial grade capable of maintaining any very large, continuous output are not known.

In *Nova Scotia,* manganese has been mined at Loch Lomond, in Richmond County, Cape Breton Island; at New Ross, in Lunenburg County; at Tennycape, Walton, and Cheverie, in Hants County; and at East Onslow and Londonderry, in Colchester County.

In *New Brunswick,* localities in which some manganese ore has been mined are: Hopewell, Dawson Settlement, and Waterside, Albert County; Markhamville and Jordan Mountain, in Kings County; and Quacco Head, 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.

In *British Columbia,* small shipments at various times have been reported from Cowichan on Vancouver Island; from near Kaslo, on Kootenay Lake; and from Birch Island, in Cariboo district.

Between 1924 and 1929 there was no production of manganese in Canada, but in 1930, 273 tons valued at $1,356 was shipped, 240 tons of it from Albert County, New Brunswick, the remainder from Lunenburg County, Nova Scotia, and from Birch Island, British Columbia. In 1931, 117 tons valued at $2,893 was shipped from Nova Scotia and New Brunswick. No production was recorded in 1932.

World production of high-grade manganese ore reached a maximum of 3,553,000 metric tons in 1927. The chief producing countries are: Russia, British India, Gold Coast, Brazil, and Egypt. The Union of South Africa also gives promise of becoming a very large producer.

USES

Probably over 90 per cent of the manganese ore produced is used in the manufacture of ferro-alloys for use in the steel industry; manganese steels have great hardness and are very resistant to abrasion. Specially pure manganese dioxide is used in the dry cells of radio batteries, in glass-making, and in the manufacture of chemicals.

Manganese-bearing minerals for metallurgical use are classified as: high-grade or manganese ore when they carry 35 per cent or more manganese; ferruginous manganese ore when they carry 10 to 35 per cent; and manganiferous iron ores when they carry 5 to 10 per cent. Prices are quoted per unit (one per cent) of metallic manganese per ton of ore, a minimum metal content generally being stipulated. Ores for chemical use must contain 80 per cent or more manganese dioxide.

A report on "Manganese Deposits of Canada" (Economic Geology Series No. 12) has been published by the Geological Survey, Department of Mines, Ottawa, and may be obtained on application to the Director.

MERCURY, OR QUICKSILVER

The amount of mercury that has been produced in Canada is negligible. In 1895, 1896, and 1897, some 138 flasks of 75 pounds each were produced at a property near Kamloops, B.C., and in 1926 a further very small amount was recovered at the same place. Other occurrences of

mercury-bearing minerals in British Columbia are known, viz: on Sechart Channel, Barkley Sound, Vancouver Island; in the Bridge River district; and in the gold washings at Boston Bar on the Fraser River. Mercury, in amounts so small as to be merely of academic interest, has also been found in some of the silver ores of Cobalt and in some Ontario gold ores.

The world's maximum production of quicksilver, in 1929, reached an estimated total of about 6,000 tons. The chief producing countries in the order of their importance are: Spain, Italy, and United States.

USES

Mercury is used in the manufacture of drugs and chemicals such as corrosive sublimate, calomel, and as a catalyser in the manufacture of glacial acetic acid; and in making of fulminate, for detonating high-explosives. Mercuric sulphide forms the brilliant red pigment, vermilion, and mercuric oxide is used in anti-fouling paint for ship-bottoms. Either as the metal or the oxide, mercury is also used in the manufacture of scientific and electrical apparatus and of thermostats, gas governors, automatic sprinklers, and other mechanical devices; and for vacuum tubes in the radio industry. It is also used for the extraction of gold and silver from their ores. Mercuric nitrate is used in the manufacture of felt hats from rabbit's fur. Minor uses of mercury are in the making of certain compounds for preventing boiler-scale, of cosmetics, of dental amalgam, and of insecticides. Increased consumption of mercury in recent years has been due to increased production of such electrical apparatus as radios, meters, and storage batteries. A new use that promises to become of considerable importance is in mercury-vapour boilers. Considerable amounts are used also in Neon and mercury lights.

MICA

Mica is widely distributed in Canada, but production, which has been practically all phlogopite, or amber mica, has been restricted largely to Ontario and Quebec; the City of Ottawa, on the Ottawa River separating these two provinces, being the centre of the industry.

In *Quebec,* the chief productive amber mica area occupies about 1,200 square miles in the region adjacent to the Gatineau and Lièvre Rivers—tributaries of the Ottawa—in Hull and Papineau Counties. A little has also been mined in Pontiac, Argenteuil, and Montmorency Counties. The more important muscovite, or white mica, occurrences are in the Saguenay District, north of the lower St. Lawrence River, where small quantities have been mined at various times in the past. Small quantities of muscovite are also reported to have been obtained by trading ships operating along the shores of Hudson Strait and the Labrador coast, in the northern part of the province. It is recorded that mica was obtained on the East-main River as early as 1685.

In *Ontario,* amber mica mining has been carried on chiefly in an area of about 900 square miles in the Counties of Lanark, Frontenac, and Leeds, extending from the town of Perth, Lanark County, to Sydenham, Frontenac County. The Lacey mine, near Sydenham, was, before being closed down some years ago, reputed to be the world's largest mica mine. Outside the above area a little phlogopite has been produced from time

to time in the Counties of Carleton, Hastings, and Haliburton. Numerous occurrences of muscovite mica are known, scattered through a wide belt of country stretching from the Ottawa River on the east to Georgian Bay on the west; and in the Sudbury, Lake of the Woods, and Rainy River districts in the newer part of the province. From some of these a little muscovite mica has been won in the past.

In *British Columbia,* muscovite, or white mica, deposits are known on Mica Mountain, near Tête Jaune, Cariboo mining division; in the Big Bend area, on the Columbia River, Revelstoke mining division; and near Fort Grahame, on Finlay River, Omineca mining division. A certain amount of exploratory work has been done on these deposits, especially on the last-named, but so far there has been little production from them.

Production of mica of all grades—rough cobbed, thumb-trimmed, splittings, and grinding-scrap—amounted to 310 tons valued at $6,828 in 1932, as compared with a maximum production of 4,091 tons valued at $357,272 in 1924.

World production of mica probably amounts to about 15,000 tons annually. The chief producing countries are: United States, British India, Canada, Madagascar, and Union of South Africa.

USES

Nearly all the world's production of sheet mica is used for insulating purposes, in the manufacture of electrical equipment. Mica "splittings" are used for making built-up mica plate, employed for the same purposes as natural sheet mica; also layered with paper or cloth, to form flexible wrapping or winding insulations, known as mica paper, mica cloth, mica tape, etc. Mine waste and shop-scrap mica is ground up for use in the manufacture of roofing, lubricants, rubber goods, etc.; and, for its decorative effect, in the surfacing of stucco and plaster; and in concrete. A certain amount of clear sheet muscovite, or white mica, is used in stove doors, furnace windows, goggle eye-pieces, gas masks, and for similar purposes, where both transparency and resistance to heat or shock are required. Coarse ground white mica is also used for Christmas-tree "snow"; and the finest grade for imparting lustre to wallpaper.

A report on "Mica" (No. 701) has been published by the Mines Branch, Department of Mines, Ottawa, and may be obtained on application to the Director.

MINERAL WATERS

Mineral springs are found in many localities in Canada and the waters from these may be classified as follows: *table waters,* in which the principal constituents of the solids consist of bicarbonate of soda; *aperient waters* containing sulphates of magnesium and sodium; and *waters used externally,* as highly saline and sulphur waters. The most important of the Canadian springs have the following location: New Brunswick, Kings County; Quebec, in the Counties of Chambly, Champlain, Kamouraska, Hochelaga, Maskinonge, Quebec, St. Hyacinthe, St. Maurice, Two Mountains, Vercheres, and Yamaska; Ontario, in Bruce, Carleton, Huron, Lanark, Prescott, Russell Counties; in the western provinces in several localities, including Regina and Manitou in Saskatchewan, and the hot sulphur water springs at Banff, Alberta, and West Kootenay in British Columbia.

Many of these springs are operated in connexion with bottling works.

Several Canadian waters have similar composition to well known imported waters although absolute correspondence can scarcely be expected in view of the numerous constituents of a mineral water, and they might well replace these.

In 1932 Canada produced 76,714 Imperial gallons of natural mineral waters, valued at $7,170.

A report on "Mineral Springs of Canada" (Nos. 435 and 472) has been published by the Mines Branch of the Department of Mines and may be obtained on application to the Director.

MOLYBDENUM

Deposits of molybdenite (MoS_2) are known to occur in Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba, and British Columbia, but the only production since 1929 was 1,222 pounds of concentrate made in the Mines Branch Laboratories from ore mined in Bagot Township, Ontario, in 1931. In the year of maximum Canadian production, 1917, 1,554·3 tons of molybdenum ore and concentrates were shipped. Up to the present the Moss mine, near Quyon in Pontiac County, Quebec, has been the chief producer.

In *Nova Scotia* small test shipments of molybdenite ore have been made from prospects at Deep Cove, Gabarus Bay, Cape Breton County; Leminster, near Windsor, in Hants County; and New Ross in Lunenburg County.

In *New Brunswick* molybdenite is known to occur in Stanley Parish, York County and in Pennfield Parish, Charlotte County.

The Province of *Quebec* has furnished over 80 per cent of all the molybdenum produced in Canada to date, though both Ontario and British Columbia have a greater number of known deposits. Much the greatest part of Quebec's production in turn has come from the Moss mine, in Pontiac County. In the same county small shipments have also been made from properties in Aldfield, Alleyn, Clapham, Clarendon, Huddersfield, Litchfield, and Thorne Townships. In Abitibi County a test mill for concentrating molybdenite was built in La Corne Township, but no production from it has been reported since 1929. In Hull County small shipments have been made from Eardley, Egan, and Masham Townships; and occurrences are known at various points in Chicoutimi, Megantic, Portneuf, Saguenay, Témiscamingue, and Terrebonne Counties, as well as in the Territories of Abitibi, Mistassini, and New Quebec.

In *Ontario* more molybdenite occurrences are known and there has been a larger number of producers than in any other province. Production has been confined largely to a belt of territory about 150 miles long, stretching from the Ottawa River, near Ottawa, through the southern part of Haliburton County. The Ross mine, at Mount St. Patrick, in Renfrew County, has been the most important shipper in Ontario. There are also well-known properties in the neighbourhood of Wilberforce, in Haliburton County. Outside of southeastern Ontario many occurrences are known in northern and western Ontario.

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In *Manitoba* molybdenite occurs near Lake of the Woods, in the country east of Lake Winnipeg, and in northern Manitoba. A prospect near Falcon Lake in the Lake of the Woods region is the only one that has received much attention.

In *British Columbia* occurrences of molybdenite are numerous. Some of the localities from which ore has been shipped are: Alice Arm, Skeena mining division; Lost Creek, near Nelson; New Hazelton, Omineca mining division; Texas Creek, in Lillooet; Rossland, Trail Creek division; Olalla, in Osoyoos; and Lac la Hache, Clinton mining division.

The world's maximum production of molybdenum, as contained in ore and concentrate shipped, is estimated to have been about 3,500 tons in 1929. By far the chief producing country is United States, which supplies about 90 per cent of the world's output; Norway comes second with about 7 per cent; and Australia formerly an important producer now accounts for about 2 per cent.

USES

Much the more important use of molybdenum is as a constituent of alloy steels. It is also used in the making of special grades of cast iron. A certain amount of the metal is also used in the manufacture of such appliances as electric lamps and furnaces. Chemical compounds of molybdenum are used as reagents in a number of industries.

A comprehensive treatise on "Molybdenum" (No. 592), its metallurgy, uses, and occurrence, has been published by the Mines Branch, Department of Mines, Canada, and may be obtained on application to the Director.

MOULDING SANDS

Every province of Canada has deposits of various grades of natural bonded moulding sand suitable for use in nearly all foundries making iron, brass, or aluminium castings. Only in the Province of Ontario, however, has the industry, engaged in the production of such sand, made any marked advance. The principal deposits in this province are located in Wentworth and Welland Counties. The next area of importance is in Brant County in the vicinity of Brantford. Elsewhere there has been a small production most of which has been due to the efforts of foundrymen producing for their own use or of farmers who sell to local foundries. Little production has taken place in New Brunswick or Prince Edward Island.

There are also deposits of clean silica sand or others with a slight amount of bond, supplies from which have been used by steel foundries for moulds or by all classes of foundries for core making. The best known deposits of this type are situated on Black Island in Lake Winnipeg, Manitoba; East Templeton, St. Rémi d'Amherst, and near Ville-Marie, Quebec; and at Melford, Nova Scotia.

Canada does not export any moulding sand at present, but for the period of approximately 25 years prior to 1906, a large quantity was exported annually from the area between Ruthven and Leamington, Ontario, to such places as Cleveland, Toledo, and Detroit.

It is estimated that about 75 per cent of our consumption of moulding sand is imported from the United States.

A report is being prepared on the occurrences of natural bonded moulding sand deposits in Canada, which will include the results of a series of standard and tentatively standard tests made on bulk samples collected from the various Canadian deposits.

The production of natural bonded moulding sands in Canada is as follows:—

1930	43,642	tons valued at	$31,768
1931	9,940	" "	13,881
1932	8,493	" "	5,355

NATURAL GAS

Natural gas has been found in Canada in the Provinces of New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan, Alberta, and British Columbia; but production is confined chiefly to Alberta, Ontario, and New Brunswick.

Alberta furnishes about 70 per cent of the total Canadian production; the main productive area being in Turner Valley, where wet gas after being stripped of its naphtha content is piped to Calgary, Lethbridge, and other places to be used for fuel. The Viking gas-field supplies Edmonton and the surrounding district. The Medicine Hat field, the oldest in the province, supplies the city of Medicine Hat, Redcliff, and other neighbouring points. Other productive fields are the old Bow Island field, now being used for the storage of excess gas from Turner valley; the Foremost field; the Brooks field, supplying the town of that name; and the Range well, near the southern boundary of the province, from which gas is exported to the state of Montana.

In *Ontario,* where the production of natural gas has been recorded for 40 years, making it the oldest gas-producing province in the Dominion, the chief gas wells are found just north of Lake Erie in the Counties of Haldimand, Welland, Norfolk, Elgin, Essex, and Kent. The yield from the Ontario gas-fields has been declining for some years, but extensions of these are still being found and new wells being brought into production. A new field, developed on a considerable scale in 1930 and 1931, is situated in Tuscarora Township in Brant County.

In *New Brunswick,* a small gas-field near Moncton supplies that city and the neighbouring town of Hillsboro with natural gas for domestic and industrial purposes.

In *Manitoba,* a small production is obtained from private wells near Coulter, Treherne, and Waskada.

In *Quebec,* a small quantity of natural gas was at one time obtained from wells near Three Rivers; and in 1929, 1930, and 1931, there was considerable activity in exploring for gas in the country south of the St. Lawrence River, between Montreal and Quebec City. Small flows of gas were obtained in some of the wells drilled but none was sufficiently large to be of commercial importance.

In *Saskatchewan,* natural gas has been encountered in wells drilled near Estevan, Riverhurst, and Eastend, in the southern part of the province.

In 1930, the year of maximum production, the natural gas produced and sold in Canada amounted to 29,376,919 thousand cubic feet valued at $10,289,985.

In 1932 Canadian production amounted to 23,420,174 thousand cubic feet valued at $8,899,462, distributed as follows:*

Alberta	15,985,744 M	cu. ft.	valued at	$ 3,820,722
Ontario	7,244,624	"	"	4,544,000
New Brunswick	645,010	"	"	317,603
Manitoba	600	"	"	180

Reports on "Oil and Gas in Western Canada" (Economic Geology Series No. 5) and "Oil and Gas in Eastern Canada" (Economic Geology Series No. 9) have been published by the Geological Survey, Department of Mines, Ottawa, and may be obtained on application to the Director.

NICKEL

Canada produces over 80 per cent of the world's supply of nickel; all of it from the Sudbury district, in the Province of Ontario, except a small quantity recovered as a by-product of the treatment of the silver-cobalt-nickel ores of Cobalt in the same province. The Sudbury ore-bodies are irregular masses of mixed sulphides of iron, copper, and nickel associated with basic igneous rock of the norite type and are found scattered around the edge of an elliptical area about 36 miles long and 16 miles wide. Some of them have been proved to extend in depth to at least 4,000 feet and the known reserves of the district amount to well over 200,000,000 tons that will probably average nearly 3 per cent nickel, thus constituting by far the largest known reserve of that metal in the world.

Production in the Sudbury district is entirely in the hands of two concerns, much the larger and older of which, the International Nickel Company of Canada, smelts its ore in the vicinity of the mines, but refines its nickel, in part, at Port Colborne, Ontario, in part at Clydach, Wales. The other company, Falconbridge Nickel Mines, Ltd., smelts its ore on the mine, but sends the resulting nickel-copper matte to Christiansand, Norway, for separation and final treatment.

Outside the Sudbury district, deposits of nickeliferous pyrrhotite associated with chalcopyrite are known to occur in Ontario at the Alexo mine in Dundonald Township, near the Porcupine gold-field, where there was a small production for a few years, and at Shebandowan Lake, west of Port Arthur; in New Brunswick, near Stephen; in Manitoba, on the Maskwa River in the southeastern part of the province; in British Columbia, on Emory Creek in the Yale mining division; and in the Northwest Territories at Rankin Inlet, 300 miles north of Churchill on the west coast of Hudson Bay.

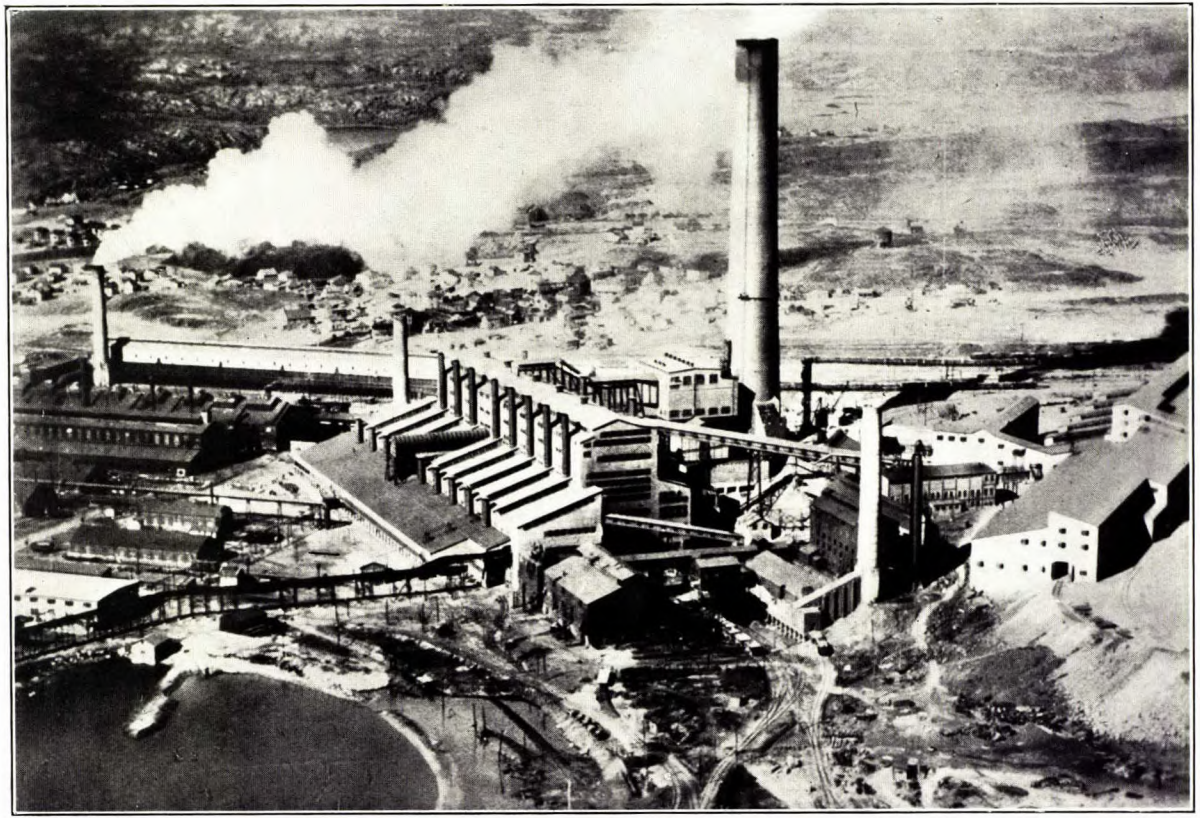
In 1929, the year of maximum production, Canada produced 55,137 tons of nickel, but due to world-wide depression in industry only 15,164 tons in 1932.†

The only other important producer of nickel in the world is New Caledonia.

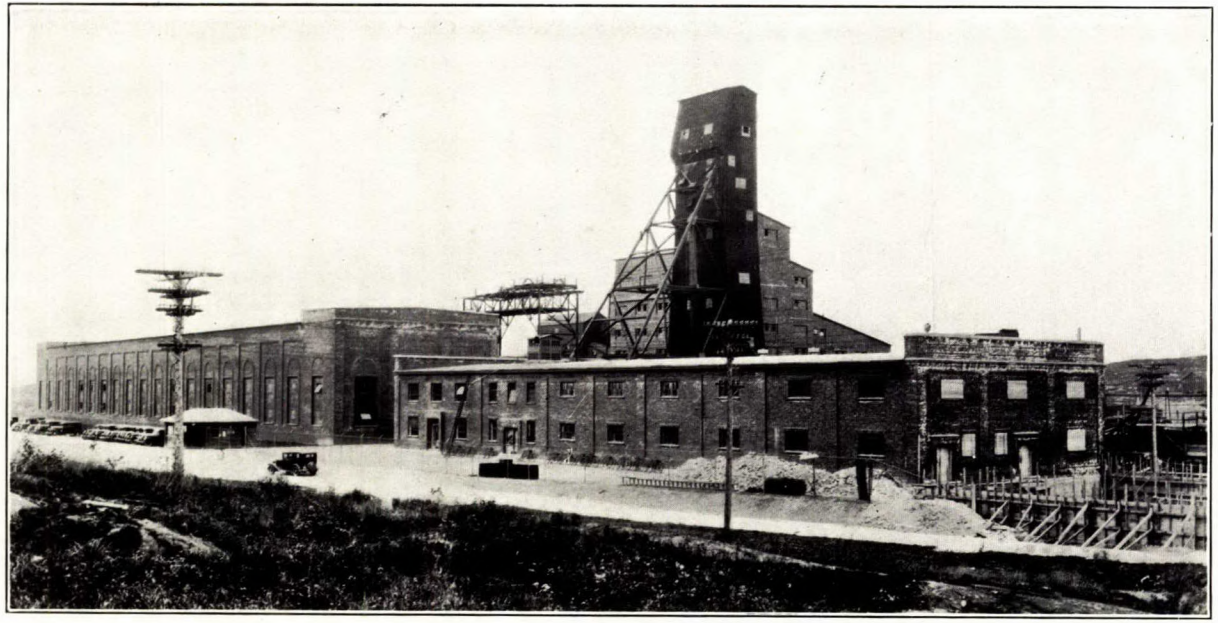
USES

Though nickel does not yet rank in industrial importance with such metals as iron or copper it occupies a very important place in the arts and industries, especially in the form of alloys, to which it imparts its highly

* Figures subject to revision.
† Preliminary figures subject to revision.



Plant of International Nickel Company at Copper Cliff, Ontario.



The Frood nickel mine, Sudbury, Ontario.

useful properties of great strength and resistance to corrosion. Its most extensive use is in nickel steels and nickel cast irons and in Monel metal, an alloy of nickel and copper.

Nickel steels containing one-half to 7 per cent nickel are much used in automobile, aircraft, and locomotive construction and for a great variety of machinery parts, on account of their dependability, high strength and toughness; corrosion resistant steels, carrying 7 to 35 per cent nickel, are used for building trim, cooking utensils, turbine blades, marine fittings, chemical apparatus, etc.; and heat-resistant steels, containing 7 to 35 per cent nickel, in the construction of oil-refining, ceramic, and glass-making plants, in furnace and mill parts in metal-working industries, in equipment for high-temperature chemical processes, etc.

Chilled cast irons containing 4 to 5 per cent nickel combine toughness with great hardness, hence are used for crusher jaws, rolls, etc.; and corrosion-resistant cast irons carrying 12 to 20 per cent nickel, for oil-refinery equipment, automobile and Diesel engine parts, mine equipment, etc.

Monel metal, a so-called "natural" alloy containing about 68 per cent nickel, 30 per cent copper, and about 1·5 per cent iron, is made direct from Sudbury ore without preliminary separation of the nickel and copper. It resembles silver in appearance, is superior to bronze in durability, equals steel in strength, and is amenable to both hot and cold working, hence finds a multitude of uses in a great variety of industries. In aircraft construction it is used for such vital parts as gasoline tanks, propeller sheathing, pontoons, and landing gear; in building construction for roofs, flashing, store fronts, ventilating equipment, and for ornamental interior work, where an untarnishing silver-white metal is desired; in the chemical industry, in many types of apparatus, from evaporators to thermometer bulbs, in which easy cleansing and durability are requisites; in the food industry, for sanitary packing and canning equipment. In the manufacture of equipment for household, hotel, hospital, restaurant and dining-car service, etc., it is used for kitchen-table tops, laundry apparatus, cooking utensils, operating-room accessories, service-counters and service trucks, sinks, soda fountains; in the textile industry for dyeing and finishing equipment; in the pulp and paper industry for a variety of machine parts, to protect the paper from metallic contamination.

Other important nickel alloys are nickel-silver (10 to 30 per cent nickel); nickel bronzes (one-half to 50 per cent nickel), corrosion-resisting white metals (15 to 50 per cent nickel); aluminium and zinc base die castings (one-half to 5 per cent nickel); aluminium alloys (2 per cent nickel); nickel-molybdenum-iron alloys (60 per cent nickel); and nickel-cobalt-titanium alloy (78 per cent nickel).

Pure metallic nickel is used for coinage in 23 countries; as an element in certain types of storage batteries; as a catalyser for the production of edible oils and of soaps; and for a great variety of apparatus used in the aircraft, chemical, dairy, food, petroleum, pulp and paper, and electrical industries.

Nickel anodes and nickel salts are used for electro-plating; and nickel oxide and nickel salts in the chemical industries, and in undercoatings on enamelled ware.

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. However, 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 further attempts have been made in experimental plants erected at Rosevale, New Brunswick, and at New Glasgow, Nova Scotia, but without commercial success.

In so far as is at present known, the most important deposits of oil shale in Canada are those in Albert and Westmorland Counties, New Brunswick and in Pictou and Antigonish Counties, Nova Scotia. Oil shales of somewhat lower grade, but in some cases of very considerable extent, occur in Gaspe County, Quebec; in Lambton and Grey Counties in southwestern Ontario; along the Mattagami and Abitibi Rivers in northern Ontario; in the northern parts of Manitoba and Saskatchewan; and in the Cariboo district and on the Queen Charlotte Islands, British Columbia.

PETROLEUM

Canada's petroleum production is still small—far less than domestic requirements. The only producing provinces are Alberta, Ontario, and New Brunswick. Wells drilled in Manitoba, Saskatchewan, and British Columbia have yielded showings of oil but not in commercial quantity.

Turner Valley, in the Province of *Alberta* now furnishes over 90 per cent of the total production of the Dominion. Most of the wells in the Turner Valley are not, strictly speaking, oil wells but yield " wet gas " from which naphtha—classed as crude oil for marketing purposes—is recovered by condensation. Small quantities of crude petroleum are produced at Wainwright, Ribstone, and Red Coulee. The first recorded production of oil in Alberta was in 1914.

In *Ontario,* where the first oil well in Canada was brought into production in 1861, and which furnished most of the output of the Dominion up to 1925, production has been slowly declining since 1907. The productive wells are all situated in the southwestern part of the province, in the peninsula lying between Lakes Huron and Erie. The Petrolia-Oil Springs field in which production started in 1861 is still the most important producing area. No new fields of importance have been found in Ontario since 1917.

In *New Brunswick* a few thousand barrels of oil have been produced annually since 1910 from the small Stoney Creek oil- and gas-field near Moncton.

In the *Northwest Territories* a flow of oil was obtained in 1920 in a boring on the bank of the Mackenzie River, about 45 miles below Norman. As there was no market for the output in this remote region the field was not exploited at that time; but with the recent activity in the development of rich radium and silver deposits on Great Bear Lake, the Norman well has been reopened and a small plant erected to supply local fuel requirements.

In 1932, 1,044,412 barrels of petroleum valued at $3,022,592 was produced in Canada; in the same year $43,472,870 worth of petroleum and its products was imported. By provinces the production was as follows:

Alberta, 907,661 brls. valued at	$2,760,792
Ontario, 130,343 brls. valued at	247,468
New Brunswick, 6,408 brls. valued at	14,332

There are twenty-six refineries treating crude petroleum in Canada: one in Nova Scotia; one in New Brunswick; four in Quebec; five in Ontario; two in Manitoba; four in Saskatchewan; seven in Alberta; and two in British Columbia. Only three of these, however—the one in New Brunswick and two of those in Alberta—operate entirely on Canadian oil; four others use some Canadian crude; the remaining nineteen operate entirely on imported oils.

Reports on "Oil and Gas in Western Canada" (Economic Geology Series No. 5) and "Oil and Gas in Eastern Canada" (Economic Geology Series No. 9) have been published by the Geological Survey, Department of Mines, Ottawa, and may be obtained on application to the Director.

PHOSPHATE

The mining of apatite, or mineral phosphate, was from about 1878 to 1892 a flourishing industry in eastern Canada—in the Provinces of *Quebec* and *Ontario;* but for many years past the competition of cheaper foreign phosphates has driven the Canadian material off the markets formerly open to it. Most of the present inconsiderable production is a by-product of mica mining—apatite in Ontario and Quebec being found in the same dykes, or veins, as amber mica. The apatite-producing districts are virtually conterminous with those productive of mica. There is little doubt that considerable apatite still remains in formerly exploited deposits in eastern Canada, especially in those in the country bordering the Lièvre River, in Quebec.

Outside Ontario and Quebec, the only province in which phosphate has been mined is *British Columbia.* Here, since 1926, the Consolidated Mining and Smelting Company has been investigating the possibilities of low-grade sedimentary phosphate beds in the Crowsnest Pass area as a domestic supply of raw material for its fertilizer plant at Trail, and has mined and shipped several lots for experimental purposes.

In 1932, 1,316 tons of phosphate valued at $12,333 was produced in Canada. Maximum annual production was 31,753 tons valued at $361,045 in 1890.

World production of phosphate rock (nearly all of sedimentary type) amounts to 12,000,000 tons annually. The most important producing countries are: United States, Tunis, Morocco, Algeria, Ocean and Nauru Islands in the Pacific, Egypt, Russia, France, and Christmas Island. Algeria, Egypt, Morocco, and Tunis combined, produce about 51 per cent of the world's supply; the United States, about 35 per cent.

USES

The chief use of phosphate is in the manufacture of fertilizers. Minor quantities are used in the production of phosphorus, ferro-phosphorus, and in baking powders.

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

PLATINUM GROUP METALS

(Including Platinum, Palladium, Iridium, Rhodium, Ruthenium, and Osmium)

With the exception of a few ounces of platinum recovered occasionally from placers in the Tulameen district in British Columbia and a small amount of platinum and palladium obtained in the process of refining gold at Trail, B.C., the sole productive source of platinum group metals in Canada is the nickel-copper ores of the Sudbury district in Ontario. In these they occur in minute quantities that become concentrated with the copper and nickel during the treatment of the ore and are finally recovered as a by-product, in very important amounts, from the sludge left behind during the refining of the nickel by electrolysis. The sludge from the International Nickel Company's electrolytic nickel refinery at Port Colborne, Ont., is sent to the same company's works at Acton, near London, England, for the final refining and separation from each other of the platinum group metals.

In 1932, Canada produced 27,343 fine ounces of platinum valued at $1,099,393; and 37,613 fine ounces of palladium, rhodium, iridium, etc., valued at $901,890.

Though complete figures are not yet obtainable, it is probable the chief producing countries in the order of their importance now are: Russia, Canada, Union of South Africa, and Colombia.

USES

In the jewellery trade iridium-platinum alloys are used for gem mountings and high-grade jewellery; palladium, to replace 18 karat white gold; platinum and palladium for watch cases, etc.; platinum and palladium and rhodium as an electro-plate finish for jewellery. In the electrical trades palladium and iridium-platinum, ruthenium-platinum, palladium-silver, and platinum-gold-silver alloys are used for contacts in such instruments as thermostats, magnetos, telephone relays, etc.; platinum, palladium, and rhodium-platinum and platinum-nickel alloys for resistor and high-temperature purposes in thermocouple, high-temperature thermometers, vacuum tube amplifiers, electrical detonators, and for heating elements in electrical furnaces. Platinum, palladium, and rhodium are used for electro-plating table utensils such as electric percolators, toasters, reflectors, etc. In chemical industries pure platinum is used as a catalyst in the manufacture of sulphuric acid, rhodium-platinum alloys in that of nitric acid, and palladium in the reduction and hydrogenation of organic compounds. Platinum is used for corrosion-resistant chemical wares; platinum-gold alloys for spinnerets for making rayon fibre; platinum-surfaced equipment for handling corrosive liquids and gases; and platinum-rhodium alloys in heater windings for carbon combustion and porcelain furnaces. In dentistry, iridium-platinum and platinum-palladium-gold alloys are used for pins, lingual bars, etc.; and palladium alloys for high-grade dentures or plates. Platinum is also used to decorate china, glass, and ornamental

tile, and in the production of photographic papers; iridium-platinum alloy for hypodermic needles and cauteries; and platinum and palladium foil to take the place of gold foil where a white, non-tarnishing, decorative surface is desired.

RADIUM AND URANIUM

Since radium is formed by the atomic disintegration of uranium, the two elements are always associated in nature. Radium-bearing minerals occur at various points in Canada and have been mined in two localities.

In 1929, work was started on the development of an occurrence of uraninite in a pegmatite dyke, near Wilberforce, Haliburton County, *Ontario*. A carload of the ore sent to the Mines Branch Ore Dressing Laboratories for test yielded uraninite equivalent to 2·56 pounds of uranium oxide (U_3O_8) a ton, or one gramme of radium from 3,422 tons of ore. A concentrating mill was erected on this property in 1931, but there has been no commercial production as yet.

In 1930, very important deposits of pitchblende, the chief commercial ore of radium, associated with rich silver ore were found on Echo Bay, Great Bear Lake, in the *Northwest Territories*. In 1931, 20 tons of high-grade material from this locality was shipped to the Mines Branch Laboratories for experimental purposes. The results obtained in the treatment of this trial shipment were so successful that a commercial plant for the production of radium salts has been established at Port Hope, Ontario. The Great Bear Lake deposits are believed to be one of the most important sources of radium yet discovered.

USES

By far the more important use of radium is in radium therapy, especially in the treatment of cancer; outside of this it is used chiefly as an ingredient of luminous paint for watch and clock dials, compasses, etc. It is said that the world's total existing supply of radium is less than 600 grammes or a little over a pound, and that this is being added to at the rate of not more than 60 grammes a year.

Uranium, demand for which is small, finds its principal use as ferro-uranium, an alloy employed in the hardening and toughening of steel. Salts of uranium are used to some extent in the glass and ceramic industries as a colouring material; in the textile trade for dyeing; and in photography. The chief countries producing uranium minerals up to the present time have been the Belgian Congo, Czechoslovakia, Madagascar, Great Britain (Cornwall), and Portugal.

The following reports on radium occurrences in Canada have been published by the Mines Branch, Department of Mines, Ottawa, and may be obtained on application to the Director:

The Wilberforce Radium Occurrence (Investigations of Mineral Resources in 1929, Mines Branch Report No. 719.)

The Pitchblende and Silver Discoveries at Great Bear Lake, N.W.T. Report No. 727-3; (Reprint of Section III of Investigations in Mineral Resources and the Mining Industry, 1931.)

The Geological Survey, Department of Mines, Ottawa, has published a report on "Rare-element Minerals of Canada" (Economic Geology Series No. 11) containing chapters on radioactivity and radioactive minerals, which also may be obtained on application.

PLATE XIX

A. Pitchblende (radioactive) from Great Bear Lake.

B. Packing silver ore over a glacier in northern British Columbia.

SALT

Sodium chloride, or common salt, contained either in natural brines or in beds of rock salt, occurs in nearly every province of Canada. Large-scale production, however, has, up to the present, been confined to Ontario and Nova Scotia.

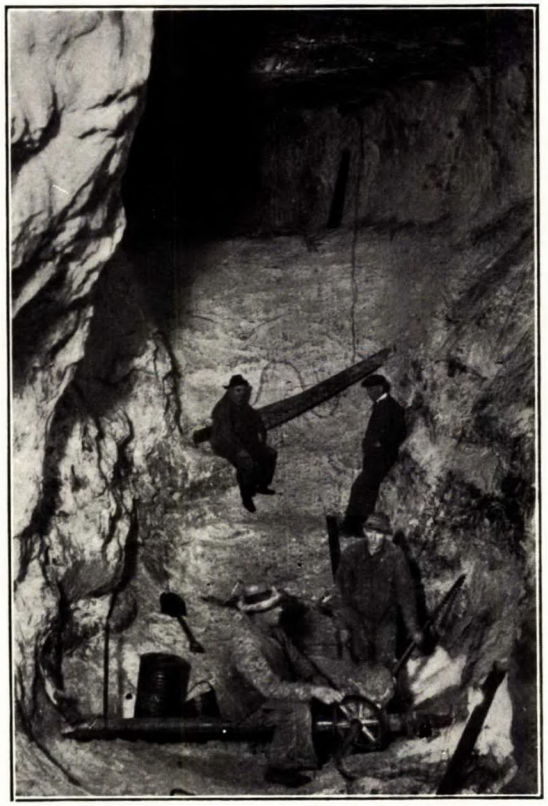
The first recorded output in *Ontario* was in 1866, where the production of salt has long been a most important industry in the southwestern part of the province. The principal producing plants are situated at the towns of Sandwich, Sarnia, Goderich, and Kincardine; and important chemical industries using salt as a basic raw material are in operation at Sandwich and Amherstburg. 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.

In *Nova Scotia,* the occurrence of brine springs has long been known, but early attempts to utilize them commercially for the production of salt proved unprofitable; and it was not until after 1918, when rock salt, hitherto believed not to exist in the province, was found in large quantity in borings made at Malagash in Cumberland County, that commercial production of salt commenced. Since 1919 there has been a steadily increasing production from the Malagash mine, where the salt is won by ordinary underground mining methods at comparatively shallow depths. Rock salt has also been found in deep borings near Amherst in Cumberland County and near Windsor in Hants County.

In *New Brunswick,* saline springs have been known for many years, and at one time small quantities of salt for local consumption were obtained from springs in Kings County. All operations of this kind, however, ceased about 25 years ago. In 1921, a bore hole put down in search of oil and gas near the village of Gautreau, in Westmorland County, passed through an estimated total thickness of 485 feet of rock salt, the hole entering the salt beds at a depth of 1,295 feet. No attempt has yet been made to exploit the Gautreau deposits.

In *Manitoba,* no deposits of rock salt have as yet been found, but numerous brine springs occur 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 1932 a small commercial plant was built at Neepawa to utilize a brine from a deep well. Production from this plant finds a ready local market.

In *Saskatchewan,* the water of Senlac Lake—a spring-fed saline lake situated about 60 miles southwest of Battleford—contains considerable sodium chloride, and between 1919 and 1921 a little salt was produced in a small plant. At Simpson a well drilled for oil and gas in township 29, range 25, west of the 2nd meridian, encountered salt formation and a flow of brine at a depth of 3,435 feet; and a small experimental evaporator has been built to test the possibility of the commercial production of salt. It is also reported that rock salt was encountered in a bore hole at Unity, at a depth of 3,110 feet.



A. Stope in a salt mine, Malagash, N.S.

B. Scene in an Ontario salt works.

In *Alberta,* apparently important beds of rock salt have been found in drill holes at Waterways and McMurray in the northern part of the province and a plant for the production of salt was erected and operated for a couple of years. There has been no production, however, for the last three years.

In the *Northwest Territories,* brine springs in the Mackenzie River valley have been the source of a small production of salt for local use since the early years of the nineteenth century.

In *British Columbia,* a few tons of salt were made experimentally in 1913, at Kwinitsa, on the Skeena River, about 45 miles from Prince Rupert, in a small evaporating plant treating the water from a local salt spring, but there has been no commercial production in this province.

In 1932, Canada produced 263,543 tons of salt valued at $1,947,551; compared with a maximum production of 330,264 tons valued at $1,578,086 in 1929.

World production of salt amounts to over 30,000,000 tons annually, the chief producing countries being: United States, Russia, Germany, China, Great Britain, India, and France; each of which produces upwards of 1,000,000 tons a year.

USES

In addition to the well known uses of salt as a food preservative, as a seasoning, and for refrigerating purposes, it is an essential raw material in many chemical industries, such as the manufacture of soda and of chlorine and their compounds. Minor uses of salt are: in the metallurgical, ceramic, dyeing, tanning, and soap-making industries; and as a fertilizer, a weed-killer, an antiseptic, and for many other purposes.

A report on "The Salt Industry in Canada" (No. 716) has been published by the Mines Branch, Department of Mines, Ottawa, and may be obtained on application to the Director.

SELENIUM

Selenium is an element that closely resembles sulphur in its properties and like the latter exists in at least three allotropic modifications, viz.: vitreous selenium, when it is melted and cooled quickly; crystalline selenium, when precipitated from certain solutions; and so-called metallic selenium, when fused and cooled slowly. In nature it is sometimes found associated with sulphur, but more frequently with sulphides of the heavy metals, as selenides. It is produced entirely as a by-product and was originally recovered from the dust chambers and from the mud of the lead chambers of sulphuric acid plants. The chief source at present is residual slime from electrolytic copper refining. It was produced in Canada for the first time in 1931, at the Ontario Refining Company's electrolytic copper refinery at Copper Cliff, Ontario. It is also found in the residual slime of the Canadian Copper Refiners plant at Montreal, Que.

In 1931, Canada produced about 11 tons of selenium; but no production is recorded for 1932. World production amounts, probably, to only a few hundred tons annually, as demand for selenium is not great.

USES

The chief market for selenium is in the glass and rubber industries. A red glass used for railway signal lamps owes its colour to selenium; and in the rubber industry there has been considerable experimentation in its use as a compounding material. The metallic modification of selenium possesses the remarkable property of changing its electrical conductivity according to the intensity of the illumination to which it is subjected, hence is used in the construction of instruments for the telegraphic transmission of sketches, photographs, etc.; in the photoelectric cell, or electric eye; and in television. For the same reason it is used in photometry. It has also been used to some extent in gas buoys and for exploding torpedoes.

SILICA

Silica in the form of sand, sandstone, quartzite, or quartz is widely distributed in Canada, and since 1906, there has been a steady commercial production of these materials for utilization in various domestic industries.

Crude silica sand from Black Island, in Lake Winnipeg, Manitoba, has been used in the manufacture of bottle glass; as has also sand from Beauséjour in the same province. Silica sand prepared from friable sandstone or quartzite by crushing, washing, drying, and screening is produced at Melocheville, East Templeton, Lac Rémi, and Guigues, in Quebec, for use in glass-making, in steel foundries, in sand-blasting, in filtration plants, etc. Silica sand prepared from rock quarried at St. Canute, Quebec, is used in the manufacture of carborundum and other purposes.

Quartzite is quarried at various points in Nova Scotia, Quebec, Ontario, and British Columbia, for the manufacture of silica brick and of ferro-silicon.

Quartz for smelter flux is quarried in Quebec, Ontario, and Manitoba; and in Quebec, considerable quartz is sorted out at the feldspar mines and sold for the manufacture of ferro-silicon.

In 1932, 189,132 tons of silica sand and quartz valued at $276,147 was produced in Canada, as compared with a maximum production of 282,522 tons valued at $523,933 in 1928.

The following reports on "Silica in Canada: Its Occurrence, Exploitation and Uses" have been published by the Mines Branch, Department of Mines, Ottawa, and may be obtained on application to the Director:

"Silica in Canada," Part I, Eastern Canada (No. 555).

"Silica in Canada," Part II, Western Canada (No. 686).

SILVER

Silver, formerly second, is now fifth as regards the value of its annual production, among the metals produced in Canada. It is recovered largely as a by-product of the working of base-metal ores, chiefly those of copper, lead, and zinc, and of gold ores—in which last it is always found alloyed with the gold; with the exhaustion of the richer deposits of silver-cobalt-arsenic at Cobalt, in Ontario, and the unprecedented fall in the price of silver, the working of ores primarily for silver has declined greatly. The producing provinces in the order of their importance are: British Columbia, Ontario, Yukon (Territory), Manitoba, Quebec, Nova Scotia, and Alberta.

In *British Columbia*, most of the silver is produced at the Consolidated Mining and Smelting Company's plant at Trail, chiefly from the ore of the same company's Sullivan lead-zinc mine at Kimberley, but, in part from argentiferous lead and zinc custom ores shipped to Trail from numerous small mines scattered over the province. Next to the Sullivan lead-zinc mine, the Premier gold-silver mine is the most important producer of silver in British Columbia. Of the total production of the province in 1932, amounting to 7,293,462 fine ounces, much the greater part was produced by these two mines; the remainder having its source in silver, copper, lead, and zinc ores, in gold bullion, and in alluvial gold.

In *Ontario*, which produced 6,335,788 ounces of silver in 1932, the chief source is still the silver-cobalt ore of Cobalt and outlying camps; next, the nickel-copper ore of Sudbury. Important amounts are also recovered from the crude gold bullion of the gold mines.

In *Yukon*, which produced 3,053,188 ounces in 1932, all but 9,084 ounces was contained in silver-lead ore exported.

In *Manitoba*, the 1,036,497 ounces produced in 1932 was recovered chiefly in blister copper from the copper-zinc ore of the Flin Flon and Sherritt-Gordon mines. In addition a small amount was contained in bullion from the gold mines.

In *Quebec*, the 628,902 ounces produced in 1932 was chiefly that contained in blister copper made from Horne mine copper-gold ore; though small amounts were also contained in gold bullion produced on the gold mines and in copper ore or concentrate exported.

The insignificant production from *Nova Scotia* and *Alberta* in 1931 was silver contained in gold bullion in the former, and in alluvial gold in the latter province.

The total production of silver in Canada in 1932 amounted to 18,347,907 fine ounces; as against a maximum of 32,869,264 fine ounces in 1910, when the Cobalt camp in Ontario was at the height of its prosperity. Recent finds at Great Bear Lake in the Northwest Territories, of silver ore rivalling in richness the richest found at Cobalt, may prove to be a source of largely increased Canadian production in future.

The estimated world production of silver in 1932 was 168,737,400 fine ounces; as against a maximum production of 261,715,000 fine ounces in 1929. The chief producing countries in the approximate order of their importance are: Mexico, United States, Canada, Australia, India, Peru, Germany, Japan, and Bolivia.

USES

The two important uses of silver are as money and in the arts. In China, it is the standard money, in India the currency of the country, and outside China and India its use for subsidiary coinage is practically universal. In the arts silver is used chiefly in the manufacture of articles of luxury such as jewellery, tableware, and toiletware. There is also some consumption of silver in certain chemical industries and considerable quantities in the form of silver salts are used in the photographic and moving picture industries.

SODIUM CARBONATE

A number of lacustrine deposits of natural sodium carbonate are known in the Province of British Columbia and since 1921 there has been a small annual production, chiefly from some of those in the Clinton mining division. Shipments have been made from Rose Lake, near Coulson, on the Pacific Great Eastern railway; from Davison Lake, on the Cariboo road; and from the Salso claims, in the Kamloops mining division.

In 1932, 495 tons of sodium carbonate valued at $5,450 was obtained from these sources, as compared with a maximum production of 1,120 tons valued at $8,140 in 1925.

USES

The principal uses of sodium carbonate are: in the manufacture of glass, soap, and paper; in the purification of oils; in the bleaching and washing of linen, cotton, and wool; and in the dyeing and printing of textiles. It is also used as a preventive of the formation of boiler scale.

PLATE XXI

Working a sodium sulphate deposit at Horseshoe Lake, Saskatchewan.

SODIUM SULPHATE

Natural sodium sulphate (Glauber's salt and salt cake) in the crystal form and in the form of saturated brines is found in numerous lakes and sloughs scattered over the Prairie Provinces and British Columbia in western Canada. All production at present is from the Province of Saskatchewan, where four plants, one at Dunkirk, one at Ormiston, one at Alsask, and one at Palo, are in operation, producing either hydrated sodium sul-

phate, known in the trade as Glauber's salt, or anhydrous sodium sulphate, known as salt cake.

In 1931, natural sodium sulphate to the value of $421,097 was produced in Canada—the maximum output since production started in 1921. In 1932 the output had a value of $271,736.

USES

Sodium sulphate is used extensively in the pulp and paper industry—in the manufacture of kraft papers; also in the glass-making, dyeing, and textile industries. A large part of the Canadian output is sent to Copper Cliff, Ontario, to be converted into nitre cake for use in the metallurgical treatment of nickel-copper matte. It also finds use to a smaller extent in medicine and in tanning.

A report (No. 646) on "Sodium Sulphate in Western Canada: Occurrence, Uses, and Technology" has been published by the Mines Branch, Department of Mines, Ottawa, and may be obtained on application to the Director.

STONE (BUILDING, MONUMENTAL, AND CRUSHED)

Canada possesses, widely distributed and in great abundance, nearly every kind of stone, useful or decorative, that is used for structural, monumental, or industrial purposes.

Quebec is the chief stone-producing province, accounting for about 46 per cent of the tonnage shipped in 1932; Ontario is second with about 44 per cent; followed, in the order of tonnage produced, by British Columbia, Manitoba, Nova Scotia, New Brunswick, and Alberta.

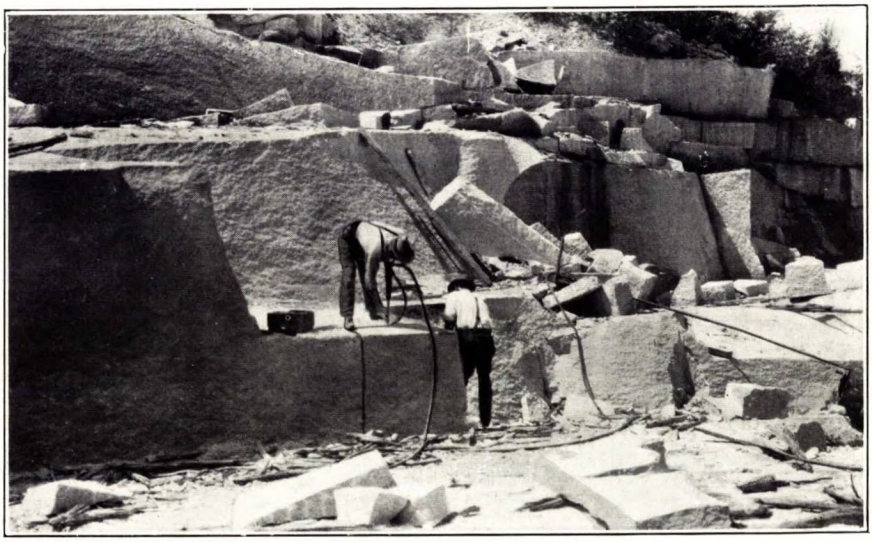
GRANITE

Granite—including under that heading, in addition to granite proper, syenite, trap-rock, and other igneous rocks—is produced in considerable quantities in the Provinces of Nova Scotia, New Brunswick, Quebec, Ontario, and British Columbia. A large part of the output, especially in Quebec, Ontario, and British Columbia, is used in road building and for railway ballast. Considerable quantities, also, are produced for building stone, for paving blocks and curbstones, and for monumental purposes.

LIMESTONE

Limestone is quarried in all the provinces of the Dominion except Prince Edward Island and Saskatchewan. About 64 per cent of the total output is marketed as crushed stone for use as road metal, railway ballast, and concrete aggregate; about 5 per cent for smelter flux; 2·5 per cent for use in pulp and paper plants, sugar refineries and various chemical works; 1·5 per cent as building, monumental, and ornamental stone; and the remainder as rubble and riprap, flagstones, agricultural limestone, poultry grit, etc. In Ontario, Quebec, and Manitoba most of the output is sold as crushed stone for railroad ballast, road metal, etc., the chief quarries producing dimension stone also are in Quebec, Manitoba, and Ontario. In Nova Scotia the chief output of limestone is for smelter flux and for use in pulp and paper mills; in New Brunswick, for agricultural purposes. Tyndall limestone from Garson, in Manitoba, Queenston limestone from Queenston, Ontario, and Deschambault limestone from St. Marc des Carrières, Quebec, are extensively quarried for building purposes.

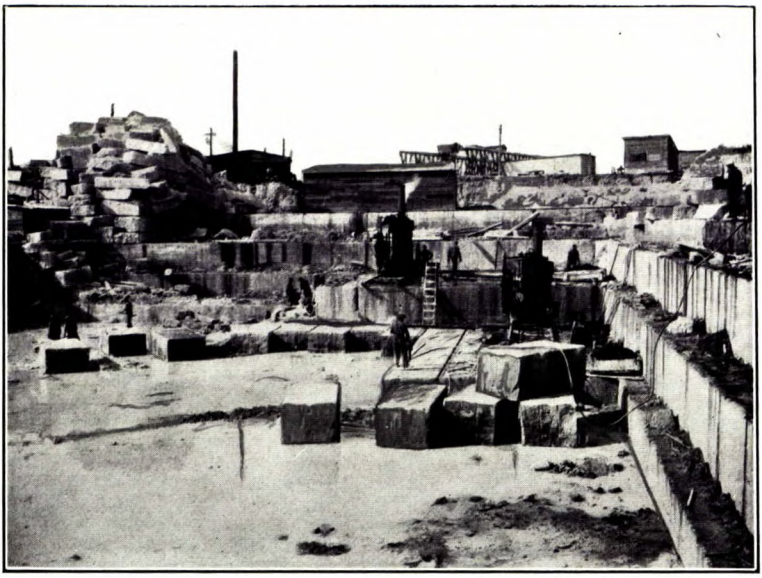
PLATE XXII



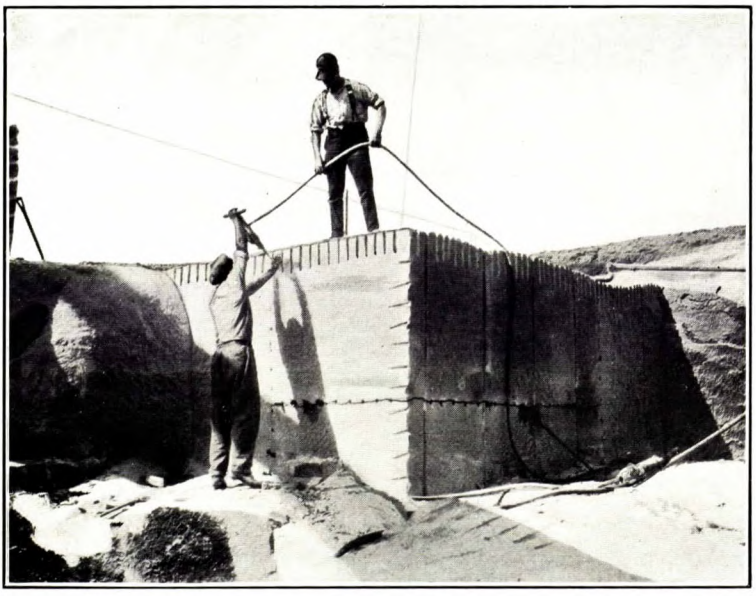
A. Breaking out curbstone, Quebec.

B. Sandstone quarry, Wallace, Nova Scotia.

PLATE XXIII



A. No. 2 quarry, Western Stone Company, Garson, Man., showing channelling machines at work.



B. Method of splitting out a mill block at Queenston quarry, St. Davids, Ont.

MARBLE

Marble is quarried in Quebec, Ontario, Manitoba, and British Columbia. In addition, there are throughout the Dominion many still unexploited deposits of crystalline limestone and serpentine, tinted and figured in a way which suggests that they could be made to yield marbles of great beauty. The principal centre of marble production in Canada at present is at Phillipsburg, Quebec, where handsome clouded grey marbles are obtained. At Bancroft, Ontario, a striking brown-veined breccia as well as several varieties of coloured marble are obtained. In Manitoba, mottled marbles, some gold and buff, others deep reds, are quarried about 100 miles north of Winnipeg; and in British Columbia, white and blue-grey marbles, near the north end of Kootenay Lake.

SANDSTONE

Sandstone is quarried in all the provinces except Manitoba and Saskatchewan, chiefly for crushed stone and building stone, though for the last-named purpose there are about nine times as much limestone and over twice as much granite as sandstone used in the Dominion. A certain amount of sandstone is also used as flagstones. Probably the best known Canadian sandstone used for building purposes is the Credit Valley stone, quarried in Ontario.

SLATE

Slate for roofing material, mantles, and slabs was quarried south of the St. Lawrence River in Quebec from 1854 to 1923, but there has been no recent production from this source. Small amounts of slate for the manufacture of roofing material have also been quarried occasionally in Nova Scotia and British Columbia.

In 1930, the year of maximum production, Canada produced:

Granite	1,851,132	tons	valued	at	$3,379,951
*Limestone	7,732,675	"	"	"	8,075,616
Marble	26,089	"	"	"	809,582
Sandstone	384,610	"	"	"	769,060

In 1932, production was:

Granite	398,025	tons	valued	at	$1,037,851
*Limestone	3,887,927	"	"	"	3,332,929
Marble	11,424	"	"	"	247,480
Sandstone	506,534	"	"	"	549,126

* Does not include limestone used in the making of lime and cement.

The Mines Branch of the Department of Mines has published a report (No. 733) on "Canadian Limestones for Building Purposes," which may be obtained on application to the Director. Reports on granites and crystalline metamorphic building stones and on sandstones are being prepared.

SULPHUR AND PYRITES

Workable deposits of native sulphur are not known to occur in Canada; but deposits of sulphide of iron, or pyrites, are widespread and a number of these have been worked for their sulphur content, commercial production of pyrites having been carried on in the Provinces of Quebec, Ontario, and British Columbia. There is also an increasingly important recovery of waste sulphur gas from metallurgical plants treating base-metal sulphide ores.

In *Quebec,* cupriferous pyrites has been mined in the Eastern Townships for the production of sulphuric acid and copper since 1871 at least, and for many years Quebec was the chief producer of pyrites in Canada. At present the most noteworthy producer is the Aldermac mine in northwestern Quebec. The Aldermac ore—cupriferous pyrites—is treated by fine-grinding and flotation to produce a marketable copper concentrate and a pyrite concentrate adapted to the production of sulphurous gases by the Freeman flash-roasting process.

In *Ontario,* a large number of deposits have been worked for pyrites, the chief producing centres being in northwestern Ontario—where pyrites was mined for the production of sulphuric acid as early as 1868; the Goudreau area, in the Michipicoten district, north of Sault Ste. Marie; and the Northpines mine near Sioux Lookout, 200 miles northwest of Port Arthur. For a number of years, however, the production of pyrites in Ontario, as elsewhere in Canada, has been adversely affected by the competition of cheap foreign sulphur. Since 1925, also, waste sulphur gas from the nickel-copper smelters at Sudbury has been used in steadily increasing quantities for the production of sulphuric acid.

In *British Columbia,* pyrites has been produced as a by-product of the concentration of the copper ore of the Hidden Creek mines at Anyox and of the Britannia mine on Howe sound; and of the lead-zinc ore of the Sullivan mine at Kimberley. Large quantities of formerly waste sulphur gas from the Consolidated Mining and Smelting Company's smelter, also, are now being utilized in the making of sulphuric acid for use in the same company's fertilizer plant at Trail.

The estimated quantity of sulphur contained in pyrites shipped and in waste gases utilized in Canada, in 1932, amounted to 53,172 tons valued at $470,014. In 1917, 416,649 tons of pyrites containing 155,453 tons of sulphur and valued at $1,610,760 was shipped.

World production of sulphur amounts to approximately 3,000,000 tons, and of pyrites to about 8,000,000 tons annually under normal conditions. The chief countries producing sulphur are the United States, Italy, and Japan; those producing pyrites, Spain, Norway, Italy, Japan, Portugal, United States, and Germany.

USES

Much the most important use of sulphur and of pyrites is for the manufacture of sulphuric acid, which in turn is an essential material in a large number of chemical and metallurgical industries such as the explosives industry, the fertilizer industry, petroleum refining, and the iron and steel industry. Both also have an important use in the wood pulp industry, where they are burned for the production of the sulphur dioxide used in the preparation of the solvent liquors employed in the manufacture of sulphite pulp.

TALC AND SOAPSTONE

Both talc in its purer forms and talcose rocks known as soapstone are known to occur in extensive deposits at numerous places in Canada—in the Provinces of Ontario, Quebec, and British Columbia.

Deposits near Madoc, in southeastern *Ontario*—the chief centre of talc production in the Dominion—are to be included among the most important deposits of high-grade talc on the American continent. They yield a fine, white, foliated talc that has no superior for certain purposes. In western Ontario, soapstone is of widespread occurrence in the country lying between Port Arthur and Kenora; and a plant for the production of cut soapstone was, for a time, in operation near Vermilion Bay, in the Lake of the Woods district.

In *Quebec*, soapstone in block form has been produced at Robertson and Broughton, in the Eastern Townships, since 1922; and other deposits, some of which have been opened up, are known to occur in the extensive belt of serpentine rocks that traverses this district.

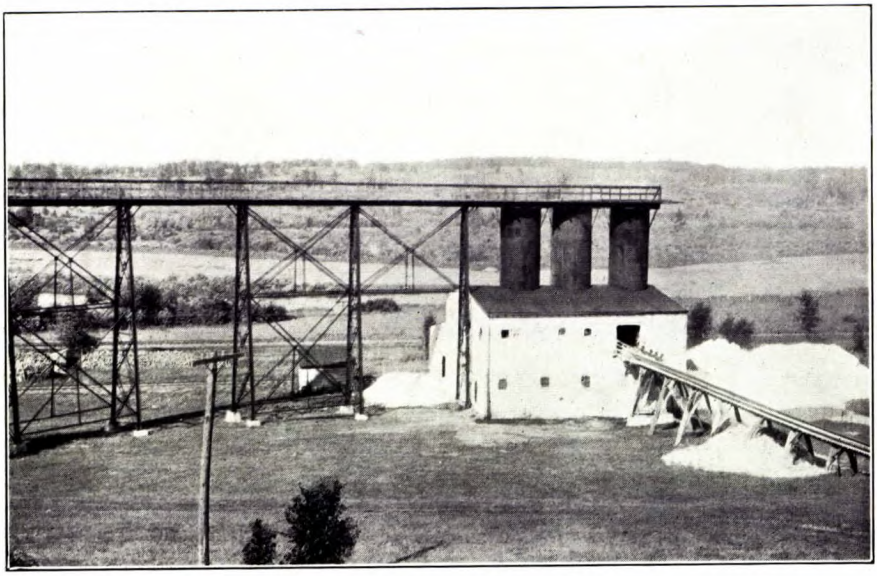
In *British Columbia*, deposits of talc are known in the Windermere, Yale, Lillooet, and Victoria mining divisions. In the Victoria mining division (on Vancouver Island) small amounts of talc have been mined intermittently since 1919. Recently, attention has been drawn to deposits of high-grade massive talc (steatite) found near Vermilion Summit, at the base of Mount Whymper, in the Windermere mining division, as well as elsewhere along this section of the Alberta-British Columbia boundary.

Canadian production of talc reached a maximum of 21,671 tons valued at $166,934 in 1920; in 1932, production was 12,103 tons of talc, valued at $112,287, and soapstone to the value of $46,751.

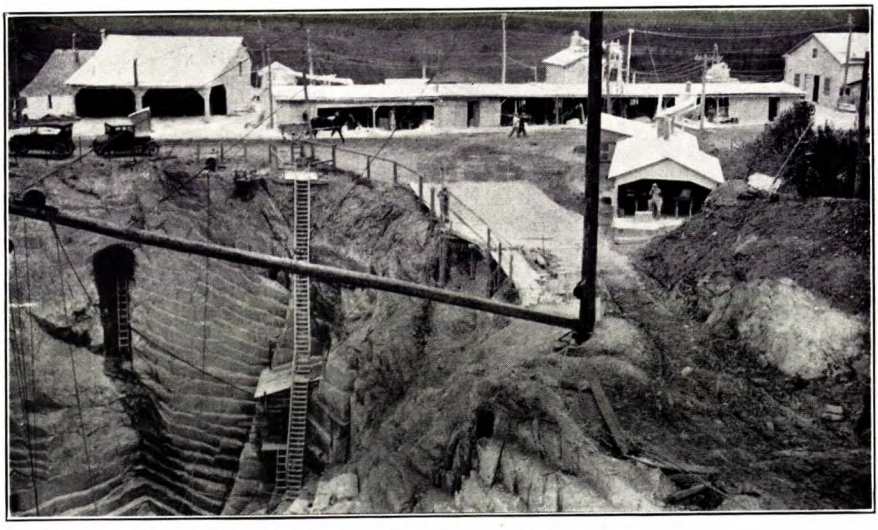
World production of talc is probably in the neighbourhood of 400,000 tons annually, the chief producing countries in the order of their importance being United States, France, Italy, Austria, and Canada.

USES

The uses of talc, over 90 per cent of which is marketed in pulverized form, depend on its physical properties; its white colour and softness adapting it for use in the manufacture of paper; and its soapy feel and freedom from grit, for cosmetics. It is also useful as a filler in paints, rubber, and textiles; for polishing glass and finishing leather; for the dusting of automobile tires and rubber goods generally; as a lubricant; in refractory ceramic products; for foundry facings, etc. Off-colour and impure grades are used in the manufacture of roofing. About 50 per cent of the powdered talc sold is used in paint, about 16 per cent in paper, 12 per cent in roofing, 5 per cent in rubber, 4 per cent in cosmetics, 1 per cent in lubricants, and the remainder for miscellaneous uses. Pure massive talc has the property of becoming very hard when heated to high temperatures; thus it may be cut or carved while in its soft, natural state into a wide variety of shapes, such as electrical fittings, gas-burner tips, etc., which on subsequent heat treatment become hard enough to scratch glass—so-called "lava" products. Massive talc is also used for making crayons, pencils, and French chalk.



A. Lime plant near Ottawa, Ontario.



B. Soapstone quarry, Leeds, Quebec.

Soapstone, due to its great resistance to chemicals and heat, finds a very important use as a lining for the alkali-recovery furnaces of kraft pulp mills. It is, also, a very suitable material for table-tops, sinks, hoods, etc., in chemical laboratories; and for laundry tubs, mantels, base-boards, wainscoting, etc. Due to its ability to retain heat, it is used in griddles, foot-warmers, fireless cookers, and stove linings, and, due to its high dielectric strength, for electric switchboards, insulators, fuse-guards, etc. Dust from the sawing benches of soapstone cutting plants may be used in the manufacture of roofing, as an admixture in concrete, and as a filler.

The Department of Mines, Ottawa, has published reports on "Talc and Soapstone" (Mines Branch Publication No. 583) and "Talc Deposits of Canada" (Geological Survey, Economic Geology Series No. 2), both of which may be obtained on application.

TIN

Though occurrences of tin are known at a number of localities in Canada, it has not yet been found in commercial quantity, consequently Canada produces no tin ore.

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. Considerable exploratory work has been done on this occurrence.

In *New Brunswick* it has also been found associated with tungsten minerals, in a wolframite deposit at Burnthill Brook, in York County.

In *Ontario* cassiterite has been recognized, in minute quantities, in some of the nickel, silver, and other ores produced.

In *Manitoba* some work has been done on tin-bearing pegmatite dykes found on the Winnipeg River, about 75 miles northeast of Winnipeg.

In *British Columbia* occurrences of tin have been reported from several localities. For example, it has been found in the form of stannite at the Snowflake mine, in the Revelstoke mining division, and small amounts of cassiterite have been separated in the course of concentrating the ore of the Sullivan lead-zinc mine at Kimberley.

In *Yukon* a little cassiterite is sometimes found with the gold in the placer miners' sluice boxes.

The chief countries producing tin ore are, in the order of their importance: Federated Malay States, Bolivia, Netherlands East Indies, Siam, and Nigeria.

USES

The chief use of tin is in the manufacture of tin-plate, for containers for food, oil, and other materials. Next in importance is its use as an ingredient of solder, babbitt, and bearing metals. It is also a constituent of certain brasses, bronzes, and other alloys, such as white metal and type metal. Minor uses include the making of tinfoil, collapsible tubes, wire, rubber, and various chemicals. Probably one-third of the tin consumed in industry goes into tin-plate, a third into solder, babbits, etc., and a third into miscellaneous uses.

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,* ilmenite carrying from 18 per cent to 25 per cent titanium occurs in large bodies at Ivry, Terrebonne County, and at St. Urbain, Charlevoix County. Occasional small shipments have been made from both these places during the last 30 years, chiefly from St. Urbain. Practically all the ore shipped has been exported to the United States, though some small lots have been sent to England for experimental purposes. Rutile associated with the ilmenite in one of the St. Urbain deposits, is the only potentially commercial source of rutile known in Canada.

Titaniferous magnetites carrying 5 per cent and upwards 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, Rainy Lake, in the Rainy River district of Ontario, which are also vanadiferous; those on the Saguenay River, near Lake St. John, Chicoutimi County, Quebec; and those at Bay of Seven Islands, on the lower St. Lawrence, Saguenay County, also in Quebec.

It is estimated that a total of about 40,000 tons of ore has been shipped from ilmenite deposits in Quebec during the last 20 years. Average shipments for the last five years have been about 1,800 tons a year.

World production of titanium minerals is not large, amounting to 40,000 or 50,000 metric tons annually.

The chief producing countries of ilmenite are: India, Norway, Senegal, and Brazil; of rutile, Norway and United States.

USES

The two chief uses of titanium are: in the production of ferro-titanium alloys for use in steel-making and in the production of white non-poisonous pigments of great covering power. The use of white titanium pigments, "titanium whites," has expanded rapidly in recent years. The natural compounds of titanium—ilmenite and rutile—as well as the artificial compound, titanium carbide, have been employed to some extent as ingredients of electrodes for arc lamps. Rutile is used in the ceramic industry as a colouring material, especially in the manufacture of artificial teeth; and various chemical compounds of titanium are used in the textile and leather industries as dyes and mordants. During the Great War considerable titanium tetrachloride was used for the production of smoke screens. More recently a nickel-cobalt-titanium alloy has been used to advantage for rectifier tubes, in the moving parts of internal combustion engines, and in other extremely hot places.

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 ore 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 at West Waverley, in Halifax County; near South East Margaree, in Inverness County; and at Indian Path, in Lunenburg County, where work has recently been done on a deposit of scheelite.

In *New Brunswick*, a little tungstein ore, chiefly wolframite, has been obtained at Burnthill Brook in York County.

In *Quebec*, scheelite has been found in a quartz vein in Beauce County; and, in *Ontario*, it has been noted in small nodular masses in some of the veins near Pearl Lake in the Porcupine gold-field. Its occurrence is also reported in southeastern *Manitoba*.

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 *Yukon*, water-worn nodules of scheelite are sometimes caught in the gold miners' sluice boxes at 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 recorded was in 1912, when 14 tons of concentrates was produced by Scheelite Mines, Ltd., of Moose River, Nova Scotia.

The average grade of tungsten ores contains usually not more than 3 or 4 per cent of the metal; but before smelting these are concentrated to an average grade of about 60 per cent tungsten oxide (WO_3). The world's requirements of tungsten are met by the production of about 15,000 tons of such concentrate annually.

The chief producing countries, in the order of their importance are: China, Burma, Federated Malay States, United States, and Bolivia.

The principal use of tungsten is as an alloy metal in the making of high-speed tool steels; and of "stellite," a cobalt-chromium-tungsten alloy, also employed in high-speed cutting tools. Tungsten is also used for filaments in incandescent lamps; in contacts for internal combustion engines; and in valves of airplane and automobile engines.

VOLCANIC DUST

Extensive beds of volcanic dust are found at several places in the Provinces of Saskatchewan and British Columbia, in western Canada. A few hundred tons a year are produced at Waldeck, near Swift Current, in Saskatchewan, where beds up to 30 feet thick are being worked, and also from a deposit south of Gull Lake Development work has also been done on deposits at Williams Lake in the Cariboo district of British Columbia.

In 1931, Canada produced 128 tons of volcanic dust valued at $2,560; and in 1932, 180 tons valued at $3,600. In the United States about 60,000 tons is produced annually.

USES

Volcanic dust is used for the same purposes as ground pumice, i.e. in the manufacture of cleansers, scouring powders, abrasive soaps, and for glass-bevelling. It has also been used to some extent as an admixture in

cement and plaster; as a road-surfacing material; and as a substitute for fuller's earth in the refining of hard oils and fats. Recently, it has been found that volcanic dust can be used also as a substitute for feldspar in many types of clayware glazes, and to a lesser degree as a flux in ceramic bodies.

The Mines Branch, Department of Mines, Ottawa, has published a report on "Siliceous Abrasives" (No. 673) containing a section on volcanic ash, which may be obtained on application.

ZINC

From the point of view of monetary value zinc ranks sixth among the metals produced in Canada. It is at present produced in only two provinces, British Columbia and Manitoba, chiefly in British Columbia. It has, however, been produced to some extent in Quebec, Ontario, and Nova Scotia in the past, and these three provinces are potentially future sources of zinc. Deposits of lead and zinc ores of some promise have also been found in the vicinity of Great Slave Lake in the Northwest Territories.

In *British Columbia* the output of zinc, which in 1932 amounted to about 76 per cent of that of the whole Dominion, is derived chiefly from the immense lead-zinc deposits of the famous Sullivan mine, at Kimberley. In addition to the Sullivan mine, however, there are a large number of other smaller mines scattered over the province producing zinc ore, especially in the Slocan and Ainsworth mining divisions, in the Kootenay district. Practically all the zinc ore mined in British Columbia is treated at the Consolidated Mining and Smelting Company's electrolytic reduction plant at Trail, for the production of refined zinc. Formerly, a certain amount of zinc contained in ore was shipped abroad for treatment. Since 1930 no such shipments have been recorded.

In *Manitoba* the production of zinc has, so far, come entirely from the Hudson Bay Mining and Smelting Company's Flin Flon copper-zinc mine in The Pas district, which commenced producing in 1930. Flin Flon ore is treated at the mine, and the zinc is marketed in the form of electrolytically refined metal. Copper-zinc ore very like that at Flin Flon is also mined at the Sherritt-Gordon mine, at Sherridon, about 40 miles north of Flin Flon, but due to the low price of zinc copper concentrate only has as yet been shipped from there.

In *Quebec*, for a number of years about 1,000,000 pounds of zinc was produced annually from a lead-zinc mine at Notre-Dame-des-Anges in Portneuf County, but production from this source ceased in 1929. In 1930, zinc concentrate was produced for a few months on the Amulet zinc-copper mine, in the vicinity of Rouyn, in northwestern Quebec, but pending an increase in metal prices this mine also has been closed. Other properties in northwestern Quebec that could produce considerable zinc if the price of the metal warranted it, are the Abana copper-zinc mine in Dupuy Township and the Horne copper-gold mine at Rouyn. Promising deposits of sphalerite and galena have been partly developed in Lemieux Township in the interior of Gaspe Peninsula. All the zinc ore produced in Quebec was shipped abroad for treatment.

In *Ontario,* a little zinc ore was mined in times past at several places in southeastern Ontario; and near Rossport on the north shore of Lake Superior. From 1928 to 1930 also, zinc concentrate was produced in a small mill on the Yukon-Treadwell company's zinc-copper-lead mine near Chelmsford, in the Sudbury district, but low metal prices caused a cessation of milling operations toward the end of 1930. Commercial deposits of zinc-lead ore have also been developed in the Sudbury district at Geneva Lake, near Cartier; but these had not reached the productive stage when the depression in the world's metal market stopped further work on them.

In *Nova Scotia,* a concentrating mill was built on the Stirling zinc-lead-copper mine in 1929 and, in 1930, about 1,700 tons of zinc concentrate was produced before the plant was shut down owing to depression in the metal markets.

Canada's production of zinc in 1932 amounted to 86,142 tons valued at $4,144,454, as against a maximum production of 133,824 tons valued at $9,635,166 in 1930.

The world's estimated production of zinc in 1932 was 875,135 tons as against a maximum of 1,620,898 tons in 1929. The chief zinc-producing countries, in the order of their importance, are: United States, Belgium, Poland, Canada, France, and Australia.

USES

The chief use of zinc is in galvanizing iron and steel objects, that is, providing them with a zinc coating to protect them from rust. Its next most important use is as a constituent of brass and other alloys. Large quantities in the form of rolled sheets are employed in roofing, plumbing, etc. Further large quantities are used in the manufacture of pigments, electrodes, and other miscellaneous purposes.

A report on "Zinc and Lead Deposits in Canada" (Economic Geology Series No. 8) has been published by the Geological Survey, Department of Mines, Ottawa, and may be obtained on application to the Director.

MINERAL PRODUCTION OF THE PROVINCES

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PRINCE EDWARD ISLAND

Area 2,184 square miles. Population 1931, 88,038

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 standstones 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.

NOVA SCOTIA

Area 21,428 square miles. Population 1931, 512,846

Mineral Production 1931 and 1932

Product	1931		1932	
	Quantity	Value	Quantity	Value
		$		$
Metallic—				
Gold.....fine oz.	460	9,509	964	19,928
Manganese ore..... tons	60	2,400	.....	.....
Silver.....fine oz.	48	14	47	15
Non-Metallic—				
Barite..... tons	16	363	.....	.....
Coal..... "	4,955,563	19,016,720	4,084,581	15,167,793
Diatomite..... "	1,484	29,679	1,438	28,760
Grindstones..... "	.....	.....	12	433
Gypsum..... "	707,817	878,487	341,508	398,861
Quartz..... "	3,116	6,836	.....	.....
Salt..... "	27,718	143,761	31,897	150,708
Silica brick..... M	621	22,044	.....	.....
Structural Materials—				
Clay products.....	.....	467,126	.....	172,557
Lime..... tons	18,430	79,418	6,533	35,534
Sand and gravel..... "	403,858	198,757	423,487	136,677
Stone..... "	83,181	225,632	34,661	87,307
Total.....	.....	**21,080,746**	.....	**16,198,573**

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 coalfields, though not so extensive as those of some of the western provinces, are more highly developed, the annual production being 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. Large quantities of coke also are made at the Sydney plants, for domestic as well as for metallurgical use, and sulphate of ammonia and tar are recovered as by-products in the process.

Next to coal the most important mineral product in point of value is gypsum, large quantities of which are mined in the province, chiefly for export to the United States. Third in importance, though the youngest, of Nova Scotia's mineral industries is the mining of salt, large deposits of which are being worked at Malagash, in Cumberland County. There is

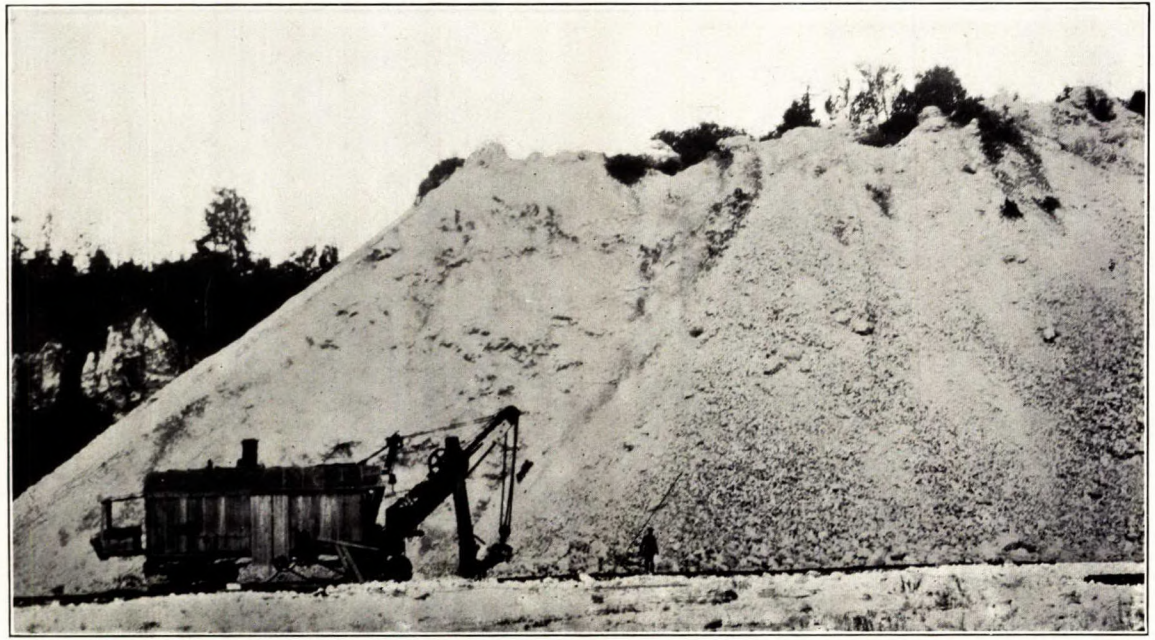
Plant of Dominion Steel and Coal Company, Sydney, Nova Scotia.

also an important and increasing production of diatomite, which is of widespread occurrence, the chief productive area up to the present being in Colchester County, where it has been dug since 1896.

From the widely distributed clays of the province there is an annual production of brick, tile, and semi-refractory clay products; and marble, granite, and sandstone of excellent quality for building and ornamental purposes are found in abundance, as well as limestone for building, fluxing, or lime-making.

More or less gold has been won every year since 1860; and at the beginning of the present depression zinc, copper, and lead were being produced from apparently extensive deposits of complex ore in Richmond County, Cape Breton. Other minerals and metals that have been produced in the province are: manganese, barite, antimony, arsenic, and tungsten. Occurrences of tin, also, are known.

Copies of the mining laws, mines' reports, maps, and other literature pertaining to the mineral possibilities of Nova Scotia may be had on application to the Deputy Minister, Department of Public Works and Mines, Halifax, N.S.



A New Brunswick gypsum quarry.

NEW BRUNSWICK

Area 27,985 square miles. Population 1931, 408,219

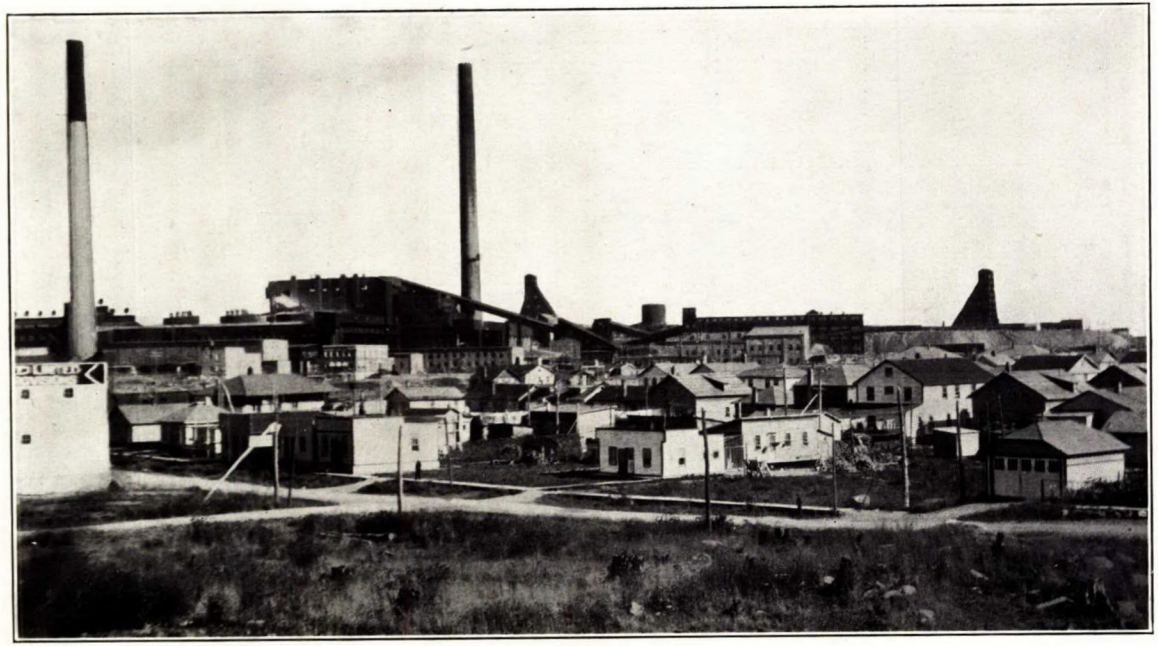
Mineral Production 1931 and 1932

Product	1931		1932	
	Quantity	Value	Quantity	Value
		$		$
Metallic—				
Manganese ore..... tons	57	493	.....	.....
Non-Metallic—				
Coal..... tons	182,181	743,196	212,695	794,168
Grindstones..... "	299	12,308	256	11,802
Gypsum..... "	58,957	451,264	38,019	297,520
Manganese (bog).....	77	462	662,452	326,191
Natural gas.....M. cu. ft.	655,891	323,184	6,408	14,332
Petroleum..... brls.	6,577	15,461	.....	.....
Structural Materials—				
Clay products.....	.....	143,348	.....	68,151
Lime..... tons	11,241	127,054	11,572	109,184
Sand and gravel..... "	183,475	18,149	569,150	447,239
Stone..... "	62,325	341,991	16,805	154,918
Total.....	.....	**2,176,910**	.....	**2,223,505**

New Brunswick is essentially a producer of non-metallic minerals, though occurrences of antimony, manganese, copper, nickel, tungsten and other metals are known and have, from time to time, attracted some attention.

At present the most important mineral products from a monetary point of view are coal, gypsum, and natural gas. A small amount of petroleum also is produced; and there is a considerable output of cut and polished granite. Brick, tile, sewer pipe, and other clay products, and lime are manufactured chiefly for local use.

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



Noranda mine and smelter, Noranda, Quebec.

QUEBEC

Area 594,434 square miles. Population 1931, 2,874,255

Mineral Production 1931 and 1932

Product		1931		1932	
		Quantity	Value	Quantity	Value
			$		$
Metallic—					
Chromite	tons	.....	.....	78	1,113
Copper	lb.	68,376,985	5,723,154	67,336,692	4,296,216
Gold	fine oz.	300,075	6,203,101	401,105	8,291,576
Silver	"	530,345	158,414	628,902	199,184
Titanium ore	tons	1,509	10,261	.....	.....
Non-Metallic—					
Asbestos	tons	164,296	4,812,886	122,977	3,039,721
Feldspar	"	10,381	86,842	3,390	39,062
Iron oxides	"	5,410	48,205	5,017	44,161
Magnesite	"	11,411	295,579	8,892	262,860
Mica	"	290	30,601	41	4,076
Mineral water	Imp. gal.	19,868	4,746	15,506	4,697
Peat	tons	1,170	5,937	762	2,286
Phosphate	"	.....	.....	1,316	12,333
Quartz	"	26,987	69,759	20,123	71,645
Soapstone	"	.....	34,439	.....	46,751
*Sulphur	"	14,586	108,617	17,954	133,838
Structural Materials—					
Clay products	.....	.....	2,360,908	.....	1,064,551
Cement	brls.	4,942,323	7,092,895	2,210,584	3,155,702
Lime	tons	111,496	804,218	93,813	587,901
Sand and gravel	"	7,657,964	1,952,959	3,458,128	893,896
Stone	"	4,265,529	5,893,042	2,246,825	2,360,901
Total	.....	.....	**35,696,563**	.....	**24,512,470**

*Sulphur contents of pyrites shipped and estimated sulphur contained in sulphuric acid made from waste smelter gases.

From the point of view of value of its total mineral output, Quebec now stands second among the provinces of the Dominion—and third as regards its metal output. Long a leader in the production of non-metallic minerals such as asbestos, feldspar, and mica, outstanding developments in the northwestern part of the province in recent years have now made it also the second most important producer in the Dominion of both gold and copper. In association with these silver also is produced.

Lead and zinc were formerly mined at Notre-Dame-des-Anges, in Portneuf County; and large deposits of the same metals have been partly developed in the Gaspe Peninsula. Zinc also occurs in considerable quantity in association with some of the copper-gold deposits of northwestern Quebec, but due to temporary lack of demand is not at present being produced.

The province is one of the world's chief producers of aluminium, obtained by reducing imported ore—chiefly from British Guiana—in electric furnaces located at Arvida, on the Saguenay River, and at Shawinigan Falls, on the St. Maurice.

Ores of titanium occur and have been to some extent worked at Ivry, near St. Agathe, north of Montreal, and near Baie St. Paul, on lower St. Lawrence River.

In regard to non-metallic minerals, Quebec has long been especially prominent as a producer of asbestos, feldspar, and mica; Canada's fame as the world's chief producer of asbestos resting entirely on the output from Quebec. Other mineral products that are now or have, in the past, been won in important quantities are: magnesite, pyrite, graphite, chromite, molybdenite, apatite, limestone, marble, granite, soapstone, etc. Cement, brick and tile, sand and gravel and other common structural materials also are produced in large amounts.

Information concerning mining operations, mineral resources, mining laws, etc., of the Province of Quebec may be obtained on application to the Director, Bureau of Mines, Quebec City, Quebec.

ONTARIO

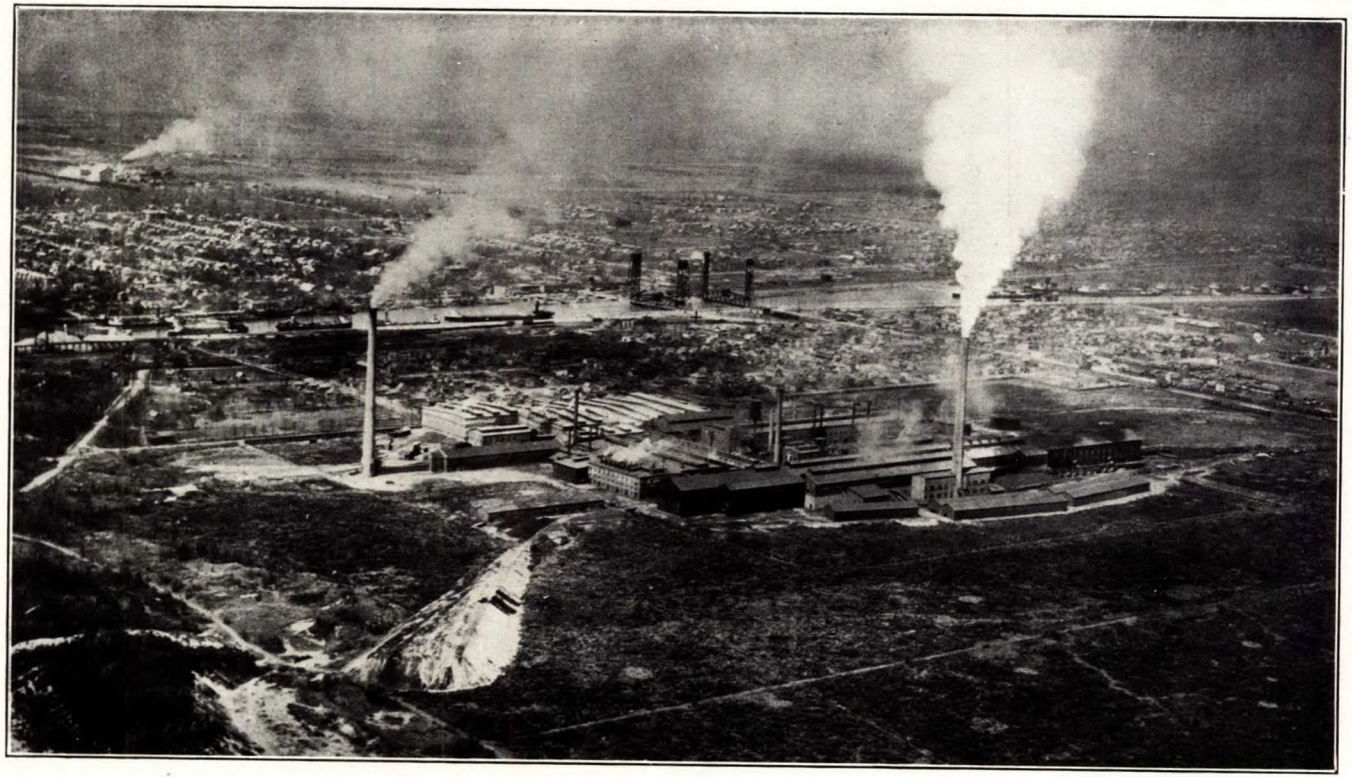
Area 412,582 square miles. Population 1931, 3,431,683

Mineral Production 1931 and 1932

Product		1931		1932	
		Quantity	Value	Quantity	Value
			$		$
Metallic—					
Arsenic	lb.	3,575,936	135,170	2,424,342	98,714
Bismuth	"	7,331	3,532	16,798	7,289
Cobalt	"	521,051	651,179	490,631	587,957
Copper	"	112,882,625	9,096,463	77,055,413	4,407,928
Gold	fine oz.	2,085,814	43,117,600	2,280,105	47,133,952
Lead	lb.	985,633	41,647	86,477	1,828
Molybdenite (concentrate)	lb.	1,222	280	.....	.....
Nickel	"	65,666,320	15,267,453	30,327,968	7,179,862
Palladium, rhodium, etc	oz.	46,918	1,217,717	37,613	901,890
Platinum	"	44,725	1,595,117	27,284	1,097,021
Selenium	lb.	16,899	32,108	.....	.....
Silver	fine oz.	7,438,951	2,222,014	6,335,788	2,006,648
Non-Metallic—					
Actinolite	tons	35	456	.....	.....
Diatomite	"	60	840	11	309
Feldspar	"	7,962	100,119	3,657	42,920
Fluorspar	"	40	620	32	464
Graphite	"	548	32,149	346	18,483
Gypsum	"	53,358	374,469	35,655	186,175
Mica	"	1,049	23,465	269	2,752
Mineral water	Imp. gals.	197,540	8,578	61,208	2,473
Natural gas	M cu. ft.	7,419,534	4,635,497	7,386,154	4,719,297
Peat	tons	504	1,096	2,486	5,307
Petroleum	brls.	122,365	219,993	130,343	247,468
Quartz	tons	97,888	148,642	66,135	93,574
Salt	"	231,329	1,760,388	231,138	1,789,751
Silica brick	M	279	13,702	93	4,303
Sulphur*	tons	6,508	65,080	3,332	33,320
Talc	"	11,806	122,044	12,064	111,585
Structural Materials—					
Clay products		.....	3,552,800	.....	1,639,508
Cement	brls.	3,470,056	5,006,826	1,599,342	2,288,975
Lime	tons	147,660	1,222,270	166,703	1,273,230
Sand and gravel	"	7,465,017	2,562,477	6,994,447	1,971,239
Stone	"	3,359,364	2,881,444	1,905,138	1,655,016
Total		.....	**96,113,235**	.....	**79,509,238**

* Sulphur content of pyrites shipped and estimated sulphur contained in sulphuric acid made from waste smelter gases.

Ontario is the premier mineral-producing province in Canada, as regards both the value of its annual output and the variety of its mineral products; in 1932 it was credited with over 43 per cent of the total value of the mineral production, divided among some 44 different products.



Nickel refinery at Port Colborne, Ontario.

It furnishes about 75 per cent of the gold won in the Dominion; practically all the nickel, cobalt, platinum metals, and arsenic; over one-third the silver; the biggest part of the copper; and, in the past, substantial amounts of lead and zinc also have been produced.

Among the non-metallic minerals salt is the most important product, from the point of view of monetary value, followed by gypsum. Other minerals that have been produced commercially include actinolite, apatite, corundum, feldspar, fluorspar, graphite, pyrites, mica, molybdenite, natural gas, petroleum, quartz, and talc. Ontario deposits of talc, feldspar, mica, and graphite are among the largest known on the North American continent.

Structural materials of mineral origin such as cement, lime, brick, tile, limestone, marble, sandstone, granite, trap, sand, and gravel, are produced in quantities commensurate with domestic needs.

Iron blast furnaces using imported ore are operated at Hamilton, Sault Ste. Marie, and Port Colborne. Large smelting and refining plants at Sudbury and Port Colborne produce refined copper and nickel, with platinoid metals, silver, gold, and selenium as by-products; and waste gas from the Sudbury smelters is converted into sulphuric acid.

The following figures taken from the Reports of the Ontario Department of Mines illustrate the rapid growth of the mineral industry in Ontario since 1891.

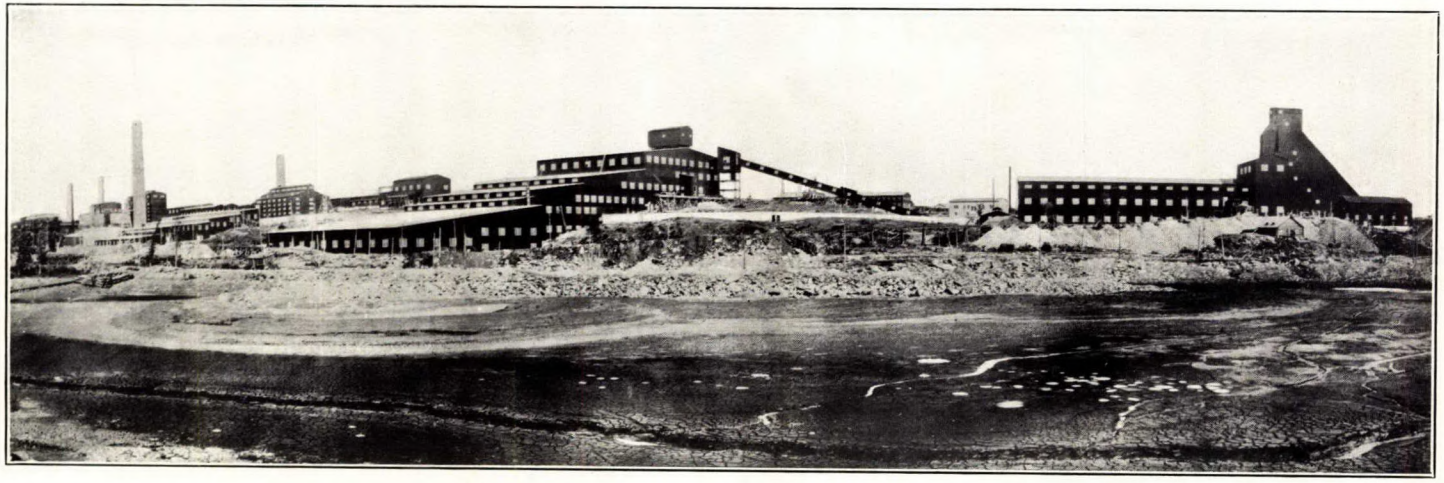
Mineral Production of Ontario, by Five-Year Periods, since 1891

Year	Value	Year	Value
	$		$
1891	4,705,673	1916	65,303,822
1896	5,235,003	1921	48,128,387
1901	11,831,086	1926	85,098,706
1906	22,388,383	1931	95,643,207
1911	41,976,797		

A maximum production of $117,960,722 was attained in 1929.

The Provincial Government maintains an assay office in Toronto, for the free identification of minerals, for free assays under certain specified conditions, and for general assay work at a fixed schedule of charges. A sampling and testing laboratory also is maintained at Cobalt, where parcels of gold ore from 100 pounds upwards may be sent to be tested, the shipper receiving the value of his ore, less treatment charges, and a report outlining the process best adapted to its treatment.

Full information concerning mining operations, mineral resources, mining laws and regulations, etc., may be obtained on application to the Deputy Minister, Department of Mines, Toronto, Ontario.



Flin Flon mine and smelter, Flin Flon, Manitoba.

MANITOBA

Area 251,832 square miles. Population 1931, 700,139

Mineral Production 1931 and 1932

Products		1931		1932	
		Quantity	Value	Quantity	Value
			$		$
Metallic—					
Copper	lb.	45,821,432	3,835,254	52,706,861	3,362,803
Gold	fine oz.	102,969	2,128,558	122,507	2,532,444
Selenium	lb.	3,870	7,353	.....	.....
Silver	fine oz.	836,547	249,877	1,036,497	328,275
Zinc	lb.	35,173,749	898,338	41,736,600	1,004,016
Non-Metallic—					
Coal	tons	1,306	3,797	1,552	3,684
Gypsum	"	23,076	231,124	12,719	113,175
Natural gas	M cu. ft.	600	180	600	180
Quartz	tons	67,214	76,624	87,253	102,493
Salt	"	.....	.....	508	7,092
Structural Materials—					
Clay products		.....	122,628	.....	49,773
Cement	brls.	544,160	1,267,893	242,112	549,594
Lime	tons	21,014	207,401	18,235	172,110
Sand and gravel	"	871,986	294,178	440,309	188,974
Stone	"	153,248	642,649	78,423	299,282
Total		.....	**9,965,854**	.....	**8,713,895**

Until comparatively recently virtually all Manitoba's mineral output consisted of non-metallic mineral products, chiefly gypsum and such structural materials as cement, lime, brick, stone, sand, and gravel. Some two-thirds of the province—in its eastern and northern parts—is, however, underlain by the same rock types that have proved so prolific of metals in Ontario and Quebec. Recent developments have made Manitoba the second most important producer of zinc in the Dominion and the fourth in importance in the production of copper and gold. Silver and selenium also are obtained as by-products.

The chief producer of copper, zinc, and gold is the well known Flin Flon mine in northwestern Manitoba. Other large mines of a similar type in the same region are the Sherritt-Gordon and the Mandy. A copper smelter is in operation at Flin Flon producing blister copper that is shipped to eastern Canada for refining; and an electrolytic zinc reduction plant producing refined metallic zinc. Gold quartz veins are widely distributed both in southeastern and in northern Manitoba, and from a number of these there has been more or less production since 1917, the principal purely gold mines in operation at the present time being the Central Manitoba and the San Antonio, both of which are situated in the south-eastern district.

Gypsum is quarried in large quantities at Gypsumville at the north end of Lake Manitoba; and a handsome mottled limestone—Tyndall stone —used for building purposes throughout Canada, at Garson, a few miles northeast of the city of Winnipeg. Portland cement is manufactured at Winnipeg from limestone quarried at Steep Rock on the shore of Lake Manitoba, mixed with local clay; and brick and tile, at various points from local material.

Oil shales of possible future commercial value are found throughout the Manitoba escarpment; lignite occurs and has been mined to a small extent at Turtle Mountain; and sand suitable for glass-making and for foundry purposes on Black Island in Lake Winnipeg. Occurrences of nickeliferous pyrrhotite, tungsten, molybdenum, and tin are known in southeastern Manitoba; and considerable development work has been done on deposits of lithium minerals near Pointe du Bois about 100 miles northeast of Winnipeg.

Information concerning mining operations, mineral resources, mining laws, etc., of the Province of Manitoba may be obtained on application to the Director, Mines Branch, Department of Mines and Natural Resources, Winnipeg, Manitoba.

SASKATCHEWAN

Area 251,700 square miles. Population 1931, 921,785

Mineral Production 1931 and 1932

Products	1931		1932	
	Quantity	Value	Quantity	Value
		$		$
Gold.....fine oz.	.....	.....	11	227
Non-Metallic—				
Coal..... tons	662,836	945,259	887,139	1,229,449
Silver.....fine oz.	.....	.....	14	4
Sodium sulphate.....	.....	421,097	.....	271,736
Volcanic dust..... tons	128	2,560	180	3,600
Structural Materials—				
Clay products.....	.....	166,257	.....	109,739
Sand and gravel..... tons	1,388,594	396,707	362,841	66,942
Total.....	.....	**1,931,880**	.....	**1,681,697**

The mineral production of the Province of Saskatchewan has up to the present been small and has consisted entirely of non-metallic materials, chiefly of lignite and natural sodium sulphate. Its mineral-producing, possibilities, however, are considerable, not only in non-metallics but also in metals, some 80,000 square miles of only slightly explored territory in the northern part of the province being underlain by the same rock formations that have proved so prolific of metals in Manitoba, Ontario, and Quebec.

Southern Saskatchewan contains extensive beds of lignite, and lignite is being mined at a number of points including Estevan, Roche Percée, Pinto, Bienfait, and the Dirt Hills. Probably the most extensive beds of refractory clays, including ball clay, known in Canada occur in southern Saskatchewan and have been worked to some extent for use in the manufacture of firebrick, stoneware, pottery, sewer pipe, etc. Natural alkaline salts occur in numerous small lakes and sloughs and within the last few years the recovery of sodium sulphate from some of these has become a considerable industry. Extensive beds of bentonite and volcanic ash occur in the province, and natural gas has been found but not in commercial quantities.

In the northern districts a number of promising occurrences of metalliferous minerals have been found, among them gold quartz veins at Amisk Lake, southwest of Flin Flon. A considerable portion of the great copper-zinc-gold deposits at Flin Flon, also, lies within the boundaries of Saskatchewan.

Information concerning the mining laws, mineral resources, etc., of the Province of Saskatchewan may be obtained on application to the Deputy Minister, Department of Natural Resources, Regina, Saskatchewan.

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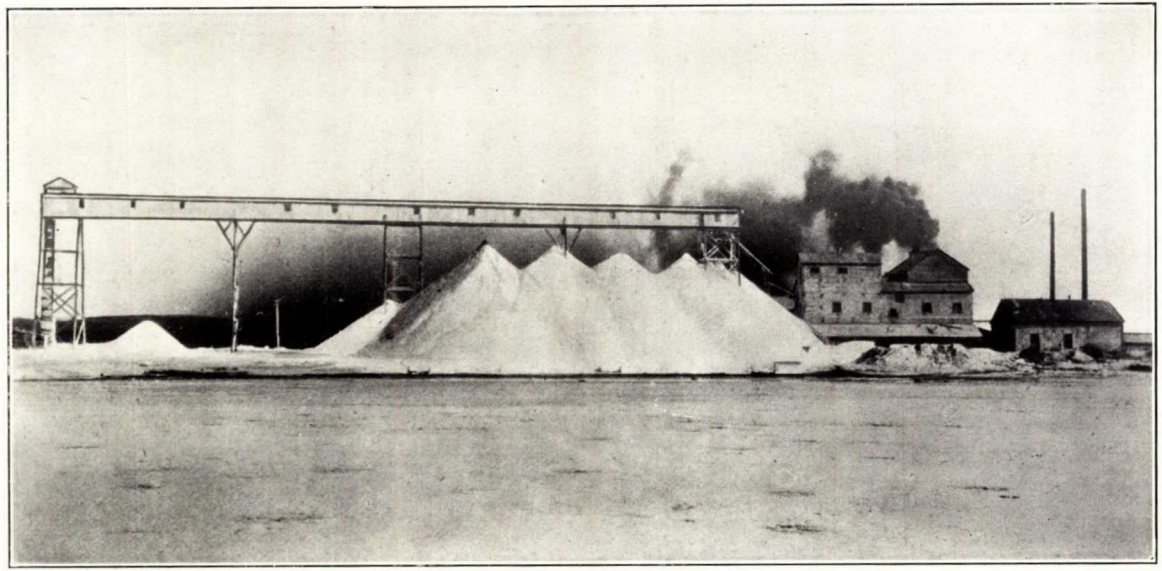

A sodium sulphate plant at Dunkirk, Saskatchewan.

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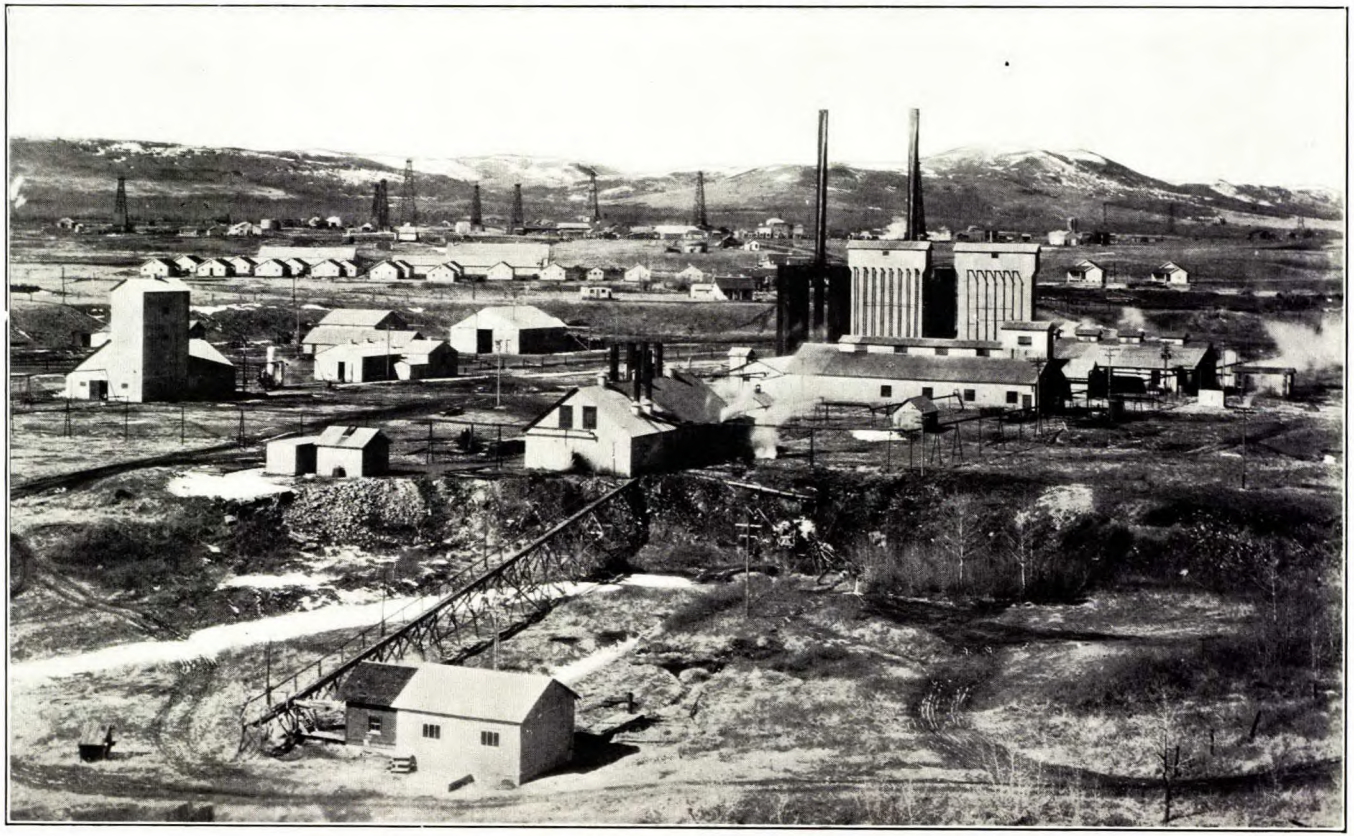


Turner Valley oil and gas fields, Alberta, showing gas-scrubbing plant.

ALBERTA

Area 255,285 square miles Population 1931, 731,605

Mineral Production 1931 and 1932

Product	1931		1932	
	Quantity	Value	Quantity	Value
		$		$
Metallic—				
Gold.....fine oz.	195	4,031	83	1,716
Silver..... "	29	9	9	3
Non-Metallic—				
Coal..... tons	4,564,015	13,342,675	4,870,648	13,526,309
Bituminous sands..... "	1,015	4,060	343	1,372
Natural gas.....M cu. ft.	17,798,698	4,067,893	15,370,968	3,853,794
Petroleum..... brls.	1,413,631	3,976,220	*907,661	*2,760,792
Structural Materials—				
Clay products.....	.....	529,716	.....	329,584
Cement..... brl.	626,483	1,286,080	193,571	399,922
Lime..... tons	5,118	46,785	6,642	56,577
Sand and gravel..... "	1,050,988	313,616	734,067	250,025
Stone..... "	2,496	9,642	1,428	2,985
Total.....	.....	**23,580,727**	.....	**21,183,079**

*Includes small production from Norman in the Northwest Territories.

With the exception of a little alluvial gold won annually from the sands of Saskatchewan River the recorded mineral production of the Province of Alberta has all been non-metallic.

The mineral resources that are being actively exploited include: coal, natural gas, petroleum, and clay and quarry products. The coalfields of Alberta are the most extensive in the Dominion and production from them amounts to over one-third that of all Canada. They include lignite, bituminous, semi-bituminous, and anthracite. Natural gas from five producing fields furnishes a superabundant supply of that fuel for local household use and industries. Petroleum from nearly fifty producing wells furnishes about 90 per cent of Canada's output of crude oil.

Known mineral resources that still await commercial exploitation include immense deposits of bituminous sands, beds of rock salt, and gypsum, and refractory clays, situated in the more northerly parts of the province.

Information concerning the mining laws, mineral resources, etc., of the Province of Alberta may be obtained on application to the Deputy Minister, Department of Lands and Mines, Edmonton, Alberta.

BRITISH COLUMBIA

Area 355,855 square miles. Population 1931, 694,263

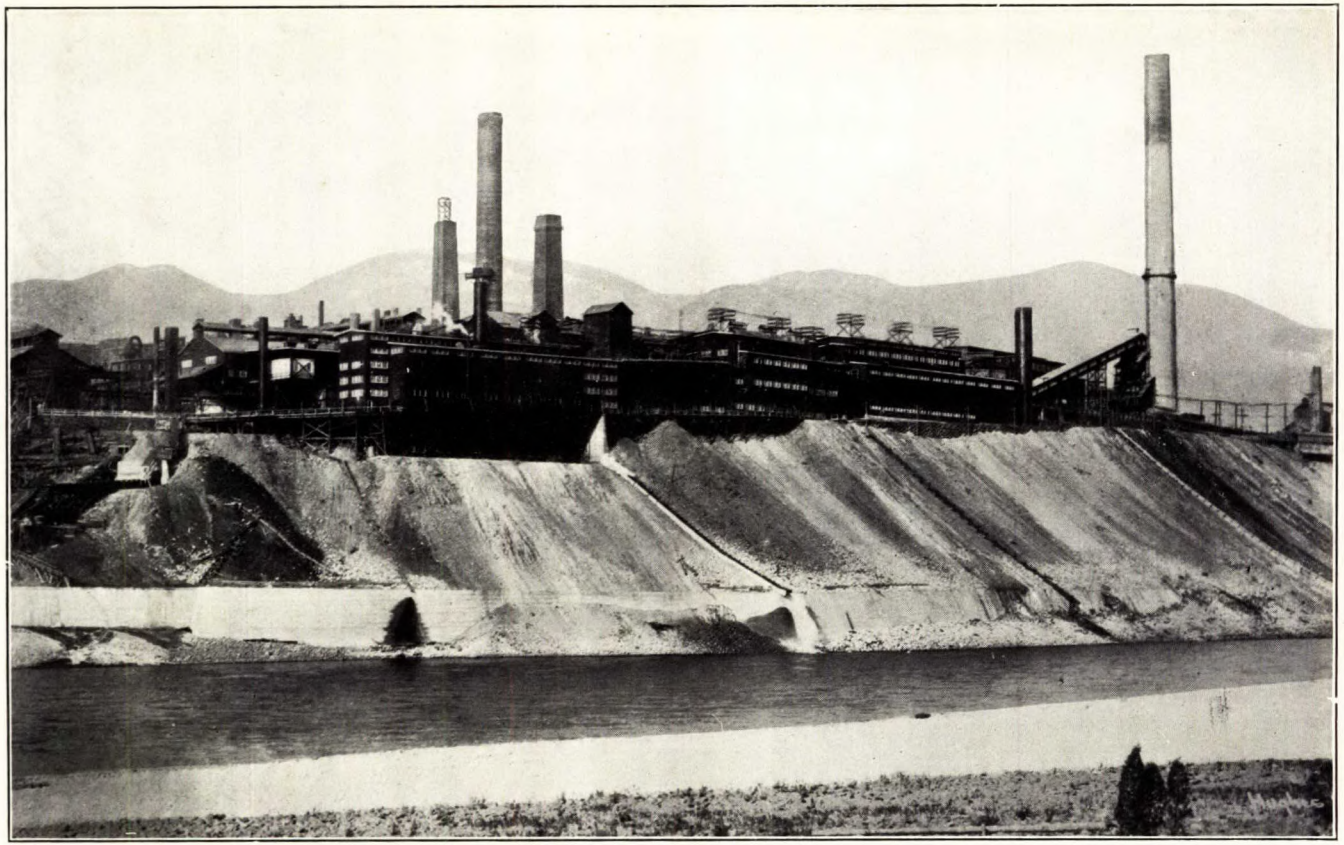
Mineral Production 1931 and 1932

Product		1931		1932	
		Quantity	Value	Quantity	Value
			$		$
Metallic—					
Bismuth	lb.	110,876	154,118	57	51
Cadmium	"	.....	180,958	.....	26,824
Copper	"	65,223,348	5,495,194	50,580,104	3,227,111
Gold	fine oz.	160,069	3,308,920	199,004	4,113,778
Lead	lb.	261,902,236	7,097,812	252,007,574	5,326,432
Platinum	fine oz.	50	1,783	59	2,372
Selenium	lb.	731	1,389	.....	.....
Silver	fine oz.	8,061,599	2,408,000	7,293,462	2,309,958
Zinc	lb.	202,071,702	5,160,911	130,546,958	3,140,438
Non-Metallic—					
Coal	tons	1,876,406	7,150,996	1,681,490	6,392,801
Bentonite	"	187	935	7	176
Diatomite	"	66	2,270	47	440
Grindstones	"	322	25,795	60	3,500
Gypsum	"	20,544	176,173	10,728	84,084
Iron oxides	"	110	1,000	223	2,000
Quartz	"	519	1,297	15,621	8,435
Sodium carbonate	"	712	7,351	495	5,450
Sulphur*	"	29,031	255,760	31,886	302,856
Talc	"	30	600	39	702
Structural Materials—					
Clay products		.....	497,570	.....	**216,179
Cement	brls.	578,636	1,172,549	253,112	536,528
Lime	tons	29,826	277,269	17,152	160,001
Sand and gravel	"	2,726,704	914,322	1,487,513	525,604
Slate	"	250	500	250	3,750
Stone	"	471,717	1,075,784	407,642	378,052
Total		.....	**35,337,756**	.....	**26,767,522**

*Sulphur content of pyrites shipped and estimated sulphur content of sulphuric acid made from waste smelter gases.
**Does not include bentonite.

British Columbia was for many years the premier mining province of Canada but was surpassed, in so far as the monetary value of its output was concerned, by Ontario in 1907 and by Quebec—by a small margin—in 1931. Mining, however, still occupies a relatively more important place in the economic life of British Columbia than it does in either Ontario or Quebec.

Its mineral resources are extremely varied though in the past the chief mineral products have been the metals—gold, silver, copper, lead and zinc—and coal. The Consolidated Mining and Smelting Company's plant at Trail in the southern part of the province is the largest non-ferrous metal-



Plant of Consolidated Mining and Smelting Company, Tadanac, British Columbia.

lurgical works in the British Empire and one of the largest in the world. Other mineral products that have been or are capable of being produced are: among the metals, arsenic, antimony, bismuth, cadmium, manganese, molybdenum, mercury, platinum, and selenium; and among non-metallic products, bentonite, diatomite, fireclay, fluorspar, gypsum, hydromagnesite, pyrites, soapstone, sodium carbonate and talc; in addition to such common structural materials as brick, tile, cement, lime, and building stone.

British Columbia is the source of by far the largest part of Canada's output of lead and zinc, of most of its silver, of much of its copper, and of about 7 per cent of its gold. It contains the largest known deposits of diatomite and fluorite in Canada; and its resources in non-metallic minerals, which heretofore have received little attention as compared with metals, are as varied as those of any part of Canada.

Detailed information concerning the mining laws, mining operations, mineral resources, etc., of British Columbia may be obtained on application to the Provincial Mineralogist, Department of Mines, Victoria, British Columbia.

Gold dredge operating in Yukon.

YUKON TERRITORY

Area 207,076 square miles. Population 1931, 4,230

Mineral Production 1931 and 1932

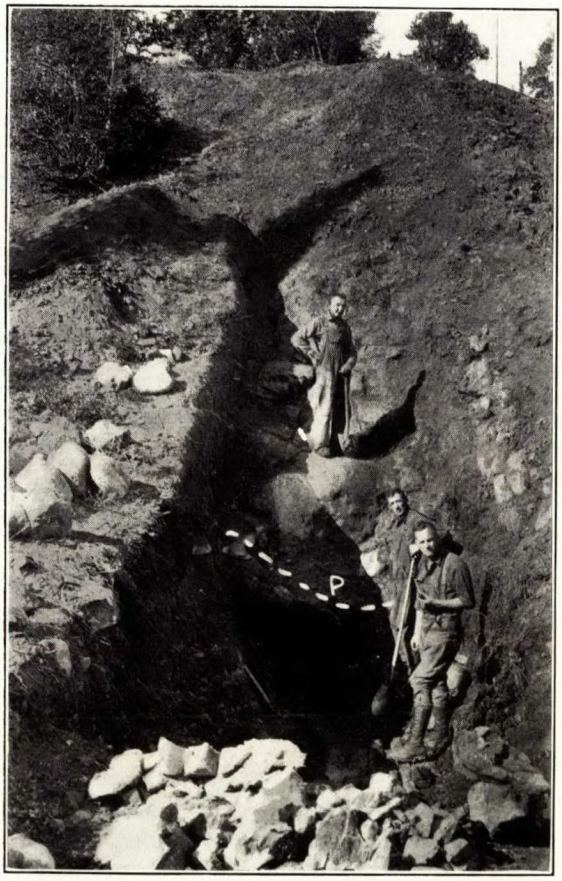
Product	1931		1932	
	Quantity	Value	Quantity	Value
		$		$
Metallic—				
Gold.....fine oz.	44,310	915,969	40,608	839,442
Lead..... lb.	4,454,613	120,724	3,853,327	81,444
Silver.....fine oz.	3,694,728	1,103,615	3,053,188	966,994
Non-Metallic—				
Coal..... tons	904	5,039	808	3,491
Total.....	.....	**2,145,347**	.....	**1,891,371**

Yukon Territory, which includes the northerly continuation of the metalliferous mountain belt extending through British Columbia, was first made famous by the Klondike gold-fields, situated in the vicinity of Dawson, on the Yukon River.

Though the Yukon goldfields have long passed their most productive period, very considerable quantities of alluvial gold are still won by dredging operations on a large scale and it has been estimated that the territory still contains over 268,000,000 cubic yards of auriferous gravel carrying $54,500,000 in gold that remains to be won. The other chief mineral product is silver-lead ore, which is mined in the vicinity of Mayo. Copper also has been mined in the territory. A certain amount of coal is mined for local use and it is estimated that the territory contains some 2,840 square miles of coalfields containing probably 250,000,000 tons of bituminous coal and 4,690,000,000 tons of lignite.

Detailed information concerning the mining laws and regulations may be had on application to the Dominion Lands Administration, Department of the Interior, Norlite Building, Ottawa.

PLATE XXXIV



Prospecting a radium deposit at LaBine Point, Great Bear Lake.

NORTHWEST TERRITORIES

Area 1,309,682 square miles. Population 1931, 7,133

The Northwest Territories of Canada—Franklin, Keewatin, and Mackenzie—cover an area larger than that of British India. In these, mineral occurrences of great potential value have been discovered in widely separated localities, the most noteworthy being the rich deposits of silver and radioactive pitchblende found at Great Bear Lake in 1931, which are now being actively developed. Native copper and rich copper ore have been found in the country southwest of Coronation Gulf and in the vicinity of Bathurst Inlet; nickel-copper ore at Rankin Inlet, on the west shore of Hudson Bay; and lead-zinc ore in the vicinity of Great Slave Lake. In the vicinity of Norman, on the lower Mackenzie River just north of the Alberta boundary, an oil well drilled some years ago now furnishes motor fuel for use on the transportation routes to Great Bear Lake.

Information concerning the mining laws and regulations of the Northwest Territories may be obtained on application to the Dominion Lands Administration, Department of the Interior, Norlite Building, Ottawa.

EXPLANATORY REMARKS AND GENERAL INFORMATION

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. At Ottawa, in addition to an Economic Mineral Museum, the Department has under its jurisdiction the National Museum of Canada 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, Mines Branch, Department of Mines, Ottawa, and for information on subjects relating to general and economic geology to The Director, Geological Survey, Department of Mines, Ottawa.

Statistics.—Canadian production figures used are those published by the Dominion Bureau of Statistics, in which 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 metals, whether refined in Canada or not, are calculated on the basis of the average price in some recognized market; the value of non-metallic products is the estimated value at the mine or place of shipment. .

Figures of world production, or of countries other than Canada, are for the most part taken from "The Year Book of the American Bureau of Metal Statistics" or from "The Mineral Industry."

Unless otherwise indicated, the ton used throughout is the short ton of 2,000 pounds.

Canada
Department of Mines

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

MINES BRANCH

JOHN McLEISH, Director

~~1929~~

Revised 1933

LEGEND

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

NOTE - Important producing areas are indicated by an enlarged symbol. Printed lists of mine operators available for each product

702 ~~693~~

H.E. Baine, Chief Draughtsman

Base map from plate of the Department of the Interior

MINERAL MAP
OF THE
DOMINION OF CANADA

Natural Scale $\frac{1}{6,336,000}$

Scale 100 miles to one inch