Canada

The Canadian Mineral Industry 1954

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* Geological Survey of Canada

** Corundum, emery, garnet, grindstones, pumice, and grinding pebbles.

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PREFACE

This volume contains reviews on the metals and minerals produced in Canada in 1954. Production statistics for the year are preliminary, those for 1953 being final. Except where noted, statistics were supplied by the Dominion Bureau of Statistics. Market quotations are mainly taken from standard marketing reports published in London, Montreal, and New York.

All the reviews were prepared by officers of the Mines Branch, with the exception of that on uranium, which was written by Dr. A. H. Lang of the Geological Survey of Canada.

The Branch is indebted to all those who contributed data for the reviews, and in particular to mining operators and others connected with the mineral industry.

John Convey,
Director, Mines Branch.

INTRODUCTION

Mineral development reached a record level in Canada in 1954, bringing in its wake new highs in volume and value of production and contributing greatly to the outstanding growth under way in the Canadian mineral industry. Of special importance were marked extensions in iron ore and nickel production facilities, steady development of the uranium industry, progress in proving additional reserves of crude petroleum in Western Canada, and discovery of several important base-metal deposits.

Production was valued at $1,488,382,091*, an eleven per cent increase over 1953 and the tenth consecutive annual increase in the value of mineral production. All provinces and territories shared in the general increase. Ontario was the major producer, followed by Alberta, Quebec and British Columbia. Of the separate minerals, crude petroleum headed the list in value, followed by nickel, copper, and gold. Details are given in the tables at the end of this introduction.

Exports of metals and minerals in raw or semi-fabricated forms increased two per cent in value over 1953 to $689,000,000 and accounted for 18 per cent of Canada's total export sales. In tonnage, United Kingdom markets absorbed 51 per cent more copper than in 1953, 1 per cent less lead, and 6 per cent more refined zinc, while United States bought 9 per cent more nickel and 13 per cent more lead, but 15 per cent less copper and 2 per cent less zinc.

Base metal prices improved markedly during the year. Lead rose from 13.00 cents at the beginning to 14.25 cents at the end of the year, and zinc 11.35 cents to 12.85 cents. Copper remained firm, closing the year at 29.01 cents. Nickel was 57 cents until mid-November, when it was increased to 61.40 cents.

A total of 129,445 persons were employed in the industry at salaries and wages totalling $465,305,873 compared with 130,038 and $453,065,518 in 1953.

An outstanding development was the great expansion in Canadian reserves of crude petroleum from 1,845,422,000 barrels in 1953 to an estimated 2,207,614,000 barrels. Much of this increase came from the extension of existing fields in Alberta, but Saskatchewan led the provinces in the amount of reserves found in new areas.

Almost $1,000,000 a day was spent on oil exploration and development activity in Western Canada, but geophysical exploration was below the peak levels of the last few years. No major field discoveries were made in Canada in 1954. The chief development in Alberta was the establishment of the Pembina

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* Excluding aluminum valued at $182,000,000, all of which is produced from imported ores.

field, discovered in 1953, as a major producing field. In Saskatchewan, the discovery of the Frobisher field gave the southeastern part of the province its first light gravity oil field. Alberta continued to supply over 90 per cent of the production but Manitoba and Saskatchewan showed significant rates of growth, Manitoba tripling its production of 1953 to 2,148,184 barrels and Saskatchewan doubling its production to 5,422,899 barrels.

At the end of the year Western Canada had 6,451 producing oil wells with a daily potential production of 413,000 barrels, equivalent to almost three-quarters of the Canadian market demand that year. Daily production averaged 263,200 barrels.

Some progress occurred during the year in providing new market outlets for this production. Trans Mountain Oil Pipe Line Company built a 27-mile spur from the British Columbia-Washington border to Ferndale, Washington, to service a new refinery there, and plans were made to extend this line 36 miles southwestward in 1955 to a refinery under construction at Anacortes. Interprovincial Pipe Line Company spent $51,000,000 on the looping of large sections of its line in Canada and United States. An outlet for the medium-gravity crude oil from the Fosterton-Cantuar-Success group of fields in Saskatchewan was provided by the construction of a 153-mile line from Cantuar to the Interprovincial pipe line at Regina, from which the oil will be shipped to St. Paul, Minnesota.

Natural gas reserves in Western Canada rose to 16 trillion cubic feet. The problem of providing major market outlets for such quantities of gas was very much to the forefront during 1954.

Financing arrangements for the proposed 2,250-mile natural gas pipe line of Trans-Canada Pipe Lines Limited from Alberta to Toronto and Montreal were still incomplete at the year's end. The Board of Transport Commissioners for Canada and the Alberta Government granted the company extensions, first to April 30, 1955, and later to October 31, 1955, on the time limit set in which to complete these arrangements.

Notable headway was made by the metal mining industry; one indication of this is seen in the amount of new railway construction that was either under way or completed. In northwestern Ontario, both Canadian National Railways and the Canadian Pacific Railway Company began the construction of lines into the Manitouwadge base-metal area. In northern Quebec, the CNR started to build a line from Beattyville, near Barraute, into the Chibougamau area. Meanwhile, the 360-mile railway from Seven Islands on the St. Lawrence River to the Iron Ore Company of Canada property at Schefferville in New Quebec-Labrador was completed, as was also the 48-mile line in British Columbia connecting the new aluminum centre of Kitimat, 400 miles north of Vancouver, to the main line of the CNR.

The disclosure by diamond drilling of very large tonnages of relatively low-grade uranium ore in the Blind River district of northern Ontario gained wide prominence during 1954 and plans for large-scale production were completed by Pronto Uranium Mines Limited and Algom Uranium Mines Limited, the two major operators in the field.

Several important events took place in the iron ore industry which, together with developments already under way at the beginning of the year, point to a great expansion in Canada's output of iron ore within the next few years. An initial production of 1,781,453 long tons was obtained during the year from the Iron Ore Company of Canada project in New Quebec-Labrador. This served to offset a decline in output from Ontario and the Island of Newfoundland, and led to a new high of 6,572,855 long tons in the Canadian output of iron ore.

In eastern Ontario, Marmoraton Mining Company Limited had, by the end of the year, almost completed stripping the 130-foot capping of limestone overlying its magnetite orebody. In northwestern Ontario, Caland Ore Company Limited planned to dredge the Falls Bay portion of Steep Rock Lake for open-pit mining of the orebody beneath; production is expected to start in 1960.

Two new sources of iron ore appeared on the mineral scene. Late in the year, Noranda Mines Limited began turning out iron oxide sinter by processing pyrite at its new plant at Port Robinson, near Welland in southern Ontario. In northern Ontario, The International Nickel Company of Canada Limited set to work on its plans to produce pelletized iron ore from pyrrhotite. Construction at Copper Cliff of the first unit of the new plant, which is to have an eventual production of 1,000,000 long tons of iron ore annually, is well advanced.

Canada's output of nickel reached an all-time high of 161,279 tons. The major development in the industry was the commencement of production from the Lynn Lake property of Sherritt Gordon Mines Limited in northern Manitoba. The first shipment of concentrates was made early in the year to the company's new refinery at Fort Saskatchewan, Alberta, which produced its first nickel in midsummer.

In the Sudbury area, International Nickel continued its extensive program of expansion which, during the past decade, has involved an expenditure of $150,000,000. During 1954, the company set aside $30,000,000 for expansion, including $16,000,000 for the new pyrrhotite plant, and began its first Canadian production of high-purity electrolytic cobalt at its Port Colborne refinery. Falconbridge Nickel Mines Limited made marked progress in carrying out its $55,000,000 expansion program, designed to increase the company's production of nickel to 27,500 tons annually by 1960. Three new mines, the Hardy in Levack township, the East Falconbridge in Falconbridge township, and the Mount Nickel in Blezard township, began production.

Canada's copper production rose to 302,732 tons, the highest since 1942, under the strengthening influences of a steady demand and a firm price. Each of the producing provinces recorded increases in output, the greatest gains being made by Ontario and Quebec. Contributing to the higher output in Quebec was Opemiska Copper Mines (Quebec) limited, in the Chibougamau area, which had its first full year of operation in 1954. Manitoba's output increased 30 per cent over 1953 because of new production from the Lynn Lake mine of Sherritt Gordon Mines Limited.

Considerable development was carried out at several promising copper properties. At the end of the year two companies in Quebec, Gaspe Copper Mines Limited in the Gaspé peninsula and Campbell Chibougamau Mines Limited in the Chibougamau area, neared production. Interest continued high in the copper-zinc discovery of Geco Mines Limited in the Manitouwadge area of northwestern Ontario, which shows every indication of becoming a major copper producer.

The steady improvement in the demand for, and the price of, lead resulted in the production of 218,495 tons, the highest since 1943. Contributing to the greater output was the near-completion of the extensive modernization of the Trail smelter begun a few years ago by The Consolidated Mining and Smelting Company of Canada Limited. Elsewhere in Canada, new output came from New Brunswick, where Keymet Mines Limited brought its lead-zinc property, 15 miles north of Bathurst, into production in October.

A slackening in the demand for zinc was reflected in a 6 per cent decrease in output below 1953 to 376,491 tons. The decrease was mainly in British Columbia, where Consolidated Mining and Smelting reduced its output of refined zinc by about 20 per cent. In Eastern Canada, Brunswick Mining and Smelting Corporation Limited built a 50-ton pilot mill near its Austin Brook zinc-lead-pyrite deposit, 17 miles southwest of Bathurst, for the treatment of development ore.

Canadian gold production increased 7 per cent to 4,366,440 ounces, mainly because of the settlement early in 1954 of strikes that had curtailed production in northern Ontario and Quebec for several months in 1953. The average mint price of gold was $34.11, the lowest since 1933, because of the high premium on the Canadian dollar. Early in 1955 the Government announced that, subject to the approval of Parliament, cost-aid payments under the Emergency Gold Mining Assistance Act would be extended at a reduced rate to the end of 1956.

Coal production dropped almost a million tons to 14,913,579 tons in 1954, the fourth successive decrease since the high of 19,139,000 tons in 1950. Most of the loss in output was in Alberta, where production decreased 18 per cent below 1953.

Industrial minerals continued in strong demand, particularly in the construction and chemical industries. Asbestos recorded the most valuable output at $86,409,212. Four new or enlarged mills came into produuction: the modernized and enlarged mill of Canadian Johns-Manville Company Limited at its Jeffrey mine at Asbestos, Quebec, the 5,000-ton mill of Asbestos Corporation Limited at its new Normandie mine near Vimy, and the 4,000-ton mill of Johnson's Asbestos Company at Black Lake - all in the Eastern Townships of Quebec, and the new 500-ton mill of Cassiar Asbestos Corporation Limited in northern British Columbia.

With the completion of the St. Lawrence Cement Company's 1,500,000-barrel plant at Villeneuve near Quebec City, Canada's annual cement productive capacity exceeded the 25,000,000-barrel mark. New construction planned for 1955 will raise over-all productive capacity a further 2,375,000 barrels. Huge quantities of cement will be needed for the St. Lawrence Seaway project, which got under way during 1954.

Activity in the gypsum industry was at a high level and several important developments promised a considerable expansion in output in the near future. These included the expenditure of $6,000,000 by National Gypsum (Canada) Limited to develop a large gypsum deposit at Dutch Settlement, north of Halifax, Nova Scotia, for an eventual annual production of 1,000,000 tons.

Important developments took place in other segments of the industrial minerals field. Canadian Rock Salt Company Limited neared completion of 1,100-foot shaft on its property at Ojibway near Windsor, Ontario. Mining of practically pure rock salt on a large scale is expected in 1955. A promising potash industry continued to take shape in Saskatchewan, where one company had sunk a shaft to about 1,000 feet on its property near Unity and two others continued active exploration of their holdings. Canada's capacity of sulphur production was further increased during 1954 with the entry into production of Noranda's new plant at Port Robinson, Ontario, with an annual capacity of 18,000 tons of elemental sulphur and 36,000 tons of sulphur in the form of sulphur dioxide. Shell Oil Company extended its sulphur plant at Jumping Pound in Alberta to double its current output of 11,000 tons annually. The new production is for use in the treatment of uranium ore from the Gunnar Mines property in the Beaverlodge area of northern Saskatchewan.

Output of Leading Metals and Minerals in Canada
1954 and 1953*

	1954		1953	
	Quantity	$	Quantity	$
Metallics				
	lb.		lb.	
Nickel	322,557,961	180,173,392	287,385,777	160,430,098
Copper	605,464,042	175,712,693	506,504,074	150,953,742
	oz.		oz.	
Gold	4,366,440	148,764,611	4,055,723	139,597,985
	lb.		lb.	
Zinc	752,982,353	90,207,285	803,523,295	96,101,386
Lead...............	436,990,488	58,250,831	387,411,588	50,076,822
	tons		tons	
Iron ore	7,361,598	49,666,507	6,509,818	44,102,944
	oz.		oz.	
Silver	31,117,949	25,907,870	28,299,335	23,774,271
Platinum metals	343,706	20,906,556	303,563	20,046,390
Others		50,326,561		23,797,120
Total, metallics		799,916,306		708,880,758
Non-metallics				
	tons		tons	
Asbestos	924,116	86,409,212	911,226	86,052,895
	bbl.		bbl.	
Cement	22,437,477	59,035,644	22,238,335	58,842,022
	tons		tons	
Sand and gravel.....	110,961,034	58,987,671	101,033,949	53,485,401
Stone	32,767,925	39,857,134	19,849,017	30,613,051
Clay products.......		32,360,098		29,777,731
Others		58,856,561		54,470,477
Total, non-metallics		335,506,320		313,241,577
Fuels				
	bbl.		bbl.	
Petroleum, crude ..	96,080,345	243,877,030	80,898,897	200,582,276
	tons		tons	
Coal	14,913,579	96,600,266	15,900,673	102,721,875
Others.............		12,482,169		10,877,017
Total, fuels		352,959,465		314,181,168
Total, all metals and minerals.......		1,488,382,091		1,336,303,503

* Final figures, Dominion Bureau of Statistics.

Value of Mineral Production in Canada by Provinces and Territories
1954 and 1953*

	1954	1953
	$	$
Ontario	496,747,571	465,877,093
Alberta	279,042,735	248,863,295
Quebec	278,818,070	251,881,781
British Columbia	158,630,867	158,487,812
Nova Scotia	73,450,898	67,364,408
Saskatchewan	68,216,009	48,081,970
Newfoundland	42,898,033	33,780,622
Manitoba	35,106,922	25,264,112
Northwest Territories	26,414,000	10,300,230
Yukon	16,588,664	14,738,562
New Brunswick	12,468,322	11,663,618
Canada	1,488,382,091	1,336,303,503

* Final figures, Dominion Bureau of Statistics.

METALLICS

ALUMINUM

Output of aluminum in 1954 from the plants of The Aluminum Company of Canada, Ltd., (Alcan), Canada's only producer, reached a record of 560,000 short tons, an increase of 2 per cent over 1953 and 12 per cent over 1952.

Alcan's four reduction plants in Quebec, at Arvida, Isle Maligne, Shawinigan Falls, and Beauharnois, have a combined capacity of about 550,000 short tons of aluminum a year. With the entry into production of the multi-million dollar project at Kitimat, British Columbia, on August 3, 1954, total installed capacity of the company's plants was raised to 638,000 tons a year. On October 13, 1954, the company announced its decision to go ahead with the installation of a fourth 140,000 h.p. generator and additional smelter facilities, at a cost of $45,000,000, and thus increase the rated capacity of the Kitimat smelter from 91,500 tons to 151,500 tons a year. This new unit is scheduled for completion early in 1957.

Construction of the first stage of the smelter, with a rated capacity of 91,500 tons, and of the basic hydro-electric installation to supply the requirements of a smelter several times this size, required 3 1/2 years' work and an initial investment of over $275,000,000. This was the largest part of the company's 1951-1954 program, which has also involved expansion in Eastern Canada, development of bauxite and alumina production in Jamaica, and expansion of bauxite mining activities in British Guiana and French West Africa.

As a producer of aluminum, Canada is second only to the United States, and is by far the world's leading exporter, accounting for about 75 per cent of the net world exports. There is no bauxite, the ore of aluminum, in Canada, and the industry is totally dependent on imported bauxites obtained mainly from British Guiana, with substantial amounts from French West Africa, Surinam, United States, Jamaica, France, and Japan. With the Kitimat plant well into production, increasing amounts of alumina will be shipped to British Columbia from Jamaica, where Alumina Jamaica Limited, a subsidiary of Alcan, brought an alumina plant into production last year. An alumina plant at Port Alfred, Quebec, close to the reduction plants at Arvida, converts imported bauxite ores to alumina.

Most of Canada's production is exported under government purchase contracts to the United States and the United Kingdom, domestic consumption of primary aluminum being less than 100,000 short tons annually.

Production, Trade, and Consumption

	1954		1953	
	Short tons	$	Short tons	$
Production				
Ingot	560,000*		548,445	
Imports				
Bauxite				
British Guiana	2,140,641	10,684,762	2,036,159	10,782,604
French Africa	417,003	2,458,979	386,891	2,454,415
Surinam	282,730	2,735,430	109,579	1,334,365
United States	51,156	1,054,455	67,658	1,618,710
Jamaica	55,933	3,053,543	-	-
France	2,911	12,812	-	-
Japan	565	27,853	-	-
Trinidad	4,480	36,432	88,178	393,650
Total	2,955,419	20,064,266	2,688,465	16,583,744
Cryolite				
Denmark (Greenland)	4,409	803,620	-	-
United States	45	11,220	84	20,832
Total	4,454	814,840	84	20,832
Aluminum Products				
Semi-manufactured		2,261,117		4,157,969
Fully-manufactured		13,423,094		12,283,851
Total		15,684,211		16,441,820
Exports				
Primary Forms				
United States	198,480	70,772,233	233,468	80,288,113
United Kingdom	211,140	75,256,214	188,927	65,893,299
Other countries	58,874	23,433,776	37,297	14,384,272
Total	468,494	169,462,223	459,692	160,565,684
Semi-Fabricated				
United States	6,021	3,077,244	10,836	5,569,555
India	3,351	1,666,372	2,179	1,079,138
Other countries	8,075	4,297,552	4,362	2,358,043
Total	17,447	9,041,168	17,377	9,006,736

* estimated

	1954		1953	
	Short tons	$	Short tons	$
Manufactured				
United States		1,349,747		2,176,012
Colombia		213,138		161,513
Other countries		559,286		2,139,896
Total		2,122,171		4,477,421
Scrap				
United States	6,904	1,602,957	10,042	2,662,775
Other countries	7,019	2,285,970	3,412	1,143,217
Total	13,923	3,888,927	13,454	3,805,992
Consumption of ingot	80,000		92,335	

World Production of Primary Aluminum

(Thousands of short tons)

Year	World	U.S.A.	Canada	Canada Percentage of World
1953	2,660	1,252	548	21
1954 (est.)	2,960	1,450	560	19

Uses

Aluminum has many desirable characteristics which make it almost essential in many branches of modern industry. It weighs only about one-third as much as nickel, copper, zinc, or steel, and less than one-quarter as much as lead. It resists corrosion and is a good conductor of electricity and heat. Aluminum is soft and malleable in its pure state and can be shaped and formed easily. It can also be made strong and hard by the addition of small quantities of other metals such as copper, silicon, manganese, magnesium, and nickel. Structural aluminum equal in strength to structural steel has a greater volume but only half the weight. Aluminum has non-sparking and non-magnetic qualities and is non-toxic.

For a given volume, aluminum costs about one-fifth as much as copper and about one-half as much as lead or zinc. Aluminum is being used to a greater extent in the fields of house wiring, telephone and telegraph lines, and motor and generator components where copper has been the standard material.

Aluminum Consumption in Canada, 1954*

(Unfabricated virgin aluminum and semi-fabricated aluminum)

	%
Aircraft	12.3
Automotive	4.4
Building and construction	29.1
Canning and packaging	1.6
Chemical industry	0.3
Electrical	13.6
Food and farming	1.1
Hardware	1.3
Household and commercial supplies	20.3
Paints	0.1
Plumbing and heating	1.0
Transportation	0.8
Other uses	14.1
Total	100.0

* The percentages shown are based on quarterly reports by consumers of virgin aluminum ingot and semi-fabricated shapes. Three quarters for the year 1954 are available at this time. This consumption pattern does not include the consumption of secondary aluminum or aluminum scrap.

Prices

The Canadian price of aluminum ingot remained at 19 cents per lb. throughout 1954. On January 1, 1955, the price of ingot in Canada was raised to 19.75 cents per lb.

The price of aluminum ingot in the United States was 21 1/2 cents per lb. until August 5, 1954, when it was raised to 22.20 cents.

ANTIMONY

No metallic antimony has been produced in Canada since 1944, when The Consolidated Mining and Smelting Company of Canada Limited discontinued operation of its antimony refinery at Trail, British Columbia, which had been turning out metal since 1939. Production since then has been in the form of antimonial lead, derived from lead concentrates produced from ores of the company's Sullivan mine at Kimberley, British Columbia, and from lead-silver ores and concentrates containing antimony shipped by other mines to Trail for treatment. Antimonial lead produced at Trail normally contains 25 per cent antimony, but in 1954 lead containing 1 per cent, 5 per cent, and 35 per cent was also produced. Lead bullion produced at the smelter contains about one per cent antimony and the antimonial lead is recovered from the anode mud formed in the electrolytic refining of lead. In the smelting process, slags and flue dust containing a high percentage of antimony are accumulated and, as they cannot be readily treated at Trail, are sold from time to time to foreign smelters.

Based on figures for 1953, the principal producing countries on a mine basis are China (8,800 tons of contained antimony), Bolivia (6,376), Mexico (4,100) and Algeria (1,995). The United States, the principal consumer, used about 12,000 tons of primary metal in 1954 compared with 14,300 tons in 1953. World supply was in excess of demand during 1954 but the price per pound in the United States remained at 31.97 cents throughout the year.

Occurrences and Development

A number of occurrences or deposits of the principal antimony mineral stibnite (Sb_2S_3) have been explored and partly developed in Canada but results generally have not been encouraging. The better-known occurrences are:

1. Mortons Harbour mine, New World Island, Notre Dame Bay, Newfoundland.
2. West Gore deposit, Hants county, Nova Scotia.
3. Lake George property, Prince William parish, York county, New Brunswick.
4. South Ham deposit, Wolfe county, Quebec.
5. Gray Rock property, Truax Creek, Bridge River district, British Columbia.
6. Stuart Lake mine, Fort St. James area, British Columbia.
7. The Caroline property, West Kootenay district, British Columbia.
8. Highet Creek deposit, Mayo district, Yukon.
9. Wheaton River deposits, near Whitehorse, Yukon.

Production, Trade, and Consumption

	1954		1953	
	Short Tons	$	Short Tons	$
<u>Production</u>				
Antimony content of antimonial lead	465		358	
Doré slag	135		386	
Total	600	321,150	744	291,862
<u>Imports</u>				
<u>Antimony metal</u>				
United Kingdom	585	296,071	277	152,663
Belgium	245	108,975	269	107,060
Netherlands	59	27,778	154	51,915
Mexico	50	25,050	-	-
United States	33	13,956	29	14,357
Czechoslovakia	29	10,263	70	19,047
West Germany	21	8,689	55	20,067
Other countries	-	-	11	6,231
Total	1,022	490,782	865	371,340
<u>Antimony oxides</u>				
United Kingdom	81	37,595	37	18,256
United States	22	12,123	26	13,993
West Germany	11	5,394	-	-
Belgium	1	511	1	524
Total	115	55,623	64	32,773
<u>Antimony salts</u>				
United States	11	12,175	13	15,137
United Kingdom	1	1,063	-	-
West Germany	-	-	2	2,300
Total	12	13,238	15	17,437
<u>Exports</u>				
Antimony content of antimonial lead	349		188	

	1954		1953	
	Short Tons	$	Short Tons	$
Consumption				
Antimony metal used in				
Antimonial lead..............	467		466	
Type metal..................	59		106	
Babbitt	128		118	
Solder	10		15	
Cable alloys..................	4		2	
Antimony oxide	53		52	
Other alloys and miscellaneous	137		100	
Total..............	858		859	
Producers domestic shipments of antimony contained in antimonial lead alloy........	63		144	

No development was reported to have been carried out on any Canadian antimony deposits in 1954.

Uses and Consumption

The metal is used chiefly to impart hardness and mechanical strength to lead. Electric storage batteries for cars and trucks absorb large amounts of antimonial lead with an antimony content ranging from 4 to 12 per cent. Antimony is also an important constituent in cable covering, solders, babbitt metal, and type metal.

A potential new use has been reported in the electronics field for transistors and rectifiers made of an aluminum-antimony alloy.

Sulphides of antimony are used as pigments in paint and rubber manufactures. Antimony oxide is employed for the flame-proofing of paints, plastics, and textiles.

Prices

The average price of contained antimony produced in Canada was estimated by the Dominion Bureau of Statistics to have been 26.76 cents a pound.

The United States price for antimony, 99.50 per cent, boxed, at New York was 31.97 cents a pound throughout the year. The Canadian price is based on the United States price converted into Canadian funds.

ARSENIC

Deloro Smelting and Refining Company, Limited, Deloro, Ontario, is the sole producer of refined white arsenic (arsenic trioxide, As_2O_3). The company recovers arsenic as a by-product in the treatment of silver-cobalt ores from the Cobalt-Gowganda area of northern Ontario and from French Morocco, and from the treatment of residues produced by Eldorado Mining and Refining Limited at its refinery at Port Hope, Ontario. Roasting capacity of the Deloro refinery is about 100 tons of refined white arsenic per month.

Production, Trade and Consumption

	1954		1953	
	Pounds	$	Pounds	$
Production	443,900	18,800	1,403,740	56,150
Exports[a,b]	1,422,600	58,871	576,500	24,928
Imports	-	-	32,233	5,881
Consumption by Industry	1953		1952	
	Pounds		Pounds	
Glass industry	343,279		340,631	
Insecticides, wood preservatives, and miscellaneous	88,804		114,314	
Alloys	36,515		68,127	
Total	468,598		523,072	

a Does not include arsenic content of gold ores exported for refining.
b Arsenic trioxide and arsenic sulphide.

Canadian Producers

Crude arsenic trioxide is recovered by O'Brien Gold Mines Limited as a by-product in the treatment of its gold ore, but no shipments have been made since 1952. The material is stockpiled at the property in western Quebec and is refined at Deloro when market conditions warrant treatment.

Beattie-Duquesne Mines Limited, Duparquet township, Quebec, also recovers crude arsenic from the roasting of arsenical gold ores in a Cottrell plant. The crude arsenic, containing about 70 per cent As_2O_3, is stored at the mine site. No crude has been refined since 1948 when the Duparquet refinery was dismantled.

Uses

Major uses of arsenic and its compounds in order of importance are: as insecticides and weed killers, in the manufacture of glass, and in wood preservatives. Lead arsenate, calcium arsenate, and paris green are the principal arsenic insecticides. Sodium arsenite is used as a weed killer, as sheep dip, and for control of such pests as termites and grasshoppers. In

Canada, the glass industry is by far the largest consumer of refined white arsenic, which is used as a decolourizer. Large amounts of white arsenic are used in wood preservatives such as Wolman salts (25 per cent sodium arsenate) and zinc meta-arsenate.

Prices

Refined white arsenic was quoted at 5 1/2 cents per pound (powdered, in barrels, carlots) throughout 1954 according to the Oil, Paint and Drug Reporter. This price has been in effect since August 1952, when it was reduced from 6 1/2 cents per pound on the same basis.

BISMUTH

About 74 per cent of the production of bismuth in 1954 was refined metal from The Consolidated Mining and Smelting Company of Canada, Limited, at Trail, British Columbia. The remainder was crude bismuth produced at the La Corne mine near Val d'Or, Quebec, by Molybdenite Corporation of Canada Limited.

Production, Trade, and Consumption

	1954		1953	
	Pounds	$	Pounds	$
Production				
British Columbia	202,000	454,500	71,298	160,421
Quebec	70,700	128,674	46,068*	49,136
Total	272,700	583,174	117,366	209,557
Exports	134,513		46,068*	
Consumption, metal (producers' domestic shipments)	73,795		67,268	

* Bismuth contained in bismuth oxychloride.

British Columbia

Bismuth produced at Trail originates for the most part in the lead-zinc-silver ores produced at the Consolidated Mining and Smelting Company's Sullivan mine at Kimberley, but recovery is also made of bismuth contained in custom ores and scrap material from manufacturers. The sources of the company's bismuth output are not reported separately.

Lead bullion produced at the Trail lead smelter contains about 0.05 per cent bismuth. The residue resulting from the electrolytic refining of the bullion is treated for the recovery of contained precious metals, bismuth, and antimony. The major steps involved in the recovery of bismuth are:

(1) Melting of the residues (anode mud) to metal and slag
(2) Elimination of antimony and arsenic as a fume
(3) Cupellation to Doré metal and lead-bismuth slag
(4) Reduction of cupellation slag to lead-bismuth alloy
(5) Removal of copper by drossing
(6) Removal of gold and silver by the Parkes process
(7) Removal of lead by the Betts process leaving bismuth slimes
(8) Reduction of slimes to bismuth metal

The refined bismuth, so produced, has a purity exceeding 99.99 per cent.

Quebec

In ores of the La Corne mine, both molybdenite and bismuth are of economic importance. Reserves at the end of 1954 were estimated to be 200,000 tons averaging 0.51 per cent molybdenite (MoS_2) and 0.035 per cent bismuth. Ore milled in 1954 was 105,924 tons from which 875,000 pounds of MoS_2 and 70,700 pounds of crude bismuth metal averaging 97.4 per cent bismuth were produced. About half of the bismuth output was sold during the year. Production was suspended during 1953 and early 1954 to permit the opening of two new levels at the 625- and 750-foot horizons and the preparation of the mine for production at 500 tons a day. Production was resumed in March 1954.

Treatment of the La Corne ore involves bulk flotation to produce a concentrate averaging 80 per cent MoS_2 and 10 per cent bismuth. The bismuth is recovered by leaching with hydrochloric acid and then hydrolysing with water to form bismuth oxychloride which is smelted in cast-iron crucibles to form crude bismuth metal. This is poured in 100-pound ingots.

Uses

Bismuth, in amounts up to 50 per cent, is used with tin, lead, and cadmium to make various low-melting point alloys which find application in fire-protection devices, electrical fuses, and solders. Because bismuth expands on solidification and retains this property in alloyed form it is used in type-metal alloys.

Permanent magnets of a very high energy potential are made from finely pulverized manganese-bismuth compounds.

In the field of atomic energy, considerable research has been directed into the possible use of low-melting-point bismuth alloys having low neutron-capture qualities as coolants in atomic piles.

Bismuth salts have a fairly wide application in the preparation of pharmaceutical and cosmetic products. Kaolin-base preparations have, to some extent, replaced bismuth compounds for pharmaceutical purposes.

In the United States, consumption by principal uses in 1952 and 1953 was as follows:

	1953		1952	
	Pounds	Per cent of total	Pounds	Per cent of total
Pharmaceuticals................	318,000	21	406,800	22
Solders........................	238,000	15	145,800	8
Fuse alloys....................	187,000	12	261,700	14
Other alloys...................	682,000	45	865,800	50
Rectifier coatings.............	34,000	2	25,500	2
Other uses.....................	71,000	5	69,400	4
Total..............	1,530,000	100	1,775,000	100

Prices

The Engineering and Mining Journal quoted the price of bismuth in ton lots as $2.25 a pound in New York throughout the year. The crude bismuth metal produced by the Molybdenite Corporation of Canada Limited had an estimated value of $1.82 a pound.

CADMIUM

Cadmium is a minor constituent of most zinc ores and is recovered as a by-product in the refining of zinc at various plants throughout the world. In Canada, The Consolidated Mining and Smelting Company of Canada, Limited (Cominco) at Trail, British Columbia, and Hudson Bay Mining and Smelting Company Limited at Flin Flon, Manitoba, produce refined cadmium from the treatment of zinc concentrates from their own and custom ores. The metal is accumulated in cadmium-rich precipitates that result from the purification of the zinc electrolyte used in the electrolytic process for making refined zinc. About 70 per cent of the cadmium in the concentrates is recoverable, and metal of a purity not less than 99.95 per cent is produced in the form of balls, sticks, or slabs. The refinery at Trail has a rated capacity of 1,400,000 pounds of cadmium a year and the Flin Flon refinery 360,000 pounds, but the output at both refineries has been much below rated capacity.

Domestic Sources

British Columbia

Much of the output of cadmium at Trail came from zinc concentrate produced at Cominco's Sullivan mine near Kimberley where about 11,000 tons of silver-lead-zinc ore a day were mined. Other important sources were Cominco's Bluebell mine on Kootenay Lake, its Tulsequah mine near the northwest coast, and the Jersey mine of Canadian Exploration Limited near Salmo. Some cadmium was contained in zinc concentrates exported by Britannia Mining and Smelting Company Limited, Howe Sound, and other producers. The Sullivan zinc concentrates averaged about 0.14 per cent cadmium but the cadmium content of some of the other concentrates produced ranged up to 0.82 per cent.

Yukon

United Keno Hill Mines Limited in the Mayo district is the principal producer. It shipped zinc concentrates containing about 310,000 pounds of cadmium to the Trail smelter.

Manitoba and Saskatchewan

Hudson Bay Mining and Smelting Company's cadmium production came from its Flin Flon copper-zinc mine on the provincial boundary, and from several small subsidiary mines nearby.

Eastern Canada

Zinc concentrates exported by 12 mines in Quebec and other provinces in Eastern Canada contained an average of 0.20 per cent cadmium. The largest producer was Barvue Mines Limited, Barraute, Quebec, which shipped 65,000 tons of zinc concentrate in 1954. No payment was received from foreign plants or smelters for the cadmium contained in these concentrates and the amount recovered was not reported.

Uses

Cadmium is used chiefly as an electro-deposited protective coating for iron and steel products and, to a lesser extent, for copper-base alloys. Where cost is not of prime significance, cadmium is preferred to zinc as a coating because it can be deposited more uniformly in the recesses of intricately shaped parts; it has a slightly higher resistance to atmospheric corrosion; and it has a higher rate of deposition per unit of electric power.

Cadmium-plated articles include a wide range of parts and accessories used in the construction of aircraft, automobiles, military equipment, and household appliances.

Production, Trade, and Consumption

	1954		1953	
	Pounds	$	Pounds	$
Production, all forms				
British Columbia	658,796	1,119,953	721,862	1,443,724
Yukon	215,425	366,223	238,426	476,852
Saskatchewan and Manitoba	153,000	260,100	157,997	315,994
Total.......	1,027,221	1,746,276	1,118,285	2,236,570
Production, refined(a) ...	1,058,624		977,226	
Exports				
United Kingdom	565,438	913,334	357,562	648,217
United States............	164,657	234,147	611,341	1,042,442
Other countries	46,296	60,874	660	1,330
Total.......	776,391	1,208,355	969,563	1,691,989
Consumption				
Plating			226,631	
Other			12,615	
Total.......	197,686		239,246	

	1953	1952
Refinery production, principal countries(b)		
United States............	9,682,197	8,387,824
Canada(a)...............	977,226	819,822
Italy	350,363	293,443
Australia	505,041	506,980
Great Britain	379,555(c)	335,081

(a) Includes some metal from imported ores.
(b) American Bureau of Metal Statistics, except for Canada.
(c) United States Mineral Trade Notes.

The second largest use is for bearing alloys used in internal combustion engines specially designed for high speeds and temperatures. These alloys are usually either the cadmium-nickel alloy composed of about 98.5 per cent cadmium and 1.2 per cent nickel or the cadmium-silver-copper alloy containing 98.3 per cent or more cadmium, 0.7 per cent silver, and 0.6 per cent copper.

Cadmium is also used in making low-melting-point solders and fusible alloys of the cadmium-tin-lead-bismuth type for automatic sprinkler systems, fire-detection apparatus, and valve seats for high-pressure gas containers.

The addition of about one per cent of cadmium considerably strengthens copper wire without seriously reducing its conductivity.

In the field of atomic energy, the metal is used for shielding purposes and in devices for reactor control.

Nickel-cadmium storage batteries are reported to have a longer life period than the standard lead-acid battery. The use of this type of battery is increasing, particularly for military applications and low-temperature conditions.

Cadmium sulphide and cadmium sulphoselenide are used where bright, high-quality, yellow and red colours, respectively, are required for paints, inks, ceramic glazes, paper, rubber, and glass. Cadmium oxide, cadmium hydrate, and cadmium chloride are used in electro-plating solutions. Cadmium bromide and iodide are used to make photographic films, also in the process of engraving and lithographing. Cadmium stearate goes into the making of vinyl plastics.

Prices

The New York price of cadmium in commercial sticks was $2.00 a pound during January 1954, but was reduced to $1.75 for the balance of the year. Special shapes for platers were quoted at $1.75 a pound from January 31 to June 19 when they were reduced to $1.70 a pound.

The average Canadian price estimated by the Dominion Bureau of Statistics was $1.70 a pound compared with $2.00 a pound in 1953.

CALCIUM

The only commercial source of calcium metal in Canada is Dominion Magnesium Limited at Haley, Ontario. This company is the world's largest producer of the metal.

Production was initially commenced in 1943 by the distillation method, a batch process similar to that employed by the company in its production of magnesium, the same retorts being used in the distillation of either metal. Lime is mixed with aluminum in the required proportions and briquetted. The briquettes or pellets are charged into tubular retorts of chrome-nickel steel, which are heated and evacuated. The aluminum combines with the oxygen of the lime, and the free calcium distils off and condenses in crystalline form on a water-cooled condenser that is removed from the retort when the operation is complete and the vacuum released. The purity of the metal is dependent upon the purity of the raw material. Commercial calcium as now produced contains less than 2 per cent magnesium while special grades obtained by redistillation contain less than 0.1 per cent magnesium. The metal is melted and cast into ingots and billets of varying sizes. The metal is also supplied as coarse powder and granules.

Calcium is a soft, lustrous, white metal which decomposes very rapidly in moist air. It is an active reducing agent, and reacts readily at high temperatures with practically all the elements except the inert gases. It is both ductile and malleable and may readily be extruded on heating to 420-460°C. Its commercial forms include chunks, bars, rods, and powder.

Uses

Calcium metal has many uses in the metallurgical industry. It is a reducing agent in the preparation of uranium, titanium, vanadium, thorium, zirconium, etc; an alloying agent for aluminum, bearing metals, copper, lead, and magnesium; a decarburizer and desulphurizer for ferrous metals and alloys; a debismuthizer of lead; and a deoxidizer of iron castings. It is also used in separating argon and nitrogen, dehydrating alcohol, and removing sulphur from petroleum fractions.

Production and Trade

Information on Canadian production, exports, and imports of calcium metal is not available for publication. According to United States statistics, calcium metal imports from Canada were: 1952 - 376 short tons; 1953 - 495 short tons; 1954 (1st 10 months) - 241 short tons. Canada also exports calcium metal to other countries, chiefly the United Kingdom.

CHROMITE

Canada has no known deposits of commercial-grade chromite ores. During World War II some chromite was produced in the area between Quebec City and Sherbrooke in the Eastern Townships of Quebec but no shipments have been made from this source since 1949. The Bird River deposits in the Lac du Bonnet district in southeastern Manitoba are large but low grade.

Canadian consumption of chromite, which is mainly used in the production of ferrochrome, has continued to decline, the 1954 consumption of 65,141 tons being about 70 per cent of that in 1952 to 1953. Canadian production of ferrochrome at capacity levels is dependent upon exports, mainly to United States and the United Kingdom. The establishment of production in England and South Africa and the proximity of Scandinavian ferrochrome in the sterling area resulted in a loss of export sales previously contracted in Canada. The relatively small demand in Canada was unable to support ferrochrome operations at one plant, and in order to meet the Canadian requirements which had normally been supplied by that plant, ferrochrome was imported from the United States.

Chromite is consumed in Canada by Electro Metallurgical Company at Welland, Ontario, where high and low-carbon chromium alloys are produced in a modern plant using electric furnaces. Exothermic chromium alloys are produced by Chromium Mining and Smelting Corporation, Limited at Sault Ste. Marie, Ontario, in electric furnaces.

Canadian Refractories Limited produces chrome refractories for furnace linings in its plant at Marelan, about 50 miles west of Montreal.

World Mine Production

Turkey and Russia together accounted for about 40 per cent of the estimated world output of 3,700,000 metric tons of chromite in 1953. Most of the production from Turkey is a very high (52% Cr_2O_3) metallurgical-grade ore.

South Africa with its large reserves of medium-grade ore in the Transvaal ranks after Turkey. Most of the output is of chemical grade, of which South Africa is the only producer, Southern Rhodesia competes with Turkey as the major source of metallurgical-grade ore.

The Philippines, with very large reserves of ore of metallurgical and refractory grades, occupies fourth position.

In the Americas, Cuba is the most important producer. Its output comprises both refractory and metallurgical grades.

Consumption and Uses

World consumption of chromium is about three and one-half times the combined consumption of nickel, tungsten, molybdenum, and cobalt.

Approximately one-half of all chromite consumed is metallurgical grade, 35 per cent is refractory grade and 15 per cent chemical grade.

Trade and Consumption

	1954		1953	
	Short Tons	$	Short Tons	$
Imports, chromite				
Philippine Islands	8,960	117,325	19,040	251,925
Union of South Africa...	20,883	267,347	48,408	685,776
United States*	1,563	66,540	32,059	1,423,080
Southern Rhodesia and Nyasaland	6,111	120,772	16,345	537,498
Turkey................	-	-	2,240	108,270
Total	37,517	571,984	118,092	3,006,549
Exports, ferrochrome				
United States	14,768	2,632,941	28,469	7,879,061
Belgium	245	50,994	55	11,324
United Kingdom........	245	47,643	5,263	2,078,802
Other countries	46	9,602	37	9,674
Total	15,304	2,741,180	33,824	9,978,861
Consumption, chromite.	65,141		93,552	

*Country of origin not known.

Metallurgical-grade Chromite

For metallurgical consumption in the manufacture of ferrochrome, chromite should contain 45 to 50 per cent Cr_2O_3, with a chromium-iron ratio which varies from 2.8 to 1 to 3 to 1. The material should be in lump form, as it is used in electric furnaces, and should contain as little silica as possible.

Ferrochrome is mainly consumed as low-carbon and as high-carbon ferrochrome, both of which contain from 67 to 71 per cent chromium. Low-carbon ferrochrome is used in stainless and in heat-resistant steels because of its low carbon content. These steels are widely used in the chemical and petrochemical industries. High-carbon ferrochrome is used in the production of other other chromium-bearing steels and alloy cast-irons. Chromium in these steels greatly increases corrosion resistance and resistance to oxidation.

In cast-iron, chromium increases hardness, strength, and resistance to oxidation.

Chromium metal is used in the production of high-temperature, corrosion-resistant alloys as well as in chromium bronzes, hard-facing alloys, welding-electrode tips, and certain high-strength aluminum alloys. High-temperature alloys contain from 18 to 28 per cent chromium together with varying amounts of cobalt, tungsten, molybdenum, nickel, titanium, and columbium. The main uses of high-temperature alloys are in the jet and gas turbine engine industry for such parts as nozzle guide vanes and turbine blades. They are also used in heat exchangers, boiler superheaters, and superchargers.

Chromium plating is used to improve the outward appearance of steels but these electroplated finishes actually require only small quantities of chromium. Many articles such as dies, gauges, and punches are plated with a thicker layer to obtain hardness and wear resistance.

Refractory-grade Chromite

For the manufacture of refractories, alumina (Al_2O_3) substitutes for some of the chromic oxide (Cr_2O_3) and specifications call for a 57 per cent minimum of combined Cr_2O_3 and Al_2O_3 with as little iron and silica as possible, usually around 10 and 5 per cent, respectively. The chromium-iron ratio is of no consequence in this grade but the ore must be hard and lumpy, not under 10-mesh. Fine ore is suitable for the manufacture of brick cement or in the chrome-magnesite brick industry.

Refractory-grade chromite is manufactured into bricks for use as a neutral lining for furnaces. Because of its high melting point and chemical inactivity, chromite is widely used in contact with acid or basic fluxes. Hence it is common practice to use chromite bricks near the slag line in open-hearth furnaces, separating the silica bricks of the roof and the top of the sides from the dolomite or magnesite bricks of the hearth and sides below the slag line. Other chrome refractories are used for patching brickwork and ramming mixtures for furnace bottoms.

Chemical-grade Chromite

For chemical consumption, the specifications are not as rigid as in the metallurgical and refractory grades. Standard chemical ores contain 44 per cent Cr_2O_3, and iron is not a problem within reasonable limits. The ore should not contain more than 15 per cent alumina (Al_2O_3), 20 per cent FeO, 3 per cent SiO_2, and the sulphur must be low. The chromium-iron ratio is usually about 1.5 to 1. Fines are preferred because the ore is ground in processing to sodium and potassium chromates or bichromates.

Sodium bichromate or its derivatives are widely used in the tanning of leather, as pigments in the paint and dye industries, in the surface treatment of metals, and as a source of electrolytic chromium metal.

Prices

According to E. & M. J. Metal and Mineral Markets of December 30, 1954, the United States prices were as follows:

Chrome ore - per long ton, dry basis, subject to penalties if guarantees are not met, f.o.b. cars N.Y., etc.

Rhodesian

48 per cent Cr_2O_3, 3 to 1 ratio, lump long-term contracts	\$43 to \$44
48 per cent Cr_2O_3, 2.8 to 1 ratio, lump, long-term contracts	\$40 to \$41
48 per cent Cr_2O_3, no ratio long-term contracts	\$32 to \$33

South African (Transvaal)

48 per cent Cr_2O_3, no ratio	\$32 to \$33
44 per cent Cr_2O_3, no ratio	\$22 to \$23

Turkish

48 per cent Cr_2O_3, 3 to 1 ratio, lump,	\$46 to \$47
46 per cent Cr_2O_3, 3 to 1 ratio, lump,	\$43 to \$44

Pakistan (Baluchistan)

48 per cent Cr_2O_3, 3 to 1 ratio	\$43 to \$44

Ferrochrome - per lb. of Cr:

High-carbon (4 to 9% C) 65 to 69 per cent Cr, lump, carloads, f.o.b. destination continental U.S.A. 24 3/4 cents, low-carbon, 34 1/2 cents.

Chromium (chrome metal)

per lb., 97 per cent, 0.5 C - $1.16

Electrolytic chromium

99 per cent min., f.o.b. Niagara Falls, N.Y., $1.16 per lb.

Tariffs

Canadian

Chrome ore - free

Chromium metal - in lumps, powder, ingots, blocks or bars, and scrap alloy metal containing chromium, when imported by manufacturers for use exclusively for alloying purposes in their own factories - free

Ferrochrome

British preferential	- free
Most favoured nation	- 5 per cent ad valorem
General	- 5 per cent ad valorem

United States

Chrome ore - free

Chromium (chrome metal) - 12 1/2 per cent ad valorem

Chromium nickel and chromium vanadium - 12 1/2 per cent ad valorem

Ferrochrome

3 per cent or more carbon on Cr. content - 5/8 cent per lb.
less than 3 per cent carbon on Cr. content - 12 1/2 per cent ad valorem

COBALT

Shipments of cobalt, all forms from ores of Canadian origin increased to 2,181,900 pounds from 1,602,545 pounds in 1953. The increase was largely due to expansion in the nickel industry, which produces cobalt as a by-product. In October, production of high-purity electrolytic cobalt began for the first time in Canada at the Port Colborne refinery of The International Nickel Company of Canada Ltd.

Consumption of cobalt in Canada decreased, following the general trend in the free world. For example, in the United States, the largest consumer, it is estimated that consumption in 1954 was 35 per cent less than in 1953, about the same as the estimated decrease in Canadian consumption. The decline was due chiefly to smaller use of cobalt in high-temperature alloys.

Production

Cobalt-Gowganda Area, Ontario

Cobalt ore shipments made via the Temiskaming Testing Laboratories, Cobalt, amounted to 1,254,425 pounds of contained cobalt compared with 1,167,987 pounds in 1953. These shipments were made chiefly to Deloro Smelting and Refining Company Limited, Deloro, Ontario; a much smaller amount went to Cobalt Chemicals Limited, Cobalt, Ontario. One small parcel of cobalt ore was exported to the United States.

The Canadian Government's premium price plan expired on March 31, 1954, but its place was taken by a similar plan involving a limited quantity of cobalt on behalf of the United States Government. The prices paid for cobalt ores under the latter plan were as follows, f.o.b. Cobalt, Ontario:

7 - 7.99%	cobalt,	$1.00	per	lb.	of	contained	cobalt
8 - 8.99%	"	$1.15	"	"	"	"	"
9 - 9.99%	"	$1.30	"	"	"	"	"
10 - 10.99%	"	$1.40	"	"	"	"	"
11 - 11.99%	"	$1.50	"	"	"	"	"
12% plus	"	$1.60	"	"	"	"	"

The main shippers of cobalt ore during 1954 were Cobalt Consolidated Mining Corporation Limited, Silver-Miller Mines Limited, Mensilvo Mines Limited, and Harrison-Hibbert Mines Limited.

Silver ore shipments made during 1954, via the Temiskaming Testing Laboratories, were mainly to Deloro Smelting and Refining Company, which purchased the cobalt content of these ores for its own account. Shipments amounted to 172,110 pounds of contained cobalt compared with 132,316 pounds in 1953.

Certain flotation concentrates containing from 100 to 500 ounces of silver per ton plus some copper also contain from 2 to 2 1/2 per cent cobalt. These concentrates are shipped to the smelter of Noranda Mines Limited, but the cobalt is not recovered.

Sudbury Area, Ontario

Cobalt occurs in minor amounts in the nickel-copper ores and is recovered as cobalt oxide or electrolytic cobalt from residues obtained in the refining of nickel.

The International Nickel Company of Canada Limited recovers cobalt oxide from the electrolyte at its nickel refinery at Port Colborne, Ontario. The cobalt is separated by precipitation and is shipped as an impure cobalt oxide to the Mond Nickel Company Limited plant at Clydach, Wales, for the production of black and grey oxides and an extensive range of cobalt salts. In October, International Nickel began the first production in Canada of a high-purity electrolytic cobalt at its Port Colborne refinery. Recovery of the cobalt content of nickel matte produced by International Nickel began in 1940 at Clydach, but this cobalt has never been included as Canadian production in Canadian Government statistics.

Falconbridge Nickel Mines Limited produces electrolytic cobalt from nickel-copper matte exported to its nickel refinery at Kristiansand, Norway.

Great Bear Lake Area, Northwest Territories

Concentrates shipped from the Crown-owned mine of Eldorado Mining and Refining Limited at Port Radium, Great Bear Lake, contain small amounts of cobalt. A speiss produced from the company's Port Hope refinery residues contains about 12 per cent cobalt and is sold to Deloro.

Other Developments

Although production of nickel began at the refinery of Sherritt Gordon Mines, Limited, at Fort Saskatchewan, Alberta, from nickel concentrates of the company's mine at Lynn Lake, Manitoba, no cobalt was produced during 1954. It is expected that production will ultimately be forthcoming at a rate of about 300,000 pounds of metal annually.

Several occurrences of cobalt were discovered during the year, the most notable being those on the copper properties of Opemiska Copper Mines (Quebec) Limited, in the Chibougamau area of Quebec, and Pater Uranium Mines Limited, in the Algoma area of Ontario.

Domestic Refinery Production

The Deloro smelter operated at capacity during the year in custom smelting of Moroccan ores, the World War II stockpile of Canadian concentrates, and concentrates purchased during and after the Korean emergency for account of the United States Government. The smelter also treated silver ores, Eldorado speiss, and scrap metal for its own account for domestic requirements.

The smelter of Cobalt Chemicals Limited began treating cobalt and silver ores and concentrates during the first quarter of the year. However, owing to technical and economic difficulties, operation of the smelter was suspended during the fourth quarter.

The International Nickel Company of Canada Limited commenced the production of electrolytic cobalt at its Port Colborne, Ontario, nickel refinery.

World Mine Production

According to the American Bureau of Metal Statistics, the main producers of cobalt in 1953 were: Belgian Congo (18,249,679), Canada (1,602,545 - D.B.S.), French Morocco (1,417,558), United States (1,251,160), and Northern Rhodesia (1,032,640). It is estimated by the United States Bureau of Mines that the free world production of cobalt in 1954 increased to 14,500 short tons, a 7 per cent rise over 1953.

Output in the United States is expected to increase considerably in the next few years. Production from the refinery of Calera Mining Company at Garfield, Utah, based on Idaho concentrates, and from the refinery of National Lead Company at Fredericktown, Missouri, will account for the increase.

More than half of the cobalt mined in Northern Rhodesia in 1954 was treated in the new refinery of Rhokana Corporation at Nkena.

Consumption and Uses

About 90 per cent of the total consumption of cobalt is in the form of metal, marketed as rondelles, granules, shot, and powder. The remaining 10 per cent comprises black and grey oxide; inorganic salts such as the acetate, carbonate, sulphate, etc.; and organic compounds such as linoleates, naphthenates, and resinates, which find extensive use in the paint industry as driers.

The largest single use for cobalt is in high-temperature cobalt-base alloys used for such parts as nozzle guide vanes and turbine rotor blades in the jet and gas-turbine engine industry and in guided missiles. The metal is an important constituent of permanent-magnet alloys, cemented carbides, hard-facing rods, and high-speed steel. A radioisotope, Cobalt 60, is widely used by industry for radiographic examinations, and also in the 'Cobalt Bomb' used in the treatment of cancer.

The largest use for cobalt oxide is in ground-coat frits to promote adherence between fired enamel and the metal base to which it is applied. The inorganic salts are used in electroplating and are added to animal feeds.

The more important Canadian consumers of cobalt are: Deloro Smelting and Refining Company Limited; Canadian General Electric Company, Limited; Nuodex Products of Canada, Limited, Toronto (driers); Ferro Enamels (Canada), Limited, Oakville, Ont.; Atlas Steels, Limited, Welland, Ont.; Dominion Glass Company, Limited, Montreal; and Canadian Hanson and Van Winkle Company, Limited, Toronto (electroplating).

Prices

The commercial prices of cobalt according to E. & M. J. Metal and Mineral Markets, were the same as in 1953:

> Cobalt metal, \$2.60 per pound in the form of rondelles or granules in 500- to 600-pound containers, ex docks or store New York or Niagara Falls, N.Y. In 100-pound containers the price is \$2.62 per pound, and in less than 100-pound containers, \$2.67 per pound.
> Cobalt metal fines, \$2.60 per pound of cobalt contained f.o.b. New York or Niagara Falls, N.Y., standard package of 650 pounds.
> Cobalt oxide, ceramic grade, 72 1/2 to 73 1/2 per cent cobalt, \$1.96 per pound east of Mississippi and \$1.98 1/2 per pound west. Quotations are for oxide packed in 350-pound containers.

The prices in Canada by Deloro Smelting and Refining Company Limited are comparable to the above prices with due regard to the premium on the Canadian dollar.

Tariffs

Canada

Ore - free: cobalt metal; British preferential - free, most favoured nation - 15% ad valorem, general - 25% ad valorem: cobalt oxide; British preferential - free, most favoured nation - 10% ad valorem, general - 10% ad valorem.

United States

Ore and metal - free; cobalt linoleate - 5¢ per lb.; cobalt oxide - 5¢ per lb. ; cobalt sulphate - 2 1/2¢ per lb.; other cobalt compounds and salts - 30% ad valorem.

Production, Trade, and Consumption

	1954		1953	
	Pounds	$	Pounds	$
Shipments from Canadian ores (contained cobalt)				
In concentrates exported	5,000		51,324	82,118
In metals, alloys, oxides, & salts	2,176,900		1,551,221	3,930,959
Total	2,181,900	5,593,200	1,602,545	4,013,077
Exports				
Concentrates (contained cobalt)*				
United States	3,300	5,693	37,100	60,418
Cobalt metal				
United States	1,139,039	3,778,413	749,919	2,379,207
Others	-	-	19,450	48,700
Total	1,139,039	3,778,413	769,369	2,427,907
Cobalt alloys				
France	3,700	16,736	10,970	49,972
Japan	893	4,803	116	520
Mexico	240	392	30	173
Israel	89	330	-	-
United States	4	41	335	1,423
Other countries	-	-	423	6,950
Total	4,926	22,302	11,874	59,038
Cobalt oxides & salts				
United Kingdom	816,365	1,425,254	916,517	1,874,852
United States	10,000	11,000	5,000	5,500
Brazil	9,465	17,728	9,545	17,257
Others	375	666	1,437	2,790
Total	836,205	1,454,648	932,499	1,900,399

* Excludes cobalt content of nickel matte shipped to England by International Nickel.

(Cont'd over)

	1954		1953	
	Pounds	$	Pounds	$
Imports				
Concentrates (gross weight)				
United States	10,300	1,195	1,502,800	307,601
Morocco	-	-	2,785,200	320,650
Norway	100	126	-	-
Total	10,400	1,321	4,288,000	628,251
Oxides				
United Kingdom	4,260	7,200	28,500	47,833
United States	2,675	7,195	-	-
Total	6,935	14,395	28,500	47,833
Cobalt metal for re-export in same condition				
United States	50,000	60,047	38,032	73,766
Consumption* (contained cobalt)	160,342		241,702	

* Producers' domestic shipments plus metal used by producer.

COPPER

Mine production in 1954 amounted to 299,926 short tons, about 18 per cent greater than that of 1953. Ontario and Quebec accounted for 74 per cent of the total, the remainder coming from Saskatchewan, British Columbia, Manitoba, Newfoundland, and Nova Scotia, in that order.

Refinery production, at 252,643 tons, showed a 6.6 per cent increase, while domestic consumption of refined metal was down about 5 1/2 per cent from 1953. All refined copper came from Canada's two refineries at Copper Cliff, Ontario, and Montreal East, Quebec. The former operates chiefly on blister copper from the smelter of The International Nickel Company of Canada, Limited, and the latter on material from the smelters of Noranda Mines Limited and Hudson Bay Mining and Smelting Company, Limited, and copper scrap: as a result of the strike at the Noranda smelter some blister copper had to be imported from Rhodesia in order to maintain the output of refined metal at Montreal East.

According to the American Bureau of Metal Statistics, world mine production in 1953 (the latest full year available) totalled 3,068,180 short tons, of which the United States produced 948,509, Northern Rhodesia 410,810, Chile 400,284, Russia 334,500, and Canada 228,267. Production for 1954 is estimated as about two per cent lower.

World smelter production in 1953 was 3,352,056 tons, the United States, Northern Rhodesia, Chile, Russia, West Germany, Belgian Congo, and Canada being the leading producers, in that order.

Developments at Producing Mines

Newfoundland

Buchans Mining Company Limited, in central Newfoundland, milled 340,000 tons of zinc-lead-copper ore, from which concentrates containing about 3,300 tons of copper were produced and shipped from the port of Botwood. Most of the ore was mined in the Rothermere shaft section of the property and here considerable development was carried out on new orebodies found at deeper horizons.

Nova Scotia

Mindamar Metals Corporation Limited continued to operate its Stirling zinc-lead-copper mine in southern Cape Breton Island, producing zinc concentrates and lead-copper concentrate containing about 1,000 tons of copper.

Quebec

Noranda Mines Limited resumed operations at the mine and smelter on February 13 upon the settlement of a strike that began in August 1953. Production of ore from the Horne mine was 1,155,941 tons, from which 21,881 tons of copper and 168,067 ounces of gold were produced. The smelter treated 1,136,519 tons of ores and concentrates, including material from other copper, gold, and silver mines that yielded 84,622 tons of anode copper containing 321,140 ounces of gold and 2,436,740 ounces of silver. The copper and precious metals were recovered at the electrolytic copper refinery of Noranda's subsidiary, Canadian Copper Refiners Limited, Montreal East.

Waite Amulet Mines, Limited and Amulet Dufault mines delivered to the Waite Amulet mill 430,412 tons of copper-zinc ore, from which concentrate containing 20,773 tons of copper was produced. Seventy-six per cent of the ore came from the East Waite mine.

Normetal Mining Corporation Limited milled 328,450 tons of ore to produce concentrates containing 6,959 tons of copper. The No. 4 internal shaft was deepened to 5,400 feet below the surface and six new levels were established. Ore developed on the bottom level was found to be comparable in grade with that mined at higher horizons.

Quemont Mining Corporation, Limited milled 718,695 tons of ore containing 11,425 tons of copper in concentrates. The deepening of the main shaft by 1,080 feet to a depth of 3,600 feet was commenced.

East Sullivan Mines Limited treated 916,119 tons of ore, producing concentrates containing about 13,000 tons of copper. Overburden was stripped from the "A" and "B" orebodies in preparation for open-pit operations to the 175-foot level.

Golden Manitou Mines Limited produced a small amount of copper in lead concentrate from the company's zinc-lead deposits. The development of a low-grade copper deposit north of the main workings was resumed between surface and the 800-foot level, and preparations were made to commence regular production of copper concentrates in 1955.

Opemiska Copper Mines (Quebec) Limited produced high-grade copper concentrates containing about 7,000 tons of copper at the company's property 25 miles west of Chibougamau Lake. Shipments were made by truck to St. Felicien and thence by rail to the Noranda smelter. Reserves were increased by the discovery of several new vein systems to the south of the older workings.

Quebec Copper Corporation Limited, a subsidiary of East Sullivan Mines Limited, commenced production in February 1954 on the old Huntingdon property near Eastman in Brome county. Concentrates containing about 3,500 tons of copper were shipped to the Noranda smelter. A significant new ore zone was discovered by exploration at depth.

Gaspé Copper Mines Limited, a subsidiary of Noranda Mines Limited, continued mine development and plant construction at its property in central Gaspé. A new road to Anse Pleureuse on the St. Lawrence River was completed and improved docking facilities were provided at the nearby port of Mont Louis. A breakdown occurred in the submerged cables by which electric power was to be brought to the mine from the north shore of the St. Lawrence River. This was expected to delay by several months the start of smelting operations, originally planned for May 1955.

There was a small output of copper concentrates by Weedon Pyrite and Copper Corporation Limited in Wolfe county and of bulk lead-copper concentrates by Ascot Metals Corporation Limited, in Sherbrooke county.

Ontario

The International Nickel Company of Canada Limited mined 14,456,254 tons of ore from the Creighton, Frood-Stobie, Levack, Garson, and Murray mines, and from the Frood open pit, all in the Sudbury area. Eighty-three per cent of the ore was mined in underground operations. Mine development, which had been carried out at an accelerated pace since World War II, was reduced to a rate commensurate with current production. At the company's Copper Cliff refinery 126,637 tons of refined copper were produced.

Falconbridge Nickel Mines Limited treated 1,407,909 tons of ore from its mines in the Sudbury area, an increase of 20 per cent over the amount treated in 1953. The company's refinery at Kristiansand, Norway, produced 11,243 tons of copper and 19,395 tons of nickel.

The Falconbridge and McKim mines were in production throughout the year. Mount Nickel, Hardy, and Falconbridge East mines came into production in that order. Development towards production was under way at the Longvac, Boundary, and Fecunis Lake properties. Falconbridge mill capacity was increased by 500 tons to 2,800 tons a day. A new mill of 1,500 tons capacity was almost completed at the Hardy mine.

Milnet Mines Limited, about 18 miles north of Falconbridge, made shipments of nickel-copper ore to the Falconbridge mill during the year.

Nickel Offsets Limited and Nickel Rim Mines Limited (formerly East Rim Nickel Mines), both in the Sudbury area, shipped copper-nickel concentrates to the Falconbridge smelter.

Near Matachewan, New Ryan Lake Mines Limited continued the production of copper concentrates, which it shipped to Noranda.

Manitoba

Hudson Bay Mining and Smelting Company, Limited. The company's copper-zinc mine, concentrator, smelter, and zinc plant are at Flin Flon on the Saskatchewan boundary. Of the 1,524,441 tons of ore produced, most was concentrated, a small amount being smelted directly. The smelter treated 453,087 tons, comprising Flin Flon and Cuprus concentrates, direct smelting ore, and zinc plant residues. Blister copper containing 45,222 tons of copper, 126,302 ounces of gold, and 1,879,573 ounces of silver was produced and shipped to an electrolytic refinery.

The company's Schist Lake mine 3 1/2 miles southeast of Flin Flon was brought into production in August. About 53,618 tons of ore averaging 5.23 per cent copper and 7.0 per cent zinc were shipped by truck to Flin Flon for treatment.

Cuprus Mines Limited (a subsidiary of Hudson Bay Mining and Smelting Company) discontinued operations in August at its copper-zinc property 7 1/2 miles southeast of Flin Flon. The Cuprus orebody, from which production was commenced in 1948, was completely mined out.

Sherritt Gordon Mines Limited began milling ore on a preliminary basis at Lynn Lake in October 1953. The concentrator of 2,000 tons capacity is located at the "A" mine, from which the first ore was produced. The "EL" mine, located 2 1/4 miles south of the "A" mine, was brought into production in May 1954. Ore milled during the year totalled 557,589 tons, from which 70,400 tons of nickel concentrate and 10,580 tons of copper concentrate were produced. The copper concentrate was all treated at a

Canadian custom smelter. A part of the nickel concentrate was shipped to and treated by the International Nickel Company at Copper Cliff, Ontario; the remainder was treated at Sherritt Gordon's new chemical-metallurgical plant at Fort Saskatchewan, Alberta, from which output commenced in July. During the remainder of the year, 1,983 tons of nickel and 168 tons of copper in the form of copper sulphide precipitate were produced at Fort Saskatchewan.

Saskatchewan

Hudson Bay Mining and Smelting Company, Limited. The larger part of the company's Flin Flon orebody is in Saskatchewan and the output of copper and zinc credited to the province comes from this source.

British Columbia

Britannia Mining and Smelting Company Limited treated 916,419 tons of ore at its property on Howe Sound. About 30,000 tons of copper concentrates containing 8,667 tons of copper were produced and there were 358 tons of copper contained in precipitates recovered from mine water. Considerable exploration was done on the company's extensive property but no discoveries of importance were reported.

The Granby Consolidated Mining, Smelting & Power Co., Limited, at its Copper Mountain mine 12 miles south of Princeton, produced 1,871,862 tons of 0.82 per cent copper ore which was milled in its concentrator at Allenby, 8 miles north of the mine. Concentrates containing 12,328 tons of copper were shipped to a smelter at Tacoma, Washington. Ore reserves were depleted to about one year's supply, but consideration was being given to the treatment of one million tons of waste dump material containing 0.5 per cent copper.

Other Developments

Newfoundland

Bathurst Mining Corporation Limited, and Maritimes Mining Corporation Limited acquired the Tilt Cove copper mine, a former producer on Notre Dame Bay. Over two million tons of ore averaging 2.2 per cent copper were outlined by exploratory drilling and investigation of the old workings. Several other old copper properties in the area were acquired by associated companies.

Independent Mining Corporation Limited discovered several new copper-zinc orebodies south of old workings at the York Harbour mine near Corner Brook, which was a small producer early in the century.

New Brunswick

Brunswick Mining and Smelting Corporation Limited. A 150-ton pilot mill was constructed and underground development commenced on the company's properties southwest of Bathurst, where extensive zinc-lead-pyrite deposits with low values in copper were outlined by drilling in 1952 and 1953.

The American Metal Company Limited in November announced the discovery of several extensive deposits on its Little River property, 30 miles northwest of Newcastle. The ore was reported to be similar to, but of higher grade than, the Brunswick deposits.

Quebec

Campbell Chibougamau Mines Limited. The construction of a 1,750-ton concentrator neared completion and production was expected to commence in May 1955, upon the delivery of hydro-electric power from the Lake St. John area. Reserves, including those on an adjoining property leased from Merrill Island Mining Corporation Limited, are estimated to be in excess of 2 million tons averaging 2.9 per cent copper.

Anacon Lead Mines Limited, by merger of several companies, acquired the property of Chibougamau Explorers Limited about 20 miles south of Chibougamau Lake. The shaft was deepened to 1,245 feet and the construction of a 500-ton mill begun. Ore reserves were estimated at 560,000 tons averaging 0.73 per cent copper and 0.29 ounces per ton gold.

Eastern Metals Corporation Limited continued to explore its nickel-copper property in Montmagny county. The shaft was deepened several hundred feet and a substantial quantity of new ore was found in the "South" or "Copper" zone. Plans of the company's associate, Eastern Smelting and Refining Company Limited, to construct and operate a smelter at Chicoutimi for the treatment of copper-nickel ores were still in abeyance at the end of the year.

Ontario

Geco Mines Limited, near Manitouwadge Lake, 40 miles northeast of Heron Bay, Lake Superior, did exploratory drilling on a 1953 discovery that indicated over 14 million tons in three deposits averaging 1.72 per cent copper and 3.55 per cent zinc. Preparation is under way for production at a milling rate of 3,300 tons of ore a day.

Exploration on several other properties in the Manitouwadge area disclosed some promising occurrences of copper and zinc.

Copper deposits, apparently of considerable extent, were also discovered near Tashota, on the Canadian National Railways, by Tech Exploration Company Limited and on Timagami Lake by Temagami Mining Company Limited.

Manitoba

Hudson Bay Mining and Smelting Company Limited was preparing its North Star mine, 12 miles east of Flin Flon, for production early in 1955: similar work was proceeding at Don Jon Mines Limited (a company subsidiary adjoining the North Star), with the probability that the two properties will be worked as a joint operation.

Sherritt Gordon Mines Limited discovered a relatively small copper-zinc orebody on property, in which it holds a major interest, adjoining its Lynn Lake Mine.

Saskatchewan

Hudson Bay Mining and Smelting Company Limited carried out exploration and underground development at its Birch Lake mine, 9 1/2 miles southwest of Flin Flon, where a small copper deposit has been outlined, and at its Coronation mine, 13 1/2 miles southwest of Flin Flon, where surface drilling indicates a copper-zinc orebody of about 825,000 tons to a depth of 1,000 feet. A small mill will be erected at the latter mine.

British Columbia

Granduc Mines Limited's property, 25 miles northwest of Stewart, which is being developed jointly by The Granby Consolidated Mining, Smelting, and Power Company Limited and Newmont Mining Corporation, is reported to have reserves estimated at 9,500,000 tons averaging 1.5 per cent copper; these were outlined by both surface and underground exploration. The Granduc property is situated in an almost inaccessible location a few miles east of the Alaska boundary, and various plans for providing access at low cost are now under study.

The American Metal Company Limited carried out an extensive exploration program on the property of Canam Copper Company Limited, 28 miles east of Hope, where a large tonnage of ore averaging 1.5 per cent copper was indicated.

On Vancouver Island, Cowichan Copper Company Limited did exploration work on its property 30 miles west of Duncan, and Noranda Mines Limited continued the exploration of the Yreka Copper Mines property in the northwest part of the island.

Yukon

Hudson Bay Exploration and Development Company, Limited. Exploration of the Wellgreen mine in the Kluane Lake district, was continued and reserves at the end of the year were estimated at 500,000 tons averaging 1.34 per cent copper and 2.14 per cent nickel. Three hundred tons of ore were shipped to Flin Flon, Manitoba, for metallurgical pilot plant tests.

Northwest Territories

North Rankin Nickel Mines Limited completed a 350-foot shaft and carried out exploration on two levels which outlined 460,000 tons averaging 3.3 per cent nickel and 0.81 per cent copper. The property is near Rankin Inlet on the northwest coast of Hudson Bay, 300 miles north of Churchill, Manitoba.

Consumption and Uses

Canadian consumption of prime copper is virtually limited to two rod mills and two brass mills. The rod mills are those of Canada Wire and Cable Company, Limited, at Montreal East, Quebec, and Phillips Electrical Co. (1953) Limited, at Brockville, Ontario. The brass mills are operated by Anaconda American Brass Limited at New Toronto, Ontario, and Noranda Copper and Brass, Limited, at Montreal East, Quebec. Other smaller consumers in Canada are Canadian Arsenals Limited, the Royal Canadian Mint, Aluminum Company of Canada Limited, and several foundaries.

About 50 per cent of the world consumption of copper is ultimately used by the electrical industry for conductors such as wire, cable, bus-bars, etc. Increasing quantities of copper tubing are being used in plumbing. The remainder is used in brass, bronze, cupro-nickel, nickel-silver, and other copper alloys and copper salts.

Prices

The Canadian price of electrolytic copper in Canadian funds was steady throughout the year at slightly more than 29 cents per pound. At the beginning of the year the price was 29.25 cents, went to a high of 29.57 cents at the end of April and closed at 29.01 cents. The price variations were mainly due to fluctuations of the Canadian dollar in terms of the United States dollar.

Tariffs

There is no tariff on imports of copper ores or concentrates into Canada. Copper in bars, rods, wire, and semi-fabricated or fully processed products is subject to varying tariff rates.

In the United States the suspension of the United States import tax of 2 cents per pound was continued for another year to June 30, 1955. The bill contained a provision, as in similar preceding measures, that the tax would be restored automatically should the average price for a month drop to 24 cents or less.

Production, Trade, and Consumption

	1954		1953	
	Short Tons	$	Short Tons	$
Production, all forms*				
Ontario	140,055	80,902,875	130,583	77,587,439
Quebec	82,597	48,170,428	54,920	32,886,057
Saskatchewan	36,050	21,024,360	30,588	18,316,355
British Columbia	24,547	14,315,949	24,148	14,371,494
Manitoba	12,379	7,219,345	9,411	5,635,573
Newfoundland	3,313	1,932,142	2,814	1,684,862
Nova Scotia	985	574,175	788	471,962
Total	299,926	174,139,274	253,252	150,953,742
Production, refined**	252,643		236,966	
Exports				
In ingots, bars, slabs, etc.				
United Kingdom	77,867	45,531,448	51,384	31,607,540
United States	60,814	35,661,145	74,655	45,450,580
France	7,728	4,416,620	2,940	1,917,674
Brazil	5,751	3,323,142	2,345	1,520,688
Other countries	3,970	2,423,161	670	443,439
Total	156,130	91,355,516	131,994	80,939,921
In rods, strips, sheets & tubing.				
Switzerland	4,953	2,968,879	2,313	1,477,089
United States	1,144	965,953	3,050	1,994,453
Denmark	784	488,546	112	73,527
Cuba	675	648,110	322	333,369
Brazil	614	424,025	49	33,004
New Zealand	252	269,114	220	230,816
Venezuela	222	211,877	123	125,201
Other countries	1,114	983,425	666	599,539
Total	9,758	6,959,929	6,855	4,866,998

* Blister copper from Canadian ore plus recoverable copper in concentrates, matte, etc., exported.

** Production from Canadian ore, foreign ore, and scrap.

(Cont'd)

	1954		1953	
	Short Tons	$	Short Tons	$
Exports				
In ore and matte.				
United States	34,073	18,399,501	35,716	19,286,856
Norway	10,547	5,695,326	9,063	4,893,966
West Germany.....	1,716	926,694	2,926	1,579,959
United Kingdom....	1,075	580,635	1,121	605,667
Japan.............	-	-	2,332	1,259,037
Total	47,411	25,602,156	51,158	27,625,485
Consumption, refined............	102,001		108,526	

GOLD

Canadian gold production in 1954, at 4,360,818 fine ounces valued at $148,747,161, was about 8 per cent higher in quantity and value than in 1953. All provinces except Newfoundland showed an increase in production, as did Yukon and Northwest Territories. Ontario and Quebec recorded the largest gains, a reflection of the settlement early in 1954 of the strikes which curtailed production for about 6 months in 1953. No new gold mines were brought into production, and exploration and development continued to be very limited. Owing to the high premium on the Canadian dollar the average Mint price of gold was $34.11 in 1954, the lowest since 1933.

Gold was fourth in value of output among Canadian minerals in 1954. Canada holds second place in the free world output, South Africa being first with about three times Canada's production.

Cost-aid payments by the Federal Government under the Emergency Gold Mining Assistance Act in 1954 were approximately $16,500,000 or $4.30 per ounce of gold produced. Owing to the low premium on the free gold market over the official price, all straight gold mines in Canada were on cost-aid in 1954. Shortly after the close of the year, the Government announced that, subject to the approval of Parliament, the Act would be extended to the end of 1956, but would be so modified as to reduce payments to approximately $11,000,000 annually.

Production and Developments

Yukon

About half the gain in output over 1953 was from dredging and hydraulic operations of The Yukon Consolidated Gold Corporation, Limited, and the balance from expanded operations of the many small operators. Most of the latter are now using bulldozers to move the gravel, and are less dependent upon the water supply than formerly.

The base-metal operation of United Keno Hill Mines Limited supplied over 900 ounces of by-product gold.

Northwest Territories

The three producing mines are in the Yellowknife area.

Giant Yellowknife Gold Mines Limited, the largest, with a milling capacity of 750 tons a day, produced about 10,000 ounces less than in the previous year. During 1954 another roaster was added and with other new equipment it is expected that the mill tonnage will be raised to 1,000 a day. What may prove to be the largest orebody in the mine was indicated by diamond drilling below the 750-ft. level.

At the Con mine of The Consolidated Mining and Smelting Company of Canada Limited, the mill rate was raised 30 tons to 450 tons a day and gold production in 1954 increased by several thousand ounces. Considerably more ore than in 1953 was mined from the Rycon section, and development of the adjoining property of Negus Mines Limited which was purchased by Con was carried out below the bottom level. A new ore zone of some importance was located on the upper levels of the older Con workings.

Consolidated Discovery Yellowknife Mines Limited produced about 56,369 ounces of gold, about 53 per cent more than in 1953 from about the same tonnage of ore owing to much higher grade from the new deep levels. During October the mill heads averaged 2.78 ounces per ton, a record high grade for a Canadian gold mine. Development doubled the ore reserve tonnage and raised the grade considerably.

Very little work was done on gold prospects in the Territories during 1954.

British Columbia

Four companies, namely, Bralorne Mines Limited, Kelowna Mines Hedley Limited, Pioneer Gold Mines of British Columbia Limited and The Cariboo Gold Quartz Mining Company Limited, accounted for all the lode gold production, this being 78 per cent of the total gold output of the province in 1954. Island Mountain Mines Limited, a contributor to the lode gold output, was taken over by Cariboo Gold Quartz in August. Output from the Bralorne mine was about 7,000 ounces less than in 1953 and that from the neighbouring Pioneer was almost 5,000 ounces more.

Production

		1954	1953
		Fine Ounces	
Yukon	Placer operations	87,810	66,080
	Base-metal mines	906	-
	Total	88,716	66,080
N.W.T.	Auriferous quartz mines .	307,874	289,929
B.C.	Auriferous quartz mines .	207,900	204,045
	Placer operations	7,207	11,360
	Base-metal mines	52,282	49,571
	Total	267,389	264,976
Alta.	Placer operations	199	65
Sask.	Placer operations	-	-
	Base-metal mines	99,551	88,327
	Total	99,551	88,327
Man.	Auriferous quartz mines.	114,103	108,370
	Base-metal mines	23,096	22,939
	Total	137,199	131,309
Ont.	Auriferous quartz mines		
	Porcupine	1,039,715	876,814
	Kirkland Lake	392,612	404,901
	Larder Lake	355,746	334,247
	Patricia	350,891	340,113
	Thunder Bay	95,562	113,713
	Sudbury	42,711	41,265
	Matachewan	30,224	31,173
	Miscellaneous	690	237
	Total	2,308,151	2,142,463
	Base-metal mines	43,089	39,974
	Total	2,351,240	2,182,437
Que.	Auriferous quartz mines		
	Bourlamaque area	282,287	281,905
	Malartic area	328,945	313,689
	Noranda area (incl. Belleterre)	179,803	169,109
	Total	791,035	764,703
	Placer operations	16	-
	Base-metal mines	307,336	256,995
	Total	1,098,387	1,021,698

		1954	1953
		Fine Ounces	
N.S.	Auriferous quartz mines .	116	17
	Base-metal mines	3,647	3,231
	Total	3,763	3,248
Nfld.	Base-metal mines	6,500	7,654
Canada	Auriferous quartz mines .	3,729,179	3,509,527
	Placer operations	95,232	77,505
	Base-metal mines	536,407	468,691
	Total	4,360,818	4,055,723

Most of the placer production came from the underground drifting operations of Noland Mines Limited, the bulldozer and shovel operation of Enterprise Placers Limited, and the dredge operation of Kumhila Dredging Company Limited. Several small hydraulic operations contributed to the total.

The chief base-metal producer of gold was The Consolidated Mining and Smelting Company of Canada Limited. Deer Horn Mines Limited did considerable development work on its prospect in the Kitimat area.

Alberta

The small production was washed from the sands of the Saskatchewan River.

Saskatchewan

The province's gold production is obtained as a by-product from the operations of the Saskatchewan portion of Hudson Bay Mining and Smelting Company's base metal deposits which straddle the Manitoba-Saskatchewan boundary at Flin Flon, Manitoba.

Manitoba

Output from Nor-Acme Gold Mines Limited in the Snow Lake area, at 67,718 ounces, was about the same as in 1953 and that from San Antonio Gold Mines Limited in the Rice Lake area, at 42,826 ounces, was 1,854 ounces higher, the result of bringing the mill tonnage to near-capacity level. Some lode gold production was obtained also from development work on the adjoining Forty-Four mine, controlled and operated by San Antonio. The remainder of the province's gold output came mainly from the Manitoba portion of Hudson Bay Mining and Smelting Company's Flin Flon mine, with a small amount from the copper-nickel deposits of Sherritt Gordon Mines Limited in the Lynn Lake area.

Ontario

Ontario accounted for about 54 per cent of Canada's gold output in 1954. The production came from 33 gold mines and from the base metal mines in the Sudbury area. The increase of approximately 170,000 ounces came mainly from the Porcupine area, where most of the mines which were closed by strikes in 1953 were reopened early in 1954.

Theresa Gold Mines Limited, which had been a small intermittent producer, was closed during the year, and Paymaster Consolidated Mines Limited was reopened in October.

Good results were reported from development work on the new levels of Hallnor Mines Limited and of Delnite Mines, Limited in the Porcupine area.

In the Kirkland Lake area, Macassa Mines Limited had encouraging results from work on its new deep levels and Kirkland Lake Gold Mining Company Limited obtained better than average results from its development work. Diamond drilling below the 3,700-ft. level at Kerr-Addison Gold Mines Limited indicated more excellent ore.

In the Geraldton area, MacLeod-Cockshutt Gold Mines Limited discovered a new ore zone parallel to its "F" zone. At the adjoining Consolidated Mosher Mines Limited further development brought ore reserves to an estimated 1,404,000 tons; no production plans have been announced.

Cochenour Willans Gold Mines Limited in the Red Lake area found an ore zone in a new section of its property, as did Madsen Red Lake Gold Mines Limited. McKenzie Red Lake Gold Mines Limited completed its new shaft to 1,650 ft. by the year end, giving the mine 4 new levels.

Quebec

The production in 1954 came from 16 lode gold mines, which contributed about 72 per cent of the output, and from 11 base-metal companies, including, Noranda Mines Limited and five companies which ship ore to it. As noted in the table, there was also an insignificant production of placer gold, the source being the sands of Ditton River near Scotstown in the Eastern Townships. No new lode gold properties came into production in 1954 nor did any cease operations. Production at Elder Mines Limited and Powell Rouyn Gold Mines Limited, two of the lode gold mines, increased by 13,000 ounces and 4,000 ounces, respectively, compared with 1953. Both were closed from August 21, 1953 to February 22, 1954 owing to the strike at Noranda Mines Limited. Three other lode gold producers, namely, Malartic Gold Fields Limited, Bevcourt Gold Mines Limited, and East Malartic Mines Limited showed gains of 9,000, 7,000, and 6,000 ounces respectively over 1953, while production from Barnat Mines Limited decreased by 7,000 ounces and from Lamaque Gold Mines Limited by 4,000 ounces.

Output of gold from base-metal properties was augmented by that from two new producers, Opemiska Copper Mines (Quebec) Limited in the Chibougamau area, which entered production in December 1953, and Quebec Copper Corporation Limited, in Eastern Townships which entered production in February 1954.

The shaft at Eldrich Mines Limited was collared and sinking and underground development were scheduled to start early in 1955 as soon as hydro power became available. Diamond drilling has indicated 650,000 tons of ore.

Chibougamau Explorers Limited started construction of a 500-ton a day mill on its gold-copper property in the Chibougamau area. It is scheduled for operation by September 1955, when hydro power is expected to be available. Ore reserves stand at 535,000 tons. Additional development work in the shaft area is expected to prove up a further substantial tonnage.

Campbell Chibougamau Mines Limited commenced construction of its 1,750-ton mill on its copper-gold property in the Chibougamau area, which is expected to be in production by March 1955, when hydro power will be available. Ore reserves are over 2,400,000 tons and additional ore has been indicated.

Nova Scotia

Most of the gold output came from Mindamar Metals Corporation's zinc-lead mine at Stirling. A small amount was produced by Renfrew Gold Mines Limited which operated for a short time in 1954.

Newfoundland

All the output came from the base-metal operations of Buchans Mining Company Limited near Red Indian Lake in Central Newfoundland.

IRON ORE

Canada's production (shipments) of iron ore in 1954 - 6,500,229 long tons[1], valued at $46,758,382 - increased 12.3 per cent over 1953. This was entirely due to shipments made by Iron Ore Company of Canada from its newly producing mines in Labrador-New Quebec. But for these shipments, Canada's total would have been down about 19 per cent from 1953, because of the greatly depressed market for iron ore in both the United States and Canada.

(1) All tonnage figures are in long tons of 2,240 lbs., unless otherwise stated.

In 1953, Canada was again in eighth place as a producer of iron ore, following the United States, Russia, France, Sweden, the United Kingdom, West Germany, and Luxembourg. World production during 1953 was approximately 352,088,000 net tons[(1)], of which the Canadian share amounted to 1.84 per cent. In view of current expansion and development programs, Canada's share should be considerably larger within a relatively few years.

At Wabana, Newfoundland, Dominion Wabana Ore Limited continued its modernization and expansion program, both underground and on surface. At Sorel, Quebec, Quebec Iron and Titanium Corporation continued to produce desulphurized iron from ilmenite mined at Allard Lake, Quebec. At Port Robinson, Ontario, Noranda Mines Limited brought into production a plant that will produce iron oxide sinter from pyrite mined at Noranda, Quebec. From its Labrador-New Quebec deposits, Iron Ore Company of Canada made its first shipments of direct-shipping iron ore. At the Helen and Victoria mines in the Michipicoten area, Algoma Ore Properties Limited continued the underground development program begun in 1953. At Steep Rock, all production came from the Hogarth open-pit mine and the Errington underground mine was developed to the stage where it could be brought into production on relatively short notice. In British Columbia, mining was temporarily suspended near the end of the year at the Iron Hill mine of The Argonaut Mining Co. Ltd., because of the lack of a market. Shipments from the Texada Island properties of Texada Mines Limited continued at about the same rate as in 1953.

Development was again exceedingly active in 1954. In addition to development at producing properties, three additional projects were under way. At Marmora, Ontario, Bethlehem Mines Corporation practically completed stripping the limestone overlying its magnetite orebody, in preparation for production during the spring of 1955. In the Steep Rock Lake area of Ontario, Caland Ore Company, Limited, launched two large dredges that will commence removing the silt overlying 'C' orebody in Falls Bay, in 1955. At Copper Cliff, Ontario, The International Nickel Company of Canada Limited began construction of an ammonia-leaching plant that will produce annually one million tons of by-product iron ore from low-grade pyrrhotite.

Exploration for iron ore has been very active since the end of World War II. In 1954, as in recent years, much of the activity has taken place in the Ungava Bay area of New Quebec; along the "Labrador Trough" in New Quebec and Labrador; in southeastern Ontario and the adjoining part of Quebec; in northwestern Ontario, north and west of Lake Superior; and on the coast of British Columbia. The outlook for exploration in the 1955 field season, and indeed for many seasons to come, is most promising.

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(1) Annual Statistical Report for 1953, American Iron and Steel Institute.

In contrast to the period 1924-1938, when no iron ore was produced, the ore is rapidly becoming one of Canada's major mineral products. On the basis of current developments, it is expected that production by the mid-1960's will attain a scale of 30 to 40 million long tons per year, valued at $300 to $400 million.

Iron Ore Production (Shipments) in Canada By Properties*

	1954	1953	1952
Wabana (direct-shipping ore)...........	2,155,731	2,399,821	1,477,153
Labrador-New Quebec (direct-shipping ore)................................	1,781,453	-	-
Helen and Victoria (sinter).............	991,870	1,166,832	1,145,830
Steep Rock (direct-shipping ore)........	1,156,654	1,301,377	1,274,666
Quinsam Lake (magnetite concentrate) ..	164,338	553,591	551,812
Texada Island (magnetite concentrates) .	331,566	333,077	209,016

* Shipment figures based on company data.

Most of Ontario's output of iron ore was exported to the United States, where it is in demand because of its high grade and good furnace qualities. In turn, most of the ore used in Ontario blast furnaces was imported from the United States. This interchange results partly from geography, and partly from company affiliations.

Most of the ore from Labrador-New Quebec was exported to the United States. Part of the output of iron ore from Wabana supplied the parent company's iron and steel plant at Sydney, Nova Scotia, and the remainder was exported to the United Kingdom and to West Germany. Most of British Columbia's output of magnetite concentrates was exported to Japan, there being no market for it in Canada.

Ore imported from Brazil and Liberia in 1954 was used as open-hearth lump ore at various plants.

Production and Development

During 1954, there were six iron ore properties in production and two under active development. Of the six producing properties, three produced direct-shipping ore, two produced magnetite concentrates, and one produced sinter; of the two under active development, one will produce direct-shipping ore and one will produce pelletized magnetite concentrates. In addition, there was one company producing by-product iron oxide sinter from pyrite, one producing by-product desulphurized iron from ilmenite, and one erecting a plant to produce by-product iron oxide pellets from low-grade pyrrhotite. The following table lists all the companies concerned with the operation or development of these properties.

In Production

Company	Location	Ore	Product
Dominion Wabana Ore Limited	Wabana, Bell Island, Nfld.	hematite	direct-shipping ore
Quebec Iron and Titanium Corporation	Allard Lake, Quebec (mine); Sorel, Quebec (smelter).	ilmenite-hematite	desulphurized iron
Iron Ore Company of Canada	Labrador-New Quebec nr. Schefferville, Que.	goethite and hema-tite	direct-shipping ore
Noranda Mines Limited	Noranda, Quebec (mine); Port Robinson, Ont. (smelter).	pyrite concentrate	by-product iron oxide sinter
Algoma Ore Properties Limited	near Jamestown, Ontario.	siderite	sinter
Steep Rock Iron Mines Limited	Steep Rock Lake, Ontario.	geothite	direct-shipping ore
The Argonaut Mining Co. Ltd.	near Campbell River, B.C.	magnetite	magnetite-con-centrates
Texada Mines Limited	Texada Island, B.C.	magnetite	magnetite con-centrates

Under Development

Company	Location	Ore	Product
Bethlehem Mines Corporation	Marmora, Ont.	magnetite	pelletized magnetite con-centrates
Caland Ore Company	Steep Rock Lake, Ontario.	goethite	direct-shipping ore
The International Nickel Company of Canada Limited	Copper Cliff, Ontario.	low grade pyrrhotite	pelletized by-product iron oxide

About half the production in 1954 came from underground mines and about half from open-pit mines. Three underground methods are in use - room and pillar at Wabana, sub-level stoping at Algoma, and block caving at Steep Rock: at all three ore is brought to the surface on conveyor belts. At Algoma, however, work has commenced on a unique continuous aerial rope-way which will deliver ore from underground directly to the sinter plant.

At the open-pit mines, ore is transported principally by diesel trucks of 22-ton capacity, although 46-ton tractor-trailer units are employed at the Argonaut property and a number of 34-ton units have been ordered by Steep Rock Iron Mines. There is now a trend towards the use of skip hoists and con-veyor belts to raise open-pit ore to the surface and to the use of conveyor belts for complete surface transportation of ore. The former is exemplified in

Production, Trade, and Consumption

	1954		1953	
	Long Tons	$	Long Tons	$
Production (shipments) .	6,500,229	46,758,382	5,812,337	44,102,944
Imports				
United States	2,620,747	19,086,037	3,579,295	25,705,847
Brazil	78,885	1,194,361	114,458	2,116,129
Liberia	10,359	135,202	27,293	371,734
Total	2,709,991	20,415,600	3,721,046	28,193,710
Exports				
United States	2,726,083	21,912,113	1,843,542	14,126,702
United Kingdom	929,621	5,548,918	1,076,124	6,541,794
West Germany.........	693,204	3,971,698	528,485	3,133,407
Japan	482,821	3,661,924	855,398	7,041,088
Total	4,831,729	35,094,653	4,303,549	30,842,991
Indicated Consumption*.	4,378,491		5,229,834	
Domestic production as a percentage of indicated consumption	148.5		111.1	

* Indicated Consumption = Production (shipments) + imports - exports.

Canada by the skip-hoist system which will transport ore from the bottom of the Marmora pit to the plant on surface, and by the conveyor system which transports ore from the bottom of the Hogarth pit to the screening plant. The latter is exemplified by the construction of a conveyor belt system at Wabana to transport ore a distance of about two miles to the company's ore docks.

Dominion Wabana Ore Limited

Production of direct-shipping iron ore (hematite) from Wabana Mines, located off Bell Island in Conception Bay, amounted to 2,526,131 tons during 1954, an increase of about 5 per cent over 1953. Of this tonnage 2,383,244 tons were produced from the underground mines and 142,887 tons by contract mining on the surface. Shipments amounted to 2,155,731 tons, about 10 per cent lower than the record tonnage of 2,399,821 tons shipped in 1953. Destination of the 1954 shipments was: the parent company's iron and steel plant at Sydney, N.S., 555,747 tons; United Kingdom, 897,249 tons; and West Germany, 702,735 tons. Analysis (dry basis) of the ore shipped during 1954 averaged 50.21 per cent iron; 13.42 per cent silica; and 1.70 per cent moisture. Phosphorus content remained normal at 0.88 per cent.

Progress was made on the new internal exploration slope (Forsyth Mine), which was commenced in 1953 and which extends north from the bottom of No. 3 Mine. The concentration of all major surface plant facilities in the No. 3 Mine area continued during 1954. Plans for 1955 call for the construction of a sink-float plant, to replace hand-sorting of the ore, and the construction of a 9,000-foot belt conveyor to replace the present diesel truck haulage system. Installation of this new surface conveyor belt will bring the total length of the Wabana conveyor system to about 21,500 feet.

Quebec Iron and Titanium Corporation

Shipments of ilmenite-hematite ore during 1954 from the Allard Lake, Quebec, operations of Quebec Iron and Titanium Corporation to the company's electric smelter at Sorel, Quebec, were 271,192 tons. The content of the ore is approximately 35 per cent TiO_2 and 40 per cent Fe. Production figures for the smelting operation at Sorel during 1954 were: ore treated, 239,410 tons; titanium dioxide concentrate (electric smelter slag) produced, 109,786 tons; slag shipped, 106,511 tons; desulphurized iron produced, 80,859 tons; desulphurized iron shipped, 89,740 tons; and high-sulphur iron shipped, 3,492 tons. The slag contains over 70 per cent TiO_2.

The reduction of output in 1954 reflects a shutdown of two of the five furnaces at the treatment plant. This was not due to any lack of demand for the company's products, but to the necessity of large-scale development work in order to obtain greater operating efficiency and lower production costs. As a result of its investigative work, the company ascertained that the iron from the furnaces can be desulphurized in the ladle rather than by the more costly methods of refining in the electric furnace. The company also established that upgrading of the ore and treatment prior to smelting increases the throughput of the furnaces and results in better quality products. Construction of an ore beneficiation plant will, therefore, begin in January 1955, with completion scheduled for early 1956.

Iron Ore Company of Canada

Production commenced in June 1954 at the Ruth Lake No. 3 and Gagnon (formerly Ferriman Nos. 3 and 5) mines in Labrador-New Quebec. The first ore arrived at Sept Iles from Ruth Lake No. 3 deposit, via the 360-mile Quebec North Shore and Labrador Railway, on June 24, 1954, and the first shipment of ore from the port of Sept Iles took place on July 31. Ore shipments were continued throughout the summer and fall, the last boat leaving Sept Iles on December 5th. The following table shows the tonnage of ore mined and shipped and the average iron content of the ore.

Iron Ore Company of Canada
Iron Ore Production and Shipments, 1954

	Ore Mined in Quebec and Labrador		Ore Shipped from Sept Iles.	
	Tonnage	Iron Content (dry)	Tonnage	Iron Content (dry)
	Long Tons	%	Long Tons	%
Quebec				
Non-Bessemer	607,745	58.634	537,948	58.652
Manganiferous	50,745	55.038 (4.92% Mn)	42,780	54.745 (4.95% Mn)
Labrador				
Non-Bessemer	1,065,081	61.138	922,653	60.919
Manganiferous	394,903	52.942 (5.86% Mn)	278,071	52.133 (6.41% Mn)
	2,118,474		1,781,452	

Of the total shipments of 1,781,452 tons, 1,611,430 tons were shipped via tidewater and 170,022 tons were shipped via the St. Lawrence Canal. The iron ore transfer terminal at present under construction at Contrecoeur, near Montreal, is expected to be completed by April 1955. Iron ore shipments via the St. Lawrence Canal are expected to total one million tons in 1955 and, by 1957, two million tons per year.

Bethlehem Mines Corporation

By the end of 1954, the removal of the 130 feet of limestone overlying the Marmora magnetite orebody was almost completed. This stripping program has involved the removal of 20,500,000 net tons of limestone. Also by the end of the year, the primary crushing plant and skip hoist system were practically ready for operation and the secondary crushing plant was expected to be ready by March 1, 1955. The company expects to have the mill and pelletizing plant ready for operation by April 1, 1955. The crude ore contains about 37 per cent iron. The pelletized concentrate, which will contain about 64.3 per cent iron, will be produced at the rate of about 500,000 tons per year. It will be transported by C.N.R. ore cars 64 miles to the company's dock at Picton, on the Bay of Quinte, to be trans-shipped into lake boats for export to the parent company's plant at Lackawanna, near Buffalo, New York.

Noranda Mines Limited

In September 1954, this company brought its sulphur-iron plant at Port Robinson, Ontario, into partial production. Pyrite concentrates are shipped by rail from Noranda and undergo a double roasting operation to produce elemental sulphur, sulphur dioxide gas for the preparation of sulphuric acid, and iron oxide sinter. The plant is designed to handle about 370 tons of pyrite concentrates per day, from which a daily production of 240 tons of sinter analyzing 68 per cent iron, 2.5 per cent SiO_2, and 0.05 per cent S is expected.

The International Nickel Company of Canada Limited

At Copper Cliff, Ontario, this company is erecting an ammonia-leaching plant to treat low-grade pyrrhotite ore. As a by-product of this process, the company has announced that it will produce annually one million tons of iron oxide containing more than 65 per cent iron and less than 2 per cent SiO_2. The iron oxide will be pelletized and the pellets will be hardened on a continuous, straight-line, sintering machine of Lurgi design, 8'3" wide.

Algoma Ore Properties, Limited

This company's production comes from the Helen and Victoria underground mines in the Michipicoten area of Ontario. During 1954, shipments from the sintering plant at Jamestown totalled 991,870 tons compared with 1,166,832 tons in 1953. Of this amount, 167,464 tons were shipped by rail to the parent company's iron and steel plant at Sault Ste. Marie and 824,406 tons were shipped by vessel to lower lake ports. The Helen and Victoria siderite, as mined, contains about 35 per cent iron. The average analysis (natural) of the sinter for 1954 was 50.89 per cent Fe, 2.86 per cent Mn, and 11.08 per cent SiO_2. Estimated shipments for 1955 are 1,300,000 tons. Sinter plant capacity is 1,500,000 tons per year.

As part of the four-year program started towards the close of 1953 to develop three more mining levels below the present Helen first and second levels, the new No. 5 service shaft was advanced 1,895 feet and the aerial ropeway incline tunnel 1,888 feet. This development is known as the Helen Underground Stage 3. The underground aerial ropeway haulage system will be unique in that ore will be transported in 3-ton buckets up a 22-degree underground incline for 5,000 feet and then on surface 2 miles to the sinter plant.

Steep Rock Iron Mines Limited

During 1954, shipments of direct-shipping goethite iron ore from the Steep Rock Lake area totalled 1,156,654 tons, about 11 per cent below the 1953 shipments of 1,301,377 tons. All production came from the Hogarth open pit. The average iron content (dry - 1953 shipments) of the various grades of ore was Seine River, 57.49 per cent; Rainy Lake, 46.15; Steep Rock lump, 60.50; and Freeborn 54.49 with 2.04 per cent sulphur.

At the Hogarth open pit, new installations for primary crushing, for transporting the ore to the surface by belt conveyor, and for screening and loading began operations on August 14, when the first car was loaded and hauled away over the newly completed railway spur line. Development of the Errington No. 1 underground mine began in 1950, and by 1954 the mine was ready for production. This mine replaces the Errington open pit, which reached the economic depth for open pit mining in December 1953. At the end of 1954, preparations were under way to move the two large dredges Steep Rock and Marmion overland approximately 2 miles from the Hogarth mine to a point at the south end of the Middle Arm of Steep Rock Lake, where they will start dredging the 50 million cubic yards of silt overlying 'G' orebody, which lies between the Errington and Hogarth Mines.

Caland Ore Company

This company, a subsidiary of Inland Steel Company of Chicago, Illinois, U.S.A., has been exploring 'C' orebody, located in Falls Bay of Steep Rock Lake, Ontario, since 1950. By 1953, the potentialities had been assessed and a long-term lease, on a royalty basis, was negotiated with Steep Rock Iron Mines Limited.

During 1954, Caland Ore Company launched the Clarence B. Randall and the Joseph L. Block, the two large 10,000 H.P. dredges - largest ever built - that will dredge the silt from above 'C' orebody. By the close of the year the first was within two months of completion and the second within four. The estimated 180-200 million cubic yards of material to be removed will be pumped approximately 4 1/2 to 5 miles overland to the disposal area in Marmion Lake. Dredging is expected to begin in the spring of 1955 and to be completed by January 1, 1960, with first ore production scheduled for 1960. Full annual production of about 3 million tons of direct-shipping ore will not be reached until several years later.

The Argonaut Mining Co. Ltd.

The Iron Hill mine, situated near Upper Quinsam Lake, about 17 miles southwest of Campbell River, B.C. and about 13 miles from the east coast of Vancouver Island, was in production for only 8 1/2 months of 1954. There was a shutdown in April and in mid-November production ceased because of a lack of market. During the shutdown period in April, a changeover was made in the mill from "dry" to "wet" magnetic separation. Production of concentrates during 1954 was 263,116 tons and shipments totalled 164,338 tons, all to Japan. The crude magnetite contains about 38.4 per cent iron and the concentrates about 57.5 per cent. It is understood that a contract has been obtained for shipments to Japan during the 1955 fiscal year.

Texada Mines Limited

This company, whose property is located on Texada Island, B.C., continued mining and milling magnetite ore throughout 1954, with production coming from the Prescott open pit (14 per cent), the Lake pit (46 per cent), the Paxton north and south pits (39 per cent), and the remaining 1 per cent from two small prospects close to the Lake and Paxton mines. Shipments for the year totalled 331,566 tons, about the same as 1953. The grade of the ore, as mined, averaged close to 42 per cent Fe, while the mill concentrates averaged 57 per cent Fe, 1.23 per cent S, and 0.22 per cent Cu.

Prices

Although prices of Canadian iron ores are, in general, negotiated by contract, Ontario and Quebec prices are based on the market price of iron ore from the Lake Superior district of the United States. Prices on most ores, domestic and foreign, are dependent on quality, quantity, commissions, delivery, and other factors. The following quotations from the American Metal Market of December 31, 1954, are considered representative of prices throughout 1954, but may have been subject to penalties or premiums, according to the content of impurities, etc. Where unit price is quoted, one unit is equivalent to 1 per cent or to each 22.4 pounds of specified iron content.

Lake Superior Iron Ores. (Price effective July 1, 1953: announced June 24, 1953; represents an increase of 15 cents per ton, plus 5 cents per ton for transportation, previously paid by purchaser. Prices unchanged for 1954 according to announcement of February 17, 1954.)

Gross ton, 51.50 per cent iron natural, rail of vessel, lower lake ports.

Mesabi non-Bessemer	-	$ 9.90
Mesabi Bessemer	-	10.05
Old range non-Bessemer	-	10.15
Old range Bessemer	-	10.30
Open-hearth lump	-	11.15
High phosphorous	-	9.90

The foregoing prices are based on upper lake rail freight, lake vessel freight rates, handling and unloading charges, and taxes thereon, which were in effect on June 24, 1953, and increases or decreases after such date for buyer's account.

Swedish iron ore, Atlantic ports, 60 to 68 per cent, minimum:
Per unit - 22.00 cents

Brazilian iron ore, Brazilian port, 68 to 69 per cent:
Per unit - 20.00 cents

Tariffs

Neither Canada nor the United States maintains tariffs on iron ore.

LEAD

As indicated in the table that follows, Canada's lead production in 1954 rose by 27,565 tons, largely from British Columbia, and showed an increased value of $8,914,135. Exports of lead in ore and concentrates, at 59,755 tons showed a slight decline. Fifty-one per cent of such exports came from Eastern Canada, the remainder from British Columbia and Yukon. There was a decrease in the quantities of domestic and foreign ore treated at Canada's only lead smelter operated by The Consolidated Mining and Smelting Company of Canada Limited (Cominco) at Trail, British Columbia.

Lead consumption was about the same as in 1953. The value ($11,429,398) of tetraethyl lead compounds imported was about 9 per cent greater. Ethyl Antiknock Limited, a subsidiary of Ethyl Corporation of

New York, announced plans to build near Sarnia, Ontario, a tetraethyl lead plant large enough to supply Canadian requirements.

Exploration activities resulted in greatly increasing zinc-lead reserves in a number of undeveloped deposits, and important new discoveries were made in New Brunswick and Yukon.

Developments at Producing Properties

British Columbia

The Sullivan zinc-lead-silver mine at Kimberley, owned by The Consolidated Mining and Smelting Company of Canada Limited (Cominco), is Canada's principal source of lead. The amount of ore mined in 1954 was 2,681,635 tons compared with 2,643,252 tons in 1953. A large part of the ore came from open-pit operations and pillar removal in the upper part of the orebody.

At Cominco's Bluebell silver-lead-zinc mine at Riondell on Kootenay Lake, the output was reduced by 25 per cent owing to a three months' strike. Tulsequah Mines Limited, a Cominco subsidiary in northwestern British Columbia, increased its output as a result of the expansion of its mill capacity in 1953 from 300 to 500 tons.

Production of refined lead at the Trail smelter was 166,005 tons compared with 165,752 in 1953. Work on modernization of the smelter was continued and construction of a new sinter feed preparation plant was completed.

Canadian Exploration Limited near Salmo operated its Jersey mine at about 1,000 tons a day, or 55 per cent of the mill capacity.

Sheep Creek Gold Mines Limited completed the construction of a 500-ton mill at its Mineral King lead-zinc mine 26 miles southwest of Athalmer and commenced production in May 1954.

Sil-Van Consolidated Mining and Milling Company Limited discontinued operations in April at its property near Smithers.

Other producers of lead concentrate were: Violamac Mines Limited near Sandon; Sunshine Lardeau Mines Limited near Camborne; Giant Mascot Mines Limited near Spillimacheen; Silver Standard Mines Limited near Hazelton; and Yale Lead and Zinc Mines Limited at Ainsworth.

Ontario

In May, Jardun Mines Limited began production of lead and zinc concentrates in a new 300-ton mill at its property 18 miles northeast of Sault Ste. Marie.

Production, Trade, Consumption

	1954		1953	
	Short tons	$	Short tons	$
Production, all forms				
British Columbia	174,343	46,479,913	148,818	38,472,263
Newfoundland	18,743	4,996,827	17,702	4,576,214
Yukon	16,279	4,340,004	15,795	4,083,449
Quebec	8,526	2,273,045	9,237	2,387,930
Nova Scotia	2,087	556,468	1,826	472,074
Ontario	1,293	344,700	328	84,892
Total	221,271	58,990,957	193,706	50,076,822
Production, refined (includes lead from imported ores)	166,005		165,752	
Exports				
In ore & concentrates				
To: United States	42,466	10,366,861	40,617	9,986,518
W. Germany	8,864	2,062,115	9,609	2,192,522
Belgium	8,425	2,139,282	11,457	2,605,704
Total	59,755	14,568,258	61,683	14,784,744
Refined lead, including scrap				
To: United States	60,207	13,973,444	50,094	12,550,205
United Kingdom	50,528	10,588,283	51,156	10,022,265
Japan	3,484	744,207	283	60,717
Brazil	2,397	517,548	1,061	245,913
Other countries	663	138,017	808	171,555
Total	117,279	25,961,499	103,402	23,050,655
Imports, lead and lead products				
Tetraethyl compounds		11,429,398		10,456,800
Pigs and blocks		38,677		62,427
Manufactures, N.O.P.		200,784		255,067
Litharge		326,260		274,654
Capsules		113,894		97,384
Miscellaneous		117,490		116,804
Total		12,226,503		11,263,136

	1954		1953	
	Short tons	$	Short tons	$
Domestic Consumption, refined lead (primary and secondary)				
Ammunition	5,302		3,784	
Oxides, paints, pigments ..	6,537		6,602	
Solders..................	2,506		2,867	
Babbitt and type metal	300		500	
Antimonial lead*	2,518		4,169	
Cable covering	19,357		17,635	
Pipes, sheets, traps, and bends	4,874		4,995	
Block for caulking	2,675		3,597	
Batteries**..............	11,253		12,589	
Miscellaneous	2,583		1,621	
Total	57,905		58,359	

* Lead used to make antimonial lead alloy.
** Lead consumed in battery makers' own plants. Does not include content of antimonial lead.

World Production on Mine Basis*

	1953	1952
	Short tons	
United States	335,412	390,161
Canada	195,791	168,842
Mexico	244,213	271,196
Peru	135,473	105,571
Other South America..............	44,022	58,762
Yugoslavia.......................	93,864	87,048
Germany	69,351	56,875
Spain	57,973	45,622
Italy	38,628	44,293
Other Europe except Russia	80,219	74,741
Africa	195,006	191,039
Australia	258,521	247,719
Russia	202,000	170,000
Asia	32,926	26,391
Total	1,983,399	1,938,260

* American Bureau of Metal Statistics.

Quebec

Lead or lead-copper concentrates were produced in addition to zinc concentrate by the following companies:

Company	Location	Type of Ore
New Calumet Mines Ltd.	Pontiac county	zinc-lead
Anacon Lead Mines Ltd.	Portneuf county	zinc-lead
United Montauban Mines Ltd.	Portneuf county	zinc-lead
Golden Manitou Mines Ltd.	Abitibi East county	zinc-lead-copper
Consolidated Candego Mines Ltd.	North Gaspé county	zinc-lead
Ascot Metals Corporation Ltd.	Sherbrooke county	zinc-lead-copper

At New Calumet, the No. 4 shaft was deepened to 2,205 feet and five new deeper levels were established in the Longstreet orebody.

Operations at United Montauban, where production began in August 1953, were found to be uneconomic at the prevailing metal prices and the mine was closed in February 1954.

Deepening of the shaft at Golden Manitou was completed to 3,000 feet and development was begun on three new levels.

Consolidated Candego, which had been in production intermittently since 1948, was closed in October, when all developed ore had been exhausted.

Ascot Metals reported the discovery of an orebody of higher than average mine grade at its Suffield property.

New Brunswick

Keymet Mines Limited completed a 200-ton mill at its property 15 miles north of Bathurst. The mill was destroyed by fire in April but was rebuilt and began producing zinc and lead concentrates in October.

Nova Scotia

Mindamar Metals Corporation Limited continued to operate its Stirling zinc-lead-copper mine on Cape Breton Island at a rate of 600 tons a day for the production of zinc concentrate and bulk lead-copper concentrate.

Newfoundland

Buchans Mining Company Limited produced zinc, lead, and copper concentrates in its 1,350-ton mill. Considerable development was carried out on recently discovered orebodies in the Rothermere shaft section of the property.

Yukon

United Keno Hill Mines Limited, in the Mayo district, deepened the internal shaft 414 feet at its Hector mine on Galena Hill and established three new levels. It did some underground development at its Shamrock mine on the neighbouring Keno Hill. The company produced concentrates containing about 13,800 tons of lead from its Hector and Calumet Mines.

Mackeno Mines Limited produced concentrates containing about 2,500 tons of lead from its property adjoining the Calumet mine of United Keno Hill Mines.

Other Developments

New Brunswick

Brunswick Mining and Smelting Corporation constructed a 150-ton pilot mill near its Austin Brook zinc-lead-pyrite deposit 17 miles southwest of Bathurst. An exploration shaft was sunk 400 feet on the company's Anacon deposit, 5 miles north of the Austin Brook, and development was begun on two levels. The ore from this development will be used to feed the new pilot mill. Diamond drilling on these properties in 1952 and 1953 outlined over 46 million tons of ore to a depth of 1,000 feet, averaging 5.25 per cent zinc and 1.84 per cent lead.

In November, American Metal Company Limited announced the discovery of several extensive zinc-lead-copper-pyrite orebodies on its Little River property 30 miles northwest of Newcastle. The extent of the ore had not been delineated, but it is reported to be similar in type to that of the Brunswick orebodies though richer in zinc, lead, and silver.

New Larder "U" Island Mines Limited began sinking a shaft planned for a depth of 1,500 feet to confirm drilling indications of one million tons of 8.2 per cent combined lead and zinc on its property several miles east of the Brunswick Austin Brook property.

Yukon

Drilling on the Vangorda property of Prospectors Airways Company Limited near the Pelly River, 30 miles northwest of the Canol road disclosed extensive flat-lying deposits of zinc-lead ore.

American Smelting and Refining Company completed a drilling program on a property 38 miles north of Watson Lake where over a million tons averaging 15 per cent combined lead and zinc were outlined.

Northwest Territories

Pine Point Mines Limited, controlled by Cominco with Ventures Limited holding a minority interest, continued to explore its property near Pine Point south of Great Slave Lake by sinking two prospect shafts to investigate mining conditions and provide ore for bulk sampling tests. Although the company has made no official announcement regarding reserves, the Pine Point deposits of zinc-lead ore are known to be relatively flat-lying and very extensive.

Uses

Lead is used principally in storage battery manufacture, cable covering, and in tetraethyl lead compounds for improving the quality of gasoline. It is also used for acid tank lining, ammunition, bearing metal, Babbitt metal, solder, litharge, red lead, and white lead.

In the field of atomic energy, there is an expanding use of lead for shielding against radiation.

The lead content of storage batteries and many other lead manufactures can be recovered when the article or application ceases to be serviceable. Hence the use of secondary lead is a very important factor in the overall consumption.

Prices

The Canadian price of lead ranged between 12.00 and 14.8 cents a pound. For the most of the latter part of the year it was 14.25 cents a pound. The average Canadian price calculated by the Dominion Bureau of Statistics was 13.3 cents a pound.

MAGNESIUM

Magnesium is produced in Canada at Haley, Ontario, by Dominion Magnesium Limited and at Arvida, Quebec, by Aluminum Company of Canada, Limited (Alcan). Since 1950-51 when regular production was resumed by these companies output has increased steadily, but statistics on production and trade are not available for publication.

There are seven magnesium foundries in Canada, the largest and most modern being that of Light Alloys Ltd. at Haley, Ontario, which is equipped for sand-slinger and precision moulding operations.

Production

The plant at Haley, which uses the Pidgeon silicothermic process, has a capacity of 7,000 tons annually if devoted entirely to production of magnesium and its alloys, but calcium also is produced. Dolomite, quarried locally, is calcined and mixed with ferrosilicon containing 75 per cent silicon, and the mixture is briquetted. The briquettes are charged into tubular retorts of chrome-nickel steel, which are heated and evacuated. The magnesium oxide in the calcined dolomite is reduced by the silicon, producing magnesium vapour and dicalcium silicate. The magnesium vapor distils from the charge and is condensed into crystals on a water-cooled condenser that is removed from the retort when the operation is complete and the vacuum released. The crystals are melted and refined and the molten metal is cast into ingots. Melting and refining losses average 2 per cent of crystal weight. By this process, metallic magnesium is produced directly from the calcine in one operation. Production of 1 ton of magnesium requires about 10 tons of raw dolomite or 4.8 tons of calcined dolomite, and about 1 ton of 75 per cent grade ferrosilicon.

Ferrosilicon is the main single factor in the cost of magnesium output, and in April 1953 Dominion Magnesium commenced production of ferrosilicon at its own plant, Electro-Reagents (Quebec) Limited, Beauharnois, Quebec, with a resulting reduction in the price of its magnesium.

The source of Alcan's magnesium is brucitic limestone from a company-owned quarry at Wakefield, Quebec. The metal is produced at Arvida, Quebec. Plant capacity is 4,000 metric tons a year.

Uses

Magnesium can be rolled, extruded, and forged. It is the lightest structural metal, its weight being two-thirds that of aluminum and less than one-quarter the weight of steel. It is also of growing importance as a reducing agent in process metallurgy. The greater portion of the output is exported in the form of pure metal, the principal uses of which are: high-strength alloys for structural purposes, especially in the aircraft industry; the production of titanium; as an alloying ingredient for aluminum alloys.

The increasing use of magnesium as a cathodic protecting agent for pipelines and for iron and steel equipment used underground or in and about sea water constitutes an important market for the metal.

Magnesium products are being used to make many kinds of equipment where a saving in weight is important, especially in the field of transportation.

MANGANESE

Canada produces no manganese ore. However, the availability of abundant and cheap power has enabled the establishment of a modern ferromanganese plant at Welland, Ontario, in which high- and low-carbon ferromanganese and silicomanaganese are manufactured in electric furnaces for domestic consumption and for export. The plant is operated by Electro Metallurgical Company, Division of Union Carbide Canada Limited. Metallurgical-grade ore is also used by Chromium Mining and Smelting Corporation, Limited, at Sault Ste. Marie, Ontario, to make manganese alloys.

Canadian Furnace Company Limited at Port Colborne, Ontario, produces silvery pig-iron from low-grade manganiferous ores.

World manganese ore prices declined markedly in 1954 following the re-entry of Russia into the manganese market, the decreased rate of steel production in the free world, and a decline in purchases by the United States Government.

Canadian production of ferromanganese is dependent upon an export market, and in 1954, because of the substantial decline in price in the foreign market and the offerings by Japan, Russia, Norway, and Sweden, it remained at the low level set in 1953. Canadian producers dropped their prices in the Canadian market, thereby largely retaining this market for the Canadian product.

Canadian Occurrences and Developments

During 1954, Strategic Materials Corporation carried out experimental work in an endeavour to produce a marketable manganese product from its low-grade deposit near Woodstock, New Brunswick. Diamond drilling and a gravimetric survey have indicated large tonnages of the ore.

Canadian Manganese Mining Corporation Limited, a subsidiary of New Delhi Mines Limited, did exploratory work on its property in the Tetagouche Falls area near Bathurst, New Brunswick.

A small amount of bog manganese ore has been mined in the past from the bog deposits of New Brunswick.

Labrador Mining and Exploration Company Limited has developed 13,321,000 long tons of manganiferous iron ore averaging 49.93 per cent iron and 7.45 per cent manganese, and Hollinger North Shore Exploration Company Limited has developed 40,045,000 long tons averaging 50.25 per cent iron and 7.70 per cent manganese at their respective iron ore properties in Labrador and Quebec.

Trade and Consumption

	1954		1953	
	Short Tons	$	Short Tons	$
Imports, manganese ore				
United States*.........	32,304	1,590,348	31,709	1,190,745
Cuba.................	6,944	255,931	-	-
Gold Coast	5,600	248,625	10,035	453,462
Belgian Congo	2,240	96,839	-	-
India.................	1,794	70,976	11,043	372,228
United Kingdom	76	14,123	55	11,428
France...............	5	201	-	-
Other countries	-	-	13,840	692,000
Total......	48,963	2,277,043	66,682	2,719,863
Exports, ferromanganese				
Spain	1,772	207,184	-	-
United States	1,748	327,121	399	104,013
Colombia..............	89	14,850	34	7,150
Venezuela.............	28	5,869	123	26,780
Mexico................	2	301	127	26,529
Total.......	3,639	555,325	683	164,472
Consumption, ore				
Metallurgical grade	62,916		62,462	
Battery grade..........	3,136		3,188	
Total.......	66,052		65,650	

* Country of origin not known.

World Production

World mine production of manganese ore during 1953 was estimated at 9,300,000 metric tons, of which an estimated 3,500,000 metric tons, or 38 per cent of the total, came from Russia.

The free world supply of manganese comes mainly from India, Union of South Africa, Gold Coast, and French Morocco. Indian output is generally consigned to United States while North African production is destined for European markets. The output of Gold Coast and Union of South Africa goes to both markets. Production from Gold Coast, Union of South Africa, and India is mostly metallurgical grade, but Gold Coast also ships a large amount of battery grade. Of importance is the growing production in Brazil, Cuba, Turkey, Mexico, Egypt, and Japan.

To encourage domestic production of manganese ore the United States Government, in 1951, introduced an incentive price purchase plan for domestic ore based on a price of $2.30 per long-ton unit for ore of 48 per cent manganese content. Deliveries at the end of 1954 amounted to 11,727,438 long-ton units as against a total plan calling for 37,000,000 long-ton units.

The United States Government has also entered into agreements with commercial interests for research and development work in upgrading domestic ores, and the recovery of manganese from steel-furnace slags. Success in any of these projects would be of utmost importance to the North American continent in an emergency.

Consumption, Uses, and Specifications

Approximately 95 per cent of the world output of manganese ore is used to make manganese alloys for the steel industry. An average of 13 pounds of manganese is needed to produce a ton of steel ingot, this amount being necessary to deoxidize, clean, and combine with sulphur so as to produce steel that may be readily rolled and fabricated. As an alloying element, manganese improves the strength and toughness of structural steels and cast-irons. The dry-battery industry accounts for three per cent, and the chemical industry for the remainder.

Metallurgical-grade Manganese

Most of the manganese consumed by the steel industry is in the form of high-carbon ferromanganese and the remainder as low- and medium-carbon ferromanganese, silicomanganese, spiegeleisen, manganese metal, and ore, in the order given.

Electrolytic manganese metal is used in place of low-carbon ferromanganese to reduce the carbon content in stainless steels, thus eliminating the need of a carbon stabilizer.

General specifications for metallurgical-grade manganese ore are as follows: minimum of 48 per cent manganese, maxima of 7 per cent iron, 8 per cent silica, 0.15 per cent phosphorus, 6 per cent alumina and one per cent zinc. The ore should be in hard lumps less than 4 inches, and not more than 12 per cent should pass a 20-mesh screen.

Battery-grade Manganese

Manganese ore for dry-cell use must be a manganese dioxide (pyrolusite) ore of not less than 75 per cent MnO_2 and not more than 1.5 per cent iron, and should be very low in such metals as arsenic, copper, zinc, nickel, and cobalt.

Chemical-grade Manganese

Chemical-grade manganese ore should contain at least 35 per cent manganese. It is used to make manganese-sulphate fertilizer and other salts for use in the glass, dye, paint, varnish, and photographic industries.

Canadian Consumers

Consumers of metallurgical-grade ore are Electro Metallurgical Company at Welland, Chromium Mining and Smelting Corporation Limited at Sault Ste. Marie, and Canadian Furnace Company Limited at Port Colborne, all in Ontario.

Consumers of battery-grade ore are National Carbon Limited and General Dry Batteries of Canada Limited, both of Toronto; Burgess Battery Company, Limited, Niagara Falls; and Ray-O-Vac (Canada) Limited, Winnipeg.

Electrolytic manganese metal imported from United States is used at Atlas Steels, Limited, Welland, Ontario, in making low-carbon stainless steel. It is also used by the aluminum and magnesium alloy industry.

Prices

According to E. & M.J. Metal and Mineral Markets, the price for metallurgical grade ore of Indian origin fell during September from a high of \$1.08 - \$1.10 to a low of 70 - 75 cents per long-ton unit of manganese, c.i.f. U.S. ports, duty extra. At the end of the year the price was 78 - 80 cents.

Owing to the great drop in ore prices, the price of standard ferromanganese was cut from \$200 to \$190 a short ton, and the Indian Government abolished its 15 per cent export tax on manganese ore.

E. & M.J. Metal and Mineral Markets quotations for manganese alloys, at the end of 1954, were as follows:

Ferromanganese 74 - 76 per cent Mn - \$190 per net ton, f.o.b. Clairton, Sheridan, and Johnstown, Pa.; Marietta and Ashtabula, Ohio; Alloy, W. Va.; and Sheffield, Ala.

Silicomanganese Per lb., carload lots, f.o.b. shipping point, freight allowed, 65 - 68 per cent Mn.

Maximum	1 1/2% C,	18 to 20% Si	- 11.0¢
"	2% C,	15 to 17 1/2% Si	- 10.8¢
"	3% C,	12 to 14 1/2% Si	- 10.6¢

Spiegeleisen Per gross ton, carload lots, f.o.b. Palmerton, Pa.

Maximum	3% Si,	16 to 19% Mn	- \$84.00
"	"	19 to 21% Mn	- \$86.00
"	"	21 to 23% Mn	- \$88.50
"	"	23 to 25% Mn	- \$91.00

The price of electrolytic manganese was 30 cents per pound in carload lots, f.o.b. Knoxville, Tenn., with freight allowed east of Mississippi.

Tariffs

Canada

	British Preferential	Most Favoured Nation	General
Manganese ore	free	free	free
Ferromanganese (per lb. of contained Mn)	free	1¢	1 1/4¢
Silicomanganese (per lb. of contained Mn)	free	1 1/2¢	1 3/4¢

United States

Manganese ore

Over 10% but less than 35% Mn.
On Mn content - 1/4¢ per lb.
- Cuba free

35% Mn and over, battery and chemical grades
On Mn content - 1/4¢ per lb.
- Cuba free

Metallurgical grades
On Mn content - 1/4¢ per lb.
- Cuba free

Manganese Alloys

Ferromanganese, 30% or more Mn.
Containing not over 1% carbon
On Mn content - 15/16¢ per lb. and 7 1/2% ad valorem.
Containing over 1% and less than 4% carbon
On Mn content - 15/16¢ per lb.
Containing not less than 4% carbon
On Mn content - 5/8¢ per lb.

Manganese silicon (including silicon manganese)
On Mn content - 15/16¢ per lb. and 7 1/2% ad valorem.

Spiegeleisen containing not more than 1% carbon and manganese boron.
On Mn content 15/16¢ per lb. and 7 1/2% ad valorem.

Manganese metal
On Mn content - 1 7/8¢ per lb. + 15% ad valorem.

MERCURY

There has been no production of mercury in Canada since September 1944 and all shipments since then have been from producer's stocks. The only known Canadian deposits of cinnabar (HgS), the principal ore of mercury, are in the Omineca Mining Division of northern British Columbia, where The Consolidated Mining and Smelting Company of Canada Limited accounted for nearly all of Canada's production of mercury during the war years 1940-1944, the source of output being its Pinchi Lake mine. Bralorne Mines Limited produced the remainder from its Takla mine, 85 miles northwest of Pinchi Lake. Output from these mines reached a peak of 22,240 flasks (a flask contains 76 pounds) during 1943 and was discontinued in September 1944 when it became cheaper to obtain mercury from Italy and Spain. The deposits in British Columbia average about 0.5 per cent of mercury and are capable of supplying Canadian requirements for many years should this become necessary.

The marked rise in the price of mercury during 1954 was responsible for staking activities and some exploratory work on occurrences in the Pinchi Lake, Bridge River, and other areas of British Columbia. Bralorne Mines Limited did limited diamond drilling at its Takla mine.

World Production and Trade

The Almaden mine in Spain is the richest source of mercury in the world. Annual output has been in the range of 40,000 to 50,000 flasks, and reserves, grading 5 to 6 per cent mercury, are sufficient to maintain this rate for 200 years. With additional equipment recently installed the mine is capable of producing up to 100,000 flasks per year.

In Italy, the Monte Amiata mine in Tuscany accounts for most of that country's output. Reserves average about 1.3 per cent mercury.

The Idria mine in the Trieste area is the principal source of output in Yugoslavia. Mexico and the United States also produce important quantities.

The United States General Services Administration has offered to purchase 125,000 flasks of domestic and 75,000 flasks of Mexican mercury at a guaranteed price of $225 per flask, and has authority to negotiate additional individual contracts with specific foreign producers.

World consumption of mercury in recent years has averaged about 150,000 flasks per year, with a peak of 270,000 flasks in 1942.

Uses

In addition to its uses in the chemical, pharmaceutical, and electrical industries, mercury is used in the manufacture of agricultural disinfectants and fungicides, and in anti-fouling compounds for ships' hulls. In the gold mining industry it is used to a limited extent in the extraction of the metal from its ores by amalgamation. Mercury is also used in dental preparations, in making detonators, as a catalyst, and in general laboratory work.

Trade and Consumption

	1954		1953	
	Pounds	$	Pounds	$
Exports				
United States	6,310	20,907	7,018	18,857
Imports				
United States[a]	160,702	403,574	140,926	318,245
Italy.............................	46,924	107,722	-	-
Mexico	36,741	119,535	27,873	56,434
United Kingdom	416	1,314	110	376
Other countries	-	-	27,503	60,985
Total	244,783	632,145	196,412	436,040
Consumption				
Production of heavy chemicals			138,928	
Pharmaceuticals and fine chemicals......................			47,728	
Electrical apparatus			9,196	
Gold mines			6,000[b]	
Miscellaneous			10,000[b]	
	214,000[c]		211,852	

a. Country of origin not necessarily United States
b. Estimated
c. Preliminary breakdown not yet available.

Prices

Canadian prices are based largely on United States prices which increased steadily from a low of $187 - $189 per flask in January to a high of $325 - $330 in October, according to E. & M.J. Metal and Mineral Markets, and closed at $318 - $322 per flask in December. These prices include an United States import duty of $19 per flask. There is no Canadian import duty.

MOLYBDENUM

Shipments of molybdenite from Canadian production increased from 162 tons in 1953 to 488 tons in 1954. The sole producer, Molybdenite Corporation of Canada Limited, recommenced milling operations at its property about 25 miles north of Val d'Or in western Quebec in March 1954 after increasing mill capacity to over 400 tons a day.

Operations had been suspended at the property during 1953 and early 1954 to permit the opening up of two new levels at the 625- and 750-foot horizons and to prepare the mine for production at the rate of 500 tons per day.

The funds for this expansion were provided by the United States Government through a loan with an option-to-purchase contract for 6,000,000 pounds of molybdenite at the lowest actual selling price during the two-month period preceding a Government call. The contract also provides that, in the event that the producing company cannot sell any part of its output during the term of the contract, then the Government will purchase the concentrate at a price of 63 cents a pound for molybdenite contained in a 90 per cent MoS_2 concentrate.

During 1954 most of the production was sold to the United States Government, the remainder going to Europe.

The Molybdenite Corporation property was operated during World War II by a Crown Company, Wartime Metals Corporation, which constructed a 275-ton mill on it. Production from May 1943 until July 1945 amounted to 2,739,539 pounds of concentrate averaging 87 per cent MoS_2 and containing 1,429,711 pounds of molybdenum. As there are no Canadian plants equipped to convert molybdenite into primary products, the concentrates were shipped to Langeloth, Pennsylvania, for treatment, and returned to Canadian consumers. The property was returned to the present operating company on July 15, 1945, and continued in production until December 1947, when operations were suspended.

The company resumed test milling early in 1951 and succeeded in producing a concentrate relatively free of bismuth and containing over 90 per cent MoS_2. By the end of 1951, it had increased the milling rate to about 280 tons per day. During 1952 underground development on the 270-, 375-, and 500-foot levels together with diamond drilling indicated further ore at greater depth and the plans to expand production were made.

During 1954 Quebec Metallurgical Industries Limited carried out exploratory work on a molybdenite property near Quyon, Quebec.

World Mine Production

World production of molybdenum in ores and concentrates in 1953 amounted to 28,200 metric tons of which 25,965 metric tons or over 90 per cent came from United States. The remaining production came mainly from Chile, Japan, and Canada in that order.

Production from United States comes chiefly from Climax Molybdenum Company at Climax, Colorado, and from the mines of Kennecott Copper Corporation, and in 1954 is expected to amount to approximately 25,800 metric tons. Production from the Climax Molybdenum Company increased considerably during 1954 but was more than offset by a decrease in production from Kennecott Copper Corporation which recovers molybdenite as a by-product in the concentration of its Utah, New Mexico, and Nevada copper ores.

Production, Imports, and Consumption

	1954		1953	
	Short tons	$	Short tons	$
Production (shipments)				
Contained MoS_2	488	534,000	162	215,527
Imports				
Molybdic oxide				
From: United States ...	211.00	207,656	178	372,185
United Kingdom .	0.25	88	1	2,333
Total	211.25	207,744	179	374,518
Calcium molybdate (grouped with vanadium oxide and tungsten oxide for alloy steel manufacture)				
From: United States	61	73,950	99	101,433
Ferromolybdenum(1)	33	58,705	101	165,501
Consumption (Mo content)				
Molybdic oxide	125		200	
Ferromolybdenum	48		56	
Calcium molybdate & sodium molybdate, etc .	14		18	
Total	187		274	

(1) Not recorded separately in the official trade statistics of Canada. Figures are from the United States Export Statistics. Those for 1954 are for 10 months only.

This decrease in by-product molybdenite was brought about by curtailed copper production resulting from a reduced rate of production early in the year and later from strikes.

Production in United States also comes from the molybdenite mine of Molybdenum Corporation of America at Questa, New Mexico; the copper mines of Miami Copper Company at Miami, Arizona; and the tungsten mine of United States Vanadium Corporation at Bishop, California.

In Chile, molybdenite is recovered as a by-product in the milling of copper ores by Braden Copper Company, a subsidiary of the Kennecott Copper Corporation.

Consumption and Uses

About 90 per cent of the total molybdenum produced is used as an additive metal in the form of ferromolybdenum, molybdic oxide, and calcium molybdate in the making of steel and cast-iron. In the production of low-molybdenum steels, molybdenum is generally used in the form of molybdic oxide. Ferromolybdenum is used where a higher molybdenum content is required, as in cast-iron and steel foundries.

Consumption of molybdenum in Canada was less in 1954 than in any year since 1949 owing to the low output of alloy steel. United States exports, however, reached an all-time high in 1954.

A large amount of the molybdenum used in alloy steels goes into the making of gears and axles for the automobile, railroad, and shipbuilding industries; shafts for mining and industrial machinery, and castings for pumps and valves.

Varying amounts of molybdenum are used in high-speed tool steels, high-temperature alloys, and stainless steels.

Molybdenum wire and sheet are used in the electric lamp, radio valve, rectifier, and resistance-wire industries. Molybdenum is used in conjunction with cobalt as a catalyst in hydroforming, desulphurization, and hydrogenation.

Molybdenum salts are used in pigments, mordants, and welding rod coatings. They have a limited use in the chemical field. Pure molybdenite is finding increasing use as a lubricant.

The more important Canadian consumers of molybdenum primary products are Atlas Steels, Limited; Algoma Steel Corporation; The Steel Company of Canada, Limited; Sorel Industries, Limited; Shawinigan Chemicals, Limited; Welland Electric & Steel Foundry, Ltd.; Dominion Engineering Works, Ltd.; and Dominion Colour Corp. Ltd.

Prices

Climax Molybdenum Company announced on December 10, 1954, its first price change since December 1950.

According to E. & M.J. Metal and Mineral Markets, December 30, 1954, prices of molybdenum in United States were as follows:

Molybdenum metal
99% purity, per lb. $3.00

Ferromolybdenum
f.o.b. shipping point, per lb.
of contained Mo

55-65% Mo, powdered $1.57
all other sizes $1.49

Calcium molybdate (CaO MoO_3)
f.o.b. shipping point, per lb.
of contained Mo $1.28

Molybdic trioxide (MoO_3)
f.o.b. shipping point, per lb. of
contained Mo

bagged $1.24
canned $1.25

Molybdenite
f.o.b. Climax, Colorado, per lb. of
contained Mo plus cost of containers.......... $1.05

Tariffs

Canada

	British Preferential	Most Favoured Nation	General
Calcium molybdate	free	free	5% ad valorem
Molybdic oxide	"	"	" "
Ferromolybdenum	"	5% ad valorem	" "
Molybdenum ore & concentrate	"	free	free

United States

(a) Molybdenum ore and concentrate, 35¢ per lb. on Mo content.
(b) Calcium molybdate, ferromolybdenum, metallic molybdenum, molybdenum powder, and all other alloys and compounds of molybdenum, 25¢ per lb. on Mo content and 7 1/2% ad valorem.
(c) Material containing over 50% molybdenum: bars, ingots, scrap, and shot, 25% ad valorem; other forms, 30% ad valorem.

NICKEL

Nickel again led all other metals in value in 1954 with an output of 319,983,340 pounds valued at $180,196,300, somewhat more than a 10 per cent increase in volume over 1953. A significant development was the beginning of production at the refinery of Sheritt Gordon Mines Limited at Fort Saskatchewan, Alberta. Except for Sherritt Gordon, three small producers in the Sudbury area, Ontario, and a small recovery from the treatment of silver-cobalt ores of the Cobalt area, Ontario, Canadian production came from the mines of The International Nickel Company of Canada, Limited (Inco), and Falconbridge Nickel Mines, Limited, all in the Sudbury area.

Deliveries of nickel in all forms by Inco were 282,000,483 pounds, an increase of 30,582,711 pounds over 1953. These deliveries were about 70 per cent of the free world output, which reached a new high of about 390,000,000 pounds, an increase of 50,000,000 pounds over 1953. A small drop in the demand for nickel to meet defence requirements resulted in an improvement in deliveries to private industry.

Production and Trade

	1954		1953	
	Short Tons	$	Short Tons	$
Production, all forms	159,992	180,196,300	143,693	160,430,098
Exports, by forms				
Matte or speiss	65,823	72,862,335	63,909	70,312,715
Oxide	1,486	1,463,424	1,299	1,328,992
Refined nickel	91,410	107,828,514	79,909	90,900,597
Total ...	158,719	182,154,273	145,117	162,542,304
Exports, by destination				
United States	105,906	123,628,706	95,751	108,116,943
United Kingdom	32,016	35,218,056	32,592	35,841,974
Norway*	19,562	21,666,109	16,365	18,001,280
West Germany	212	346,312	42	103,822
Brazil	191	238,134	114	169,206
Other countries	832	1,056,956	253	309,079
Total ...	158,719	182,154,273	145,117	162,542,304

* For refining and re-export only.

Activities at Producing Mines

The International Nickel Company of Canada, Limited

The total ore mined in 1954 was 14,456,254 tons, of which 2,468,046 tons were from open-pit operations. Ore production from the underground mines averaged more than 44,000 tons per mine operating day. Preparation for a third crusher station was begun at the Creighton mine; new shaft stations were established at the 3,200-, 3,400-, and 3,600-foot levels in the Garson mine; and development of the area below the 1,600-foot level at the Levack mine was continued.

Construction near Copper Cliff of the pyrrhotite plant unit was begun. This $16,000,000 plant will treat nickel-bearing sulphide concentrates low in precious metal content by an atmospheric pressure ammonia leaching process. In addition to nickel, an iron oxide product analyzing about 68 per cent iron will be recovered.

Falconbridge Nickel Mines, Limited

General expansion was continued during the year. Three new mines, the Hardy in Levack township, East Falconbridge in Falconbridge township, and Mount Nickel in Blezard township, began production. A concentrator was completed at the Hardy mine late in 1954. Expansion of the Kristiansand refinery in Norway to a capacity of 45,000,000 pounds of nickel annually was begun.

Development was continued on the Fecunis Lake, Longvac, and Boundary mines in Levack township. Completion of the two shafts at Fecunis Lake is expected in 1956. Production from Longvac mine is expected to commence in 1955.

Sherritt Gordon Mines Limited

The concentrator at the mine site at Lynn Lake, Manitoba, began production of nickel concentrates on November 7, 1953 and the first shipment to the Fort Saskatchewan refinery was made in January 1954 upon completion of the railway extension from Sherridon to Lynn Lake. The refinery began treating concentrates in July and by the end of the year production of nickel was approaching the designed capacity.

In September it was announced that Inco had signed a contract with the General Services Administration of the United States Government for the delivery of a minimum of 4,500,000 pounds of refined nickel in the period ending August 1955 from Sherritt Gordon nickel concentrates. These are the excess of Sherritt Gordon's production over the quantity required for processing at Fort Saskatchewan. The initial shipment of nickel under this contract was made in January 1955.

Nickel Rim Mines, Limited (formerly East Rim Nickel Mines, Limited)

The mine is in MacLennan township, about seven miles north of Falconbridge. Work was stepped up to develop further ore reserves. Concentrates produced in the 500-ton mill are sold under contract to Falconbridge Nickel Mines Limited.

Nickel Offsets, Limited

This property, comprising 51 claims in Foy and Bowell townships, is about 20 miles north of Chelmsford, Ontario. A 300-ton mill is operated and concentrates are sold under contract to Falconbridge. The mill treated about 230 tons of ore per day.

Milnet Mines, Limited

The mine is in Parkin township, about 22 miles northeast of Sudbury. Operations ceased in the latter half of the year, when available ore was mined out. Shipments of crushed ore were made to Falconbridge for treatment.

Development and Exploration

Quebec

Development of the nickel-zinc-copper deposit of Eastern Metals Corporation Limited in Rolette township, Montmagny county, was continued. The shaft was deepened to over 650 feet and further underground drilling was done. A raise was driven from the second to the first level in the nickel zone. Intensive underground development was carried out in the south or copper zone.

Ontario

A shaft was sunk to 360 feet on the Gordon Lake-Werner Lake property of Quebec Nickel Corporation, Limited in the Kenora district. Up to August, diamond drilling indicated reserves of over 1,300,000 tons of ore in two main zones.

In the Sudbury area International Nickel carried out 480,000 feet of exploratory drilling.

Manitoba

In the Mystery Lake area in the central part of the province, Canadian Nickel Company, an Inco subsidiary, continued its program of exploration. Activity was centred largely on occurrences adjacent to Moak Lake, where a large tonnage of low-grade ore averaging about 0.7 per cent nickel has been indicated. It is proposed to sink a 1,300-foot shaft and to do 10,000 feet of crosscutting and drifting for purposes of underground exploration.

In the southeastern part of the province, Maskwa Nickel Chrome Mines, Limited, a subsidiary of Falconbridge, continued to investigate nickel-copper deposits in the Bird River region. Drilling has indicated 1,350,000 tons of ore grading 1.15 per cent nickel and 0.34 per cent copper on one claim. The area is reported to have interesting possibilities.

British Columbia

Work was discontinued at the mine of Western Nickel Mines Limited near Choate, as no extensions to the known ore reserves were found.

Yukon

Exploratory work was continued on the Wellgreen property of Hudson Bay Exploration and Development Company Limited in the Kluane Lake district. Diamond drilling results are reported to have indicated 500,000 tons of ore averaging 2.15 per cent nickel and 1.35 per cent copper, with small amounts of platinum and palladium.

Extensive diamond drilling and 3,000 feet of lateral work was done on the Quill Creek nickel-copper property of Prospectors Airways Limited about 40 miles southwest of the Hudson Bay property.

Northwest Territories

North Rankin Nickel Mines Limited, formerly Rankin Inlet Nickel Mines Limited, at Rankin Inlet, on west coast of Hudson Bay continued diamond drilling and underground development to trace the downward extension of the deposit. Some 460,000 tons of ore averaging 3.3 per cent nickel and 0.81 per cent copper was outlined to a depth of 300 feet.

Canadian Nickel Company carried out extensive airborne reconnaissance surveys and detailed mapping on numerous nickel showings in the Ferguson Lake area, central Keewatin District.

Uses

From 40 to 50 per cent of the world nickel consumption is in the manufacture of stainless and other alloy steels and of nickel cast-irons. Monel metal, a nickel-copper alloy, is used for a wide variety of corrosion-resisting equipment. Nimonic and Inconel alloys play an important part in the field of gas turbines and jet engines. Electro-plating uses about 18 per cent of available metal and the demand in this field continues to increase. Other uses include nickel silvers, electrical-resistance alloys, catalysts, ceramics, batteries, and many miscellaneous applications.

Prices and Tariff

The Canadian price of nickel in 1954 was 57 cents per lb. until November 25 when it was increased to 61.4 cents.

In the United States the price was 60 cents per lb. until November 25 when it was raised to 64.5 cents per lb.

The United States tariff on refined nickel is 1 1/4 cents per lb.

Nickel oxide, ore, matte, and scrap enter duty free.

The duty on nickel, bars, rods, plates, sheets, castings, strips, and wire is 12 1/2% ad valorem.

PLATINUM METALS

Production of platinum metals in concentrates totalled 325,673 ounces in 1954, about 7 per cent more than in 1953. This increase was due to greater nickel output, with which virtually all platinum production in Canada is associated. About 90 per cent of the output comes from The International Nickel Company of Canada Limited, from treatment of its own and some custom ores; the remainder comes from Falconbridge Nickel Mines Limited. Refining takes place at Acton, England, in the case of International Nickel, and at Kristiansand, Norway, in the case of Falconbridge. Most of the refined metal is sold to United States fabricators, a large part of the shipments being routed via Canada.

Preliminary figures indicate that in 1954 South Africa replaced Canada as the leading producer of platinum metals owing to increased production from Rustenberg Platinum Mines Limited about 40 miles north of Johannesburg. This mine is now the largest single source of platinum metals. Three other countries are major producers, namely, the United States with about 35,000 ounces annually, Colombia with a somewhat smaller output, and Russia, which is estimated to produce 100,000 ounces or more.

The approximate ratio of Canada's output of the platinum metals to the world output is as follows:

Metal	Canada %	World %
Platinum	45	59.5
Palladium	41	33
Rhodium, ruthenium, iridium, osmium	14	7.5

The value of platinum metals consumed in Canada is estimated to have risen to about $7,000,000 a year, largely as a result of the use of the metals as catalysts in petrochemical and petroleum plants. The United States is the largest consumer, generally using about three-quarters of the free world's production.

Production and Trade

	1954		1953	
	Ounces	$	Ounces	$
Production (shipments)				
Platinum....................	149,145	12,505,758	137,545	12,550,981
Palladium, rhodium, ruthenium, iridium, and osmium...............	176,528	7,494,809	166,018	7,495,409
Total	325,673	20,000,567	303,563	20,046,390
Exports				
Platinum metals in concentrates*...........		16,173,183		14,756,828
Platinum metals, refined and semi-processed**				
United States		10,936,039		10,921,621
Other countries		520,533		600,507
Platinum, old and scrap				
United Kingdom		9,755		10,940
Total		11,466,327		11,533,068
Imports				
Platinum and platinum metals, refined, semi-processed, and manufactured				
United Kingdom**........		17,537,757		16,076,843
United States		1,302,077		1,054,033
Other countries***.......		64,737		202,798
Total		18,904,571		17,333,674

* To U.K. for refining and processing; does not include content of Falconbridge copper-nickel matte shipped to Norway for refining.

** Derived from domestic concentrates refined and processed in U.K.

*** Mainly from Norway and derived from Falconbridge copper-nickel matte shipped there for refining.

Uses

Metals of the platinum group have many important applications. Their great resistance to corrosion, high temperatures, and spark erosion, together with their good mechanical properties, are responsible for their use in numerous electrical applications. Platinum is used extensively in the chemical industry as a catalyst, and in both the industrial and experimental fields on account of its resistance to high temperatures and corrosion.

Platinum and palladium are extensively used in jewelry, particularly for setting diamonds, where their whiteness and non-tarnishing quality are important. Rhodium is used for a non-tarnishable finish for tableware, and as a coating for projector mirrors. Ruthenium, iridium, and osmium find wide use as elements in hard alloys for pen tips and other purposes.

Prices

Prices of the metals varied in 1954, in most cases showing a decline in the latter part of the year. According to E. & M. J. Metal and Mineral Markets, United States prices per ounce were as follows:

Platinum	-	\$ 91 to \$ 77
Palladium	-	\$ 22 to \$ 17
Rhodium	-	\$118 to \$125
Ruthenium	-	\$ 75 to \$ 60
Iridium	-	\$170 to \$130
Osmium	-	\$140 to \$150

SELENIUM

Selenium is recovered as a by-product from the slimes accumulated in the electrolytic refining of certain copper anodes. It occurs in very small amounts in some copper and gold ores.

Canadian Copper Refiners Limited (a subsidiary of Noranda Mines Limited), Montreal East, Quebec, and The International Nickel Company of Canada Limited, Copper Cliff, Ontario, are the two Canadian producers of the refined metal. Production in 1954, at 368,800 pounds, was about 40 per cent greater than in 1953.

Selenium is present in International Nickel's copper-nickel deposits at Sudbury, Ontario. It is recovered at the Copper Cliff copper refinery in the form of a black, free-flowing, amorphous powder which averages 99.5 per cent selenium. The rated annual capacity of the selenium plant is 270,000 pounds.

At Montreal East, the metal is recovered from the refining of copper anodes produced at the Noranda smelter, principally from the Noranda ores, and from blister copper produced by the Hudson Bay Mining and Smelting Company Limited from its copper-zinc deposits at Flin Flon on the Manitoba-

Saskatchewan boundary. The plant is the largest in the world, with an annual rated capacity of 450,000 pounds of selenium. In addition to high-purity solid and powdered selenium, the company produces a variety of selenium products.

Selenium continued to be in very heavy demand throughout 1954 and consequently was in short supply. The supply is so uncertain that the metal has been listed as one of the most strategic for the United States stockpile. High-purity selenium prices were increased from $4.75 to $6.00 per pound in 1954, and effective January 3, 1955, the price was further raised to $7.25 per pound.

United States and Canada are the principal producing countries; small amounts are produced in Australia, Japan, and several European countries. Owing to the severe shortage of selenium, the United States is investigating a number of possible new sources.

Uses

The most important use for selenium is in the manufacture of dry-plate rectifiers for the conversion of alternating to direct current. Selenium rectifiers are in great demand because of their small size, rugged construction, low loss on aging, absence of moving parts, ability to withstand overloading, light weight, and low cost. Miniature rectifiers are used in radios, television sets, signal equipment, etc.; larger ones are used in electro-plating apparatus and for battery charging.

The glass industry is a heavy consumer of selenium. About 80 per cent of the consumption in this industry is for decolourizing, in which very small amounts of the metal are added to the glass to neutralize undesirable colour. If the proportion of selenium is increased, an amber or ruby colour is produced, but this use accounts for only a small fraction of total consumption.

Small additions of selenium to rubber improve resistance to heat, oxidation, and abrasion.

Ferroselenium or iron selenide (about 53 per cent selenium) is added to certain stainless steels to improve machinability. The selenium does not affect the hot-forging and cold-working properties or the corrosion resistance of the alloy steels.

Selenium is used in conjunction with cadmium sulphide as an ingredient of pigments which are used in a wide variety of products such as ceramics, lacquers, inks, enamels, and plastics.

Other uses of selenium are in photo-electric cells, coatings for non-ferrous metals, anti-oxidant lubricants, and as catalysts in certain chemical operations.

Production, Trade, and Consumption

	1954		1953	
	Pounds	$	Pounds	$
Production				
Quebec	190,000	950,000	113,533	476,839
Ontario	93,800	469,000	92,698	389,332
Manitoba and Saskatchewan ..	85,000	425,000	56,115	235,683
Total	368,800	1,844,000	262,346	1,101,854
Exports, metals and salts				
United States	190,686	1,047,623	102,722	428,121
United Kingdom	146,853	848,260	147,814	627,899
India.......................	3,860	25,085	1,426	7,425
Australia	2,545	20,000	-	-
France.....................	298	2,384	-	-
West Germany	50	400	200	1,450
Italy	-	-	1,458	1,929
Total	344,292	1,943,752	253,620	1,066,824
Indicated consumption by industries				
Alloy steel	7,419		7,282	
Rubber.....................	5,971		2,783	
Electronics	3,999		1,850	
Glass	3,560		2,470	
Agriculture	192		80	
Total	21,141		14,465	

Prices

The price for black powdered selenium (99.5 per cent) remained at $6.00 per pound after January 4, 1954, when it jumped from $4.75. Effective January 3, 1955, the price of selenium was further increased to $7.25 a pound. These increases were a result of the heavy demand and short supply.

SILVER

In 1954, Canada produced 29,711,805 ounces of silver, five per cent more than in 1953, and only ten per cent below the record production of 1910. Most of the production now comes from base-metal operations, which in 1954 accounted for about 84 per cent of the total. With the exception of Ontario, all producing areas showed increases, British Columbia and Quebec having the largest gains. Canada holds third place as a producer, Mexico and the United States being first and second, respectively. World production for 1954, in millions of ounces, was: Mexico 47; U.S.A. 37; Canada 29.7; Peru 20; Australia 11.5; Japan 6.9; Bolivia 6.5. Most of Canada's output is exported, chiefly to the United States. Domestic consumption in 1954 was about 6,000,000 ounces.

Developments at Producing Mines

Yukon

United Keno Hill Mines Limited, in the Mayo district, was Canada's largest single source of silver in 1954, with over 6,000,000 ounces in lead and zinc concentrates and silver precipitates. The mill rate has been raised to 500 tons per day, and shaft deepening was completed to 1,340 feet.

Mackeno Mines Limited, Mayo district, produced over 1,000,000 ounces of silver. The mill was treating approximately 100 tons per day, with mill heads averaging 60 ounces of silver to the ton.

Northwest Territories

The small production comes mainly from gold mines in the Yellowknife area: the operations of Eldorado Mining and Refining Limited at Great Bear Lake produce a small unspecified amount.

British Columbia

The Consolidated Mining and Smelting Company of Canada Limited heads the list of silver producers, much of its output coming from custom ores and concentrates shipped to the Trail smelter, although the company's Sullivan lead-zinc mine continues to be an important source of silver. The curtailment of base-metal custom shipments in 1954 caused a drop from the 1953 silver production of 16,144,791 ounces to 11,901,184 ounces.

Torbit Silver Mines Limited, near Alice Arm in the Cassiar District, showed a considerable gain in output over 1953, when a strike suspended operations for about five months. This is one of the few mines in Canada that is worked primarily for the silver content of the ore, with lead as a by-product.

Other important silver producers were Silver Standard Mines Limited near Hazleton; Highland-Bell Limited at Beaverdell; Violamac Mines Limited in the Slocan district; and Sunshine Lardeau Mines Limited at Camborne.

Manitoba and Saskatchewan

The base-metal orebody of Hudson Bay Mining and Smelting Company, Limited, at Flin Flon on the provincial boundary is the chief source of silver. Production in 1953 reached 1, 860, 773 ounces. Other producers were: Sherritt Gordon Mines Limited at Lynn Lake; Nor-Acme Gold Mines Limited at Snow Lake; and San Antonio Gold Mines Limited, at Rice Lake, the three last-named being in Manitoba.

Ontario

Although production declined slightly in 1954, the silver-cobalt mines of Cobalt-Gowganda area continued as the chief producers of silver during the year. Principal producers were: Silver-Miller Mines Limited; Siscoe Metals of Ontario Limited; Cobalt Consolidated Mining Corporation Limited; and Castle-Trethewey Mines Limited.

The International Nickel Company of Canada Limited produced about 1, 152, 758 ounces of silver as a by-product from treatment of its copper-nickel ores. Several other base-metal mines, with the 33 gold mines, made up the balance of the output.

Quebec

Most of Quebec's silver output is derived from custom ores treated first at the Noranda smelter and later by Canadian Copper Refineries Limited, Montreal, a subsidiary of Noranda Mines Limited. Shippers included Waite-Amulet Mines, Limited; Normetal Mining Corporation Limited; Quemont Mining Corporation, Limited; East Sullivan Mines Limited; Quebec Copper Corporation Limited; and Opemiska Copper Mines (Quebec) Limited: some silver concentrates were received from the Cobalt-Gowganda area of Ontario also.

The following base-metal mines, in order of output, produced substantial amounts of silver: Golden Manitou Mines Limited; Barvue Mines Limited; Anacon Lead Mines Limited; New Calumet Mines Limited; Ascot Metals Corporation Limited; and Consolidated Candego Mines Limited.

The 16 gold mines operating in western Quebec made up the balance of silver production. Settlement, early in 1954, of the strikes that had closed down some of these mines for nearly six months in 1953 was largely responsible for the increased production.

Nova Scotia

The base-metal operation of Mindamar Metals Corporation Limited, Cape Breton Island, was responsible for the entire output of silver.

Newfoundland

All silver production came from the copper-lead-zinc orebody of Buchans Mining Company Limited.

Production and Trade

	1954		1953	
	Fine Ounces	$	Fine Ounces	$
Production by provinces				
British Columbia......	10,149,901	8,450,808	9,308,874	7,820,385
Yukon	6,758,870	5,627,435	6,639,127	5,577,530
Quebec	5,082,646	4,231,811	4,571,373	3,840,410
Ontario..............	4,810,203	4,004,975	5,154,619	4,330,395
Saskatchewan and Manitoba...........	1,843,698	1,535,063	1,687,130	1,417,358
Newfoundland	743,375	618,934	648,389	544,712
Nova Scotia	265,588	221,167	234,953	197,384
Northwest Territories	57,524	47,856	54,870	46,097
Total......	29,711,805	24,738,049	28,299,335	23,774,271
Production by sources				
Base-metal ores.....	24,821,982		24,313,892	
Gold ores	585,378		619,855	
Silver-cobalt & silver ores........	4,287,200		3,350,220	
Placer gold operations	17,245		15,368	
Total	29,711,805		28,299,335	
Imports				
Unmanufactured				
United States	57,402	48,086	287,497	231,165
United Kingdom	2,763	2,317	-	-
Total	60,165	50,403	287,497	231,165
Manufactured				
United Kingdom ...		421,425		531,065
United States......		138,860		156,392
Denmark		21,078		25,207
W. Germany		14,243		8,236
Others		38,397		22,561
Total		634,003		743,461

(Cont'd on page 80)

Production and Trade (Cont'd)

	1954		1953	
	Fine Ounces	$	Fine Ounces	$
Exports				
In ore & concentrates				
United States	8,149,943	6,534,774	5,381,280	4,364,535
W. Germany	399,703	326,319	122,684	100,044
Belgium	122,694	99,995	182,554	148,773
Total......	8,672,340	6,961,088	5,686,518	4,613,352
Bullion				
United States	13,261,017	11,006,103	14,632,914	12,231,882
Other countries	1,205,998	985,714	-	-
Total......	14,467,015	11,991,817	14,632,914	12,231,882
Manufactured				
United States		46,450		68,946
Other countries		7,795		3,761
Total......		54,245		72,707

Other Developments

New Brunswick

The lead-zinc orebody of Keymet Mines Limited came into production late in the year. The ore contains some 1.46 ounces of silver per ton, and concentrates were being stockpiled as the year ended.

In the Bathurst area, exploration and development continued on the large base-metal deposits of Brunswick Mining and Smelting Corporation Limited. These contain about 2 ounces of silver to the ton, and production at a rate of 4-5,000 tons daily is expected in 1958. The Anacon-Leadridge 150-ton pilot mill was nearly completed as the year ended.

Domestic Refineries

Fine silver is produced by the following:

Quebec: Canadian Copper Refineries Limited, Montreal East.

Ontario: Royal Canadian Mint, Ottawa; International Nickel Company of Canada Limited, Copper Cliff; Hollinger Consolidated Gold Mines Limited, Timmins; Deloro Smelting and Refining Company Limited, Deloro.

British Columbia: The Consolidated Mining and Smelting Company of Canada Limited, Trail.

Uses

The lustre, colour, and strength of silver, combined with its great malleability and ductility, have caused it to be used extensively in the arts from the earliest years of the age of metal. In modern technology, its conductivity of heat and electricity--highest of all the metals--make it desirable for many purposes, while the light-sensitive properties of many of its compounds are the very basis of the photographic industry.

The metal finds its major uses in the fields of coinage, the manufacture of articles of silver and plated ware, and the photographic industry. Its use for coinage has tended to decline in recent years, while industrial and ornamental uses tend to increase.

It is also used as an alloying metal in the manufacture of industrial and scientific equipment; in nickel-steel alloys for wear resistance and thermal conductivity; and in certain types of solder and brazing metals.

In 1954, the principal uses in Canada were:

	Ounces
Coinage	1,755,393
Silverware	1,388,412
Photography	1,248,804
Plating	978,329
Wire & rod	291,298
Grain silver	72,000
Brazing alloys	47,772
Lead-silver alloys	8,955
Miscellaneous	205,600
Total	5,996,563

Prices

The New York market price of 85 1/4¢ an ounce, established in January 1953, remained unchanged throughout 1954. The Canadian price fluctuated with the exchange rate, and averaged 83.26¢ for 1954.

TELLURIUM

Tellurium is recovered as a by-product from the anode slimes accumulated in the electrolytic refining of copper anodes. It occurs in extremely small amounts in certain copper, gold, and lead ores.

The two Canadian producers of tellurium are The International Nickel Company of Canada Limited, Copper Cliff, Ontario, and Canadian Copper Refiners Limited, a subsidiary of Noranda Mines Limited, Montreal East, Quebec. The International Nickel Company's sources of tellurium are the copper ores from nickel-copper operations in the Sudbury Basin. The Montreal East plant obtains its tellurium from blister copper made in the copper smelter of Hudson Bay Mining and Smelting Company Limited, Flin Flon, Manitoba. As the Hudson Bay orebody straddles the Saskatchewan-Manitoba boundary, each province is credited with a share of the production. Output by Canadian Copper Refiners Limited varies from year to year, depending on demand.

Production

	1954(1)		1953	
	Pounds	$	Pounds	$
Manitoba and Saskatchewan.........	-	-	169	296
Ontario	7,200	12,600	4,525	7,919
Total	7,200	12,600	4,694	8,215

(1) Figures subject to revision.

The demand for tellurium is light and most of the Canadian production is usually exported to the United Kingdom. Producers' domestic shipments are approximately 3,000 pounds a year. Tellurium is marketed as lump or powder.

Uses

The principal use of tellurium is as an additive to rubber to increase resistance to abrasion and heat and to improve the aging and mechanical properties of low-sulphur rubber. Tellurium rubber is used in covering portable cables used in dredging, mining operations, and welding units, and also in special conveyor belts.

Tellurium is used as an alloying agent with copper and lead. Added to the former, it increases the hardness and the machining qualities with only a small effect on the electrical and thermal conductivity. Tellurium has no adverse effects on the hot-working properties of copper and the alloy can also be cold-worked extensively. When added to lead, tellurium improves resistance to corrosion, wear, and vibration, as well as giving the lead useful work-hardening properties. The tellurium-lead alloy is used mainly for marine cable sheathing. Small amounts of tellurium added to tin improve its tensile strength and work-hardening properties.

Small amounts of tellurium are used to control the chill depth of iron castings, and corewashes consisting of approximately 25 per cent tellurium and 75 per cent silica flour are used to prevent localized shrinkage in iron castings.

Tellurium is also used to impart bluish or brownish tints in the ceramic and glass industries and as a base for ultramarine pigments. Tellurium compounds are used in toning baths in photography.

Prices

The Canadian price during 1954 remained at $1.75 per pound. There has been little fluctuation from this figure for a great many years.

TIN

Canadian production of tin, all in concentrates, dropped to 174 long tons valued at $226,200 compared with 488 long tons valued at $581,746 in 1953. The concentrates are derived from tailings in the concentration of the lead-zinc-silver ore from the Sullivan mine of The Consolidated Mining and Smelting Company of Canada, Limited at Kimberley, British Columbia, and are shipped to United States for refining.

World production of tin in concentrates for 1954 is estimated at 174,000 long tons compared with a production of 178,000 long tons in 1953.

The International Tin Agreement, sponsored by the United Nations Conference on Tin at Geneva, December 1953, has been signed by the six producing countries and by fourteen of the eighteen consuming countries concerned. Its purpose is to control tin production and thus stabilize prices. However, the agreement will not come into force until the formal step of ratification is carried out by a sufficient number of the signatories. Canada was one of the first countries to ratify.

World tin prices fluctuated over a narrow range in 1954. The price per pound in early January was about 84 1/2 cents and in April reached a high for the year of 97 1/2 cents. Near the end of the year, production exceeded consumption and by the end of December the price had declined to 87 1/2 cents.

Canadian Occurrences

Most of the numerous minor occurrences of tin minerals in Canada are not of sufficient grade or size to be of economic interest. The most promising is one of the base metal orebodies of Brunswick Mining and Smelting Corporation, Limited at Austin Brook, New Brunswick, which contains lead, zinc, copper, tin, silver, and iron pyrites, with a reported tin content of from 0.1 to 0.2 per cent. The estimated quantity of tin-bearing ore is 30,000,000 tons. However, the complexity of the ore presents metallurgical problems and recovery of the lead, zinc, copper, and silver will doubtless take precedence in work toward solving the problems.

Most of the other Canadian occurrences are in pegmatite dykes, although in the Mayo district, Yukon, placer tin has been noted in some creeks.

Uses and Consumption

About 50 per cent of the world tin consumption in 1954 was in tin plate and 38 per cent in solder. Tin is used to make babbitt metal, bronze, and type metal; in tinning; as foil and collapsible tubes; and in chemicals. Aluminum has replaced tin to a large extent for foil and collapsible tubes. A promising new use for tin is in the organotin chemicals (organic tin compounds) which may require large quantities of the metal in the near future; the most interesting use at the moment is as a fungicide. Tin is being used to an increasing extent by the soft drink industry to can the beverages in discardable containers.

Prices

According to E. & M.J. Metal and Mineral Markets, the price of tin per pound, f.o.b. New York, was 84 1/2 cents in early January 1954, and reached a high of 97 1/2 cents in April. The price subsequently declined and by the end of the year was 87 1/2 cents.

Tariffs

Canadian

Tin in blocks, pigs, or bars for use in Canadian manufacturing, and tin-strip waste and tin-foil enter Canada duty free.

Tin in blocks, pigs, or bars, not for specific use in Canadian manufacturing, bears the following duty: British preferential free, most favoured nation 5% ad valorem, general 5% ad valorem.

Production, Trade, and Consumption

	1954		1953	
	Long Tons	$	Long Tons	$
Production, in concentrates	174	226,200	488	581,746
Imports				
Blocks, pigs, bars				
Belgium	1,131	2,198,188	984	2,144,617
Malaya	824	1,566,722	1,459	3,407,141
Netherlands	743	1,474,808	643	1,570,715
United States	713	1,364,728	41	81,605
United Kingdom	415	817,561	575	1,059,452
Portugal	10	19,775	-	-
Total	3,836	7,441,782	3,702	8,263,530
Tin plate				
United Kingdom	6,211	1,178,781	1,036	206,952
United States	2,905	518,287	5,406	1,007,450
Total	9,116	1,697,068	6,442	1,214,402
Tin-foil	Pounds	$	Pounds	$
United States	28,859	30,959	16,565	17,022
Babbitt metal				
United States	23,800	20,216	41,700	16,759
United Kingdom	2,000	698	6,700	4,799
Total	25,800	20,914	48,400	21,558
Consumption by uses	Long Tons		Long Tons	
Tin plate and tining	1,809		1,965	
Solder	1,358		1,325	
Babbitt metal	198		244	
Brass and bronze	132		237	
Tin-foil and collapsible tubes	25		36	
Miscellaneous	82		96	
Total	3,604		3,903	

TITANIUM

Shipments of ilmenite from the Allard Lake deposits in eastern Quebec in 1954 to the plant of Quebec Iron and Titanium Corporation at Sorel, Quebec, totalled 303,348* tons compared with 125,234 tons in 1953. Shipments from Sorel during 1954 were 122,960 tons of titanium dioxide slag, containing approximately 88,408 tons of titanium dioxide, compared with 1953 shipments of 140,992 tons of titanium dioxide slag, containing 100,527 tons of titanium dioxide. Shipments of ilmenite ore from the St. Urbain area of Quebec totalled 1,541 tons compared with 4,731 tons in 1953.

Titanium research in all fields from ore to metal continued at the Mines Branch, Ottawa. In industry, The Shawinigan Water and Power Company Limited at Shawinigan Falls, Quebec, and Dominion Magnesium Limited at Haley, Ontario, operated pilot plants for the production of titanium metal. Atlas Steels Limited, Welland, Ontario, obtained experience in the rolling of titanium ingots; Thompson Products Limited, St. Catharines, Ontario, did work in the field of titanium forgings; and Canadian Steel Improvements Limited, Etobicoke, Ontario, exhibited interest in the melting and forging of titanium. Vanadium-Alloys Steel Canada Limited made a study of the requirements for a titanium melting and alloying plant.

In the United States, titanium research, commercial sponge production, contract negotiations, and discussion of production targets and metallurgical problems all contributed to keeping titanium in the foreground during 1954. Commercial production and export of titanium sponge took place in Japan. In the United Kingdom, titanium sponge was produced on a pilot-plant scale.

Despite the great interest in the production of titanium metal, about 96 per cent of the total world consumption of titanium-bearing minerals is in the form of titanium dioxide used in the pigment industry. The present consumption of titanium metal is mainly for defence purposes in the aircraft industry; its general use awaits both the development of inexpensive methods of production and improvements in quality.

Ilmenite ($Fe TiO_3$), rutile (TiO_2), and sphene ($Ca Ti SiO_5$ - also called titanite) are the most abundant of the titanium minerals. The principal ores are ilmenite, ilmenite-magnetite, ilmenite-hematite, and rutile. Rutile contains up to 60 per cent titanium and is the more desirable ore, but ilmenite, which may contain 31.6 per cent titanium (52.7 per cent TiO_2), is cheaper and more plentiful. Sphene contains up to 41 per cent TiO_2; it is mined as an ore of titanium in Kola Peninsula, U.S.S.R.

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* Short tons of 2,000 lbs. used throughout, unless otherwise stated.

Production (Shipments) and Trade

	1954		1953	
	Short Tons	$	Short Tons	$
Production				
Ilmenite				
Allard Lake area........	303,348[a]		125,234[b]	
St. Urbain area	1,541	9,462	4,731	31,472
Total	304,889		129,965	
Titanium dioxide concentrate				
Allard Lake ilmenite smelted at Sorel..........	122,960		140,992	
Titanium dioxide content of above................	88,408	3,841,270	100,527	4,206,496
Imports				
Titanium dioxide and pigments containing not less than 14% titanium				
United States.............	22,714	5,747,907	23,970	5,646,914
United Kingdom	9,392	3,381,482	7,930	2,819,931
Total	32,106	9,129,389	31,900	8,466,845

(a) Shipments from Allard Lake to Sorel amounted to 303,348 tons in 1954, 339 tons of this amount were shipped from Sorel to various companies for experimental purposes.
(b) All to Sorel; of this amount, 4,563 tons were shipped from Sorel to other destinations.

Production

Quebec Iron and Titanium Corporation

The Allard Lake ilmenite deposits are located 22 miles north of Havre St. Pierre, a port on the north shore of the Gulf of St. Lawrence, 570 miles northeast of Montreal.

The presence of ilmenite in the Allard Lake area was first reported by J.A. Retty, then of the Quebec Department of Mines, in 1941. The deposits were discovered in 1946 by the prospectors of Kennco Explorations, Limited, and are held by the Quebec Iron and Titanium Corporation, a subsidiary of

Kennecott Copper Corporation (2/3) and New Jersey Zinc Company (1/3), both of the United States of America.

They are probably the largest known deposits of ilmenite in the world, with about 150 million tons of ore averaging about 35 per cent TiO_2 and 40 per cent iron indicated by drilling. The most important orebody is to be found at Lac Tio, where the estimated reserves exceed 125 million tons of ilmenite.

Exploration, carried on by Kennco Exploration from 1943 to 1947, included prospecting, geological mapping, a topographic survey, and an aeromagnetic survey. In October 1948, the newly incorporated Quebec Iron and Titanium Corporation commenced construction of a 27-mile railway to connect Lac Tio with Havre St. Pierre. Construction of wharves and terminal facilities commenced in 1949. In 1950, the railroad and harbour facilities were completed and the first shipments of ore were made to Sorel, Quebec. The railroad runs through 15 miles of rock country and 12 miles of muskeg and swamp. Its construction included a 700-foot tunnel measuring 23 feet by 18 feet; an 880-foot steel bridge across the Romaine River; and a 166-foot bridge across the Puyjalon River.

The shipments during 1950 were from the Grader deposit, located south of the Lac Tio. In 1951, mining operations by open-cut methods were commenced at the main deposit at Lac Tio. During 1951 and 1952, construction of a temporary ore crushing plant at Havre St. Pierre, a permanent primary crushing plant at the mine, and maintenance, warehouse, power, and communication facilities at the terminal area were undertaken. During 1952, an overhead 33,000-volt power line was completed, connecting the power station at Havre St. Pierre to the mine.

At Lac Tio, drilling is done with both Quarrymaster and I-R wagon drills. Benches are about 25 feet high and 25 feet deep. Broken ore and rock are loaded with 1 1/2 yard and 3 1/2 yard power shovels and transported to the crusher house in 22-ton Euclid trucks.

During 1954, production* at the mine at Lac Tio amounted to; ore blasted, 233,154 gross tons; ore crushed, 275,870 gross tons; ore shipped, 271,192 gross tons. In addition 40,233 tons of overburden were removed. The content of the ore is approximately 35 per cent TiO_2 and 40 per cent Fe.

The 11,000 ton ship "Mont Alta", chartered from Montreal Shipping Company, transported the ore from Havre St. Pierre to Sorel, Quebec, 540 miles up river from Havre St. Pierre.

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* Statistics by courtesy of Quebec Iron and Titanium Corporation.

At Sorel, the company has constructed its own docks and unloading equipment and a large electric smelting plant containing 5 special electric ilmenite ore treatment furnaces each designed to treat 300 tons of ore per day. Power is obtained from the La Trenche plant of Shawinigan Water & Power Company on the upper St. Maurice River. The contract is for 160,000 H.P. The company commenced test operations with one furnace in 1950 and since that time it has made continuous studies of the process and the operation of the furnaces.

Production figures for the smelting operation at Sorel during 1954 were: ore treated, 239,410 gross tons; titanium dioxide concentrate (electric smelter slag) produced, 109,786 gross tons; slag shipped, 106,511 gross tons; desulphurized iron produced, 80,859 gross tons; desulphurized iron shipped, 89,740 gross tons; and high-sulphur iron shipped, 3,492 gross tons. The slag contains over 70 per cent TiO_2.

The reduction of output in 1954 reflects a shut-down of two of the five furnaces at the treatment plant. This was not due to any lack of demand for the company's products, but to the necessity of large-scale development work in order to obtain greater operating efficiency and lower production costs. For this reason, at the beginning of 1954, one furnace was placed at the disposal of the plant research and development group in order to permit the investigative work necessary to the solution of the problem. As one direct result of this work, construction of an ore beneficiation plant was started in January of 1955; it is expected to be completed early in 1956. The present level of three-furnace operation will continue during the first quarter of 1955, after which the company plans a four-furnace operation.

Baie St. Paul Titanic Iron Ore Company Limited

From the St. Urbain area of Quebec, this company made shipments of ilmenite totalling 1,202 tons in 1954, compared with 4,731 tons in 1953.

Exploration

Newfoundland and Labrador Corporation Limited conducted investigations in southeast Labrador in an area underlain by anorthosite for possible concentrations of ilmenite or titaniferous magnetite. Dubuisson Mines Limited, which holds a low-grade ilmenite-hematite property in the Allard Lake area of Quebec, had metallurgical research carried out on its titanium-bearing material in an effort to upgrade it and to extract the titanium dioxide by pressure leaching with dilute sulphuric acid. Hollinger (Quebec) Exploration Company Limited holds a group of 74 claims covering a large iron-titanium deposit at Marybelle Lake, Saguenay county, Quebec, approximately 75 miles north of Mingan, Quebec. St. Lawrence Iron and Titanium Mines Ltd. has held a lease during the past four years on the old East and West Coulombe pits and the Old Furnace pits in the St. Urbain area of Quebec; the lease was allowed to lapse early in 1955. Zemke Mining Company Limited holds a block of 32 claims in Lacoste township and in the adjoining unsurveyed area to the west, Charlevoix county, Quebec; in 1954, the possibilities of the ilmenite-hematite property were investigated by the Crane Company and in the spring of 1955 the property was taken under option by Dominion Mines and Quarries, a subsidiary of Union Carbide Canada Limited. Canadian Javelin Limited continued exploration of its property in the townships of Taché and Bourget, Lapointe county, Quebec, included in the company's holdings are the St. Charles titaniferous magnetite deposits, which have been known for many years. No work was done on the Desgrosbois, Quebec, titaniferous magnetite property of Pershing Amalgamated Mines Limited during 1954. Titanium Development Corporation holds an ilmenite property adjoining the old Ivry mine in Quebec. Laurentian Titanium Mines Ltd. continued diamond drilling on its titaniferous magnetite property which is situated in Wexford and Chertsey townships, Terrebonne and Montcalm counties, Quebec; concentration tests, on behalf of the company, have been conducted by the Quebec Department of Mines.

Other Occurrences

Ilmenite and titaniferous magnetite occur in Quebec in a number of places, usually in association with bodies of anorthosite. In the St. Urbain area of Quebec, there are at least five known ilmenite deposits - the Coulombe, Furnace, General Electric, Bignell, and Joseph Bouchard (Glen). The mineral was noted in the St. Urbain area as early as 1666, and there has been a small production from the various properties since 1908. During World War II, production reached substantial proportions to help meet the demand created by the interruption of shipments of Indian ilmenite to the United States. In addition to the areas to which reference has already been made, titaniferous magnetite occurs near the Bay of Seven Islands; in the Natashquan black sands; and in the Chibougamau district. It also occurs in a number of areas in Ontario, the occurrence at Mine Centre being possibly the best known. It occurs at Burmis, Alberta, and near St. Georges, Newfoundland. Titamium-bearing minerals have been reported near White Bay on the northeast corner of Newfoundland, and in the Ramsay Brooke district about 35 miles south of Campbellton, New Brunswick.

World Production*

Titanium Ores and Concentrates

World production of rutile concentrates amounted to about 46,300 metric tons in 1953, of which an estimated 40,000 tons came from Australia. The next largest producer is the United States, with a production of 6,192 metric tons in 1953. In 1954, rutile production and shipments in the United States are estimated at 6,800 and 6,500 short tons, respectively. In Australia, the rutile is mined from beach sand deposits along the east coast. In the United States, it is produced from beach sands along the Atlantic Coast of Florida. Smaller amounts of rutile concentrates originate in French Cameroons, India, and Norway.

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* Statistics: United States Bureau of Mines; MMS No. 2305, July 28, 1954; MMS No. 2353, January 4, 1955.

During 1954, Republic Steel Corporation, Cleveland, Ohio, U.S.A., announced the acquisition of a tract of land 6 miles long and 1 1/2 miles wide at Oaxaco, Mexico, containing a reserve estimated by the company at 25 million tons of rutile. The company reported that the deposit, located about 26 miles from the nearest shipping port, Puerto Angel, was mined in 1954 and the ore stockpiled for concentration. Company plans call for monthly shipments of 2,000 tons of rutile concentrates, averaging 95 per cent titanium dioxide, to the United States in 1955.

World production of ilmenite concentrates in 1953 was estimated at 986,000 metric tons: chief producers were United States, 466,015; India, 263,649; Canada, 132,940; Norway, 90,000; and Malaya, 26,996 metric tons. United States production and shipments in 1954 are estimated at 546,500 and 528,900 short tons, respectively, containing 45 to 66 per cent titanium dioxide; ilmenite included a quantity of mixed product containing altered ilmenite, leucoxene, and rutile. About one-half of the United States production comes from the National Lead Company's mine near Tahawus, New York State, about one-third from beach sand deposits near Starke and Jacksonville in Florida, and the remainder from Virginia and Idaho. India is the next largest producer, the ilmenite being derived principally from black sands in Travancore. Canada possesses one of the world's largest deposits at Allard Lake, Quebec, Norway's output comes principally from deposits south of stavanger. Ilmenite is also produced from black sands in Australia, Malaya, Egypt, Senegal, Portugal, and Spain.

The following table indicates the approximate TiO_2 content of the ores from some of the important producing areas, and the approximate TiO_2 content of the concentrate prepared from them.

Approximate TiO_2 Content of Crude Ore and Concentrates of some of the Important Producing Areas

Producing Area	Mode of Occurrence	Form of Concentrate	Approx. % TiO_2	
			Ore	Conc.
Tahawus, U.S.A.	magnetite-ilmenite (titaniferous magnetite)	ilmenite-concentrate	17	44.7
East coast of Florida, U.S.A.	beach sands	ilmenite-concentrate	1.30	63
		mixed leucoxene, ilmenite and rutile concentrate.		80
Travancore, India	beach sands	ilmenite-concentrate	40-45	59.5
Allard Lake, Canada	ilmenite-hematite	titanium dioxide slag	35	72

Producing Area	Mode of Occurrence	Form of Concentrate	Approx. % TiO_2	
			Ore	Conc.
Sokndal, Norway	magnetite-ilmenite (titaniferous magnetite)	ilmenite-concentrate	17	44
Otanmaki, Finland	magnetite-ilmenite (titaniferous magnetite)	ilmenite-concentrate	12-15	45
West coast of Queensland and New South Wales, Australia	beachsands	rutile	26-37	96
Tisur, Mexico	rutile	rutile	15-20	95

Consumption and Uses

Titanium dioxide (titanium white), the most important compound of titanium, has wide use as a pigment in paints and in the manufacture of ceramics, cosmetics, food products, paper, and rayon. In the United States, for instance about 96 per cent of the total consumption of titanium-bearing minerals is in the pigment industry; 99 per cent of the ilmenite and 99.7 per cent of the titanium dioxide slag consumption is in the pigment industry. A small amount of titanium is used in the iron and steel industry as ferrotitanium and ferrocarbontitanium, to purify and harden steel. The production of titanium metal from titanium dioxide is increasing rapidly, but the amount of titanium dioxide consumed in this manner is very small compared with that consumed in the pigment industry. It should be noted, also that this production is mainly for research and defence purposes and that the general use of titanium metal awaits both the development of an inexpensive method of extracting it from its ores and improvements in the quality of the metal.

Titanium dioxide, in the natural form of rutile, is used commonly as a coating for welding rods; in the United States during 1953, approximately 52 per cent of the total consumption of rutile was used in the preparation of welding rod coatings. Of the total tonnage of welding rods coated in the United States in 1953 it is of interest that 40 per cent was coated with natural rutile; 29 per cent with ilmenite; 20 per cent with manufactured titanium dioxide; 11 per cent with a mixture of rutile and manufactured titanium dioxide; and less than 1 per cent with titanium slag. Crystals of titanium dioxide, made artificially, have a very high index of refraction and are being used for certain purposes in place of diamonds. Small amounts of titanium tetrachloride are used for purifying alloys of aluminum. Titanium carbide is one of the ingredients of "carbide" high-speed cutting tools, usually mixed with tungsten carbide. About

20 per cent of the total consumption of rutile in the United States, during 1953, was used in the production of carbides and alloys.

Because of its high strength-weight ratio, titanium metal has a special application in supersonic aircraft and about three-quarters of present production is going into air compressors for jet aircraft engines. Its qualities make it a desirable material for airframe construction for supersonic planes. It is used also in alloys of stainless and heat-resisting steels. Certain alloys with cobalt and nickel are used as filaments in vacuum tubes.

In Canada, the consumption of titanium metal and alloys is currently limited to prototype aircraft engines and air frames in the basic form of bars, forgings, sheet, and wire. Titanium forged parts such as turbine blades, compressor discs, and spacer rings are used in aircraft engines. Sheet products are used in such applications as fire walls, nascelles, linings, baffles, tailcones, and shrouding. Bar and wire find uses in fasteners, hardware, and welding rod.

The following table shows the consumption of TiO_2 in various forms, and ferrotitanium in Canada during 1952 and 1953, by industries. There is no production in Canada of refined TiO_2 or ferrotitanium, and there is no commercial production of titanium metal.

Consumption of Refined Titanium Dioxide, Rutile, Extended TiO_2 Pigments, and Ferrotitanium in Canada

	1953	1952
	Short Tons	Short Tons
Refined titanium dioxide TiO_2		
Paint industry	10,595	7,878
Polishes and dressings industry	113	103
Pulp and paper industry	1,161	871
Rubber goods industry	533	534
Linoleum industry	1,770	1,911
Misc. non-metallic mineral products	387	241
Toilet preparations industry	3	4
Primary plastics industry	62	35
Misc. chemical products industry		13
Rutile, ilmenite and titanium slag		
Abrasives industry	1,443	70
Estimated TiO_2 content	973	67
Extended TiO_2 pigments		
Paint industry	12,907	12,773
Estimated TiO_2 content	3,901	3,832
Ferrotitanium		
Primary iron and steel industry	213	229

The following table, prepared by U.S. Bureau of Mines, shows the consumption of titanium concentrates (ilmenite, rutile, and titanium dioxide slag) in the United States in 1953, by products. It indicates the relative size and economic importance of the principal titanium-consuming industries.

Consumption of Ilmenite, Rutile, and TiO_2 Slag in the United States in 1953
(short tons)

Product	Ilmenite		Titanium Slag		Rutile	
	Gross Weight	Estimated TiO_2 Content	Gross Weight	Estimated TiO_2 Content	Gross Weight	Estimated TiO_2 Content
Pigments (manufactured titanium dioxide)[a]	684,707	353,354	73,324	52,368	b	b
Welding rod coatings	990	584			10,476	9,812
Alloys and carbides	9,823	4,888			4,000	3,821
Ceramics	5	3			317	295
Miscellaneous	19	11	204[d]	143[d]	5,377[c]	5,105[c]

a. Includes a mixed product containing altered ilmenite, leucoxene, and rutile used to make pigments and metal. "Pigments" include all manufactured titanium dioxide, consumption of which in welding rod coatings was 1,986 tons in 1953.

b. Included in "Miscellaneous", to avoid disclosure of individual company operations.

c. Includes consumption for chemicals, metal, and fibreglass.

d. Includes consumption for welding rod coatings and research purposes.

Tariffs and Prices

Neither Canada nor the United States maintained tariffs on titanium ores during 1954.

The E.&M.J. Metal and Mineral Markets quoted the following nominal prices in the United States, for ilmenite and rutile concentrates in 1954:

Ilmenite: 59.5 per cent TiO_2, f.o.b. Atlantic seaboard, $18 to $20 per gross ton throughout 1954.

Rutile: 94 per cent TiO_2, 5 to 6 cents per lb. at the beginning of 1954, 5 1/2 to 6 cents in May, 5 3/4 to 6 1/4 cents in July; 6 to 6 1/2 cents in August; 6 1/2 to 6 3/4 cents in October; and 6 3/4 to 7 cents from November to the end of 1954.

Canadian prices are largely based on those quoted in E.&M.J. Metal and Mineral Markets.

TUNGSTEN

Shipments of tungsten concentrates continued to come from British Columbia and amounted to 1,000 tons in 1954 or about 18 per cent less than in 1953. This was due to the cessation of operations at the Red Rose mine of Western Tungsten Copper Mines Limited, south of Hazelton. Canadian Exploration Limited, the major producer, continued to carry out the extensive expansion and modernization program it set under way three years ago at its property near Salmo.

Canadian Exploration Limited

In 1954 the company mined 140,480 dry tons of scheelite with an average grade of 0.82 per cent WO_3 from its Emerald, Dodger, and Feeney orebodies and produced 91,852 short-ton units of WO_3. Shipments were made to United States under contract.

Development work at the Emerald and Dodger mines in 1954 disclosed new orebodies at depth in the Emerald mine and considerable tonnages of new ore in the Dodger mine. The capacity of the company's new tungsten mill has been increased to 600 tons per day. An acid leaching plant and a roasting and drying section were installed to upgrade all scheelite concentrates to market specifications at the mill site, thus eliminating freight and treatment charges.

Production, Trade, and Consumption

	1954		1953	
	Short Tons	$	Short Tons	$
Production (shipments)				
WO_3	1,000	3,596,387	1,223	5,689,160
Imports				
Scheelite[(a)]				
United States	4	6,164	-	-
Bolivia	-	-	55	90,467
Thailand	-	-	49	138,432
Southern Rhodesia ..	-	-	12	33,985
Australia	-	-	11	21,766
Total	4	6,164	127	284,650
Ferrotungsten[(b)]				
United Kingdom	31	90,849	9	47,938
Portugal	11	30,957	6	32,753
United States	1	3,615	16	77,551
Total	43	125,421	31	158,242
Exports				
Scheelite (W content)				
United States	612		639	
United Kingdom	-		211	
Other countries.....	7		-	
Total	619		850	
Consumption (W content)				
Scheelite	7		27	
Ferrotungsten	31		40	
Tungsten metal, etc.[(c)]	47		63	
Total	85		130	

(a) WO_3 content not known.
(b) W content not known.
(c) Includes also: tungsten metal powdeı, tungsten carbide powder, tungsten wire, tungsten chemicals.

Western Tungsten Mines Limited

Operations at the Red Rose mine, which the company held under lease from The Consolidated Mining and Smelting Company of Canada Limited, were interrupted by a fire in the upper terminal of the tramline in mid-March and were suspended until mid-June. Production was then resumed until near the end of the year when the company ceased operations because of differences of opinion with the buyer regarding impurities in the concentrate.

Domestic Refinery Production

A plant operated by a division of Kennametal Incorporated at Port Coquitlam, British Columbia, produces tungsten carbide and tungsten powder directly from low-grade tungsten concentrates. No ferrotungsten is made in Canada.

World Mine Production

World mine production is believed to have declined during 1954 because of lower prices and the termination of large purchase contracts. Preliminary data indicate that United States was the largest producer in the Free World during 1954. World mine production of tungsten ores during 1953 totalled 73,000 metric tons of concentrates containing 60 per cent WO_3, of which an estimated 20,000 metric tons came from China, the largest producer. Other relatively large producers were the U.S.S.R., Portugal, Republic of Korea, United States, Bolivia and Australia.

Developments

Burnt Hill Tungsten Mines Limited

The company continued development work at its property at the junction of the Miramichi River and Burnt Hill Creek, York county, New Brunswick.

Consumption and Uses

Tungsten is utilized as scheelite, ferrotungsten, pure metal (powder, wire, rod, sheet), and in various chemical compounds such as the meta-tungstates. The greatest single use of tungsten is in the steel industry, where it is used in the form of scheelite or as ferrotungsten for the production of high-speed steel. The type most widely used, commonly known as the 18-4-1 type, contains 18 per cent tungsten, 4 per cent chromium, and 1 per cent vanadium.

Tungsten carbide is used for tipping tools, such as milling cutters, reamers, punches, and drills; for dies in wire and tube drawing; for wear-resistant parts such as gauges, valve seats, and valve guides; and as cores in armour-piercing shells.

In the non-ferrous or super-alloy field, tungsten is alloyed with cobalt, chromium, nickel, molybdenum, titanium, and columbium in varying amounts to produce a series of hard-facing, heat-resisting, and corrosion-resisting alloys. The main use of the high-temperature alloys is in turbo-jet engines for such parts as nozzle guide vanes, turbine blades, combustion chamber liners, and tail cones. They are also used in heat exchangers, boiler super-heaters, and superchargers.

The pure metal is used in ignition and other contact points in the automotive industry. It is also used for the production of incandescent lamp filaments and certain types of bronze.

Stellite, a non-ferrous alloy containing from 5 to 20 per cent tungsten with chromium and cobalt, is used in the production of welding rods for hard facing and in making high-speed cutting tools.

The commercial applications of chemical compounds of tungsten are numerous, some of the more important being: flame-proofing combustible materials, in the dyeing industry, as catalysts and tanning agents, and in making X-ray screens.

The more important consumers of tungsten in Canada are: Atlas Steels Limited; Canadian General Electric Company Limited; Shawinigan Chemicals Limited; A. C. Wickman (Canada) Limited; Kennametal of Canada Limited; Deloro Smelting and Refining Company Limited; Wheel Trueing Tool Company of Canada Limited; Boyles Bros. Drilling Company Limited; J.K. Smit and Sons of Canada Limited; Johnson, Matthey and Mallory Limited; Canadian Westinghouse Company Limited; and Dominion Colour Corporation Limited.

Atlas Steels Limited, by far the largest consumer, uses approximately 80 per cent of the total in the form of ferrotungsten and scheelite.

Prices

According to E. & M. J. Metal and Mineral Markets, December 30, 1954, United States Prices of tungsten were as follows:

Tungsten ore, per short-ton unit of WO_3, concentrates of known good analysis, basis 65 per cent:

Foreign, c.i.f. U.S. ports, duty extra
Wolfram - \$25.75 to \$26.25
Scheelite - \$28.50 to \$29.00

Domestic, f.o.b. mine
Western high-grade scheelite - \$63
North Carolina high grade - \$63

Tungsten metal
98.8 per cent, minimum 1,000 lb. lots - \$4.40 per lb.
99.9 per cent plus, hydrogen-reduced - \$4.65 per lb.

Ferrotungsten

Per lb. of W contained, 72 to 82 per cent W - $3.80 in lots of 10,000 lbs. or more.

According to the same source, the London market quoted the following nominal prices per long ton unit of WO_3 wolfram - 195 shillings bid and 200 shillings asked.

Tariffs

Canada

	British Preferential	Most Favoured Nation	General
Tungsten ore	free	free	free
Tungsten metal	"	"	"
Tungsten oxide	"	"	5% ad valorem
Ferrotungsten	"	5% ad valorem	5% ad valorem

United States

Tungsten ore and concentrates

On tungsten content - 50¢ per lb.

Tungsten metal, tungsten carbide, and combinations containing tungsten carbide in lumps, grains, or powder.

On tungsten content - 42¢ per lb. plus 25% ad valorem.

URANIUM

Important developments in several parts of Canada combined to make 1954 a most significant year for uranium mining. Figures for production and ore reserves of producing mines may not be published, but it is clear that the output was greater than in any previous year because 1954 was the first in which the plant of the Crown-owned Eldorado Mining and Refining Limited at Beaverlodge in northern Saskatchewan was in operation for a full year. Also for the first time, production at this plant was augmented by ore shipped to it from private properties in the district.

One of the highlights was the large-scale preparation for production at the Gunnar mine in the Beaverlodge area, which is to commence in 1955. Exploration at several other private properties in Saskatchewan showed promising results. In the Blind River region of Ontario, very large tonnages of relatively low-grade uranium ore were indicated by diamond drilling and plans for large-scale production have been completed, with the first plant scheduled for operation late in 1955. Promising results were also obtained in other districts. As a result of these developments, Mr. W.J. Bennett, President of

Atomic Energy of Canada Limited, forecast in a recent address that, by the end of 1957, uranium production in Canada will be more than twelve times as great as at the end of World War II, and that the annual gross income from the production will then be about $100,000,000.

At the end of the year, 300 exploration permits and four mining permits from the Atomic Energy Control Board were in force. However, about half of the holders of exploration permits were inactive or reported only a little work.

Because of the large number of properties explored, few details can be included in this review. Only those properties on which underground exploration was done, or for which immediate plans for underground work were reported, are mentioned by name.

Saskatchewan

Private Porperties. Important advances were made at several privately owned properties, mainly in the region north of Lake Athabasca. The year marked the beginning of private production, in the form of ore trucked to Eldorado's Beaverlodge plant from the Rix-Athabasca and Nesbitt LaBine properties. Ore was also mined at the Consolidated Nicholson property and was shipped to Beaverlodge early in 1955.

Gunnar Mines Limited made good headway in preparing its property for production. The open pit was prepared for mining and construction of a treatment plant with a rated capacity of 1,250 tons a day was well advanced. The building of an airstrip near the mine was completed. The company reported that further drilling had increased the gross estimated value of the deposit to $130,000,000 and that a contract had been arranged for delivery of precipitates to the value of $76,950,000.

Eleven companies did underground exploration on their properties in the region north of Lake Athabasca. They were: Beta Gamma, Black Bay, Cayzor Athabaska, Homer Nu-Age, Lorado, Meta, National Explorations, Nesbitt LaBine (Eagle-Ace group), New Mylamaque, Rix-Athabasca, and Uranium Ridge (Pitche group). Underground exploration was also done on the Jahala Lake property in La Ronge region.

Diamond drilling was done on 50 properties in the region north of Lake Athabasca and on four between Lake Athabasca and La Ronge.

A pilot plant was completed and operated at the Nistowiak property of La Ronge Uranium Mines for further tests of a new process devised by the company with the objective of providing a low-cost means of treating the pegmatitic material found on this and nearby properties.

Eldorado Properties. Deepening of the Fay shaft was begur and at the end of 1954 had reached a depth of 1,800 feet below surface. The 7th level was developed in the Ace orebodies, and work was begun on the 8th level. The openings on the 7th level, and diamond drilling from it, showed the ore to be comparable to that on upper levels, the deepest intersection of pitchblende being 1,050 feet below surface. The 3rd, 4th, 5th, and 7th levels were extended eastward from the Ace shaft to within about 1,800 feet of the Verna shaft. These levels intersected relatively small bodies of ore of better than average grade.

The Verna shaft, 1 1/4 miles east of the Ace, was completed to the 6th level and considerable exploration was done on the 3rd, 4th, 5th, and 6th levels. In addition, an extensive program of diamond drilling was carried out on Eldorado ground and on the adjoining Radiore property for which Eldorado holds an exploration agreement. This work disclosed several fairly flat-lying pitchblende-bearing bodies in a zone of favourable rocks in the hanging-wall of the St. Louis fault. The grade is significant but more exploration is needed to permit correlation of intersections or estimates of the extent and relationships. Drilling from the surface was continued along the St. Louis fault between Verna and Raggs Lakes and was resumed at the Fish Hook Bay property.

Trial stoping was done in the Martin Lake mine and the resulting ore was trucked for treatment at Eldorado's Beaverlodge plant. The additional installations to bring this plant to a capacity of 700 tons a day were completed, the extra capacity being intended entirely for handling custom ore.

Northwest Territories

The production rate at the Eldorado mine at Port Radium was maintained, some uranium being derived from the re-treatment of old tailings. Considerable underground exploration was done, mainly on the Nos. 7 and 8 veins. The No. 2 level was extended under the area of No. 2 shaft and connected by raises to old workings from this shaft.

Apart from the Eldorado mine, the principal activity in Northwest Territories was in Marian River region, northwest of Yellowknife. Several properties that were investigated a few years ago were restaked, much additional staking took place, and several new radioactive occurrences were reported. Diamond drilling was done on two properties. Plans for sinking a shaft on the Rayrock property were announced early in 1955.

Diamond drilling was also done on a property about 40 miles east of Great Bear Lake and on one at Stark Lake near the east arm of Great Slave Lake.

Ontario

The principal activities in Ontario were in the Blind River and Haliburton-Bancroft regions. In the former, about half way between Sudbury and Sault Ste Marie, large tonnages of uranium-bearing conglomerate were outlined by diamond drilling at the Pronto property and at the Quirke Lake and Nordic Lake properties of Algom Uranium Mines Limited. It was reported that Pronto Uranium Mines Limited had outlined an orebody with a gross value of more than $70,000,000 and had negotiated a contract for the sale of precipitates to the value of $55,000,000. By the end of 1954 shaft sinking was completed to the first objective of 600 feet. The building of a treatment plant with a capacity of 1,250 tons a day was well advanced by then.

The orebodies indicated on the Quirke Lake and Nordic Lake properties were reported to have a joint gross value of more than $300,000,000, with the possibility of additional ore at depth in the Quirke Lake deposit suggested by exploratory drilling. Early in 1955 it was announced that financing arrangements had been made and that negotiations were being completed for the sale of concentrates valued at $206,910,000. Plans are being made to erect a 3,000-ton treatment plant at each property and to establish a modern town to serve both properties. A shaft was begun on the Quirke Lake property in 1954.

Several other properties were explored in Blind River region. A shaft was begun at the Buckles Algoma property late in 1954 following an extensive program of diamond drilling which was reported to have indicated 486,500 tons averaging $17.98 a ton. In addition to the above properties, diamond drilling was done on 20 properties in the general Blind River region. These preliminary results as well as certain surface discoveries offer hope that other orebodies will be outlined eventually in the territory north of Lake Huron.

Encouraging results were obtained from the exploration of several pegmatitic deposits in the Haliburton-Bancroft region. Two adits were driven to test occurrences on the Faraday property and in February 1955 it was reported that 205 feet of drifting on one deposit had yielded muck samples averaging 0.454 per cent U_3O_8 (uranium oxide). Underground exploration was continued at the Centre Lake property where two dykes were estimated to contain 2,700 tons per vertical foot, averaging 0.09 per cent U_3O_8. On the adjoining Croft property an adit was driven for further tests of part of a zone explored by diamond drilling. About 1,000 feet of drifting was reported to have shown a length of 613 feet averaging 0.084 per cent U_3O_8 for a width of 10 feet. Late in 1954 plans were reported for sinking a shaft on the Rare Earths property to test a zone estimated to contain 1,100 tons per vertical foot, averaging 0.11 per cent U_3O_8 and 0.06 per cent ThO_2 (thorium oxide). Late in the year underground exploration was resumed at the Cardiff Uranium property, where uranium-fluorite deposits had already been outlined, as reported in other years.

Diamond drilling was done on 16 properties in Haliburton-Bancroft region in 1954.

At the Beaucage property on Newman Island in Lake Nipissing a shaft was begun to permit further testing of a large deposit outlined by diamond drilling. This is mainly of interest for its columbium content, but uranium may be recovered as well.

In the Chapleau region, drilling was continued on magnetite-apatite deposits that also contain columbium, tantalum and uranium.

Diamond drilling was done on one property in Port Arthur area, and surface work at a few properties in Kenora area.

At the Eldorado refinery at Port Hope, extensive installations were made for a new refining process to be in operation in June 1955. This will increase recovery of uranium.

British Columbia

Underground and surface exploration were continued at the Rexspar property near Birch Island, Kamloops Mining Division. The owners reported that the two principal zones were estimated to contain 110,000 tons averaging 2.2 lbs. of U_3O_8 per ton, and 600,000 tons averaging 1.8 lbs. of U_3O_8 per ton.

Considerable staking was done near the head of Boulder Creek, northeast of Atlin, following discovery of radioactive shear zones containing secondary uranium minerals. The discoveries were made late in 1954 in attempting to trace the source of a pitchblende-bearing specimen and active exploration is planned for the 1955 season.

Several radioactive discoveries, including occurrences of pyrochlore, were reported from different parts of the province.

Alberta

A good deal of prospecting and staking was done in the Precambrian region north of the west end of Lake Athabasca. Radioactive occurrences were reported from eight new properties, all being of the general pegmatitic class. Diamond drilling was done at a property near Fort Chipewyan.

Manitoba

Two radioactive discoveries were reported from the vicinity of Tooth Lake in Rice Lake Mining Division. Surface work was done on properties staked in previous years in the region between Winnipeg and Kenora.

Quebec

Prospecting and staking were active in many parts of Quebec, almost entirely within the Grenville sub-province of the Canadian Shield. Several additional discoveries were reported, almost all being of pegmatitic and contact-metasomatic types. Diamond drilling was reported to have been done at 21 properties, mainly in the Maniwaki, Grand Calumet and Oka regions. In the last area, several radioactive occurrences that are mainly of interest for their columbium content were drilled.

A discovery of uraninite in magnetite-rich pegmatitic granite in Bressani township in the southern part of Chibougamau region was explored by diamond drilling. This discovery resulted in the staking of many claims in the vicinity. Opemiska Copper Mines (Quebec) Limited reported that uranium assays had been obtained from a chalcopyrite-magnetite vein on the 3rd level of its producing copper mine in the Chibougamau area.

New Brunswick

An occurrence near Hampton, reported in 1953, was explored by diamond drilling during the winter of 1953-54. This caused considerable prospecting in the province during the summer of 1954, resulting in several discoveries in widely separated localities. Some of these consist of hydrocarbon resembling thucholite, carrying fine-grained pitchblende. An occurrence near Harvey about 25 miles southwest of Fredericton and another near Upsalquitch about 10 miles southwest of Campbellton were explored by diamond drilling.

ZINC

Canada's production of zinc, both refined and in concentrates exported, was less than in 1953. Altogether 373,859 tons valued at $89,277,569 was produced, compared with 401,762 tons valued at $96,101,386 in the previous year. The decrease was largely in British Columbia, where The Consolidated Mining and Smelting Company of Canada Limited (Cominco) reduced its output of refined zinc by about 20 per cent.

Canada's two zinc plants, operated by Cominco at Trail, British Columbia, and Hudson Bay Mining and Smelting Company Limited at Flin Flon, Manitoba, produced about 214,000 tons of refined zinc compared with 250,960 tons in 1953.

Zinc produced from the provinces east of Manitoba was all exported in concentrates to United States or Europe. About half of the zinc concentrates produced by British Columbia mines other than Cominco was exported to the United States, the remainder, and that from United Keno Hill Mines in Yukon were treated at Trail.

The domestic consumption of zinc was 46,735 tons as against 50,718 tons in 1953. In Hamilton, Ontario, both Steel Company of Canada and Dominion Foundries and Steel Company commenced installation of continuous-strip galvanizing lines in 1954.

There was an increased world demand for zinc and the price of Prime Western advanced from 9.5 cents to 11.5 cents a pound during the year.

Widespread exploration was rewarded by important discoveries of zinc-lead deposits in New Brunswick and Yukon. Reserves of zinc ore were greatly increased at a number of undeveloped deposits in Nova Scotia, New Brunswick, Ontario, and the Northwest Territories.

Developments at Producing Mines

British Columbia

Cominco's Sullivan mine at Kimberley has long been Canada's principal source of zinc. In 1954 there were 2,681,635 tons of zinc-lead ore mined compared with 2,643,252 tons in 1953. Much of the ore came from open-pit mining and from pillar extraction in the upper part of the orebody.

At the company's Bluebell mine at Riondell on Kootenay Lake, output was reduced by 75 per cent owing to a three months' strike. Tulsequah Mines Limited, a Cominco subsidiary in northwestern B. C., increased its production following expansion of its mill capacity in 1953 from 300 to 500 tons a day.

Canadian Exploration Limited near Salmo continued to operate its Jersey mine at about 1,000 tons a day, 55 per cent of the mill capacity. Zinc concentrates produced in the last three months of the year were stored on the property.

Sheep Creek Gold Mines Limited completed the construction of a 500-ton mill at its Mineral King mine 26 miles southwest of Athalmer, Lake Windermere district, and began production of zinc and lead concentrates in May 1954.

Sil-van Consolidated Mining and Milling Company Limited discontinued operations in April at its property near Smithers.

Giant Mascot Mines Limited near Spillimacheen enlarged the zinc circuit of its 500-ton lead-zinc mill and resumed production of zinc concentrate, which had been discontinued early in 1953.

Other producers of zinc concentrate included: Britannia Mining and Smelting Company Limited, Howe Sound; Sunshine Lardeau Mines Limited, near Camborne; Violamac Mines Limited and Carnegie Mines Limited, near Sandon; Yale Lead and Zinc Mines Limited, at Ainsworth; and Silver Standard Mines Limited, near Hazelton.

Manitoba and Saskatchewan

Hudson Bay Mining and Smelting Company Limited mined 1,524,441 tons of copper-zinc ore from its Flin Flon mine on the Manitoba-Saskatchewan boundary. At the company's zinc plant, 124,211 tons of concentrates and 43,293 tons of zinc oxide fume were treated to produce 66,922 tons of slab zinc and 48,725 tons of residue; this last is shipped to the company's copper smelter for further treatment. The total zinc production and the amount of Special High Grade zinc made were higher than in any previous year.

The company's Schist Lake mine, 3 1/2 miles southeast of Flin Flon, was brought into production in August. About 53,618 tons of ore averaging 5.23 per cent copper and 7.0 per cent zinc were trucked to Flin Flon for treatment.

Cuprus Mines Limited (a Hudson Bay subsidiary) discontinued operations in August at its copper-zinc property 7 1/2 miles southeast of Flin Flon, as the orebody, from which production began in 1948, was completely mined out.

Production, Trade, and Consumption

	1954		1953	
	Short Tons	$	Short Tons	$
Production, all forms[a]				
British Columbia....	150,336	35,900,097	191,150	45,723,183
Quebec............	105,877	25,283,454	100,430	24,022,766
Saskatchewan & Manitoba...........	66,800	15,951,840	65,731	15,722,852
Newfoundland	30,200	7,211,760	28,002	6,698,029
Yukon	11,548	2,757,725	9,014	2,156,046
Nova Scotia.........	8,503	2,030,559	7,349	1,757,964
Ontario.............	595	142,134	86	20,546
Total.....	373,859	89,277,569	401,762	96,101,386
Production, slab zinc[b]	213,810		250,961	
Exports				
Refined metal				
United States	105,212	21,518,369	107.841	24,747,498
United Kingdom.....	91,127	15,943,953	48,894	9,213,908
India	6,238	1,057,161	-	-
Netherlands	1,624	293,360	-	-
Other countries.....	1,837	375,534	1,653	331,478
Total.....	206,038	39,188,377	158,388	34,292,884
Zinc contained in concentrates				
United States	148,140	16,726,601	168,856	20,334,969
Belgium	14,080	684,555	9,578	750,152
United Kingdom.....	9,007	698,986	4,178	1,138,686
Norway	7,158	584,662	3,170	180,930
France	1,787	144,084	6,874	518,495
Total.....	180,172	18,838,888	192,656	22,923,232
Scrap, dross, and ashes (gross weight)				
Belgium............	3,668	200,654	1,374	68,179
West Germany......	447	60,579	300	36,928
United States	420	54,390	2,181	189,540
Other countries.....	579	49,243	328	60,830
Total.....	5,114	364,866	4,183	355,477

a. Includes only refined zinc produced from Canadian ore and zinc estimated as recoverable from concentrates exported.

b. Virgin slab zinc recovered from domestic ores, foreign ores, and scrap.

Production, Trade and Consumption (Cont'd)

	1954		1953	
	Short Tons	$	Short Tons	$
Exports (cont'd)				
Zinc manufactures				
United States		23,428		34,824
Argentina		19,879		8,737
Malaya		13,253		-
Peru		13,252		13,253
Other countries		7,133		70,189
Total		76,945		127,003
Imports, zinc and zinc products				
Blocks, pigs, bars, and plates		31,538		16,048
Strips, sheets		526,408		587,732
Dust		82,708		104,831
Zinc manufactures, n.o.p.		1,740,685		2,368,677
Slugs or discs		386,829		388,991
Zinc chloride		27,722		29,457
Zinc sulphate		123,535		142,547
Zinc white		262,149		343,820
Lithopone		350,149		474,638
Total		3,531,723		4,456,741

Primary and Secondary Zinc Consumption

(Short Tons)

	1954			1953		
	Primary	Secondary	Total	Primary	Secondary	Total
Electro-galvanizing	474	17	491	531	25	556
Hot-dip galvanizing	23,858	62	23,920	21,445	1,085	22,530
Zinc die-cast alloys	6,696	17	6,713	9,065	101	9,166
Brass and bronze	6,708	70	6,778	9,485	43	9,528
Other alloys	717	54	771	1,667	44	1,711
Rolled and ribbon zinc	942	323	1,265	1,205	453	1,658
Zinc oxide	7,154	-	7,154	7,013	-	7,013
Miscellaneous	186	6	192	307	-	307
Total	46,735	549	47,284	50,718	1,751	52,469

Zinc Production of World on Mine Basis[a]

	1953	1952
	Short Tons	
United States	534,730	666,001
Canada	400,041	371,802
Mexico	220,252	229,078
South America	192,012	195,656
Europe, excluding Russia	553,338	524,806
Asia	109,864	99,606
Africa	256,598	208,494
Australia	223,004	185,557
Russia	233,500	205,000
Total	2,723,339	2,686,000

a American Bureau of Metal Statistics.

Hudson Bay was developing four new copper mines in the Flin Flon area for production: only the Coronation mine, 13 1/2 miles southwest of Flin Flon, is known to contain recoverable amounts of zinc.

Ontario

In May, Jardun Mines Limited began producing lead and zinc concentrates in a new 300-ton mill at its property 18 miles northeast of Sault Ste Marie.

Quebec

Zinc concentrates were produced at mines operated by the following companies. Most of these also produced lead or copper concentrates:

Company	Location of Mine	Type of ore
Anacon Lead Mines Limited	Portneuf county	zinc-lead
Ascot Metals Corporation Limited	Sherbrooke	zinc-lead-copper
Barvue Mines Limited	Abitibi county	zinc
Consolidated Candego Mines Limited	North Gaspé county	lead-zinc
Golden Manitou Mines Limited	Abitibi county	zinc-lead
New Calumet Mines Limited	Pontiac county	zinc-lead
Normetal Mining Corporation Limited	Abitibi county	copper-zinc
Quemont Mining Corporation Limited	Abitibi county	copper-zinc
United Montauban Mines Limited	Portneuf county	zinc-lead
Waite Amulet Mines Limited	Abitibi county	copper-zinc
Weedon Pyrite and Copper Corporation Limited	Wolfe county	copper-zinc

Ascot Metals reported the discovery of a new orebody of higher than previous mine grade at its Suffield property.

Barvue continued to be the largest producer of zinc concentrates in Quebec. The ore was mined by open-pit methods at a rate of about 5,000 tons a day.

Consolidated Candego, which had been in production intermittently since 1948, ceased all operations in October when reserves of developed ore were exhausted.

Shaft deepening at Golden Manitou was completed to 3,000 feet and development began on three new levels.

At New Calumet, No. 4 shaft was deepened to 2,205 feet and five new levels were established between 1,675 feet and 2,175 feet in the Longstreet orebody.

United Montauban, which began production in August 1953, was found to be uneconomic at prevailing metal prices and was closed in February 1954.

At the property of West Macdonald Mines Limited 10 miles north of Noranda, and controlled by Noranda Mines Limited, a zinc-pyrite orebody of some 9 million tons was prepared for production in 1955 at a rate of 1,000 tons a day. The capacity of the Waite Amulet mill is being increased from 1,800 to 2,000 tons a day to provide for the milling of West Macdonald ore. Production at Waite Amulet will be reduced to 1,000 tons a day.

New Brunswick

The 200-ton mill of Keymet Mines Limited at its property 15 miles north of Bathurst was destroyed by fire in April but was later rebuilt and began production of zinc and lead concentrates in October.

Nova Scotia

Mindamar Metals Corporation Limited operated its Stirling zinc-lead-copper mine in southern Cape Breton Island at about 640 tons of ore a day for the production of zinc concentrates and bulk copper-lead concentrates.

Newfoundland

Buchans Mining Company Limited milled 340,000 tons of ore to produce zinc, lead, and copper concentrates. Considerable development was carried out on new orebodies in the Rothermere shaft section of the mine.

Yukon

United Keno Hill Mines Limited, in the Mayo district, deepened the internal shaft 414 feet at its Hector mine and established three new levels.

Some underground development was undertaken at the company's Shamrock mine. Concentrates containing about 11,000 tons of zinc were produced.

Other Developments

Ontario

Near Manitouwadge Lake, 40 miles northeast of Heron Bay, Lake Superior, where a copper-zinc discovery was made in 1953, Geco Mines Limited carried out exploration by drilling which indicated over 14 million tons of ore in three deposits averaging 1.72 per cent copper and 3.55 per cent zinc. A road to the property was completed northward from Hemlo on the Canadian Pacific Railway and the construction of a railway spur was commenced southward from Hillsport on the Canadian National Railways. A program to bring the property into production at a milling rate of 3,300 tons of ore a day was well advanced.

Exploration on several other properties in the Manitouwadge area disclosed interesting copper-zinc occurrences.

Consolidated Sudbury Basin Mines Limited (formerly Ontario Pyrites Company Limited) continued exploration of the large zinc-lead-copper deposits on its Vermilion Lake and Errington mine properties about 15 miles west of Sudbury.

Quebec

Vendome Mines Limited commenced underground development on the former Mogador property near Barraute. A shaft was sunk 550 feet and 3 levels established. An orebody estimated to contain 750,000 tons averaging 7.25 per cent zinc to a depth of 600 feet had been indicated by surface drilling.

New Brunswick

Brunswick Mining and Smelting Corporation constructed a 150-ton pilot mill near its Austin Brook zinc-lead-pyrite deposit 17 miles southwest of Bathurst. An exploration shaft was sunk 400 feet on the company's Anacon deposit of a similar type of ore situated 5 miles north of the Austin Brook and development was commenced on two levels. The development ore will be used to feed the pilot mill. Over 46 million tons averaging 5.25 per cent zinc and 1.84 per cent lead to a depth of 1,000 feet was outlined by drilling on these properties in 1952 and 1953.

New Larder "U" Island Mines Limited began sinking a 1,500-foot shaft to confirm drilling indications of one million tons averaging 8.2 per cent combined zinc and lead on its property 6 miles northeast of the Brunswick Austin Brook property.

In November, The American Metal Company Limited announced the discovery of several extensive zinc-lead-copper-pyrite orebodies on its Little River property 30 miles northwest of Newcastle. The extent of the ore had not been outlined but it was reported to be similar to the Brunswick orebodies with a higher zinc, lead, and silver content.

Nova Scotia

Cape Breton Metals Limited carried out considerable exploration on its mining concession in the northern part of Cape Breton Island where widespread zinc occurrences were disclosed. Near Meat Cove the company began underground exploration of several zinc-bearing zones through driving an adit.

Newfoundland

At the York Harbour mine near Corner Brook, Independent Mining Corporation Limited discovered several new copper-zinc orebodies by exploratory drilling south of the old workings.

Yukon

Prospectors Airways Company Limited carried out a drilling campaign on its Vangorda property 30 miles west of the Canol Road-Pelly River crossing which disclosed extensive flat-lying zinc-lead deposits.

American Smelting and Refining Company completed a drilling program 38 miles north of Watson Lake where over a million tons averaging 15 per cent combined lead and zinc were indicated.

No work was done by Hudson Bay Exploration and Development Company Limited on its zinc-lead deposit on the Canol Road where 10 million tons were previously outlined.

Northwest Territories

Pine Point Mines Limited, controlled by Cominco with Ventures Limited holding a minority interest, continued the exploration of its zinc-lead property near Pine Point, Great Slave Lake, by sinking two prospect shafts to investigate mining conditions and provide ore for bulk sampling tests. The company has made no official announcement regarding reserves but the deposits are known to be relatively flat-lying and very extensive.

Uses

Zinc has a wide range of industrial uses, the more important being in galvanizing, die-casting, and brass products. In 1954, the United States consumed about 876,000 tons and the United Kingdom, the second largest consumer, 324,000 tons.

Zinc is marketed in grades that vary according to the content of impurities such as lead, iron, and cadmium. The principal grades produced are "Special High Grade", chiefly used for die-casting; "Regular High Grade", used for making brass and miscellaneous products; and "Prime Western" for galvanizing. In Canada, zinc is refined by the electrolytic process only, by which most "Special" and "Regular" zinc is produced. To meet consumer requirements for "Prime Western", Canadian producers debase the higher grades by adding lead.

In galvanizing, zinc is applied as a protective coating to iron or steel to prevent rusting. This is done usually by hot-dipping methods, but for some purposes electro-plating is used.

Zinc-base alloys, prepared from "Special High Grade" zinc to which is added 3 to 4 per cent aluminum, up to 3.5 per cent copper, and 0.02 to 0.1 per cent magnesium, are used extensively for die-casting complex shapes, especially automobile parts.

Brass, a copper-zinc alloy containing up to 50 per cent zinc, has many diversified uses in industry and the arts.

Rolled zinc is used principally for making flashlight battery cups, also for articles exposed to corrosion, such as weather stripping, roofing drains, gutters, and as anti-corrosion plates for boilers and ships' hulls. Zinc dust is used to make zinc salts and compounds, in purifying fats, in manufacturing dyes, and to precipitate gold and silver from cyanide solutions. Zinc oxide is used in compounding rubber and in making paint, ceramic materials, inks, matches, and many other commodities. Among the more industrially important compounds of zinc are zinc chloride, zinc sulphate, and lithopone, a mixture of barium sulphate and zinc sulphide used for making paint. In recent years the use of zinc compounds in paints has been increasingly replaced by titanium dioxide.

Prices

The Canadian price of ordinary electrolytic (Regular High Grade) zinc ranged between 10.35 and 12.85 cents a pound during 1954, and Prime Western between 9.50 to 11.50 cents a pound. The average price of Canadian zinc as calculated by the Dominion Bureau of Statistics, was 11.94 cents a pound.

INDUSTRIAL MINERALS

NATURAL ABRASIVES

Natural abrasives are found in all countries, and include all naturally occurring rocks or minerals capable of abrasive action. In order of their hardness the principal natural abrasives are diamond, corundum, emery, and garnet, which are termed 'high grade', and the various forms of silica or silicates that include quartz, quartzite, flint, sandstone, pumice, pumicite, and ground feldspar. Minor abrasive materials include diatomite, the 'soft silicas' (tripoli, microcrystalline silica, and rottenstone), chalk, china clay, and bath brick.

For several years past, except for a small output of grinding pebbles, no natural abrasives have been produced in Canada. Deposits of some abrasive materials have been operated in the past and there are occurrences that might be opened up, or reopened, for future production.

In this review brief notes are given on corundum, emery, garnet, crushed quartz, grindstones, oilstones, pulpstones, pumice, pumicite, and grinding pebbles.

Corundum (Al_2O_3)

Corundum is a crystalline aluminum oxide and is, after diamond, the hardest mineral. Up to the mid-1920's Canada was a major supplier of the world's corundum but, with increased use of artificial abrasives and the operation of higher grade corundum deposits in South Africa, corundum operations in eastern Ontario were suspended. There has been no primary production of corundum in Canada since then. From 1944 to 1946 approximately 2,600 tons of fine concentrate, containing 1,726 tons of corundum, was recovered from the tailings disposal area at Craigmont, northeast of Bancroft in eastern Ontario.

In southeastern Ontario there are three easterly trending corundum-bearing zones in which many small deposits occur. The main, or northern, belt is by far the largest of the three areas and consists predominantly of syenites containing feldspars, nepheline, biotite, hornblende, and pyroxene. This main belt is about 100 miles long with a maximum width of about 6 miles. Practically all of Canada's output of corundum came from the Craig and Burgess mines in this belt.

Ortona Gold Mines Limited, Toronto, formed a subsidiary company - Monteagle Minerals Ltd. - to develop its nepheline-corundum prospect in Monteagle township, about 9 miles northeast of Bancroft. Test work in the Mines Branch laboratories by the company indicates that marketable grades of nepheline syenite, white (muscovite) mica, and corundum can be recovered from the deposit, but no work was done on the project in 1954.

Production and Trade

In 1954, Canada imported 82 tons of fine- and coarse-grain corundum valued at $19,896 compared to 162 tons valued at $43,450, in 1953. Imports originate in the Transvaal, Union of South Africa, and enter the country through the United States.

World production of corundum has ranged from 8,000 to 10,000 tons a year, South Africa and India, in that order, supplying nearly all the requirements. American Abrasive Company, Westfield, Massachusetts, the only dealer in corundum in North America, purchases ore from independent producers in South Africa and ships concentrates to its plant at Westfield for upgrading, sizing, and distribution.

Uses and Prices

When fractured, corundum grains present new sharp cutting edges. This quality makes corundum especially useful for grinding wheels, particularly snagging wheels, which are used for grinding heavy forgings and castings. The finer grades are used extensively in optical work.

Prices of corundum concentrates and graded grain have varied little in recent years. Corundum concentrates, with a preferred minimum content of 90 per cent Al_2O_3, are priced at from $90 to $120 a ton according to the grade and type of corundum present.

Prices of grain corundum vary widely according to size. Some recent quotations were as follows: per pound, in ton lots, grinding wheel grain, 12 1/4 cents delivered: optical grain, sizes 120 and finer, 10 1/2 cents; sizes 140 and finer, 11 1/2 cents; optical powders, size 500 and finer, 31 1/2 cents, all f.o.b.

Emery

True emery is an intimate mixture of corundum and magnetite, with or without hematite and spinel, and varies in hardness and toughness with the relative amounts of corundum and iron oxides present. It is massive, nearly opaque, dark grey to blue-black, and has a reddish tinge if hematite is present. The magnetite is physically inseparable from the corundum, which detracts from the efficiency of emery as an abrasive, but improves its polishing action: this quality is also influenced by the rounded shape of the grains.

Three grades of emery are normally recognized:- Grecian (Naxos) is the hardest and most suitable for emery wheels; Turkish is slightly softer and the grains tend to break down - it is used for emery paper and for grinding glass; American emery is much softer and is used in pastes, compositions, and as a 'nonskid' agent in concrete and asphalt floors. Approximate annual production of emery is about 10,000 tons for the United States and 7,000 to 10,000 tons each for Greece and Turkey.

American first-grade emery ore f.o.b. New York is priced at about $12 a ton. Grain emery from Turkey and Greece is about 10 cents a pound and American grain emery commands about 6 1/2 cents a pound.

Approximately 1,100 tons of emery valued at $100,000 is used annually in Canada for the manufacture of grinding wheels, abrasive sticks, and coated papers.

Garnet

Although garnet is a common constituent of rocks, workable deposits of suitable material are scarce. Small quantities have been produced sporadically in Canada at various times, but there has been no production in recent years.

In 1954 Cubar Uranium Mines Limited, Toronto, acquired the property of Niagara Garnet Co., Ltd., about 20 miles north of Sturgeon Falls, Ontario, and announced it planned on producing garnet from the deposit.

Practically all the garnet used in making abrasive paper and cloth--the principal use-- comes from deposits near North Creek, New York, owned by Barton Mines Corporation. Garnet from this deposit has the valuable property of breaking into thin, sharp-edged plates rather than wearing down into rounded grains. Production is in the neighbourhood of 7,000 to 9,000 tons a year.

Production of garnet from alluvial sands in Idaho was started a few years ago, and from 2,000 to 6,000 tons have been produced annually for use in sandblasting of forgings and castings.

About 400 tons of graded garnet grain is used annually by the three Canadian manufactures of abrasive papers. No garnet is at present used in Canada for sandblasting purposes.

Prices of various garnet products have remained steady for some years. Ungraded garnet grain for 'sandpaper' manufacture sells for about $90 per ton, f.o.b. New York state. Prices of graded garnet grain range from $110 to $160 per short ton and those of superfine (or flour) grades in the 5 to 10 micron size used for lens grinding may reach $200 per ton.

Crushed Quartz, Quartzite, and Sandstone

Crushed and sized quartz or quartzite is used for the abrasive coating on the cheapest of coated papers - 'flintpapers' or 'sandpapers'. These are used primarily for working with soft woods as opposed to the more expensive garnet papers that are used for finishing of hard woods. Canadian requirements of graded silica are imported from the United States.

Silica sand from sandstone and beach sands is used extensively for sandblasting, metal spraying, initial grinding or surfacing of plate glass, and cutting stone with gang-saws. Most of the sand for these uses is imported from the United States but some small foundries make use of local deposits of beach sand.

Grindstones, Oilstones, Pulpstones, etc.

Suitable materials for these stones occur in certain sandstone beds in Nova Scotia, New Brunswick, and on the coast of British Columbia. Many years ago, production from these sources was considerable, but has now almost ceased, owing chiefly to competition by artificial abrasives.

Natural grindstones imported from the United States in 1954 amounted to 166 tons valued at $13,306 compared to 312 tons valued at $22,054 in 1953. Whetstones, sticks, files, and blocks of natural abrasives weighing 11 short tons and valued at $10,166 were imported from the United States in 1954 compared with 30 tons valued at $31,459 in 1953.

Pumice and Pumicite

Pumice is a highly cellular material that has been ejected during a volcanic eruption. It is an aluminum silicate that carries minor amounts of calcium, magnesium, and iron oxides and has a composition close to that of normal rhyolites. Pumice is used mainly as a lightweight concrete aggregate and is imported into the Vancouver area from nearby Washington and Oregon for the manufacture of lightweight concrete blocks, slabs, etc. Pumice costs from $6 to $8 a ton in the Vancouver area.

Pumicite, also called volcanic dust and ground pumice, is a natural glass thrown into the air during volcanic eruption to settle ultimately in beds that may be hundreds of miles from its source. Of white to yellowish to grayish colour, it occurs as finely divided powder composed of small, sharp, angular fragments of volcanic glass. It has the same origin and composition as pumice. The most important use for pumicite is in making scouring compounds and cleansers. It is used in hand soaps, and sometimes as a carrier for insecticides; its use as an extender in concrete is increasing.

Widespread deposits of pumicite occur in Saskatchewan, Alberta, and British Columbia, but owing to thinness of beds and distance from, or lack of, markets there has been no production for many years. Small operations to supply local markets for cleaners, etc , have been opened from time to time but nothing of a permanent nature has resulted. Pumice occurs over a wide-spread area in the Bridge River District of British Columbia to a depth of about one foot just under the grass roots.

Imports of pumice, pumicite, volvanic dust, lava, and calcareous tufa are grouped in import statistics and amounted to $163,028 in 1954 compared with $165,709 in 1953. Throughout 1954, according to E M & J Metal and Mineral Markets pumice-stone, per pound, f.o.b. New York or Chicago remained at 6 to 8 cents per pound for lump, and 3 to 5 cents per pound for powdered (pumicite, or volvanic dust).

Grinding Pebbles

Hard, tough, rounded pebbles, usually of flint or quartz, are used in cylindrical or conical mills for the grinding of ores, minerals, and clays where iron contamination from the usual steel grinding balls would be detrimental.

Production of grinding pebbles in Canada has for many years been confined to Alberta, where W. May of Elkwater ships pebbles from field deposits in the Cypress hills area, which extends eastward from Medicine Hat into Saskatchewan. Production has also been occasionally reported in past years from several other localities in Canada.

LIGHTWEIGHT AGGREGATES

History and Development

Industrial cinders have been utilized for many years as a lightweight concrete aggregate, but in Canada the supply has been diminishing because many industries have been using pulverized coal, oil, and gas as fuel in place of lump coal. Pumice, a naturally occurring lightweight aggregate, has not been found in sufficient quantities in Canada. Consequently, some kind of manufactured material has been required to meet increasing demand. The first such aggregate was produced in 1927, with shale as the raw material. This was the only production of lightweight aggregate until imported raw vermiculite entered the field in 1938. Expansion of the industry became more rapid following the war when foamed, blast-furnace slag and aggregate from imported perlite were first produced. By the end of 1954 there were 20 plants producing lightweight aggregates.

The following table shows the production and consumption of lightweight aggregates in Canada in 1954:

Aggregate	Quantity	Value
Clay and shale	130,000^e cubic yards	$ 900,000
Foamed slag.............	113,600 cubic yards	246,000
Pumice*	9,000^e cubic yards	56,300
Perlite*	1,950,000^e cubic feet	585,000^e
Vermiculite*.............		1,500,000^e
	Total	$3,287,300

* Raw materials imported mainly from U.S.A.

e Estimated.

Types of Lightweight Aggregate

The lightweight aggregates consumed in this country can be classified into two types. The first includes bloated clays and shales and foamed slag; the second includes vermiculite and perlite. Clay, shale and foamed-slag aggregates, as well as pumice which is imported, possess sufficient compressive strength to be used in load-bearing concrete. Vermiculite and perlite aggregates do not possess high strength, but because of their extremely low density (5 to 12 pounds per cubic foot) impart good acoustical and thermal insulation to concrete or plaster.

Raw Materials

Clays and shales are the most wide-spread of the raw materials being used in the production of lightweight aggregate. The types of these materials used are the "common" clays and shales such as are used in making brick and tile. They are usually fairly high in iron content and have a comparatively low fusion temperature. A large number of shales have been found suitable. In Ontario, shale of the Lorraine formation, and in Alberta, a shale of the Belly River formation and a surface clay are being used in the production of lightweight aggregate. Suitable clays and shales have been found in all provinces but Newfoundland. Test work on these materials has been published in a series of reports available from the Mines Branch in Ottawa.

Foamed slag is produced in two plants from blast-furnace slag which is a by-product of the steel industry. It is processed in the molten state as it comes from the blast furnace, thus its production is limited to the areas in the vicinity of steel plants.

Pumice, a highly vesicular volcanic material, has been found only in very limited quantities in Canada. The main source of this material for consumption in Canada is the western United States. A small quantity was also imported from Italy in 1954.

Vermiculite is a type of mica which exfoliates when heated to form a highly cellular material possessing good insulating qualities. As no deposits of sufficiently high quality have been found in Canada, ore is imported and expanded for domestic consumption. The majority of imports come from the United States where the main sources are Montana, North and South Carolina, Wyoming, Colorado and Georgia. Some vermiculite is also imported from the Transvaal, Africa.

Perlite is a glassy, volcanic material which "pops" when heated, giving a white cellular product very low in weight. Deposits of this material have been found in central British Columbia but had not been utilized commercially by the end of 1954. California and New Mexico are the main sources of ore imported into Canada.

Lightweight Aggregate Plants in Canada

Company	Location	Aggregate
The Cooksville Co., Ltd.	Cooksville, Ont.	Expanded shale
Light Weight Aggregates of Canada, Ltd.	Calgary, Alta.	" "
Renn Expanded Aggregates, Ltd.	Calgary, Alta.	" "
Literock, Ltd.	Edmonton, Alta.	Expanded clay
National Slag, Ltd.	Hamilton, Ont.	Foamed slag
Dominion Steel and Coal Corp.	Sydney, N.S.	" "
Perlite Industries Reg'd.	Ville St. Pierre, P.Q.	Perlite
Canadian Perlite Corp.	Montreal, P.Q.	"
Montreal Perlite Industries	Montreal, P.Q.	"
Gypsum, Lime and Alabastine (Canada), Ltd.	Caledonia, Ont.	"
Western Perlite Co., Ltd.	Calgary, Alta.	"
Perlite Products, Ltd.	Winnipeg, Ma.	"
F. Hyde and Co., Ltd.	Montreal, P.Q.	Vermiculite
F. Hyde (Ontario), Ltd.	Toronto, Ont.	"
Insulation Industries (Manitoba), Ltd.	Winnipeg, Man.	"
Insulation Industries (Calgary), Ltd.	Calgary, Alta.	"
Insulation Industries (B.C.), Ltd.	Vancouver, B.C.	"
Siscoe Vermiculite Mines, Ltd.	Cornwall and Rexdale, Ont.	"
Vermiculite Insulation, Ltd.	St. Laurent, P.Q.	"

Production Methods

Lightweight aggregate can be produced from clay or shale by two methods - the rotary kiln or sintering processes.

The rotary kiln process is similar to that used in the cement industry. If shale is the raw material, it is usually crushed to size prior to being fed into the kiln, counter-current to the heat flow. The maximum temperature utilized is usually within the range 1900^{o} to $2100^{o}F$. The discharge from the kiln is as separate particles or, if these agglomerate during the firing, as clinkers. The type of raw material and the temperature are the governing factors as to the type of product. If the charge agglomerates it must be crushed to give the desired size of aggregate. If the aggregate is discharged from the kiln as individual particles some crushing is necessary.

If a clay is the raw material, it will probably require pelletizing before firing, this being necessary since most clays are not sufficiently compact to retain the feed size desired. The pelletizing can be done by means of a horizontal drum pelletizer, an extrusion machine, or any apparatus where the clay can be mixed with a small amount of water and formed into small pellets.

The sintering process is not being used in Canada in the production of aggregate, but there are several plants in the United States which use it. This process has been adapted from the iron and steel industry, where ore fines are sintered to form lumps large enough to be processed in a blast furnace. In the production of sintered aggregates, the clay or shale is crushed fairly fine, mixed with about 5 to 10 per cent coal or coke and pelletized. The sintering machine may be of the travelling grate or rotating hearth types. The travelling grate machine is an endless chain of grates, whereas the rotating hearth machine is a circular hearth divided into pie-shaped segments. The hearth rotates in a horizontal direction. In both machines the charge of pelletized material is ignited at the surface and as it moves through the cycle an induced draft draws the ignition zone down through the charge. The fuel in the charge is sufficient to heat the material to the bloating temperature. The resulting product is discharged as a sintered cake which is crushed to the desired aggregate size.

Foamed slag is produced from the slag as it is flushed from the blast furnace or from slag ladles in the molten state. One method of foaming the slag is to run it into a shallow concrete pit where a controlled quantity of water is introduced. The water causes the slag to froth and when it cools a vesicular material results. Several machines have been developed to introduce water, steam, and air into a stream of slag, which creates a frothing or foaming condition. When the foamed slag cools it is crushed to the desired size.

Perlite is a type of volcanic rock composed of small spheroids. It contains 3 to 4 per cent water, and it is this combined water which gives perlite its peculiar "popping" characteristic when heated. Upon heating to the softening point it will expand from 4 to 20 times its original volume. Firing is generally done in horizontal kilns (stationary or rotary) or stationary vertical kilns at temperatures varying from 1600° to 2300°F. The ore is crushed and screened to size at the mine site and is received at the expanding plant ready for the popping process.

Vermiculite, which is similar in appearance to mica, contains water which may vary from about 6 to over 20 per cent. The process of exfoliation is due to the evaporation of this water when the ore is heated rapidly to temperatures between 1600° and 2000°F. The expansion, accordian-like, may be as high as 20 times the original volume. Many types of expanding furnaces have been used, but the vertical kiln, containing baffles to retard the descent of the material, is most common. The furnaces are usually gas or oil-fired.

Properties and Uses

The main use of expanded shale, clay, foamed slag, and pumice is as aggregate for lightweight concrete. All these aggregates possess sufficient compressive strength for use in load-bearing concrete. The largest consumer is the block industry. The remainder is consumed in precast slabs, beams, etc. By using these aggregates in concrete, reductions in dead loads amounting to better than 30 per cent are realized, compared with conventional concrete. Accoustical and thermal conductivity are also reduced.

Vermiculite and perlite in the expanded state have bulk densities ranging from about 5 to 12 pounds per cubic foot depending on the size. This quality along with low thermal conductivity adapt them for thermal insulation. The main use of vermiculite is as loose and plastic insulation. Other uses include concrete roof and floor decks, insulating bricks, soil conditioner, carrier for insecticides, acoustic plaster, etc. Perlite is well adapted for plaster aggregate owing to its whiteness, and in this field it finds its greatest use. It is also used extensively in concrete roofing and flooring, and as pipe insulation, either loose or in plaster.

Prices

The prices of lightweight aggregates are not uniform throughout the country. Clay and shale aggregates sell at $5.00 to $7.50 per cubic yard. The selling price of foamed slag is within the range of $2.00 to $3.00 per cubic yard. Pumice is imported from the United States at a price of approximately $6.25 per cubic yard. Perlite has a selling price varying from 25 to 40 cents per cubic foot, and vermiculite sells within the range of 30 to 40 cents per cubic foot. Both perlite and vermiculite are marketed in bags of 4 cubic feet.

ASBESTOS

During 1954 asbestos production in Canada continued at the high level experienced in recent years, increasing slightly in tonnage from 1953. To supply world-wide demand for the mineral 926,883 short tons valued at $83,079,931 were shipped compared with 911,226 short tons at $86,052,895 for the previous year. The lower value of shipments is a reflection of changes in the demand for certain grades. The decreased activity experienced in 1953 by the United States asbestos textile industry continued into 1954, and was reflected by lower shipments of spinning-grade fibre. Shorter grades however continued generally in strong demand owing, in part, to increased production in the automotive industry and in the asbestos-cement building materials industry.

Canada, the leading producer, accounts for more than 62 per cent of the world's supply of commercial asbestos. Other important producers are Russia, Southern Rhodesia, Union of South Africa, and United States.

Asbestos is mined in three Canadian provinces, British Columbia Ontario and Quebec. The Eastern Townships of Quebec ship more than 95 per cent of the Canadian production. The expansion and modernization program undertaken in recent years by the industry continued; two mills of modern design commenced production and a third unit was approaching completion at the year's end. The combined capacity of the three mills represents approximately 50 per cent of present Canadian asbestos milling capacity.

Considerable progress was achieved in relocating the railway and highway at Thetford mines, with a view to adding to ore reserves. This is being carried out by Relocations Limited, a joint subsidiary of the three companies concerned.

New occurrences of asbestos were reported in Quebec and Yukon.

Production and Trade

	1954		1953	
	Short Tons	$	Short Tons	$
Production (shipments)				
Crude			781	837,623
Milled fibres			326,340	56,226,083
Shorts and refuse			584,105	28,989,189
Total	926,883*	83,079,931*	911,226	86,052,895
Exports				
Crude				
United States	304	254,228	289	273,814
France	93	92,650	54	54,610
United Kingdom	72	86,080	206	321,459
Others	172	145,422	89	69,700
Total	641	578,380	638	719,583
Milled fibres				
United States	150,816	24,689,159	168,713	28,062,395
United Kingdom	25,058	5,153,004	19,403	4,444,483
France	20,054	3,823,540	17,130	3,306,855
Australia	19,535	3,206,323	15,629	2,436,030
West Germany	15,568	2,803,952	11,775	2,036,530
Japan	12,162	1,855,626	11,829	1,856,836
Brazil	12,078	2,075,254	7,084	1,300,588
Belgium	11,062	2,010,244	15,394	2,751,854
Others	46,511	8,258,551	49,631	8,987,315
Total	312,844	53,875,653	316,588	55,182,886
Shorts				
United States	482,666	22,929,217	474,808	22,829,483
United Kingdom	33,613	1,336,130	32,313	1,322,763
West Germany	19,756	1,241,038	11,695	782,213
France	7,314	449,330	7,864	533,717
Belgium	5,880	396,545	9,201	634,785
Others	25,014	1,760,196	25,423	1,966,733
Total	574,243	28,112,456	561,304	28,069,694
Manufactures				
United States		856,618		286,118
Colombia		62,710		19,533
Mexico		44,008		59,737
Cuba		36,941		19,101
Union of South Africa		35,391		10,956
Ecuador		34,436		25,642
Others		232,270		164,154
Total		1,302,374		585,241

* Estimated

Canadian Johns-Manville Company operates the Jeffrey mine, the world's largest asbestos mine, at Asbestos, near Danville; 75 per cent of current production is by underground mining using the block-caving method. In September, the company placed in operation the first unit of a new recovery mill. On completion in 1956, this will have a capacity of 14,000 tons of asbestos rock daily, or an annual capacity of 625,000 tons of asbestos fibre.

Asbestos Corporation Limited is completing a 5,000-ton mill at its Normandie property in Ireland township where an orebody has been developed; production by open-pit method is expected early in 1955. The company also operates the underground King mine at Thetford Mines, and the following open pits: the Beaver at Thetford Mines; the British Canadian at Black Lake; and the Vimy in Ireland township.

Johnson's Company Limited, the oldest in the industry, has an underground mine at Thetford Mines. Its associate, Johnson's Asbestos Company, produces the mineral from an open pit at Black Lake, where a 4,000-ton mill was placed in operation in July.

The underground mine of Bell Asbestos Mines Limited is located at Thetford Mines.

Open pits are worked by Flintkote Mines Limited a few miles east of Thetford Mines; by Nicolet Asbestos Mines Limited at St. Remi de Tingwick; and by Quebec Asbestos Corporation Limited at East Broughton. The last-named company is developing a major orebody recently discovered east of its present mine; it is planned to complete a 2,000-ton mill which should be in production late in 1956.

Lake Asbestos of Quebec Limited is proceeding to drain Black Lake and build a 4,000-ton mill. The property is expected to be in production late in 1957 or early 1958.

Ontario

Canadian Johns-Manville operates an open pit in Munro township, east of Matheson, northern Ontario. The fibre is particularly suited to the manufacture of asbestos-cement products. Sinking of a shaft to develop an underground orebody is proceeding.

British Columbia

Cassiar Asbestos Corporation Limited recovers long-fibred asbestos from a deposit on McDame Mountain in northern British Columbia. The fibre is shipped over the Alaska Highway to Whitehorse, from there on the White Pass and Yukon Railway to Skagway, thence by boat to Vancouver. During the year the mill was enlarged and construction of an aerial tramway to transport the asbestos rock from mine to mill was begun.

	1954		1953	
	Short Tons	$	Short Tons	$
Imports				
Manufactures				
Packing		243,769		305,455
Auto Brake Linings ...		271,723		297,460
Auto Clutch Facings ..		259,560		270,123
Brake Lining and Clutch Facings N.O.P......		127,818		89,263
Miscellaneous........		2,636,262		2,347,874
Total		3,539,132		3,310,175

Occurrences

Although there are several commercial varities of asbestos, Canadian production is entirely chrysotile. There are no known commercial deposits of amosite or crocidolite. An occurrence of the latter, however, has been reported in the iron ore region near the Labrador-Quebec boundary. The area is being explored by one of the companies to discover if a commercial deposit exists. Fibrous tremolite, actinolite, and anthophylite occur in various places. The fibres of these are usually weak and unsuitable for the manufacture of textiles; however, their chemical nature and physical characteristics are such that they are useful for filtration and other special purposes. A small production of tremolite was reported from eastern Ontario during the recent war. Apart from the producing areas, chrysotile occurs elsewhere in Quebec, Ontario, and British Columbia, and has been reported in Newfoundland, Manitoba, and Saskatchewan. Of recent interest is a new occurrence reported from the Big Salmon Lake area of Yukon.

Chrysotile generally occurs in two forms, a "cross fibre" and a "slip fibre". In the former type, the individual fibres lie across the vein in a parallel manner, and the vein width indicates the fibre length. Although fibres as long as five inches occur, most of the production is from fibres one-half inch or less in length. Slip fibre is usually deposited along fault planes and the fibres lie in an over-lapping manner. Much of the production from the East Broughton area is of this type.

Production in the Eastern Townships has been continuous since 1878. The persistence of the mineral at depth, as established by drilling, indicates that reserves will be sufficient for many years.

Production and Developments

Quebec

There are eleven producing mines operated by eight companies in Richmond, Megantic, Athabaska, and Beauce counties. Production centres about Thetford Mines, Black Lake, East Broughton, and Asbestos.

World Review

Canada supplies nearly 62 per cent of a world production exceeding 1,500,000 tons a year. The second largest producer is Russia. Swaziland, the Union of South Africa, Southern Rhodesia, and the United States are other countries whose production is significant. In South Africa, amosite and much of the world's production of crocidolite are produced. During 1954, Rhodesian Asbestos Limited completed a new processing plant. Production of chrysotile in the United States is confined to Arizona and Vermont.

Uses and Prices

Asbestos is an important industrial raw material and a world-wide trade has developed in Canadian asbestos. The longer-fibred grades can be spun like organic fibres, and are woven into textiles, packing, and certain insulating materials and heat-resisting friction materials. Shorter fibres are used in the asbestos-cement industry for the manufacture of pipe, shingle, tile, millboard, siding and other building materials. The very short varieties have physical characteristics of use in the manufacture of protective coatings, plastics, lubricants, and other specialized processes.

The automobile industry uses a large quantity of asbestos products, including woven and moulded brake linings, clutch facings, and pressure gaskets. Undercoating compounds are an important use for very short grades of fibre.

The ability of asbestos cement products to resist corrosion has resulted in rather wide application of asbestos pipe in the installation of water and sewage distribution systems.

During 1954, the prices of Canadian fibre remained unchanged. According to E. & M.J. Metal and Mineral markets bulletin of December 2, 1954, the United States prices per short ton were:

		$
Crude No. 1	-	960 to 1,500
Crude No. 2	-	595 to 900
Spinning fibres		
3F	-	514
3K	-	436
3R	-	371
3T	-	348
3Z	-	321
Shingle stock	-	150 to 200
Paper stock	-	109 to 137
Waste	-	77
Shorts	-	35 to 70

Per short ton, f.o.b. Vancouver, U.S. funds:

Spinning fibre (3K)	-	460
Shingle fibre (4K)	-	185

BARITE

Mine shipments of barite in 1954 amounted to 221,472 tons, a slight decline from the record shipments of 247,227 in 1953. As in previous years the large deposit of barite at Walton, Nova Scotia, provided most of the output. The only other producing properties in Canada are located at Parson and Brisco in the Columbia Valley, British Columbia.

Over 90 per cent of production was exported, mainly to the United States. Other export markets included Barbados, Venezuela, and Saudi Arabia.

Production, Trade, and Consumption of Barite, 1953 and 1954

	1954		1953	
	Short Tons	$	Short Tons	$
Production (mine shipments)				
Crude	163,497	1,158,833	196,199	1,487,557
Ground	57,975	844,963	51,028	732,735
Total	221,472	2,003,796	247,227	2,220,292
Imports (ground)				
From: United States	827	29,751	830	30,432
West Germany	376	8,616	341	8,106
Italy	33	897	33	867
United Kingdom	-	-	3	738
Total	1,236	39,264	1,207	40,143
Exports (crude)*				
To: United States	178,880	1,233,894	204,362	1,652,076
Consumption				
Paints	1,200		1,051	
Rubber goods	437		513	
Glass	238		209	
Oil-well drilling	2,000 (e)		2,000 (e)	
Miscellaneous	279		254	
Total	4,154		4,027	

* Not reported separately in the official Canadian Trade Statistics. The figures shown here are reported in United States Import Statistics.

e Estimated.

Domestic Producers

Nova Scotia

Canadian Industrial Minerals Limited, wholly owned subsidiary of Baryman Company Limited, produces barite from one of the world's largest deposits at Walton on the Bay of Fundy, Hants county. The barite occurs as a massive body associated with folding and faulting in the limestones, shales, and sandstones of Mississippian age. The barite is highly stained to a reddish-brown by iron oxides. The ore is mined from a large quarry and trucked less than 5 miles to the mill and wharf. No beneficiation of the ore is required other than crushing and washing. Some of it is further ground dry to minus 325 mesh for use in oil-well drilling muds. All production is shipped by boat directly from Walton. The company places reserves at 2,705,970 long tons.

Hitherto all production has come from the quarry although some underground development has taken place. The quarry has now reached a depth where underground operations are being considered by the company.

British Columbia

Mountain Minerals Limited with grinding plant at Lethbridge, Alberta, operates two properties at Parson and Brisco. Some underground development was carried out at Parson during the year to increase reserves of high-grade white barite. However, most of the production came from the quarry near Brisco. The plant at Lethbridge produces ground barite mainly for use in well drilling muds, although minor quantities are marketed for other uses in nearby localities.

Other Occurrences

The witherite (barium carbonate) deposit in northern British Columbia at Liard River crossing was further investigated during the year by stripping, and substantial tonnages of ore have been indicated. The deposit occurs as a flat-lying vein at a contact between Devonian shales and limestones. The vein, up to 20 feet in thickness, is composed of an intimate mixture of witherite, fluorite, quartz, and barite. The Conwest Exploration Company, Limited which had the property under option has now acquired it outright.

Two barite properties were also under investigation during the year; one on McKellar Island, 25 miles from Port Arthur in Lake Superior, and the other in the Lake Ainslie district of Nova Scotia. In the Lake Ainslie occurrences, fluorspar is also an important constituent of the ore and the developing company hopes to produce both barite and fluorspar as co-products.

In addition, numerous other occurrences of barite are widely distributed throughout Canada, mainly in Nova Scotia, Quebec, Ontario, Manitoba, and British Columbia.

World Sources

Total world production of barite in 1954 has been estimated at slightly less than two million tons. The United States, by far the largest producer, accounted for about 50 per cent of this production. Other major producers in addition to Canada are West Germany, United Kingdom, Italy, Yugoslavia, France, and Greece.

Uses and Specifications

The principal use of barite is in oil-well drilling muds with bentonite and other minor conditioning agents. In the United States, which consumes more than half the world's total production of barite, over 65 per cent of total consumption is used in drilling muds. Barite is used also as a pigment and filler in paints, rubber, linoleum, and papers; in the manufacture of barium chemicals; as an additive to glass batches; as an aggregate in concrete where additional weight is required such as in coatings for underwater pipes, or where shielding is required against radiation such as in X-ray rooms or atomic energy plants.

Titanium dioxide has continued to supplant lithopone (70% $BaSO_4$, 30% ZnS) as a white pigment in paints and enamels. This has greatly decreased the market for barite for this purpose, although some white barite is now used together with titanium dioxide.

Specifications for barite vary widely, depending on use and on agreement between producer and consumer.

In drilling muds, which are used to combat high pressures of gas and water in wells and to float drill cuttings, the specific gravity and grain size of the barite are important factors. The usual specifications require a minimum specific gravity of 4.2, and a grind of 98 per cent minus 325 mesh. A minimum of 90 per cent $BaSO_4$ is also usually demanded. Soluble salts are objectionable because of their flocculating tendencies.

The chemical trade demands a minimum of 95.0 per cent $BaSO_4$, with the Fe_2O_3 content not in excess of 1.75 per cent. The material is required in lump form, and colour is not important.

As a filler for paints, rubber, paper, etc., an almost pure white colour is essential, and usually a grind of 200 mesh or finer is required. A minimum of 95 per cent $BaSO_4$ is specified.

For the glass trade, barite serves as a fluxing agent, deoxidizer, and decolourizer. For this purpose a minimum of 98 per cent $BaSO_4$ may be specified, and a very low iron content, about 0.20 per cent or less. Grain sizes up to 20 mesh are required with a minimum of minus 200 mesh.

Barium Compounds

Barium compounds are used widely in industry. Barium carbonate is used to reduce "dry house" scum on bricks; in pharmaceuticals; as a flux in the enamelling and ceramic trades; and in heat-treatment compounds. The chloride is used as a pigment in lithographic inks; in the purification of salt brine and in water treatment; as a mordant in dyeing textiles; and in many other applications. Other compounds include the hydrate, phosphate, oxide, sulphide, stearate and chlorate.

Imports and Consumption of Barium Compounds in Canada

	1954		1953	
	Short Tons	$	Short Tons	$
Lithopone (70% $BaSO_4$)				
From: United States	1,411	209,610	2,158	324,710
United Kingdom	910	114,012	1,076	137,465
Other countries	229	26,527	114	12,433
Total	2,541	350,149	3,348	474,638
Blanc fixe (precipitated) $BaSO_4$				
From: United States	123	12,973	33	3,758
West Germany	102	7,635	184	11,475
United Kingdom	61	11,528	6	1,101
Belgium	26	1,891	39	2,628
Other countries	-	-	-	-
Total	312	34,027	262	18,962
	1953		1952	
	Pounds		Pounds	
Consumption of the main barium compounds in the chemical and allied products industries				
Barium chloride	473,037		348,401	
Barium nitrate	197,792		111,065	
Barytes (barite)	2,672,802		2,436,167	
Blanc fixe	494,611		462,726	
Lithopone	6,120,315		6,441,377	

Prices and Tariffs

No published quotations on barite, crude or ground, are availabe in Canada.

Quotations in United States trade journals at the end of the year were as follows:

Georgia, f.o.b. mines
Crude, jig, and lumps - $15.00 per net ton
Beneficiated - $17.00 to $19.00 per net ton in bulk;
$21.50 in bags

Missouri
Water-ground, floated, and bleached - $41.35 per ton, car lots, f.o.b. works
Crude ore - minimum 94% $BaSO_4$, or less than 1% iron - $13.25 per ton

Canada
Crude, in bulk, f.o.b. shipping point - $11.00 per long ton
Ground, in bags - $16.50 per short ton

Tariffs

Canada	
British preferential	- free
Most favoured nation	- 25% ad valorem
General	- 25% ad valorem
United States	
Crude	- $3.00 per long ton
Ground or manufactured	- $6.50 per long ton

BENTONITE

For some years, Canadian production of bentonite has been confined to Manitoba and Alberta. The greater part of the consumption is imported from the United States. Imports in 1954 were valued at $835,433, compared with $443,510 in 1953.

Consumption, 1952-53

	1953	1952
	Short Tons	Short Tons
Consumption		
Oil well drilling	19,578	16,000[e]
Petroleum refining	7,090	6,658
Steel foundries	4,163	4,959
Miscellaneous chemicals	1,635	18
Miscellaneous non-metallic mineral products	836	782
Soaps and washing compounds	739	726
Iron castings	463	-
Vegetable oil preparation	313	329
Pulp and paper	244	256
Cement products	78	86
Asbestos products	16	-
Polishes and dressings	8	32
Total	35,163	29,846

e - estimated

Canadian Production

In Manitoba, bentonite is mined near Morden by Pembina Mountain Clays from shallow beds with little overburden. The material is dried, crushed, and stored at Morden and later hauled by rail to the Winnipeg plant for grinding and activation. The company markets both a natural ground bentonite that possesses good decolourizing properties and an activated bentonite that compares favourably with the best imported.

In Alberta, swelling (alkali) bentonite comes from several locations in the Drumheller area, north of Calgary. The material, in raw lump form, is purchased by Alberta Mud Company which prepares it for markets in Western Canada. It is sold for use as a component of weed killers, as an aid in diamond drilling, for sealing irrigation ditches, and as a foundry sand bond.

Other Occurrences in Canada

In British Columbia, beds of slightly swelling bentonite up to 15 feet in thickness occur in gently dipping Tertiary sediments near Quilchena and Princeton in the south-central part of the province, but no significant production has been recorded.

In Alberta, thin seams of swelling bentonite are frequently found associated with coal seams. The Aetna Coal Company has made occasional shipments of hand-sorted material, but none have been reported since 1952.

In Saskatchewan, the Department of Natural Resources has tested bentonites from the St. Victor, Pelly, and Moosomin areas. The results are fully reported in two of that department's publications, 'Improving Saskatchewan Swelling Bentonite by Chemical and Mechanical Treatment', and 'Acid Activation of Saskatchewan Bentonites'.

No deposits of bentonite have been found east of Manitoba. Bentonite is thought to be formed by the weathering or alteration of volcanic ash, and this is not known to occur east of Manitoba.

Uses

Bentonite is used chiefly to control the viscosity of oil well drilling muds; for the bleaching, or decolourizing and filtering, of mineral, animal, and vegetable oils; and as the bonding agent in foundry sand moulds.

Non-swelling bentonite, both natural and activated, is used almost entirely for filtering and decolourizing oils. Small amounts are also used in the clarification of food products such as wine, vinegars, corn syrup, and sugar.

The colloidal, or swelling type of bentonite, besides its major uses in controlling the viscosity of drilling fluids, and as the bonding agent in foundry sand moulds, has a wide range of minor uses. It is used in the bonding and plasticizing of ceramic and refractory bodies; as a filler in paper, rubber, and other products; as a detergent in soaps and cleaners; as a stabilizer in various hydraulic cements; as a carrier for insecticides, fungicides and herbicides; and in toiletries and medicinal preparations. It is used for grouting dams and irrigation ditches and to prevent water seepage around foundations of buildings. Considerable quantities of swelling bentonite may, in future years, be used in the pelletizing of the magnetic, filtered concentrates derived from the treatment of taconites (low-grade magnetic iron ores). Bentonite has proved successful on a pilot-plant scale as a binder for producing pellets suitable for blast-furnace feed. Treated bentonite is used as a desiccant to prevent atmospheric moisture from entering packaged goods, and for coating small seeds to increase their bulk and to facilitate sowing.

Prices

Bentonite prices vary within wide limits according to the grade of the material and the amount of processing it requires. Wyoming and South Dakota standard, swelling, minus 200-mesh bentonite sells for $14.00 a ton, bagged, in carload lots at the processing plant.

Activated bentonite costs from $60 to $80 per short ton in carload lots, delivered to points in Ontario and Quebec. The price of Alberta bentonite, ground to 90 per cent minus 200-mesh, remained unchanged at $40 a short ton, f.o.b. Calgary in 1954.

CEMENT

In 1954, the Canadian cement manufacturing industry recorded the highest production of cement in its history, amounting to 22,552,788 barrels valued at $59,405,097. This was only a slight increase over the 1953 production of 22,238,335 barrels valued at $58,842,022. Per capita production amounted to 1.6 barrels which is similar to the United States per capita figure of 1.7 barrels. The rated annual capacity of the industry increased by 2 million barrels during the year by expansion of one established producer and completion of a new plant, both in Quebec. Although output from the new plant was almost negligable, the industry operated during the year at 92 per cent of the year-end rated annual capacity. Expansion now under way of a plant in Manitoba will add 1.6 million barrels annually to the rated capacity of the industry.

The Canadian cement industry has experienced a phenomenal growth during the past few years. For instance, as late as 1951 not a single barrel of cement was produced in the Maritime provinces, whereas output in 1954 was 1,251,000 barrels valued at $3,850,000. In Ontario and Quebec, where cement plants have been established the longest, more recent increases have not been as spectacular but, in the period from 1945 to 1954, production rose from 6,300,000 to 14,955,000 barrels valued at $9,790,000 and $38,265,000 respectively, an increase of 136 per cent in capacity and 294 per cent in value. Western Canada has an equally enviable record as indicated by the increase in production from 2,138,000 barrels in 1945 to 6,346,000 barrels in 1954, the former valued at $4,456,000 and the latter at $17,290,000, an increase of 197 per cent in production and 288 per cent in value.

Despite these increases in output, demand for cement exceeded production, and cement was imported to meet the deficiency, as in previous years. Imports represented over 10 per cent of Canada's domestic production and almost 11 per cent of the value. However, for the second year in succession imports fell below those of the year before. In 1952, a record high of 2,913,931 barrels of cement were imported; this figure fell in 1953 to 2,482,783 barrels and in 1954 to 2,292,200 barrels. With the 1954 increase in production capacity, which will be in full operation in 1955, it appears likely that imports of cement will be less in 1955.

Production, Trade, and Consumption

	1954		1953	
	Barrels of 350 lbs.	$	Barrels of 350 lbs.	$
Production	22,552,788	59,405,097	22,238,335	58,842,022
Exports				
To: United States ..	123,307	494,708	13,613	73,070
Others	338	1,350	1,115	4,489
Total	123,645	496,058	14,728	77,559
Imports				
From: United Kingdom	866,480	2,067,489	714,529	1,856,641
West Germany .	763,962	1,868,380	270,958	654,632
United States ..	588,890	2,130,761	1,237,555	4,253,499
Belgium	16,247	43,070	247,966	580,479
Other countries	56,621	207,190	11,775	57,907
Total	2,292,200	6,316,890	2,482,783	7,403,158
Imports (clinker)				
From: United States ..	79,886	233,542	65,837	211,513
Apparent Consumption (exclusive of clinker)	24,721,343	-	24,706,390	-

Consumption

Consumption of cement remained about the same as in 1953 at 24,721,343 barrels compared to 24,706,390 barrels in 1953. Most of the cement was used in the construction industry and, because defence, hydro, and industrial construction had progressed largely beyond the cement consuming stage, the consumption increases that marked previous years did not occur. Also, residential housing construction did not experience the large increases of previous years. For instance, in 1954 approximately 102,000 housing units were completed, only a few thousand above the 1953 figure of 97,000, which was a large increase over the 73,000 units completed in 1952. Cement consumption should increase in 1955 since there are indications that commercial building will increase although residential building will remain about the same. However, engineering projects such as the St. Lawrence seaway and power project and the New Brunswick power project on the St. John River will consume large quantities of cement when they begin those phases of construction in which concrete is necessary.

Developments

The industry continued to expand in 1954 with all of the completed expansion taking place in Quebec; one new cement plant came into production while another added a second kiln. A third company plans to begin construction of a new plant in Alberta. The total number of kilns in operation at the end of 1954 was 28. These were operated by six separate companies in seven of the ten provinces.

St. Lawrence Cement Company, the newcomer to the industry, burned the first clinker in December 1954 and should be in full operation in 1955. The plant is located at Villeneuve, a suburb of Quebec City. Rated production capacity of the new plant is 1.6 million barrels of cement annually.

Le Ciment Quebec Inc. put a second kiln into operation, increasing their annual capacity to about 0.7 million barrels. The plant is at St. Basile, Portneuf County, Quebec.

Canada Cement Company, by far the largest producer in Canada, operates plants at Exshaw, Alberta; Fort Whyte, Manitoba; Port Colborne and Belleville, Ontario; Hull and Montreal, Quebec; and Havelock, New Brunswick. The company is continuing the large expansion program begun after the last war and at present is adding a third kiln to the Fort Whyte plant which will double the present capacity of 1.6 million barrels. A grinding plant is to be built at Edmonton, Alberta, that will use clinker from the Exshaw plant; however the grinding plant will be capable of conversion to a complete cement producer.

The remaining three cement companies did not expand during the past year but two had just recently completed extensive expansion programs, while the third was only completed in 1952. These companies are: British Columbia Cement Company, Limited, whose plant is on Saanich Inlet, Vancouver Island, British Columbia; St. Mary's Cement Company, Limited, St. Mary's, Ontario; and North Star Cement Limited at Corner Brook, Newfoundland.

Construction of another plant is scheduled for 1955 with production by mid 1956. The plant will have an annual capacity of 800,000 barrels and will be built near Edmonton by the Inland Cement Company.

Medusa Products Company of Canada, Limited, Paris, Ontario, imports clinker from the United States and grinds it to make white cement; it is the only producer in Canada.

Uses

The major use for cement is for concrete construction but demand for plant-manufactured concrete products is increasing. In 1953 (1954 figures not available), 5,446,721 barrels of cement were used in the concrete products industry, a considerable increase over the 1952 figure of 4,824,482 barrels. The value of factory shipments of finished products amounted to $77,880,895 in 1953, over $10,000,000 greater than the 1952 value of $67,756,528. Products turned out included ready-mixed concrete worth $27,570,788, concrete pipe of all kinds valued at $10,070,626, gravel blocks at $19,233,976, cinder blocks at $3,193,909, and blocks containing other aggregates such as slag and lightweight aggregates at $1,970,188, artificial stone at $2,529,703, concrete bricks at $3,013,202, and other items such as concrete laundry tubs, chimney blocks, burial vaults, etc. at $10,298,503. A total of 486 plants operated during 1953, Ontario having 210, Quebec 152, British Columbia 39, Alberta 32, Saskatchewan 19, New Brunswick and Nova Scotia 9 each, Newfoundland and Manitoba 7 each, and 2 in Prince Edward Island.

CLAYS AND CLAY PRODUCTS

Clay products of all kinds made from both domestic and imported clays reached a value of $47,654,243 in 1954 compared with 44,649,679 in 1953. Structural clay products manufactured in Canada from both domestic and imported clays increased from $24,224,704 in 1953 to $26,407,203 during 1954 owing to continued expansion of housing programs and to increased government and industrial construction. Most of this increase occurred in the value of structural clay products made from domestic common clays. Imports of clay in 1954, about half of which was china clay, were valued at $3,205,214, compared to $3,083,380 in 1953.

The production capacity of brick and structural tile was still further expanded during 1954 and the search for new sources of raw material suitable for the production of building products, continued.

In the main, the various kinds of clay or shale required by the clay products industry include: (1) common clay for structural items, (2) stoneware clay for sewer pipe, flue linings, stoneware, artware, kitchen bowls, crocks, etc., (3) fireclay for refractories and (4) china clay and ball clay for porcelains (mainly electrical), sanitary ware, tableware, floor and wall tile, etc. Large quantities of china clay are also used in the paper and rubber industry, and substantial amounts of bleaching clays are used in oil refineries.

Investigations in the Mines Branch to find an economic method of recovering kyanite from recently discovered, extensive deposits of kyanite-bearing gneisses in Canada and also to extend potential markets has led to the development of a successful method of processing the concentrate into dense, volume-stable, highly refractory aggregate that should be suitable for manufacture of super-duty or mullite-type firebrick. This development is considered to be important to the refractories industry as these classes of firebrick are not manufactured in Canada and concentrates of the disseminated variety of kyanite, even though highly calcined, had been found unsuitable for such production. An investigation, carried out in the Mines Branch in co-operation with a large manufacturer of brick and tile in the Maritime provinces, that should also be of importance in advancing the production in Eastern Canada of certain grades of refractories, improved structural clay products, stoneware, etc., was the systematic evaluation from bore-hole samples of the clay deposits located near Shubenacadie, N.S.

Production and Trade

	1954	1953
	$	$
Production from domestic clays		
Clays, including bentonite	396,200	517,382
Clay Products		
Common clays	26,407,203	24,224,704
Stoneware clays	3,980,430	4,212,982
Fireclays	576,410	660,101
Other products	160,000	162,562
Total	31,520,243	29,777,731
Production from imported clays		
Stoneware clays		886,370
Fireclay		2,113,310
China clay		11,872,268
Total	16,134,000[e]	14,871,948
Grand Total	47,654,243[e]	44,649,679
Imports		
Clays		
Fireclay	396,336	460,296
China clay	1,527,075	1,647,140
All other, including activated, filtering, and bleaching clays	1,281,803	1,975,944
Total	3,205,214	3,083,380
Clay products		
United States	21,981,595	17,819,269
United Kingdom	13,539,058	13,339,754
Other countries	1,802,077	2,169,451
Total	37,322,730	33,328,474

e - Estimate

	1954	1953
	$	$
Exports		
Clays		
To: United States	34,866	23,069
Other countries	-	2,025
Total	34,866	25,094
Clay products		
To: United States	1,297,328	1,099,244
Sweden	164,967	131,304
Brazil	128,341	107,066
Belgium	103,115	117,048
India	79,173	22,683
Finland	70,793	149,833
Union of South Africa	41,491	70,489
Other countries	302,960	223,695
Total	2,188,168	1,921,362

Common Clays and Shales

Good brick clays or shales occur in all provinces at points not too distant from the more thickly populated areas, but the better grades are not plentiful. Sources of new or better raw material are therefore being sought to meet the greatly increased demand for structural clay products. Surveys sponsored in recent years by both government and commercial agencies have unearthed some fairly promising new deposits. The Mines Branch carries out evaluation tests on samples submitted from all parts of Canada, and conducts field tests in connection with the development of new deposits.

The investigation into the possibilities of making lightweight aggregate from Canadian clays and shales was continued in the Mines Branch, and a number of new sources of raw materials have been found suitable for the purpose. Owing to a diminishing supply of cinders and to the trend toward lightweight concrete construction, new sources of material for the production of lightweight aggregate are needed in various parts of Canada so that such aggregate may be produced reasonably close to consuming centers.

Stoneware Clays

Southern Saskatchewan constitutes the largest producing area in Canada of stoneware clay. The clay is selectively mined and is shipped to Medicine Hat, Alberta, where a wide variety of stoneware articles, sewer pipe, pottery, etc, is made, the kilns being fired by natural gas from local wells. Tableware including vitreous hotel ware is also made in this area, with imported china clay as part of the body composition.

The stoneware clays or semi-fireclays that occur associated with the fireclays in the Sumas Mountain, south of Vancouver in British Columbia are utilized on a large scale for making sewer pipe, flue liners, and other stoneware products.

These clays also occur in British Columbia near Williams Lake and Chimney Creek Bridge, and in Manitoba, near Swan River and Pine River but they are difficult of access and have not been exploited extensively.

Ontario and Quebec import their requirements of stoneware clay.

The stoneware clays and moderately refractory fireclays that occur near Shubenacadie and Musquodoboit, Nova Scotia, have been used in limited amounts for the production of pottery, certain stoneware products, and low-grade refractories and if the Shubenacadie deposits are opened up on a large scale a local source of good-grade stoneware clays should be created in eastern Canada for the production of good-quality buff-face brick, sewer pipe, and other stoneware products.

Fireclays

Firebrick and other refractory materials are made on a large scale at a plant about 50 miles south of Vancouver from the moderately plastic fireclay that is extracted by underground mining from the clay beds in the Sumas Mountain. Smaller enterprises have also been established in this area in recent years for the manufacture of refractories or like products from material obtained from these deposits. Some of this material is exported to northwestern United States for use in making refractories.

A plant at Claybank, Saskatchewan, utilizes the highly plastic refractory clays obtained by selective mining of the "Whitemud" beds in the southern part of the province.

The clay found at Musquodoboit, Nova Scotia is suitable for the production of stove linings, and for certain foundry purposes, and the proposed opening up of the newly explored clay deposits near Shubenacadie, Nova Scotia should make available a domestic source in eastern Canada of fireclay suitable for moderately high-temperature refractory purposes.

The rather extensive deposits of plastic fireclays that occur on the Mattagami, Missinaibi, and Abitibi Rivers in northern Ontario have not been developed commercially owing to their remoteness and to certain difficulties in extracting uniform high-quality material from them.

Fireclays imported from the United States enter Canada duty free if not processed further than by grinding, and producers of fireclay types of refractories in Ontario and Quebec resort to imported raw materials.

China and Ball Clay

China clay is an essential raw material in the manufacture of such ceramic products as electrical insulators, sanitary ware, tableware, floor and wall tile; large quantities are also consumed by the paper industry. The only production on a commercial scale in Canada was at St. Remi d'Amherst, Papineau county, Quebec, but this project was abandoned some years ago because of mining and operational difficulties. Several other deposits of kaolinized material are known to occur in Quebec. One is near Point Comfort, Thirty-one Mile Lake, the others being near Brebeuf, Lake Labelle, and Chateau Richer. None of these, however, have been proven of sufficient size and uniformity to warrant commercial development.

Extensive deposits of clay of varying quality occur at Giscombe Rapids, Fraser River, about 25 miles above Prince George, British Columbia. A road has been built into this district making the occurrences more accessible.

Of the total value of china clay imported into Canada, $973,532 worth came from the United States, and $553,543 worth from the United Kingdom.

The Saskatchewan Government is continuing to carry out an extensive program of exploration of its ball-clay resources, particularly in the southern part of the province, largely with the hope that markets for Western ball clays may be expanded in Eastern Canada and the United States. In Eastern Canada, it has been necessary to import requirements for ball clay which is also an important ingredient in so-called ceramic whiteware.

Prices for Clays

Average prices for the various kinds of clay are difficult to obtain, because of the variability in quality. An approximate indication of the 1954 prices per ton, f.o.b. shipping point, for three kinds of imported clay is as follows:

Fireclay	-	$4.50 to $ 6.00
China clay	-	$9.00 to $30.00
Ball clay	-	$6.00 to $20.00

DIATOMITE

Production of diatomite in Canada was reported to be 104 tons valued at $12,168 in 1954 compared to 103 tons valued at $12,150 in 1953. Of these quantities, 100 tons in each year was simply dried, ground, bog diatomite originating in Ontario and sold as a 'feed additive'; this is not considered as diatomite in the sense of its recognized, accepted uses. The remainder was Nova Scotia material shipped from stock.

Output in Canada has always been small and irregular and practically all domestic requirements have been imported from the United States.

Production, Trade, and Consumption

	1954		1953	
	Short Tons	$	Short Tons	$
Production (sales)	104	12,168	103	12,150
Imports				
United States	19,373	664,016	19,308	669,273
Other countries		-	42	1,337
Total	19,373	664,016	19,350	670,610
Consumption*				
Fertilizer dusting	8,840		8,989	
Filtration	7,706		8,634	
Fillers	2,033		1,274	
Insulation	55		137	
Total	18,634		19,034	

* Based on information supplied to the Mines Branch by distributors and consumers.

Occurrences in Canada

Diatomite, also known as diatomaceous earth and as kieselguhr, consists of the microscopic siliceous skeletons of water organisms known as diatoms. The purest varieties are chalklike in appearance, free from grit, porous, and friable, and have a specific gravity under 1 when dry.

In Canada there are more than 400 known occurrences of diatomite consisting of material that is of Recent (geologically) freshwater origin. These diatomite deposits appear as a grey to brown to black mud in bogs or in swamps and late bottoms of Nova Scotia, New Brunswick, Ontario, Quebec, and British Columbia. Deposits of this type cannot at present be economically operated to produce marketable grades of diatomite for industrial purposes.

The freshwater diatomite deposits of Tertiary age near Quesnel in the Cariboo area of British Columbia are by far the largest known in Canada. They occur in compact beds up to 40 feet thick, are white to cream in colour, and free from grit and vegetable matter. Small amounts of this diatomite have been marketed in recent years for insulation and concrete admixture purposes by Fairey & Company, Limited, of Vancouver. The dried, ground material appears to be suitable for fertilizer dusting, but transportation difficulties have hindered the development of the deposits. The diatomite does not appear suitable for high-grade filtering material.

World Production

United States accounts for more than 50 per cent of the world production, which amounts to about 500,000 tons a year. California, Oregon, Nevada, and Washington, in that order, were the leading producing states in 1954. Proved reserves are adequate for many years' operation at current rates.

Other important producers of diatomite include West Germany, Algeria, France, Denmark, and Japan.

Uses

In Canada, the major use of diatomite is in the manufacture of ammonium nitrate fertilizers (nitraprills), where it is used as a dusting agent for coating the prills to prevent caking and sticking. Specifications call for uncalcined material of 95 per cent minus 325-mesh and with less than 5 per cent moisture content. About 9,000 tons a year altogether is used by The Consolidated Mining and Smelting Company of Canada Limited in its plants at Warfield, British Columbia, and Calgary, Alberta, and North American Cyanamid Limited in its plant at Welland, Ontario.

As a filtration medium, diatomite is used widely in the processing of sugar, beverages, water, pharmaceuticals, oils, and many other materials. For good filter performance the size, shape, purity, and density of the material are important considerations.

As mineral filler, diatomite is used in rubber, paper, asphalt products, plastics, explosives, insecticides, paints, and many other products. Important properties of diatomite to be considered for such uses include colour, freedom from grit, low density, inertness, and particle size. It supplies bulk with little increase in weight along with desirable physical properties to the end products.

Diatomite is a good insulating agent against both sound and heat because of its porous nature, particle stability, and high melting point. It has many miscellaneous uses, typical being its use as a carrier for insecticides and catalysts, as an ingredient in ceramic bodies and glazes, and as a mild abrasive.

Prices

Diatomite varies widely in price, depending upon the source, and quantity purchased.

Chemical and Engineering News reports that at United States eastern ports domestic (U.S.) diatomite in bags, in carload lots, sells for $52 to $55 a short ton, and 'purified' grades sell at $65 a ton. Filtration grades of diatomite f.o.b. Toronto or Montreal, command from $100 to $160 per ton in ton lots, and filler grades somewhat less at $75 to $110 per ton. Diatomite for nitraprill coating, insulation, concrete admixture, and other purposes varies from $30 to $60 per short ton f.o.b. producer's plant. Diatomite insulation bricks from England, Denmark, and the United States range from $50 to $200 per thousand depending on grade, source, and insulation properties.

FELDSPAR

Production (shipments) of feldspar in Canada in 1954 amounted to 15,798 short tons, nearly 26 per cent below 1953 output. Of the total, 89 per cent came from Quebec and the remainder from Ontario. Exports, mainly to United States, declined to 1,056 short tons, an 85 per cent reduction from the previous year's total, the decline being attributed to the closing of the grinding plant of Consolidated Feldspar Corporation at Rochester, New York, to which most of the crude exports were formerly shipped.

Production, Trade, and Consumption

	1954		1953	
	Short Tons	$	Short Tons	$
Production				
Quebec	14,007	292,733	18,591	319,146
Ontario	1,791	22,143	2,655	28,018
Total	15,798	314,876	21,246	347,164
Imports				
From: United States	398	8,078	335	7,085
Exports				
To: United States	1,053	27,946	6,845	63,982
Other countries	3	260	3	252
Total	1,056	28,206	6,848	64,234
	1953 Short Tons		1952 Short Tons	
Consumption				
Glass	3,892		4,042	
Cleansers	1,568		1,807	
Abrasives	23		61	
Clay products	4,689		4,936	
Enamelling	930		798	
Heating and cooking apparatus	115		208	
Iron castings	42		90	
Electrical apparatus	650		680	
Total	11,909		12,622	

Producers

Quebec

Canadian Flint and Spar Company Limited, Victoria Bldg., 140 Wellington St., Ottawa, operating in Derry township, Quebec, continued the largest single producer of crude and operated its mill at Buckingham for the production of ground spar, mainly for the domestic pottery, glass, enamelling, and cleanser trades. Mill feed was drawn from its own and numerous other mines located chiefly in Derry and Buckingham Twps.

Bon Ami Company, Limited, Montreal, produced ground feldspar for its own use.

Ontario

Canadian Flint and Spar Company Limited, operating near Plevna, Miller township and R. VanMeter, Whitney, operating in Murchison township were the only producers. Output was shipped to Buckingham, Quebec, for processing.

Uses and Specifications

Feldspar is used chiefly by the ceramic industry in the manufacture of glass, pottery, and enamelware and by the cleanser trade in making scouring soaps and powders. A limited quantity of select material is used in the manufacture of artificial teeth.

For ceramics, feldspar is classified as potash spar or soda spar and graded in either catagory as No. 1 Ceramic or No. 2 Ceramic according to purity. To qualify as No. 1 Ceramic, feldspar should contain less than 0.06 per cent iron or other colouring oxides and under 5 per cent quartz. For No. 2 Ceramic, the iron content must be low but more latitude is permitted in respect of quartz. Colour is of no importance in either grade.

For cleansers, the material should be grit-free and approach a good white colour. Either potash or soda spar is acceptable.

Dental spar is potash spar of high purity, selected by the trade according to its firing characteristics. Up to 0.10 per cent iron oxides may be tolerated but there must be a complete absence of tourmaline, biotite, and any other dark mineral that will leave specks in the fired product.

Markets, Prices and Tariffs

Canadian Flint and Spar Company Limited is the principal purchaser of crude feldspar of all grades in Canada. Bon Ami Company Limited, 13719 Notre Dame St. E., Montreal, purchases white spar for cleanser use.

Buyers of dental-grade spar include Myerson Tooth Corporation, Cambridge, Massachusetts; Dentists' Supply Company, 220 W. 42nd. St., New York, N.Y.; and Universal Dental Company, Brown at 48th St., Philadelphis, Pa.

Prices for ceramic grade spar in 1954 remained unchanged at about $10.00 per short ton for No. 1 and $7.00 for No. 2, f.o.b. rail.

The duty on crude feldspar entering United States is 12 1/2 cents per long ton and on ground feldspar 7 1/2 per cent ad valorem.

The Canadian tariff is as follows:

Crude - Free
Ground -
British preferential - Free
Most favoured nation - 15% ad valorem
General - 30% ad valorem

Note: Import duties are subject to revision at any time and should be verified at the time shipment is being considered.

FLUORSPAR

Canadian fluorspar production in 1954 reached a new high of 120,078 tons, an increase of 36 per cent over the 1953 output of 88,569 tons. Newfoundland accounted for about 99 per cent of the total with Ontario supplying the remainder. Exports in 1954, all to the United States, reached an all-time high of 34,694 tons, an increase of 57 per cent over that of the previous year. Imports totalled 16,240 tons, as compared with 20,161 tons in 1953 and 22,314 tons in 1951.

Production, Trade, and Consumption of Fluorspar, 1953-54

	1954		1953	
	Short Tons	$	Short Tons	$
Production (shipments)				
Newfoundland	119,074	2,970,650	87,693	2,631,698
Ontario	1,004	41,288	876	38,887
Total	120,078	3,011,938	88,569	2,670,585
Imports				
Mexico	10,798	222,110	8,696	214,965
United States	3,115	100,618	4,987	166,355
United Kingdom	2,327	60,207	1,435	45,046
Spain	-	-	4,810	113,453
Other countries	-	-	233	7,096
Total	16,240	382,935	20,161	546,915
Exports*				
United States	34,694		22,079	

* From "United States imports of Merchandise for Consumption"

	1953 Short Tons	1952 Short Tons
Consumption		
Heavy chemicals and non-ferrous smelters...	59,556	45,399
Steel furnaces	22,730	22,576
Glass	672	642
Enamelling and glazing .	152	131
White metal alloys	6	-
Total	83,116	68,748

Producers

In Ontario, the Kilpatrick mine of Huntingdom Fluorspar Mines Limited, about one mile southwest of Madoc, was the only producer during 1954.

In Newfoundland, two companies were producing -- St. Lawrence Corporation of Newfoundland Limited and Newfoundland Fluorspar Limited. St. Lawrence operated 4 properties, with the Iron Springs mine supplying about 34 per cent of the total output. All material was treated in the company's mill about one mile west of St. Lawrence. The output for 1954 totalled 55,731 short tons of sub-metallurgical grade all of which was shipped to Wilmington, Delaware, U.S.A., where it received further beneficiation in a flotation mill operated by an affiliated company, St. Lawrence Fluorspar Incorporated.

Newfoundland Fluorspar, a subsidiary of Aluminum Company of Canada Limited, operates the Director mine, one and one-half miles west of St. Lawrence. This is the most important deposit discovered to date, the vein varying from one to 70 feet in width, and having a calcium fluoride content of from 60 to 80 per cent. The material was treated in a heavy-media separation plant at the mine. The output totalled 52,249 tons of sub-metallurgical grade (75% CaF_2). The entire output was shipped to Arvida.

Fluorspar Reserves in Newfoundland

While no accurate estimate of Newfoundland's reserves of fluorspar has been made, they are known to be very large, and may be classed as among the most important in the world. Fluorite mineralization in the St. Lawrence area is known to extend for as much as three miles longitudinally, and at depths up to 890 feet no significant changes in grade or width are noted. The higher-grade veins average four to five feet in width and have a fluorite content of 95 per cent or more, with a silica content of one to four per cent, while the lower-grade veins run from 15 to 20 feet in width, and have a fluorite content of about 75 per cent, with silica ranging from 10 to 15 per cent. Some forty veins have been located to date, many of which have been untouched, and none of which have been completely traced longitudinally or vertically.

Other Occurrences

Deposits of fluorspar occur in Ross township, Renfrew county, Ontario; Huddersfield township, Pontiac county, Quebec; in the Lake Ainslie district, Cape Breton Island, Nova Scotia; and near Grand Forks, British Columbia.

An occurrence of fluorite in association with witherite, barite, and quartz was located in 1953 at Lower Liard River Crossing in northern British Columbia. The occurrence is reported to be extensive, and is being explored by Conwest Exploration Company Limited.

Uses and Specifications

Fluorspar in Canada is consumed chiefly in the manufacture of aluminum fluoride used in the aluminum industry. The fluoride is added directly to the pots as a make-up to the electrolyte. The other uses of fluorspar in order of importance are: as a powerful fluxing agent in the steel industry, where about 6 pounds of spar are required per ton of steel made in the open hearth, and 20 pounds per ton for that made in the electric furnace; in the manufacture of heavy chemicals; and in the ceramic industry as a fluxing and opacifying ingredient in glass and enamels. Fluorspar is used in small amounts in numerous other metallurgical industries, including foundries and various metal-refining plants.

In United States, the largest consumer is the steel industry, which also consumes substantial quantities of hydrofluric acid and sodium fluoride. The next largest use is in the manufacture of hydrofluoric acid.

Standard fluxing gravel, or lump grade, for metallurgical use is usually sold on a specification of a minimum of 85 per cent CaF_2, and maximum of 5 per cent silica and 0.3 per cent sulphur. Fines should not exceed 15 per cent.

Glass and enamel grades call for not less than 95 per cent CaF_2, with maxima of 2 1/2 to 3 per cent SiO_2 and 0.12 per cent Fe_2O_3. The material must be in mesh sizes ranging from coarse to extra fine.

Acid-grade spar has the most rigid specifications, namely a minimum of 97 per cent CaF_2 and not over one per cent silica. Like the ceramic grade, it is used mainly in powder form.

Prices

Canadian prices of ceramic grade fluorspar as quoted by Aluminum Company of Canada f.o.b. Arvida, Quebec, and published in the December 30, 1954, issue of The Northern Miner were as follows:

Ceramic grade, coarse in 100-lb bags: Minimum carload or truckload, \$61.50 L.C.L. to one ton, \$70.70; less than one ton, \$76.85. In bulk: Minimum carload or truckload, \$57.75.

Ceramic grade, fine in 100-lb. bags: Minimum carload or truckload, \$63.50; L.C.L. to one ton, \$73.00; less than one ton, \$79.35. In bulk: Minimum carload or truckload, \$59.75.

Specifications: 95 per cent CaF_2 minimum with maximum 2.5 per cent $CaCO_3$, 2 per cent SiO_2 and 0.1 per cent Fe_2O_3.

United States year-end prices, as quoted in E.& M.J. Metal and Mineral Markets Bulletin, were as follows:

Metallurgical grade, effective CaF_2 content, per short ton, f.o.b. shipping point Illinois and Kentucky: 72 1/2 per cent, \$35.00 to \$36.00: 70 per cent, \$32.00 to \$33.00; 60 per cent plus, \$28.00 to \$29.00; and pellets, 60 per cent, nominal. "Effective units" are computed at the actual CaF_2 content less 2 1/2 times the percentage of contained silica.

Acid grade concentrates, per short ton, bulk, carload lots, f.o.b. Rosiclare, Illinois, \$47.50, effective October 1.

Ceramic grade, minimum 94 per cent CaF_2, calcite and silica variable, Fe_2O_3-0.14 per cent, \$44.00 per short ton, in bulk, f.o.b. Rosiclare. In 100-lb. bags \$4.00 extra.

European fluorspar c.i.f. U.S. ports, duty paid, per short ton: Metallurgical grade, \$26.00 to \$28.00; acid grade, \$47.50 to \$52.50, nominal.

Mexican fluorspar, metallurgical, 72 1/2 per cent effective CaF_2 content, all rail, duty paid, \$23.00 per short ton; barge, Brownsville, Texas, \$25.50.

Tariffs

The duty on fluorspar entering United States is \$1.875 per short ton if it contains more than 97 per cent CaF_2, and \$7.50 per short ton if it contains 97 per cent or less. Fluorspar enters Canada duty free.

GRANITE

Granite production reached a new peak of 16,532,733 tons valued at \$14,074,002, as compared with the 1953 production of 1,350,917 tons valued at \$5,554,530, the increase being due primarily to the large tonnage of granitic rocks used in the construction of the causeway linking Cape Breton Island with the Nova Scotia mainland. Exclusive of production for the causeway, however, the industry showed substantial gains, output being over 60 per cent higher than in 1953. All the granite for the causeway came from Nova Scotia. This accounts for the high output in 1954 from that province which is normally a small producer.

Nova Scotia contributed 87.2 per cent of the total output in 1954. Quebec, for many years the leading producer, contributed 6.4 per cent, the remainder being from British Columbia, Manitoba, Ontario, New Brunswick, and Newfoundland. Granite used as rubble and riprap, concrete aggregate, road metal, etc. in 1953 accounted for over 96 per cent of the tonnage but only 50 per cent of the value of the stone; figures for 1954 are not yet available. The remaining tonnage was used as building and monumental stone.

Exports of granite and marble (unwrought) in 1954, all to the United States, amounted to 4,761 tons as compared with 3,441 tons in 1953 and the 25-year high of 5,579 tons in 1950. Imports, mainly from United States, Sweden, Finland, and Western Germany, increased 24 per cent in value over those of 1953, to give a 25-year, if not an all-time, high of $716,152.

Production of Canadian granites for building purposes is fairly well established, and the many splendid granite buildings already erected across Canada bear witness to the excellent quality of material available. The granites quarried in many parts of Canada compare favourably with those produced elsewhere, and no difficulty should be encountered by an architect or contractor in obtaining suitable material of almost any colour desired. Canada also produces a wide variety of monumental stone the equal of many of the imported stones, and this branch of the industry is increasing steadily in spite of competition from the better-known, lower-priced imports.

In the stone industry, the term 'granite' covers all compact igneous rocks, as well as metamorphic rocks of igneous origin, adaptable to commercial use; thus, anorthosites, syenites, diorites, andesites, gneisses, and other related rocks are known to the trade under the general name 'granite'. 'Black granite' is merely a trade name employed to distinguish the darker-coloured commercial stones of igneous origin. These rocks are rarely true granites in the mineralogical sense. Stones so designated are not necessarily black, but may be of varying shades of dark grey or dark green.

Occurrences and Producing Areas

Newfoundland

Granite deposits suitable for dimension stone are widespread in Newfoundland, but they have been utilized on only a small scale for local buildings, bridge abutments, and paving. Quarrying has been confined mainly to the Petites (Rose Blanche) area of the southwest coast, the south side of Conception Bay, and to several points along the railroad. There has been little production, if any, in recent years and at present the industry is at a standstill.

Production and Trade

	1954		1953	
	Short Tons	$	Short Tons	$
Production				
Monumental and building granite				
Rough			22,087	566,683
Dressed			23,057	2,198,789
Total			45,144	2,765,472
Rubble and riprap, roofing granules, concrete aggregate, road metal, etc.			1,305,773	2,789,058
Total	16,532,733	14,074,002	1,350,917	5,554,530
Production by provinces				
Newfoundland	395,000	300,000	--	--
Nova Scotia	14,418,000	8,447,620	101,919	358,655
New Brunswick	12,000	58,000	11,500	57,506
Quebec	1,060,067	4,034,027	430,238	3,265,420
Ontario	231,844	620,685	381,141	1,045,358
Manitoba	3,000	3,000	2,950	2,850
British Columbia	412,822	610,670	423,169	824,741
Total	16,532,733	14,074,002	1,350,917	5,554,530
Exports, granite and marble (unwrought)				
To: United States	4,761	79,511	3,441	65,528
Imports, granite				
Rough				
From: United States		101,101		90,033
Sweden		87,925		69,336
Finland		19,514		26,644
Other countries		14,269		--
Total		222,809		186,013

	1954		1953	
	Short Tons	$	Short Tons	$
Imports (continued)				
Sawn				
From: United States ..		59,765		51,265
Sweden		13,611		17,367
West Germany .		8,020		2,550
Finland		6,253		17,551
Other countries		2,708		3,755
Total		90,357		92,488
Manufactures				
From: West Germany..		151,607		84,779
Finland		111,313		61,395
Sweden		90,397		80,870
United States ...		39,801		58,722
Other countries .		9,868		15,038
Total		402,986		300,804

Nova Scotia

Although granite quarrying has been carried on in Nova Scotia for many years, no extensive development has yet taken place, probably because of limited local markets and lack of variety and quality of the granite types. The high output in 1954 was a temporary effect of the construction of the causeway linking Cape Breton Island with the mainland. The granites of the province are mainly grey in colour and medium to coarse in texture. Black diorite is also available. Grey granite is produced in the Nictaux and Shelburne areas, and black from the Shelburne area.

New Brunswick

Extensive masses of granite occur in several areas of New Brunswick, the greater part suitable for one form or another of construction. In a number of places the stone is of monumental grade. These granites are greatly diversified, not only in texture which varies from the finest grain to extremely coarse, but also in colour, various shades of grey, green, black, and dark red to the lightest pink being available. Each type of stone has its special characteristics, and there is scarcely a use for granite that cannot be satisfactorily met by one or other of the granite districts of this province. Despite this the industry has remained comparatively small for many years. At present, operations are confined to the Hampstead (Spoon Island) district, where a pinkish-tinted grey granite is being quarried on a small scale, mainly for monumental use; to the Bathurst district, where a reddish-grey granite is quarried intermittently for the local building trade; and to the Antinouri Lake district, where a pink granite is being quarried for building purposes.

Quebec

For many years Quebec has been the leading producer of granite in Canada. Its displacement from that position in 1954 by Nova Scotia was due only to the temporary increase in Nova Scotia s output for the causeway construction.

Most of the production comes from the Eastern Townships south of the St. Lawrence River where a highly developed industry is based on the production of a well-known granite. North of the river, the resources of granite are more varied but the industry is less developed. At present there are at least ten important granite-producing areas in the province.

The Precambrian Shield occupies most of the province north of the St. Lawrence. In the deposits already opened, these Precambrian rocks provide a wide variety of colour, composition, and texture, and it is believed that many good deposits remain to be found. Thus, there are the blacks, pinks, browns, and reds of the Lake St. John region; the reds, greens, and greys of the Rivière-a-Pierre district; the pinks of Guenette; the banded gneisses of St. Raymond; the blacks and pinks of Rouyn; and the reds and greens of the Grenville area.

South of the St. Lawrence, the granites are considerably more recent in age than those of the Precambrian Shield and they occur as a large number of comparatively small isolated deposits. The stones have little variety in colour and all may be considered as grey granites, although they may have differences in composition and texture. Production comes from the Stanstead, Stanhope, Scotstown, St. Gerard, St. Samuel, and St. Sebastien areas. At Mount Johnson, a dark, mottled, grey granite of medium texture is being produced.

Ontario

Although Ontario contains large granite areas with numerous outcrops, these have not been exploited to any extent. Activity is confined to production of a medium-grained black granite in the River Valley area, a medium-grained red granite in the Vermilion Bay area and a coarse-grained red granite in the Lyndhurst area.

Manitoba and Saskatchewan

Granites, granite-gneisses and allied rocks of Precambrian age occupy a large part of eastern and northern Manitoba, northern Saskatchewan, and the extreme northeastern corner of Alberta. Very little of the region, however, is served by rail and road communication, and the only activity of consequence in recent years has been in the West Hawk Lake area, 100 miles east of Winnipeg, where small amounts of grey and black granite are quarried intermittently.

British Columbia

British Columbia has large areas of igneous rocks, many of which are traversed by the principal roads and railroads, or are along the Pacific Coast and thus close to water transportation. The predominant type being quarried consists of grey granites of varying shades, but in a few localities stone of other colour has been or is being worked in a small way. At Nelson Island, a high-quality light-grey granite is being produced, and at Haddington Island another highly desirable building stone, an andesite, is being quarried. Granite quarrying in the interior of British Columbia is small and intermittent and confined to areas near Nelson and Sirdar.

Uses and Specifications

Granite is quarried chiefly for the building and monumental trades. Most other uses are secondary, as they utilize the waste material left after extraction of building and monumental stone. Such uses include concrete aggregate, road metal, breakwaters, poultry grit, stucco dash, and rubble retaining walls. However, in some cases granite quarries are opened for the sole purpose of supplying concrete aggregate or road metal.

For building purposes the stone must have an even texture, be of uniform composition, and have a pleasing and lasting colour. For use in polished form in base courses and trim, the granite should be of the same quality as monumental stone but when other finishes are employed the specifications need not be quite so rigid. Iron is at all times an objectionable constituent, as it will sooner or later cause disfiguring stains. For massive structures a coarse-textured stone may be used with pleasing effect, although fine-textured stones are also in demand.

The specifications for monumental granite are more rigid and exacting, and only stone of the highest quality is used for this purpose. The stone must be free from flaws such as cracks, knots, hair lines, iron spots and any other imperfections that would mar its beauty. The texture and composition must be uniform, and the colour must be pleasing. The stone must be capable of taking and retaining a high polish, and there must be a good contrast between the different finishes such as polished and hammered surfaces. It is probably true to say that a good monumental stone will always make a good building stone whereas a good building stone will not necessarily make a good monumental stone.

A special use for granite is in the manufacture of granite press rolls for pulp and paper machines. Granite for this purpose should be fine-grained, hard, of uniform close texture, of high tensile strength, and free from soft spots and sulphides that might be acted upon by any residual chemicals remaining in the paper stock. Mica is undesirable as, besides being soft, it seems to have an affinity for the paper. Colour is unimportant, but the stone should be capable of taking a high polish.

GRAPHITE

Production of natural graphite in Canada virtually ceased during the year with the closing of Black Donald mine, near Calabogie, Ontario, for many years the sole Canadian producer. The mine, which has been operated in recent years by a division of Frobisher Limited, was first developed in 1896 and with minor interruptions has been in continuous operation since. Shipments in 1954, to the end of May, the last month for which production was reported, consisted of 89 per cent amorphous, 5 per cent dust and 6 per cent high-grade lubricating and pencil flake. Of the total shipments, which included a small shipment of crude reported by Quebec Graphite Corporation from a property in Joly Twp., Labelle County, 88 per cent was exported, mostly to the United States. Exports decreased 34 per cent in volume and 38 per cent in value compared to 1953.

Artificial graphite is produced by Electro Metallurgical Company of Canada Limited, Welland, Ontario.

Total unmanufactured (crude) imports dropped 57 per cent in value compared to 1953 while the value of ground and manufactured (refined) imports increased 14 per cent. The total value of imports exclusive of crucibles, however, was virtually unchanged.

Production of graphite has come in the past from widely separated deposits in the crystalline limestones and gneisses in the general Ottawa region and, to a minor extent, from New Brunswick. Graphitic shales and schists are common in the Maritime Provinces and in British Columbia.

Principal world sources of graphite are Mexico (amorphous), Ceylon (plumbago), and Madagascar (large flake).

Uses and Specifications

Natural graphite is used mainly in the form of crucibles, foundry facings, and other refractories, in the iron and steel industry (the largest user), and in the paint industry as a pigment and anti-corrosive element in protective coatings. Graphite is used widely as a lubricant, particularly under high-temperature and corrosive conditions, as a conductive filler for dry batteries, in lead pencils, in corrosion-resistant pipes and fittings for the chemical industry, for impregnating wood and metal surfaces in oil-less bearings, in the manufacture of stove and other polishes, and as a polishing agent for lead shot, explosives, and fertilizers. Graphite has been used recently as a moderator in atomic piles.

Artificial graphite, which is made from petroleum coke or anthracite by electric-furnace treatment, is used in the manufacture of electrodes, brushes, and other special shapes. In powdered form it competes with natural amorphous graphite in paints, polishes, foundry facings, boiler compounds, etc., and particularly where high purity is desirable, as in dry batteries.

Production and Trade

	1954		1953	
	Short Tons	$	Short Tons	$
Shipments by types				
Amorphous foundry grades	2,202	197,278	2,950	254,569
Dust grades	118	20,454	235	41,222
High-grade lubricating & pencil grades	143	36,802	281	70,737
Total	2,463	254,534	3,466	366,528
Exports, crude & refined				
To: United States...........	2,156	199,535	3,251	320,227
Australia	-	77	2	461
Total	2,156	199,612	3,253	320,688
Imports				
Unmanufactured				
From: United States...........		28,975		28,601
Mexico		15,969		91,850
Norway................		8,899		5,020
Madagascar		275		-
United Kingdom.........		174		269
France		93		-
Total		54,385		125,740
Ground & manufactured				
From: United States...........		518,586		467,078
United Kingdom		20,242		10,161
Other countries		9,996		4,743
Total		548,824		481,982
Crucibles				
From: United Kingdom.........		99,577		131,179
United States...........		56,939		85,127
West Germany		-		760
Total		156,516		217,066
Total Imports		759,725		824,788

Carbon content, mesh size, and type (flake, crystalline, or amorphous) are the principal factors which govern the selection of graphite for its various uses. The different types of graphite are inter-changeable to some extent and are frequently blended according to recipes developed and protected by the manufacturers.

No universal code of specifications is recognized, but those for No. 1 crucible flake usually require 85% or 90% carbon, through 20-mesh on 60- or 90-mesh. For lubricants, the requirement is usually a minimum of 95% carbon. In general, the demand is for material containing at least 70% carbon, although lower-grade material is potentially salable.

Consumption

	1953 Short Tons	1952 Short Tons
Polishes and dressings	10	22
Paints	54	69
Brass and copper products	23	38
Electrical apparatus	293	350
Heavy chemicals	319	309
Boilers, tank & plate works	3	6
Steel ingots & castings	1,104	1,024
Farm implements	3	4
Railway rolling stock	52	83
Machinery	50	72
Iron castings	378	305
Cooking & heating	14	17
Ferroalloys	242	179
Asbestos products	14	237
Explosives	12	1
Miscellaneous non-metallic mineral products	218	57
Miscellaneous iron and steel products	26	72
Miscellaneous non-ferrous metal products	5	-
Total	2,820	2,845

Markets

Buyers of crude and finished graphite in the United States include Joseph Dixon Crucible Company, Jersey City, New Jersey; Charles Pettinos, 1 East 42nd St., New York, N.Y.; and George F. Pettinos Inc., 1206 Locust St., Philadelphia 7, Pa.

Prices

No regular market quotations for graphite in Canada were published during the year.

Prices prevailing in the United States, as published in trade journals, were unchanged from the previous year as follows: United States - f.o.b. shipping point, per pound: crystalline flake - 13 to 26 1/2¢, amorphous, up to 85% C - 9¢. Madagascar c.i.f. New York - standard grades 85 to 87% C - $235 per ton, special mesh - $260 per ton, amorphous, Mexican, f.o.b. point of shipment (Mexico), per metric ton - 9 to $16 depending on grade.

Tariffs

	British Preferential	Most Favoured Nation	General
Canada			
Graphite, not ground or otherwise manufactured	free	5%	10%
Graphite flakes	5%	5%	25%
Graphite, ground and manufactured .	15%	20%	25%
Graphite foundary facings..........	15%	22 1/2%	25%
Graphite crucibles	free	15%	15%
Graphite bearings for use in automobiles & motor vehicles, etc.:			
Of a class not made in Canada	free	free	30%
Of a class made in Canada	free	17 1/2%	30%

United States

Amorphous - 5% ad val.
Crystalline chip, dust or lump - 7 1/2% ad val.
Crystalline flake valued per lb.:
Under 2 3/4¢ - 0.4125¢ per lb.
2 3/4¢ or more but not over 5 1/2¢ - 15% ad val.
Over 5 1/2¢ per lb. - 0.825¢ per lb.

GYPSUM AND ANHYDRITE

The production of crude gypsum in 1954 was 3,957,268 short tons, an increase of 3 per cent over 1953 production. Exports amount to 2,831,116 tons which represented about 71 per cent of the total Canadian production. Practically all of this amount was exported in the form of crude gypsum to markets in the United States. The remainder of the output was used in Canada for the manufacture of plaster and wallboard and in the cement industry.

Production and Trade

	1954		1953	
	Short Tons	Dollar Value	Short Tons	Dollar Value
Production, crude gypsum				
Nova Scotia	3,168,237	4,945,832	3,050,832	5,200,420
Ontario	357,487	982,486	334,495	899,630
Manitoba	165,900	329,900	163,313	414,401
British Columbia	147,430	397,355	145,470	387,655
New Brunswick	90,714	281,213	120,816	380,570
Newfoundland	27,500	117,250	26,531	117,208
Total.............	3,957,268	7,054,036	3,841,457	7,399,884
Exports				
Crude gypsum and plaster				
To: United States ..	2,830,945	4,204,603	2,769,990	3,794,083
Plaster of paris and wall plaster				
To: United States ..	157	6,221	77	2,853
New Zealand ..	10	203	10	197
Other countries	4	164	-	-
Total.............	2,831,116	4,211,191	2,770,077	3,797,133
Imports				
Crude gypsum				
From: United States ..	4,795	45,857	363	11,118
United Kingdom	163	5,370	184	6,292
Plaster of paris and wall plaster				
From: United States ..	19,108	416,889	22,031	466,262
United Kingdom	72	1,182	-	-
Sweden	2	303	-	-
Total.............	24,140	469,601	22,578	483,672

Nova Scotia, the chief producer of gypsum in 1954, accounted for 80 per cent of the total production. Most of the gypsum quarried in Nova Scotia is exported to the United States. However, small percentages are used in the manufacture of plaster at Windsor, Nova Scotia, and for the manufacture of plaster and wallboard at plants located in Montreal.

There was no recorded Canadian production of anhydrite in 1954. Anhydrite is of little commercial importance in Canada. However, small amounts are produced from time to time at gypsum quarries where its removal is sometimes necessary to permit the continued production of gypsum.

GYPSUM

Producers

Nova Scotia

The largest producer of crude gypsum in Nova Scotia is Canadian Gypsum Company, Limited. Gypsum from company quarries at Wentworth, near Windsor, Nova Scotia,is shipped by rail to Hantsport. From Hantsport, the gypsum is shipped by boat to plants of United States Gypsum Company located on the eastern coast of the United States.

In 1954, National Gypsum (Canada) Limited completed preliminary development of a large gypsum deposit near Milford Station, Nova Scotia. Initial production from this deposit is scheduled for May 1955. The crude gypsum is to be shipped by rail to Dartmouth and from there by boat to company-owned plants in the United States. A small percentage of this production will be shipped to Quebec for processing. National Gypsum (Canada) Limited also quarries gypsum for export purposes at Walton in Hants county, Nova Scotia. Production from the company's quarry at Dingwall, Nova Scotia, was discontinued in December 1954.

Windsor Plaster Company, Limited obtains gypsum from quarries near Brooklyn, Nova Scotia, for use in its plaster mill at Windsor.

Little Narrows Gypsum Company Limited was incorporated in April 1954 to acquire the rights and property of Victoria Gypsum Company, Limited. The new company continued operation of the gypsum quarries at Little Narrows, shipping gypsum to the United States and also to Montreal where it is used in the manufacture of plaster and plaster products.

Ontario

Gypsum, Lime and Alabastine, Canada, Limited at Caledonia, and Canadian Gypsum Company, Limited, at Hagersville, manufacture gypsum plaster and wallboard from gypsum rock obtained from mines near their plants.

Manitoba

Gypsum, Lime and Alabastine, Canada, Limited produces gypsum plaster and wallboard at Winnipeg using gypsum rock obtained from company quarries at Gypsumville.

Western Gypsum Products Limited, a subsidiary of The British Plaster Board (Holdings) Limited of London, England, also has a plant at Winnipeg. Gypsum rock from a mine at Amaranth, Manitoba, is used in this plant to manufacture plaster and wallboard.

British Columbia

Gypsum, Lime and Alabastine, Canada, Limited manufactures wallboard, insulation, and plaster products at its Port Mann plant using gypsum rock obtained from the company's quarry at Falkland. Rock from the same quarry is shipped to Calgary, Alberta, for processing.

Columbia Gypsum Company Limited, with head office in Vancouver, was incorporated in November 1954, to acquire the assets and business of Columbia Gypsum Products, Incorporated, a Washington corporation, with head offices in Spokane, Washington. The new company continued the operation of the gypsum quarry at Windermere, shipping the crude rock to cement plants at Exshaw, Alberta, and Bamberton, British Columbia. Part of the production is shipped to a company-owned plant at Spokane, Washington, where it is used to manufacture agricultural gypsum and plaster.

Canada Cement Company, Limited obtains gypsum from its quarry at Mayook, British Columbia. Gypsum from this quarry is used in cement manufacture at the company's plant at Exshaw, Alberta.

New Brunswick

Canadian Gypsum Company, Limited produces plaster and wallboard at its plant in Hillsborough. Gypsum rock for this plant is obtained from quarries and adits located in the immediate vicinity.

Newfoundland

Atlantic Gypsum Limited produces plaster and wallboard at a plant in Humbermouth, using gypsum rock obtained from quarries near Flat Bay Station, 62 miles by rail southwest of Humbermouth.

Other Gypsum Processing Plants

Quebec

Gypsum Lime and Alabastine, Canada, Limited operates a plant in Montreal East for the production of plaster and wallboard. Gypsum rock for this operation is obtained from quarries in Nova Scotia.

Canadian Gypsum Company, Limited completed the construction of a new gypsum-products plant in Montreal East early in the year. Crude gypsum rock from Nova Scotia is being used in this plant to produce plaster, wallboard, and lath.

Alberta

Gypsum, Lime and Alabastine, Canada, Limited produces plaster at its plant in Calgary using raw gypsum obtained from company quarries at Falkland, British Columbia.

The British Plaster Board (Holdings) Limited, through its subsidiary Western Gypsum Products, Limited, manufactures plaster and wallboard at a plant in Calgary. Raw gypsum for this plant is obtained from the company's mine at Amaranth, Manitoba.

Uses

Calcined gypsum, commonly known as plaster of paris, is the principal component of plaster and wallboard. Plaster of paris is also used, to a limited extent, in moulding and ceramic work and in the manufacture of special products such as acoustic board, partition tile, fire-resisting walls, insulating tile, etc.

Small quantities of gypsum are added to portland cement during its manufacture. The gypsum acts as a retardant and serves to control the setting time of the cement.

Ground gypsum is sometimes used for soil conditioning and as a fertilizer for black alkaline soils.

Prices

The nominal price of crude gypsum in 1954 was $3.00 to $5.00 per ton f.o.b. quarry or mine. However, large contracts with seaboard quarries were at prices much below these figures.

ANHYDRITE

Production of anhydrite in Canada is limited to quarries where its removal is essential to the continued production of gypsum. Anhydrite is used to a limited extent as a soil conditioner and is a potential source of sulphur compounds.

IRON OXIDES

The production of natural iron oxides, crude and calcined, in Canada declined from 10,308 tons valued at $195,801 in 1953 to 5,799 tons valued at $181,073 in 1954, chiefly as a result of a drop in the demand for crude lump oxide used by producers of manufactured gas in the Montreal area. Output of natural iron oxides was confined to an area just north of Three Rivers, Quebec, in Champlain and Laviolette counties. Total output from Quebec to the end of 1954 amounted to 439,775 tons valued at $5,568,404.

Occurrences in Canada

Quebec

Numerous deposits of iron oxide occur in St. Maurice and Champlain counties northward from Lake St. Pierre and the city of Three Rivers. Some of the deposits have been worked since 1886, and the entire output of natural oxides comes from this area. Some deposits occur on the south shore of the St. Lawrence, opposite Three Rivers, but they are in general shallow and have seldom been worked.

Western Provinces

Bog iron oxide deposits occur near Grand Rapids and Cedar Lake in Manitoba; at Loon Lake, 32 miles from St. Walburg, in Saskatchewan; at Alta Lake and near the Pend d'Oreille River in southern British Columbia, and in the Peace River district of Alberta. However, they are not of economic interest at present.

Producers in Canada

Shipments of crude, air-dried iron oxide, used as a purifying agent in the manufacture of illuminating gas, were made by two operators in 1954. Charles D. Girardin worked deposits at Almaville in Laviolette county and at St. Louis de France in Champlain county. Mrs Thomas H. Argall made shipments from a deposit at Les Forges in St. Maurice county. Other bogs north of Three Rivers have been operated intermittently for many years. Exploitation of bog iron deposits to supply the needs for coal-gas manufacture is governed by the low market value of the product and distance from consuming plants.

Sherwin-Williams Company of Canada, Limited, the sole producer of 'natural' calcined iron oxide in Canada, operates two bogs and a calcining plant (at Red Mill) in Champlain county. The lump bog ore is calcined at high temperatures and then finely ground in ball mills. The calcination product is used in making paint and as a pigment for other purposes.

Northern Pigment Company Limited, New Toronto, manufactures synthetic iron oxides from scrap iron by the ferrite process for domestic consumption and export. The product from the chemical reaction, a yellow iron oxide ($Fe_2O_3H_2O$), is washed, dried, and ground for marketing as such, or calcined to produce red iron oxides.

Uses

Crude air-dried iron oxide is used to remove hydrogen sulphide from manufactured coal gas. It is a low-priced commodity and sells for about $4.50 a ton at the 'mine'.

Iron oxide pigments are used as colouring agents in paints, linoleum, floor tile, oilcloth, wood stains and fillers, cement, stucco, mortar, and brick. They are used as colouring agents and fillers in imitation leather, shade cloth, shingle stain, paper, and cardboard. Finely ground, grit-free iron oxides are used in the manufacture of jewellers' rouge for polishing plate glass, optical glass, and metal. Siennas and umbers are used primarily in wood stains and fillers.

Production, Trade, and Consumption

	1954		1953	
	Short Tons	$	Short Tons	$
Production (sales)				
Natural (crude and calcined)...........	5,799	181,073	10,308	195,801
Imports, ochres, siennas umbers				
United States........	947	55,664	1,017	62,864
United Kingdom	105	5,754	127	7,336
Other countries	-	-	27	1,364
Total	1,052	61,418	1,171	71,564
Exports, natural and synthetic iron oxides				
United States........	2,741	360,004	2,795	319,814
France	143	22,328	124	19,999
Brazil..............	76	13,853	-	-
Mexico	69	9,601	62	9,696
Other countries	82	15,749	67	10,377
Total	3,111	421,535	3,048	359,886
	1953		1952	
Consumption, specified industries				
Coke and gas industry	7,989	85,579	8,302	81,822
Paint industry				
Calcined and synthetic iron oxide	2,456	450,031	2,441	406,781
Ochres, siennas and umbers	243	54,180	227	49,738

Prices

The Oil, Paint and Drug Reporter lists the price of iron oxides per pound, in carload lots, in the United States at the end of 1954 as follows: Red - 11¢, Black - 12 3/4¢, Brown - 13 1/2¢, Yellow - 10 1/4¢. It was announced that effective May 1, 1955, the above prices, except that of the red which remains the same, would be raised 1/2 cents per pound.

The January 13, 1955, issue of E & M J Metal and Mineral Markets lists ochre, per ton, f.o.b. Georgia mines, at $26.50 and $30.00 in 100-lb. paper bags, and f.o.b. Virginia mines, dark yellow, 300 mesh, 60 per cent ferric oxide, in bags, at $24.50 and $25.50.

Crude air-dried iron oxide in Canada sells for about $4.50 a short ton at the producing bog. Prices for calcined iron oxide in Canada could be obtained from Sherwin-Williams Co. of Canada, Limited in Montreal. Prices would probably be in line with those quoted for the United States.

LIME

Production of lime in Canada in 1954 was virtually unchanged from the previous year, down slightly from the peak established in 1951; 1,227,743 tons of quick and hydrated lime, valued at $14,899,291 were produced from Canadian lime plants compared with 1,228,760 tons valued at $14,484,013 in 1953.

The continued strong demand for lime in Canada is a reflection of this country's industrial growth and of the high level of construction activity. Requirements of the building trades for both finishing and mason's lime increased during the year. A lower consumption in metallurgical uses was offset by increases in the pulp and paper industry.

Six of the ten provinces are producers and all but Prince Edward Island have suitable deposits for the manufacture of lime. In Ontario, Manitoba, and New Brunswick both dolomitic and calcium limes are produced, while in British Columbia, Alberta, and Quebec the output is of the high-calcium variety. There are more than 40 plants in Canada burning limestone in some 150 kilns. The latter range in size from rotary units to small shaft kilns.

In some localities lime is produced by industrial plants for their own use as a raw material in processes such as the manufacture of cyanamide and calcium carbide, and in refining sugar.

Although limestone deposits are widely distributed in Canada, few of the occurrences are suitable for the economic production of a chemical lime high in calcium, low in impurities, and of a white colour.

Lime, a relatively low-priced commodity, is not generally an item of international trade except in a small way where local economic conditions dictate. This is particularly true in Canada where lime produced on the west coast is exported to the United States and similarly on the east coast where it is imported.

Producers

New Brunswick

There are two plants manufacturing lime, namely, Snowflake Lime Limited at Saint John, and Bathurst Power and Paper Ltd., at Bathurst, the latter making lime solely for its own use.

Production, Trade, and Consumption

	1954		1953	
	Short Tons	$	Short Tons	$
Production				
Quicklime	911,320	11,477,825	923,133	11,300,914
Hydrated lime........	316,423	3,421,466	305,627	3,183,099
Total	1,227,743	14,899,291	1,228,760	14,484,013
Production by provinces				
Newfoundland	-	-	160	6,942
New Brunswick	22,533	439,161	21,184	430,226
Quebec	442,626	4,327,965	424,305	4,236,639
Ontario.............	643,001	8,166,710	659,062	7,714,252
Manitoba	35,938	536,906	50,981	787,032
Alberta..............	32,599	493,303	29,263	430,924
British Columbia	51,046	935,246	43,805	877,998
Total	1,227,743	14,899,291	1,228,760	14,484,013
Imports, quicklime				
United States	26,131	282,768	21,415	230,636
United Kingdom	395	6,184	84	2,097
Total	26,526	288,952	21,499	232,733
Exports				
United States.........	30,814	550,983	33,290	543,132
Other countries	4	135	4	131
Total	30,818	551,118	33,294	543,263
Producers' shipments				
Building trades				
Finishing lime	84,553	1,668,020	77,651	1,422,813
Mason's lime	99,819	1,544,509	97,932	1,531,670
Industrial				
Non-ferrous smelters.	163,154	886,127	178,844	1,100,170
Iron and steel plants ..	58,634	659,504	57,917	680,011
Cyanide flotation mills.	26,420	393,290	24,499	345,318
Pulp and paper mills. .	231,088	2,852,658	211,120	2,651,304
Glass works	14,735	142,764	11,861	108,857
Sugar refineries	24,631	305,105	24,956	319,620
Tanneries	5,750	74,857	7,301	88,089
Sand-lime brick	15,445	179,549	14,181	167,806
Insecticides, fungicides	326	2,706	1,898	22,648
Other industries......	450,095	5,532,584	465,936	5,478,839
Agricultural	4,926	95,244	12,310	172,434
Others	48,167	562,374	42,354	394,434
Total	1,227,743	14,899,291	1,228,760	14,484,013

Quebec

Shawinigan Chemicals Limited burns lime at Shawinigan Falls from a high-calcium stone quarried at Bedford, Missisquoi county. The lime is used mainly in making calcium carbide.

Standard Lime Company Limited burns lime at Joliette and at St. Marc des Carrières, Portneuf county. In both cases a high-calcium limestone is quarried locally.

Dominion Lime Limited also produces high-calcium quicklime and hydrated lime from stone quarried at Lime Ridge, Wolfe county.

At Wakefield, about 25 miles north of Ottawa, Aluminum Company of Canada Limited produces quicklime and hydrated lime in the recovery of magnesia from brucitic limestone.

There are seven other small producers in the province.

Ontario

Gypsum, Lime and Alabastine, Canada, Limited, produces quicklime and hydrated lime, both dolomitic and high-calcium. The company has kilns and quarries in operation at Beachville, and near Hespeler and Milton.

North American Cyanamid Limited burns lime at Niagara Falls for use in the production of cyanamide. The stone is quarried at Beachville.

Brunner Mond Canada Limited burns a high-calcium stone at Amherstberg for use in making sodium carbonate.

At Beachville, Chemical Lime Limited produces a high-calcium lump lime for the iron and steel industry.

Six other smaller plants manufacture lime.

Manitoba

A dolomitic limestone is burned at Inwood by Building Products and Coal Company Limited.

Winnipeg Supply and Fuel Company Limited produces a dolomitic lime at Stonewall and a high-calcium lime at Moosehorn.

The Manitoba Sugar Company Limited operates kilns at its Fort Garry plant.

Alberta

Lime is manufactured from high-calcium limestone by Loder's Lime Company Limited at Kananaskis and by Summit Lime Works Limited near Crowsnest, British Columbia.

Three refineries of Canadian Sugar Factories Limited burn lime for their own use.

British Columbia

Pacific Lime Company Limited burns a high-calcium limestone at Blubber Bay, Texada Island. The company has completed a new plant at Vancouver, making lime from Texada Island stone.

Pacific Mills Limited at Ocean Falls burns lime for its own use in making paper.

Uses and Marketing

Lime is marketed as calcium oxide or quicklime and as calcium hydrate, usually referred to as hydrated lime. Approximately 75 per cent of Canadian output is of the former type which is shipped in bulk in lump form or as crushed lime in bulk or containers; a small part is pulverized and shipped in bags. Hydrated lime, the dry slake form, is sold as a fine powder (95 per cent passing 325 mesh), in containers, usually multi-wall bags.

Lime is a common raw material in many industrial processes. Since it is a cheap and plentiful alkali, it is widely used in controlling acidity and as a causticizer. It is used in making calcium carbide and calcium cyanamide, and in the production of soda-ash. For such uses a lime high in calcium and low in impurities is required.

High-calcium lime is important in a number of metallurgical operations. In steel making, by the basic open-hearth process, it is used for removal of sulphur, and it is also used in the electric-furnace manufacture of tool steel. It is used in the cyanidation of gold ores, in flotation of ores of several minerals, and to some extent in the preparation of alumina from bauxite by the Bayer process.

Lime is important in the pulp and paper industry, both as a causticizing agent in sulphate and soda processes and in preparation of calcium bisulphite dissolving liquor.

It is used to remove temporary hardness and turbidity from municipal waters and to neutralize industrial and municipal wastes to reduce stream pollution.

Lime is an important raw material in glass manufacture and in tanning of leather.

In agriculture, it is used to correct calcium deficiency and neutralize acidity in soils, and in the preparation of various insecticides.

In the building industry, its use for plaster, stucco, and mortar is well known. It is also used in lime-sand building bricks, cement, cold water paints, and in some forms of insulation.

Prices

Market prices for 1954 in the Montreal area were the same as in 1953: for hydrated lime, bagged in carload lots - $16.00 to $17.00 per ton; and for lump quicklime - from $10.00 to $11.00 per ton.

LIMESTONE (GENERAL)

Quarry production of limestone in Canada during 1954 decreased slightly from the peak established in 1953; 16,893,375 tons valued at $21,942,204 were produced, compared with 17,461,720 tons at $23,783,230 in 1953. Stone quarried for the manufacture of portland cement and lime is not included in these figures.

Almost all of the Canadian output is marketed in crushed form for a variety of uses. Limestone is important in many industrial processes and is the most widely quarried of all native rocks. Most of it is used as concrete aggregate, road material, and railway ballast. In recent years, much of the increased production has been due to larger requirements for concrete aggregate in the construction industry. The availability of deposits and ease of quarrying are largely responsible for its wide use. The industry is concentrated near the most heavily populated regions of the country and, consequently, Ontario and Quebec account for 85 per cent of production, although limestone is quarried in all provinces except Prince Edward Island and Saskatchewan. The latter province has a few undeveloped deposits.

Limestone occurs in this country in two forms; in bedded formations, which yield most of the production, and in massive metamorphosed deposits. Its chemical composition varies from high-calcium through magnesian to dolomite. Deposits of siliceous and argillaceous varieties occur, as well as brucitic limestone and magnesitic dolomite. Deposits of the last two varieties are currently worked. High-calcium limestone, sufficiently pure to provide industry with an important raw material for use in certain chemical and metallurgical processes, is available in only a few areas.

Because of its abundance and low cost there is virtually no international trade in limestone. However, on the Pacific coast where geographic and economic conditions are favourable, it is exported to the United States for use in the manufacture of pulp and paper and as metallurgical flux.

Production and Consumption

	1954 Short Tons	1953 Short Tons
Production by provinces		
Newfoundland	368,747	391,617
Nova Scotia	68,816	79,524
New Brunswick	129,500	129,503
Quebec	6,271,382	7,232,775
Ontario	8,088,771	8,390,852
Manitoba	1,138,779	374,869
Alberta	19,460	18,833
British Columbia	807,920	843,747
Total tonnage	16,893,375	17,461,720
Total value	21,942,204	23,783,230
Production by uses		
Structural*		80,299
Metallurgical		1,441,577
Glass making		32,789
Sugar refining		11,137
Pulp and paper		398,541
Other chemical uses		37,702
Pulverized, agricultural and fertilizer		510,547
Pulverized, other		104,258
Rubble and riprap		423,639
Concrete aggregate		6,747,666
Road metal		6,755,240
Rail ballast		888,258
Other uses		30,067
Total tonnage	16,893,375	17,461,720
Total value	21,942,204	23,783,230
Manufacture of cement	5,436,225	5,330,778
Manufacture of lime	2,126,102	2,163,427

* Includes building, monumental, and ornamental stone, flagstone, and curbstone.

Uses

Of the limestone quarried in Canada, 82 per cent is used as aggregate in concrete, road building material, and rail ballast.

Limestone is important to the metallurgical industry as a flux in furnace operations, especially in the making of iron and steel. For the latter use, a stone low in silica and high in calcium is generally required. It also finds a market in the pulp and paper industry in the preparation of calcium bisulphite liquor; higher-calcium varieties low in insolubles are preferred. It is also important in the manufacture of glass and in sugar refining. It is marketed in ground form as a filler in several industrial processes and for use in agriculture as a soil amendment. In the latter case it is applied directly to the land to overcome calcium and magnesium deficiencies and to correct soil acidity. Canadian sales of agricultural limestone during 1953 amounted to $1,242,665.

High-purity dolomite quarried near Haley, Ontario, is used in the thermal ferrosilicon process as a source of magnesium metal. The latter is also made by a different process from magnesia obtained from brucitic limestone quarried near Wakefield, Quebec.

Dolomite is quarried and dead-burned at Dundas, Ontario, by Steetly of Canada Limited for use as a refractory material in basic open-hearth steel furnaces. In 1954, the company put into operation a modern, rotary-kiln, dead-burning plant to replace a shaft kiln.

Magnesitic dolomite is mined at Kilmar, Quebec, and used in the manufacture of basic refractories. These are also made from magnesia recovered from brucitic limestone quarried near Wakefield, Quebec.

Limestone is the raw material used in the production of lime and is an important raw material in the manufacture of portland cement.

Geographical location, quality, and use all affect the price of limestone. As a commercial stone used as concrete aggregate, the price at the quarry is as low as $1.50 per ton.

LIMESTONE (STRUCTURAL)

Canadian production of structural limestone in 1954 showed a slight increase over the previous year; 83,174 tons valued at $2,451,584 were produced compared with 77,599 tons at $2,339,322 in 1953. Increases were noted in Ontario and Manitoba while Quebec reported a slight decrease. Apart from these three provinces, a small amount of stone is quarried in Newfoundland and New Brunswick.

The principal market for structural limestone in present-day construction is in the larger types of buildings, where it is used as exterior facing, and for entrances, window sills, lintels, etc. For such uses the stone is quarried as mill blocks and prepared in slabs and other shapes cut to accurate dimensions to enable the stone to be set in place without further dressing. When used for facing, the slabs may be as large as 4 feet wide by 2 feet high and vary from 4 to 8 inches in thickness. For such sections the stone must be heavily bedded, free from cracks, fissures, and other flaws, and be easily worked. Durability is necessary to resist the climatic conditions experienced during the Canadian winter season and texture and colour must be pleasing.

Stone for the larger types of buildings is quarried in rough blocks which may weigh as much as ten tons and which are sawn into slabs in dressing sheds, either at the quarry or elsewhere. These slabs are cut and shaped to the exact dimensions required by the builder. Few occurrences of limestone in Canada are suitable for this use. There is a small production of hand-trimmed stone to provide facing, sills, etc., for use in residential and small building construction.

Most of the structural limestone produced in Quebec is quarried at St. Marc des Carrieres, Portneuf county. The stone has a pleasing grey colour and finds a market in eastern Ontario and Quebec. There are three firms operating, each possessing a dressing plant for production of finished stone. In the Montreal area, several small quarries are producing hand-trimmed stone for residential construction.

A heavily bedded section of the Lockport formation is quarried near Queenstone, Ontario, for the production of mill blocks. This stone is in silver grey, and variegated buff and grey colours and is widely used in Eastern Canada in the construction of large public buildings.

There are three quarries operating near Tyndall, Manitoba, thirty miles northeast of Winnipeg. The stone is unique, possessing a distinctive mottling in buff and grey and is used both in exterior and interior work. It is sometimes polished to a pleasing finish for use as an interior decorative stone.

Apart from stone produced in Canada, a considerable quantity of Indiana limestone is imported in the form of rough blocks and finished in Canadian dressing plants. Small imports are also received from the United Kingdom.

Prices

The price of structural limestone in quarry blocks depends upon size, grade, texture, and colour of stone, and on quarry location. Domestic stone is marketed as low as $1.20 per cubic foot and imported stone varies between $1.00 and $1.75 per cubic foot at the quarry site.

Production and Trade

	1954		1953	
	Short Tons	$	Short Tons	$
Production				
Rough	43,603	344,338	37,384	477,042
Dressed	39,571	2,107,246	40,215	1,862,280
Total	83,174	2,451,584	77,599	2,339,322
Pr oduction by provinces				
Newfoundland	470	1,848	-	-
New Brunswick	150	300	150	300
Quebec	24,224	1,449,875	27,582	1,447,513
Ontario	53,766	623,641	45,427	564,998
Manitoba	4,564	375,920	4,440	326,511
Total	83,174	2,451,584	77,599	2,339,322
Imports, building stone				
United States	34,605	653,751	30,371	580,603
United Kingdom	125	6,666	615	13,789
Italy	-	-	14	742
Total	34,730	660,417	31,000	595,134
Exports, building stone, unwrought				
All to United States	228	8,492	105	2,217

MAGNESITE AND BRUCITE

Production of calcined brucite granules and magnesitic dolomite was virtually unchanged from 1953. Production statistics for these minerals include the value of Quebec's output of metallic magnesium and were $4,008,678 in 1954 compared with $3,056,392 in 1953. The increase resulted from greater production of magnesium metal.

The only deposits being worked for magnesia are in the province of Quebec, north of the Ottawa River. At Kilmar in Argenteuil county, Canadian Refractories Limited mines magnesitic dolomite, a rock which is an intimate mixture of magnesite and dolomite. The mine output is beneficiated to control impurities, calcined in a rotary kiln to a dead-burned clinker from which a number of basic refractory products are manufactured. The company also operates a plant for the production of basic brick at Marelon, ten miles south of Kilmar, near the Ottawa River. Refractory products manufactured from this raw material include basic bricks of various sizes and shapes, high-temperature cement, ramming mixtures, and other specialized products.

Production and Trade

	1954		1953	
	Short Tons	$	Short Tons	$
Production[1]				
Magnesitic dolomite and brucite		4,008,678		3,056,392
Imports				
Dead-burned and caustic calcined magnesite				
From: United States	3,545	263,021	6,711	389,893
United Kingdom ...	53	9,834	90	8,426
Other countries....	2,518	133,045	-	-
Total	6,116	405,900	6,801	398,319
Magnesite fire-brick				
From: United States		390,692		954,861
United Kingdom....		6,881		-
Total		397,573		954,861
Magnesia alba and levis				
From: United States	5,869	275,193	3,220	225,055
United Kingdom....	162	64,698	116	47,512
Other countries ...	67	2,681	18	1,020
Total	6,098	342,572	3,354	273,587
Magnesia pipe covering				
From: United States		104,399		160,729
United Kingdom....		35,157		26,324
Total		139,556		187,053
Magnesium sulphate				
From: West Germany....	1,367	27,970	1,660	33,378
United States	867	36,551	998	42,159
United Kingdom....	75	4,350	70	4,425
Netherlands.......	56	1,503	33	923
Total	2,365	70,374	2,761	80,885
Magnesium carbonate and magnesium oxide				
From: United States	5,628	479,125	5,999	551,198
United Kingdom....	400	55,835	306	45,352
Total	6,028	534,960	6,305	596,550

(1) Does not include value of secondary products such as refractories but does include value of magnesium metal produced in the province of Quebec.

	1954		1953	
	Short Tons	$	Short Tons	$
Exports				
Basic refractory materials, dead-burned				
To: United States	4,694	361,984	4,015	277,931
Brazil	1,969	118,127	-	-
Other countries.....	1,224	57,431	586	27,764
Total............	7,887	537,542	4,601	305,695

Hydromagnesite occurrences near Atlin and Clinton, British Columbia, have been worked intermittently.

A deposit of brucitic limestone is quarried by Aluminum Company of Canada, Limited at Farm Point near Wakefield, Quebec, 22 miles north of Ottawa. The mineral brucite, a hydroxide of magnesium, occurs as granules in a matrix of calcite. Quarry output is crushed, sized, calcined, and separated into marketable forms of magnesia and lime. Both quick and hydrated lime are produced. Part of the magnesia is used by the company at Arvida, Quebec, in the production of magnesium metal. The remainder is marketed as magnesia for the manufacture of high-magnesia basic refractories, as a soil additive, and for other purposes. The lime is marketed both for building and industrial uses.

Other occurrences of brucitic limestone are known in Canada in the vicinity of Wakefield and Bryson, Quebec, Rutherglen in Ontario, and on West Redonda Island, British Columbia.

Although magnesite and hydromagnesite deposits occur at several locations in Western Canada, mostly in British Columbia and Yukon, they are generally not extensive or are remote from transportation and consequently are not worked. The more important of these occurrences are at Marysville, near Cranbrook, British Columbia, and are owned by The Consolidated Mining and Smelting Company of Canada, Limited.

Uses

Magnesia is a raw material for the production of magnesium metal and of basic refractories. It is used in the preparation of oxysulphate and oxychloride cement. The latter is formed by the reaction of active magnesia with a solution of magnesium chloride, forming a durable cement used principally as a floor covering. It is also used to prepare magnesium bisulphite dissolving liquor for the treatment of wood pulp. In the latter process of pulp making, it is possible to recover most of the magnesia and sulphur for re-use. Other uses for magnesia are in the preparation of a number of magnesium chemicals and compounds for use in the pharmaceutical trade and in industry, in soil additives, and to control acidity. An example of the last is its use in neutralizing sulphuric acid solutions where it forms a compound more soluble than that obtained with lime.

MARBLE

There was virtually no change in Canadian marble production during 1954; 57,480 tons valued at $564,975 were produced compared with 59,655 tons valued at $546,991 in 1953. Output is marketed principally in crushed or ground forms for use in terrazzo flooring, stucco dash, artificial stone, poultry grit, and the manufacture of whiting substitute. Crushed marble is also used by the pulp and paper industry in preparing dissolving liquor.

In Quebec, there is a small output of quarry blocks to provide ornamental stone for building construction. For this use the stone is sawn, matched, shaped, and polished. Three quarries produce mill blocks, one of which commenced operations during the year. Canadian production of such marble is only a small part of the country's requirements and the domestic market is mainly supplied by imports from Italy and the United States in the form of mill blocks or sawn slabs which are finished in Canadian marble dressing plants.

Production

	1954		1953	
	Short Tons	$	Short Tons	$
Quebec	25,523	294,553	28,319	284,846
Ontario	31,957	270,422	31,336	262,145
Total	57,480	564,975	59,655	546,991

Imports, 1954*
(Dollars)

	United States	Italy	Other	Total 1954	Total 1953
Rough marble	49,916	118,291	11,058	179,265	131,075
Sawn marble	71,017	170,283	13,521	254,821	206,706
Marble for tombstones	38,913	-	-	38,913	56,763
Marble manufactures	17,463	25,884	5,822	49,169	32,245
Ornamental marble for churches................	1,290	133,777	845	135,912	132,207
Total	178,599	448,235	31,246	658,080	558,996

* Imports of mosaic flooring material, part of which is marble, were valued at $305,700 in 1954 compared to $243,286 in 1953.

Canadian Marble Quarries

Quebec

Missisquoi Stone and Marble Company Limited quarries a clouded grey marble at Phillipsburg near Lake Champlain. This is the largest marble quarry in Canada and its products include mill blocks, sawn slabs, and finished marble. In addition, quarry and mill waste are crushed and sized for use as terrazzo chips and poultry grit.

Near North Stukely, in Shefford County, the Oxford Marble Company Limited works an occurrence of serpentine marble in red, green and grey. Both mill blocks and terrazzo chips are produced. This marble has been used in recent years as an interior decorative stone in several public buildings.

Near St. Denis de Brompton, Richmond County, the Green Marble Quarry Company opened a deposit of green marble in 1954 for the production of mill blocks. The stone polishes well, and two distinct marbles, one of which is a breccia, are being offered to the market.

At Portage du Fort, Pontiac County, Canadian Dolomite Company Limited quarries a white crystalline variety of dolomite which is crushed and sized for the production of terrazzo chips, stucco dash, artificial stone aggregates, and similar products. South Stukely Marble and Terrazzo Company and Delbo Incorporated, North Stukely, both in Shefford County, produce white marble for similar purposes.

Ontario

Silvertone Black Marble Quarries Limited, St. Albert Station, southeast of Ottawa, produces a black marble in the form of terrazzo chips. Marble from this location has been quarried as mill blocks for use as an ornamental building stone.

Terrazzo chips in red, pink, buff, green, black, and white are produced by Stocklosar Marble Quarries from deposits in the vicinity of Madoc, Hastings County, and by Pulverized Marble Products Limited, whose plant is located at Kaladar in Lennox and Addington county. The latter company also quarries a crystalline dolomite at Kaladar for the production of plaster aggregate and other uses.

Bolenders Limited, north of Haliburton at Eagle Lake, produces poultry grit and stucco dash from a crystalline limestone.

Other Occurrences in Canada

There are a number of undeveloped occurrences of highly coloured marbles in Manitoba along the Hudson Bay and the Flin Flon branches of the Canadian National Railways and at Fisher Branch, 100 miles north of Winnipeg. Other deposits exist in British Columbia.

Prices

The price of marble varies widely and is affected by use, quality, colour, and figure.

MICA

There was a marked recession in the mica producing industry in Canada in 1954, the reduced volume being attributed to lower consumption in industries and severe competition from other producing countries, notably Madagascar, now the principal world source of phlogopite.

Primary production (sales) of mica of all classes declined 34 per cent in volume and 44 per cent in value in 1954 below 1953. Unmanufactured exports fell 61 per cent in volume and 69 per cent in value, while imports, including manufactures fell 37 per cent in value in the same period.

Phlogopite production in Canada comes from the general Ottawa region in adjacent portions of Quebec and Ontario. Quebec is by far the larger producer. There was no reported production of muscovite during the year. Mica schist continued to be mined near Albreda, British Columbia.

Producers

Quebec

Templeton and Wakefield townships supplied a large part of the Quebec output with Buckingham, Wentworth, and Amherst townships making substantial deliveries. E. Wallingford Limited, Perkins, continued to be the principal producer.

Ontario

Production in Ontario came from North Burgess and Bedford townships. J. C. Donnelly and Peter Farrel, Stanleyville, and Oliver Marks, Sydenham, were the principal producers.

British Columbia

Geo. W. Richmond Company Limited and Fairey and Company Limited, both of Vancouver, continued to grind mica schist, mined near Albreda, for the roofing trade.

Uses and Properties

Mica is used in three principal forms, namely, natural sheet, splittings, and ground mica.

Natural Sheet

Sheet mica is used principally for electrical insulation in a wide variety of electrical machines, instruments, lighting and power fixtures, and industrial and household appliances; in electronic equipment such as radios, television and sound-recording equipment; as the dielectric in capacitors; and as a glaze for compass dials, boiler gauges, furnace observation holes, and lamps.

Production, Trade, and Consumption

	1954		1953	
	Pounds	$	Pounds	$
Production (primary sales)				
Trimmed			50,933	65,949
Splittings			8,289	16,568
Sold for mechanical splittings			168,537	30,521
Rough, mine-run or rifted			62,744	5,310
Ground or powdered			664,741	25,236
Scrap			1,309,884	17,544
Total	1,503,229	90,479	2,265,128	161,128
Imports (including manufactures)				
United States		395,122		472,004
India		43,666		231,519
United Kingdom		14,417		16,021
Total		453,205		719,544
Exports, unmanufactured				
Rough				
United States	60,200	12,647	240,500	43,704
Trimmed				
Japan	16,800	18,884	57,800	55,775
United States	600	2,699	21,600	37,785
Total	17,400	21,583	79,400	93,560
Scrap				
United States	453,600	6,241	1,354,700	19,583
Ground				
United States	200,000	12,000	320,000	19,158
France	40,000	1,319	-	-
Total	240,000	13,319	320,000	19,158
Total unmanufactured mica	771,200	53,790	1,994,600	176,005
Exports, mica manufactures				
United States		2,335		123
Brazil		512		-
Total		2,847		123

	1953	1952
	Pounds	Pounds
Consumption		
Roofing	836,000	782,000
Wallpaper	62,500	98,000
Electrical apparatus	498,433	520,957
Rubber goods	364,685	308,795
Paints	1,686,228	1,503,321
Mica products	106,801	62,203
Asbestos products	32,698	40,155
Coal-tar distillation	192,000	108,000
Miscellaneous	6,976	640
Total	2,786,321	3,424,071

Sheet mica is sold commercially according to variety, size, and quality and is selected by the manufacturer according to its intended application.

Muscovite (potassium mica) of superior quality possesses the best dielectric properties of all the micas and is used extensively for insulation at high frequencies and high voltages and for capacitors. Because of its high mechanical strength, and transparency it is favoured also for glazing.

Phlogopite (magnesium or amber mica) varies considerably as regards dielectric strength, hardness, structural strength, and other properties but its electrical properties are such that it finds wide acceptance as an insulator in a variety of electrical installations at normal industrial and domestic frequencies and voltages. Its high thermal resistance makes it suitable for use under high-temperature conditions, as in heaters, toasters, flat irons, etc. and its softness, as compared to muscovite, makes it particularly suitable for flush commutators in which the copper and mica segments are required to wear at the same rate.

Biotite (iron or black mica) has comparatively low dielectric strength and is somewhat brittle. However, it finds limited application as insulation in low-powered fixtures and appliances.

Splittings

Mica splittings are used in the manufacture of built-up sheet in which the mica is bonded with natural or synthetic resins of suitable dielectric properties, baked, and pressed into sheets of any required size. Either muscovite or phlogopite may be employed, according to end use. Splittings are used similarly in the manufacture of mice tape, cloth, and paper, and are cut or moulded into washers, tubes and many other forms.

Built-up mica sheet is used, within the limits of its dielectric characteristics, in place of natural sheet, particularly in cases where large size would make the use of natural sheet uneconomical.

Ground Mica

Mica may be ground wet or dry according to use.

Dry ground mica is usually lower grade, off-colour material, mainly muscovite and phlogopite but to some extent biotite, and is used principally in the roofing trade as a backing for asphalt tile and tar paper. It is also used for moulded high-frequency insulation in which the mica is bonded with ceramic binders to form a compound which may be pressed into any desired shape. Other uses are in protective coatings and to a limited extent in grease lubricants.

Wet ground mica is prepared mainly from good quality muscovite scrap chiefly for the paint, rubber, and wallpaper trades. White products are preferred. In paint, wet ground mica serves as a pigment and extender; in rubber, as a dusting agent and lubricant on tire walls, and as a filler in hard rubber. In wallpaper it is used to produce decorative effects. Wet ground biotite also is used as a lubricant in rubber tire manufacture.

A new form of mica insulation is now being prepared in United States from muscovite scrap treated by a chemical process. The resulting pulp is formed into a continuous sheet by methods similar to those used in the manufacture of paper.

Specifications

Natural Block Muscovite

Size and quality gradings for block muscovite in general use in Canada and United States conform generally to those adopted by the American Society for Testing Materials (Designation 351-49T). Grade sizes are shown in the following table:

A.S.T.M. grade sizes	Area of max. rectangle	Minimum dimension of one side
	Sq. inches	Inches
OOEE Special	100 and over	4
OEE Special	80 to 100	4
EE Special	60 to 80	4
E Special	48 to 60	4
A-1 (Special)	36 to 48	4
No. 1	24 to 36	3
No. 2	15 to 24	2
No. 3	10 to 15	2
No. 4	6 to 10	1 1/2
No. 5	3 to 6	1
No. 5 1/2	2 1/4 to 3	7/8
No. 6	1 to 2 1/4	3/4

O = Over E = Extra

A.S.T.M. specifications for the quality-grading of block muscovite provide for six grades as follows: clear, clear and slightly stained, fair stained, good stained, stained, heavy stained, and black stained and spotted. In all grades except the last (black stained and spotted) the mica must be free from mineral inclusions and in all but the last two, free from mineral inclusions and cracks.

Natural Phlogopite Sheet

In Canada, size gradings for phlogopite sheet conform generally to those applying to muscovite but are expressed in terms of linear dimensions (in inches), the following grades being in common use: 1 x 1 and 1 x 2, 2 x 3, 2 x 4, 3 x 5, 4 x 6, 5 x 8 and larger.

No formal quality grading which applies specifically to phlogopite has been established but, in general, the soft, light-coloured varieties are regarded as having the best electrical qualities. These grade down to the darker, more brittle varieties in the lower grades. The terms "light amber", "medium amber", and "dark amber" are commonly used in reference to quality.

Ground Mica

There are no specifications for ground mica common to the industry. A.S.T.M. (Designation D607-42), however, specifies the requirements for mica pigment.

Dry-ground mica is sold for roofing purposes in sizes ranging from 8-mesh to under 200-mesh according to individual requirements.

Wet-ground mica (which has not been produced in Canada up to the present) is sold in United States and Canada at minus 160-mesh for rubber and minus 200-mesh for paint and wallpaper. In general, wet-ground muscovite must be white or nearly so.

Since covering power is one of the dominant properties of finely divided mica, low bulk density is usually specified. For dry-ground roofing mica a bulk density of about 17 pounds per cubic foot may be specified. A.S.T.M. (D607-42) specifies 10 pounds per cubic foot for mica pigment.

Markets

Mica purchasers in Canada and United States, classified according to their requirements, include the following:

Canada

All grades

Walter C. Cross, 209 Eddy St., Hull, P.Q.
Blackburn Bros., Limited, 85 Sparks St., Ottawa, Ont.

Block

Mica Company of Canada Limited, 4 Lois St., Hull, P.Q.
Geo. P. Dowe, Co., Limited, P.O. Box 505, Richmond Hill, Ont.

Scrap

Geo. W. Richmond, 4190 Blenheim St., Vancouver, B.C.
Fairey and Company, 661 Taylor St., Vancouver, B.C.

United States

Muscovite & Phlogopite - all grades

Minerals & Insulation Co., 53 Central Avenue, Rochelle Park, N.Y.
American Mica Insulation Co., 410 Frelinghuysen Ave., Newark 5, N.J.
Ashville Mica Company, Newport News, Va.

Muscovite & Phlogopite Block

Hal Delphin & Co., 880 Bergen Ave., Jersey City 6, N.J.
Industrial Mica Corporation, 223 South Van Brunt St., Eaglewood, N.J.
Blanchard Mica Inc., 2315 Broadway, New York 24, N.Y.

Muscovite Block

Ford Radio & Mica Corp., 536-540 63rd St., Brooklyn, N.Y.
Gillespie-Rogers-Pyatt Co., Inc., 75 West St., New York, N.Y.
Reliance Mica Co., 341-351 39th St., Brooklyn 32, N.Y.
Farnham Manufacturing Co., Ashville, N.C.
Manchard Trading Corp., 2315 Broadway, New York 24, N.Y.
Spruce Pine Mica Company, Spruce Pine, N.C.
Micacraft Products Inc., 710 McCarter Highway, Newark 5, N.Y.

Phlogopite Splittings

The Macallen Company, Macallen St., Boston 27, Mass.
New England Mica Company, Waltham 54, Mass.
Continental Diamond Fibre Co., Valparsiso, Ind.

Muscovite Scrap

Hayden Mica Company, Wilmington, Mass.
F.D. Pitts Company, 85 Chestnut Hill Road, Newton 67, Mass.

Phlogopite Scrap

U.S. Mica Company, Jordan and Van Dyke Streets, East Rutherford, N.J.
Electronic Mechanics Inc., 101 Clifton Blvd., Clifton, N.J.

Prices

Prices offered for trimmed sheet phlogopite by Ottawa region dealers at the close of 1954 were virtually unchanged from 1953 and were approximately as follows:

Size inches	Per Pound $
1 x 1 and 1 x 2	0.40 - .60
1 x 3	0.75
2 x 3	1.00
2 x 4	1.40
3 x 5	2.00
4 x 6	2.50
5 x 8	3.00

Clean scrap phlogopite sold up to about $25 per ton delivered at plant. Scrap muscovite sells for about $25 to $30 per ton f.o.b. shipping point, when available.

E. and M.J. Metal and Mineral Markets of December 16, 1954, quoted without change from December 1953 as follows:

North Carolina, clear sheet -

Size inches	Per Pound $
1 1/2 x 2	0.70 to 1.60
2 x 2	1.10 to 1.60
2 x 3	1.60 to 2.00
3 x 3	1.80 to 2.30
3 x 4	2.00 to 2.60
3 x 5	2.60 to 3.00
4 x 6	2.75 to 4.00
6 x 8	4.00 to 8.00

Tariffs

Canada

	British Preferential	Most Favoured Nation	General
Mica, phlogopite and muscovite, unmanufactured in blocks, sheets, splittings, films, waste and scrap..............	10%	10%	25%
Mica schist	free	free	free

United States

Mica, unmanufactured (not including waste or scrap), valued per lb.:	
Not over 15¢	4¢ per lb.
Over 15¢	2¢ per lb. and 15% ad val.
Mica, cut or stamped to dimension, form or shape	40% ad val.
Mica films and splittings, not cut or stamped to dimensions, and in thickness:	
Not over 0.0012 inch	12 1/2% ad val.
Over 0.0012 inch	20% ad val.
Mica films and splittings cut or stamped to dimension	22 1/2% ad val.
Mica plates and built-up mica, and all manufactures wholly or in chief value of mica	25% ad val.
Untrimmed phlogopite mica from which no rectangular piece over 2 inches long or 1 inch wide may be cut	5% ad val.
Mica waste and scrap valued per lb.	
Not over 5¢	
Phlogopite	12 1/2% ad val.
Other	15% ad val.
Over 5 but not over 15¢	4¢
Over 15¢	2¢ /lb + 15% ad val.
Mica, ground or pulverized	12 1/2% ad val.

NOTE: Tariff schedules are subject to change at any time and should be verified through a customs agency at time of shipment.

NEPHELINE SYENITE

Shipments of nepheline syenite in Canada in 1954, continuing the steady growth that has characterized the industry since its inception nearly twenty years ago, rose to another record of 123,669 short tons, an increase of 9 per cent over 1953. Of the total, glass grade accounted for 70 per cent, pottery grade 22 per cent, and crude 13 per cent. Exports, mostly to the United States, rose 10 per cent over 1953 to 83,952 tons and accounted for 68 per cent of total shipments.

Production was confined to American Nepheline Limited, Lakefield, Ontario, sole producer of ceramic-grade nepheline syenite in the western hemisphere, operating extensive deposits on Blue Mountain, near Nephton, Methuen Township, Peterborough County, Ontario.

A 16-mile spur line of the Canadian Pacific Railway, connecting Nephton with the main line at Havelock, was put into operation on December 20, 1954. This eliminates much of the trucking formerly required between Nephton and Lakefield.

Other Occurrences

Deposits of nepheline syenite occur elsewhere in Ontario: near Bancroft, Hastings county; Gooderham, Haliburton county; in the French River area, Georgian Bay district; and at Fort Caldwell, Thunder Bay district. In Quebec, nepheline syenite occurs in the Labelle-Annonciation and other areas, and in British Columbia in the Ice River district near Field.

Canada and Russia are the only important producers of nepheline syenite. Canada is the sole source of high-grade ceramic material.

Uses and Specifications

Nepheline syenite is used widely in the ceramic industry, replacing feldspar as a source of alumina and the alkalis in the manufacture of glass, pottery, enamels, floor and wall tile, refractory cements, porcelain balls and liners, and other ceramic products. About two-thirds of the annual Canadian output is consumed by the glass industry. Low-grade material finds a limited market for use in cleansers and certain clay products. Finely divided material now available has been suggested for use as a pigment extender for paint, as a filler for plastics and rubber, and as an inert carrier for insecticides.

To be of commercial interest nepheline syenite must be amenable to treatment for the removal of iron-bearing impurities such as tourmaline, hornblende, magnetite, and biotite, so that the iron oxide content can be reduced to a maximum of about 0.08 per cent. Finely divided iron impurities often cannot be removed by ordinary dry methods and are frequently the cause of rendering otherwise promising deposits useless for commercial purposes.

Production, Trade and Consumption

	1954 Short Tons	1954 $	1953 Short Tons	1953 $
Production, crude				
(ore transported to storage)	159,885		160,918	
Shipments				
Ground				
Glass grade	86,098		80,677	
Pottery grade	27,365		22,577	
Miscellaneous	8,639		8,918	
Total	122,102		112,172	
Crude	1,567		1,173	
Total Shipments	123,669	1,770,528	113,345	1,576,271
Exports, crude and processed materials				
To: United States	79,967	1,197,031	72,031	1,044,978
Netherlands	1,658	29,841	551	9,922
United Kingdom	824	14,776	585	10,483
Puerto Rico	800	14,000	2,700	45,900
Other countries	703	13,450	508	9,498
Total	83,952	1,269,098	76,375	1,120,781

	1953 Short Tons	1952 Short Tons
Consumption		
Glass	14,545	11,042
Pottery	1,273	1,125
	15,818	12,167

Mesh sizes of nepheline syenite products sold in Canada are: glass grade, minus 28-mesh; pottery grade, minus 200-mesh and finer.

Prices and Tariffs

Prices of processed nepheline syenite at the close of 1954 were as follows:

Bulk, carload lots, f.o.b. shipping point (Nephton or Lakefield)

Glass grade	28-mesh	-	$14.50
Pottery grade	200-mesh	-	18.50
" "	270-mesh	-	19.00
B grade	100-mesh	-	10.00

Add $3.00 per ton in bags

A-400 (all minus 325-mesh)	bulk	-	$24.00
	bagged	-	28.00

Nepheline syenite, all classes, enters the United States free of duty.

PHOSPHATE

There was no production of phosphate in Canada in 1954. Excepting for a small, sporadic output, production in Canada ceased about 60 years ago with the development of large sedimentary deposits in the United States. Past production in Canada, which reached a maximum of over 30,000 tons per annum in 1890, came chiefly from the Gatineau-Lièvre River district in Quebec and from the Perth district in Ontario.

During the year Multi-Minerals Limited, Toronto, continued exploration of a large magnetite-apatite property near Nemegos, Ontario.

Eastern Canadian requirements of phosphate rock are obtained chiefly from Florida. Supplies for western plants come mainly from Montana. Imports in 1954 reached an all-time high of 644,860 short tons, an increase of 12 per cent over 1953.

Uses

Most of the phosphate rock imported into Canada is used for the manufacture of commercial fertilizers, chiefly superphosphate, made by treating the raw material with sulphuric acid. In the United States, phosphate fertilizers of the slag or calcined type are produced on a limited scale. Finely ground phosphate rock is used to some extent for direct application to the soil.

Phosphate rock is the chief source of elemental phosphorus, compounds of which are widely used in the manufacture of detergents, flame retardants, water softeners, pigments, opacifiers, food preservatives, pharmaceutical preparations, livestock feed supplements, leavening agents, flotation reagents, rodent poisons, fireworks, matches, and many other products.

Production, Trade, and Consumption

	1954		1953	
	Short Tons	$	Short Tons	$
Imports				
Phosphate rock				
From: United States	625,756	4,192,358	565,300	3,659,858
Netherlands Antilles	11,200	273,840	11,200	291,460
Other countries	7,904	111,435	-	-
Total	644,860	4,577,633	576,500	3,951,318
Superphosphate & phosphate fertilizers				
From: United States.......	198,853	4,249,270	200,311	3,986,386
Other countries	6,530	189,940	4,277	199,898
Total	205,383	4,439,210	204,588	4,186,284
Phosphoric Acid				
From: United States.......	350	57,111	422	57,767
United Kingdom	(lbs.)760	290	-	-
Total	350	57,401	422	57,767

	1953 Short Tons	1952 Short Tons
Consumption		
Phosphate rock		
Fertilizers	416,714	418,495
Heavy chemicals	78,408	65,394
Pig-iron	532	671
Stock & poultry feeds	15,986	17,615
Miscellaneous non-metallic mineral products	9,450	9,582
Total	521,090	511,757

Ferro-phosphorus is used in the manufacture of iron castings to increase fluidity in the melt and in the manufacture of structural steel to increase strength. Phosphorus is used as a deoxidizer and hardening agent in copper alloys.

Specifications

Because of its open texture, sedimentary phosphate rock is preferred for acid treatment to the compact, crystalline apatite. The tri-calcium phosphate (B.P.L.) content should approach 80 per cent.

For furnace treatment, apatite should contain a minimum of 70 per cent tri-calcium phosphate. Size specifications call for a minimum of 80 per cent on 10-mesh.

Apatite for furnace treatment is purchased by Electric Reduction Company, Limited, Buckingham, Quebec.

Prices and Tariffs

Prices quoted by United States journals at the close of 1954 were unchanged from the previous year; Florida pebble phosphate, f.o.b. mine, ranged from $3.95 to $7.00 per long ton for material grading from 66 to 77 per cent, B.P.L.

Domestic apatite lump from the Ottawa region when available, sells for about $16.00 per short ton delivered at plant.

Phosphate rock is not dutiable under the Canadian tariff.

ROOFING GRANULES

Total consumption of roofing granules, used in making asphalt roofing and siding, amounted to 133,917 tons valued at $3,563,578 in 1954, according to figures supplied to the Mines Branch by manufacturers. In 1953, the previous peak consumption year, comparative figures were 127,011 tons valued at $3,414,318 (f.o.b. consuming plant).

Imports, all from the United States, reached a record high of 104,865 tons compared to 88,924 tons in 1953. Of the total imports, 86,024 tons were artificially coloured granules made from slate and igneous rocks. Natural coloured granules made from slate, igneous rock, and black slag made up the balance of the imported granules. About 80 per cent of the granules imported were made from igneous rocks, 16 per cent from slate, and 4 per cent from crushed black slag. The average value of all varieties in 1954 decreased to $26.61 per short ton (f.o.b. consuming plant) from $26.88 the previous year.

Roofing Granule Plants in Canada

Quebec

Wendell Mineral Products Limited with a large grey rhyolite deposit 3 miles north of Landrienne, Quebec, and a colouring plant at Landrienne station was idle throughout 1954. Last production of natural and artificially coloured roofing granules was late in 1953. No sales of granules to manufacturers of asphalt roofing and siding were made in 1954.

Consumption and Trade*

	1954		1953	
	Short Tons	$	Short Tons	$
Consumption				
Natural................	28,737	484,523	26,018	463,837
Artifically coloured......	105,180	3,079,055	100,993	2,950,481
Total..............	133,917	3,563,578	127,011	3,414,318
Consumption by colour				
Black and grey-black** ..	38,833	743,952	36,443	762,782
Green	39,523	1,107,479	43,075	1,148,688
Red	19,000	476,647	20,475	498,294
Blue	13,643	489,326	13,352	457,946
White	12,190	468,808	9,671	321,223
Grey	6,891	167,838	***	***
Buff...................	2,255	66,629	2,432	74,189
Brown..................	1,582	42,899	902	26,306
Total..............	133,917	3,563,578	127,011	3,414,318
Imports				
From: United States	104,865	2,936,134	88,924	2,521,578

* Compiled from figures supplied to the Mines Branch, partly estimated in 1954.
** Includes natural granules used as undercoat granules by some companies.
*** Included in 'black and grey-black' in 1953.

Ontario

In 1954 Building Products Limited completed construction of a new plant for colouring roofing granules near its basalt quarry east of Havelock. The granules produced at this location are used in the company's own operations, but late in 1954, for the first time, a percentage was sold to other manufacturers of roofing and siding.

The company, by far the largest producer of roofing granules in Canada, operates a black amphibole rhyolite quarry and a pink syenite quarry a few miles northwest of Madoc, and a grey basalt quarry near Havelock. Rock from the first two quarries is trucked to the granule plant for crushing and sizing. Road metal is produced from the basalt quarry, the undersize being used for making roofing granules. The sodium silicate colouring process is used to make a complete line of artificially coloured roofing granules from the grey basalt and pink syenite. The black amphibole rhyolite has been used as a natural black granule material.

British Columbia

Geo. W. Richmond continued to supply natural granules from his crushing and screening plant in Vancouver to west coast roofing manufacturers. Sources of material are a dark grey slate at McNab Creek, Howe Sound, and a green siliceous rock at Bridal Falls near Chilliwack.

Roofing and Siding Plants in Canada

In 1954 granule-coated roofing and siding was manufactured by 9 companies in 16 plants across Canada, as follows:

Company	Location of Plant
Bishop Asphalt Papers Limited	Portneuf Station, Quebec and London, Ontario.
The Brantford Roofing Company Limited	Brantford, Ontario
Brantford Roofing (Maritimes) Limited	Coldbrook, New Brunswick
Canadian Gypsum Company, Limited	Mount Dennis, Ontario
The Philip Carey Company, Limited	Lennoxville, Quebec
Building Products Limited	Montreal, Quebec Hamilton, Ontario Winnipeg, Manitoba Edmonton, Alberta
Sidney Roofing & Paper Company, Limited	Victoria, British Columbia, and Lloydminister, Alberta
Canada Roof Products Limited	Vancouver, British Columbia
The Barrett Company, Limited	Montreal, Quebec, and Vancouver, British Columbia
Canadian Johns-Manville Company, Limited	Asbestos, Quebec

Specifications and Colouring

Specifications for rock types suitable for making roofing granules are very rigid and few rocks possess all the qualities required. The rock should break well with a not too sharp fracture and yield, on crushing, a high percentage in the granule size range (-10+35 mesh for coarse, and minor amounts of -28+48 mesh for fines). No stone source should be considered unless it contains many years' supply of rock having uniform characteristics chemically, physically, and mineralogically and unless it lies within economical hauling distance of roofing plants.

Any stone source for roofing granules should contain a minimum of acid-reactive materials such as carbonates, sulphides, sulphates, or high-alkali materials. Pyrites by themselves in small quantities do no harm, but pyrites in conjunction with carbonates inevitably lead to poor weathering. Rocks should be hard and tough enough to withstand breakage and dusting through handling with mechanical equipment. The stone should be fine-grained with low porosity so that it withstands weathering effects from freezing and thawing and so that a minimum of pigment is required to cover the granules.

A granule should have 'tooth', or adhesive properties in relation to asphalt and the ability to 'wet' well with that material. For instance, granules made from quartz, feldspar, and some rhyolites do not have this latter property because, on crushing, they fracture with a glassy smooth surface. There is no rule by which to determine the ability of a granule to take colour but, in general, for a full range of colours a light-shade base granule is preferred to a dark-shade one because less pigment is required to hide the colour of the base granule.

Opacity of rock granules appears to be a very important property by which to determine the acceptability of a base-rock material. If the ultra-violet light of the sun's rays passes through the granules, the resultant deterioration of the asphalt underneath causes a loss of adhesion, with ultimate loss of the granules from the roofing. Some manufacturers and consumers of granules claim that the infra-red (heat) rays of the sun have a more direct influence on the durability of roofings than ultra-violet rays. Major producers of roofing granules maintain test stations in warm, humid climates where panels of roofing and siding can be exposed to accelerated weathering over a period of years. The results of this test are taken as the final criterion on the durability of the roofing and the quality of the granule. Quick laboratory tests of the quality of a granule and the stability of the colour coat that check with actual weathering conditions have been devised.

Processes for colouring granules are covered by many patents. The two most widely used processes are the sodium silicate process, in which the granules are thoroughly coated with sodium silicate, clay, the required pigment, and a little titanium dioxide, and heated to the required temperature in a rotary kiln, and the phosphoric acid process, in which the granules are mixed thoroughly with zinc oxide, clay, liquid phosphoric acid, and the required pigment, and then heated.

The colour of granules is usually heightened by oiling after colouring with a paraffin-base oil but this effect tends to wear off in use. Oiling also improves the adhesiveness of the granules. A good granule shingle has a life expectancy of twenty years or more.

United States Production

The production of roofing granules in 1953, as reported to the Bureau of Mines, United States Department of the Interior, amounted to 1,618,831 short tons valued at $27,819,624 compared to 1,619,195 tons valued at $26,122,857 in 1952. The average value of all types of granules rose from $16.13 a short ton in 1952 to $17.19 in 1953. Of the total production in 1953, artificially coloured granules accounted for 1,282,325 tons, and natural granules 336,506 tons. The average value of natural granules was reported as $9.47 per short ton, while that of artificially coloured granules was $19.21 per ton: this compares with 1952 figures of $9.09 and $18.21 per ton respectively.

Canadian Prices

Prices paid for roofing granules, f.o.b. consumers' plants, depend upon the type of granule, distance from producing plant, and whether the colour is natural or artificial. Imported natural granules in 1954 averaged $18.03 per short ton compared with $17.83 per short ton in 1953, f.o.b. Canadian roofing manufacturing plants. These figures include black granules produced from slag but not artificially coloured. The average prices of all artificially coloured granules per short ton in 1954, with 1953 figures in brackets, were: reds $25.08 ($24.34); greens $27.97 ($26.66); blues $35.94 ($34.37); white $38.45 ($43.18); grey $24.64; buff $29.49 ($30.50); brown $27.12 ($29.16). The average value of all types of granules per short ton f.o.b. consumers' plants was $26.61 in 1954 compared with $26.88 in 1953.

SALT

The production of salt in Canada in 1954 was 962,458 short tons, an increase of less than 1 per cent over the 1953 output. Imports, on the other hand, increased 20 1/2 per cent to 370,411 tons in 1954.

All of Canada's salt output is derived from underground deposits of salt, over 90 per cent being produced by the evaporation of brine obtained from these deposits. The production of mined rock salt in 1954 amounted to 80,356 short tons, approximately 8 1/2 per cent of the total salt production.

The Canadian Rock Salt Company Limited, a subsidiary of the Canadian Salt Company Limited, has completed the sinking of a shaft to beds of high purity salt located about 1,000 feet below the surface at Ojibway, near Windsor, Ontario. Production of rock salt from this deposit will begin early in 1955.

The presence of a large body of salt at an average depth of 400 feet has been indicated by diamond drilling in the vicinity of Pugwash, Nova Scotia. Malagash Salt Company Limited, a subsidiary of The Canadian Salt Company Limited, is planning to mine this salt by means of a 500-foot shaft. The start of shaft sinking operations is scheduled for April 1955.

Production, Trade and Consumption

	1954		1953	
	Short Tons	Dollar Value	Short Tons	Dollar Value
Production by types				
Fine vacuum salt	411,675		375,928	5,605,107
Coarse grainer salt ..	1,886	(not	4,934	100,042
Mined rock salt	80,356	available)	70,510	536,190
Salt, chemical*	468,541		503,556	733,162
Total	962,458		954,928	6,974,501
Production by provinces				
Ontario	730,937	4,524,427	749,046	3,919,810
Nova Scotia	146,659	1,928,137	127,819	1,272,463
Saskatchewan	36,737	891,240	35,100	760,082
Alberta...............	30,125	707,125	24,885	601,515
Manitoba	18,000	456,000	18,078	420,631
Total	962,458	8,506,929	954,928	6,974,501
Exports				
To: United States..	949	14,445	2,218	26,323
Bermuda	138	5,915	122	5,212
Other countries	112	5,575	14	964
Total	1,199	25,935	2,354	32,499
Imports				
From: United States..	306,893	1,692,709	235,622	1,461,727
Spain	23,179	145,902	20,619	154,787
Bahamas	22,449	89,489	35,806	165,260
United Kingdom	6,942	153,187	7,505	157,535
Other countries	10,948	70,141	7,780	78,065
Total	370,411	2,151,428	307,332	2,017,374
Apparent Consumption	1,331,670	10,632,422	1,259,906	8,959,376

* Mainly in brine and used by the producers in the manufacture of chemicals.

Producers

Ontario

Salt is obtained in the southwestern section of the province from salt beds 800 to 1,500 feet below the surface. In 1954, Ontario accounted for 76 per cent of the total Canadian production.

Fine salt, obtained by vacuum-pan evaporation of brine from local wells, was produced by Purity Flour Mills, Limited at Goderich, by The Canadian Salt Company Limited at Sandwich, and by The Dominion Salt Company Limited (changed to Sifto Salt Limited in March 1954), a subsidiary of Dominion Tar & Chemical Company, Limited, with plants at Goderich and Sarnia.

Coarse salt, obtained by open-pan evaporation of brine, was produced near Warwick by Warwick Pure Salt Company. The Dominion Salt Company Limited (changed to Sifto Salt Limited in March 1954) also produced coarse salt in limited quantities at its Goderich plant.

Dow Chemical of Canada Limited uses brine obtained from wells near its plant at Sarnia to produce caustic soda, chlorine, and other chemicals.

Brunner, Mond Canada, Limited produces industrial salt, soda ash, calcium chloride and other chemicals at its plant at Amherstburg using brine obtained from wells in the near vicinity.

Nova Scotia

Malagash Salt Company Limited operates a rock salt mine at Malagash. The salt is crushed and screened to give a coarse salt for use in ice and dust control on highways and for ice removal from railways. Small amounts of salt from Malagash are used locally for curing hay and as a fish preservative.

The Dominion Salt Company Limited (changed to Sifto Salt Limited as of March 1954) produced fine salt at a plant near Amherst by vacuum-pan evaporation of brine obtained from local wells 1,100 to 1,800 feet in depth.

Prairie Provinces

Fine salt, obtained by vacuum-pan evaporation of brine from salt beds 1,000 to 3,500 feet below the surface, was produced by the Canadian Salt Company Limited at Neepawa, Manitoba, and Lindbergh, Alberta, and by Prairie Salt Company, Limited (changed to Sifto Salt Limited in March 1954), a subsidiary of Dominion Tar & Chemical Company, Limited, at Unity, Saskatchewan. Part of the Lindbergh output is fused, crushed, and screened to give a coarse salt for use in refrigerator cars, tanning hides, water softeners, etc.

Western Chemicals Ltd. of Calgary, Alberta, uses brine obtained from salt beds 3,600 feet below the surface to produce caustic soda, chlorine, and hydrochloric acid at its chemical plant near Duvernay, Alberta. The plant completed late in 1953, had its first full year of production in 1954.

Other Occurrences

Salt beds have been found at depth on the west coast of Cape Breton Island; under Hillsborough Bay, Prince Edward Island; and at Weldon and Dorchester in New Brunswick.

Underground salt beds, varying from a few feet to many hundreds of feet in thickness, extend from the extreme north of Alberta through central Saskatchewan and into the southern part of Manitoba. Information on the nature and size of these beds is obtained from the logs of oil and gas wells drilled in this area.

Uses

The uses of salt are many. The finer grades of salt, produced by the vacuum-pan evaporation of brine, are used extensively in the chemical industries for the manufacture of soda ash, caustic soda, and related chemicals. Fine salt is also used for household and food purposes.

The coarser grades of salt are used in the curing of fish, for ice and dust control on highways, for dairy uses, for the regeneration of zeolites in water softening, as refrigerants, etc. Coarse salt is obtained by the use of open-pan evaporators, by the pressing or fusion of fine salt into blocks or pellets which are then crushed and screened, and by the mining, crushing, and screening of rock salt. Coarse salt produced by the open-pan evaporation of brine or by the fusion of fine salt is very pure but expensive, and hence is used only where purity is essential, as in the curing of fish or in the dairy industry. Mined salt is generally rather impure and finds its greatest use in the control of ice and dust conditions on highways and the removal of ice on railways.

SAND AND GRAVEL

Sand and gravel production rose to a new high of 105,430,550 tons valued at $56,884,521 in 1954. This was a 2.4 per cent increase over the previous record in 1952 of 102,895,540 tons valued at $51,339,043. In terms of value, sand and gravel ranked tenth in mineral production and third, after asbestos and cement among the industrial minerals.

Although occurrences of gravels and sands are widespread, deposits of suitable material are scarce in parts of Canada. Sand for concrete construction is in short supply in the more densely populated areas, and the industry is turning to manufactured sand to help satisfy the demand. Crushing or grinding equipment such as hammer mills, short-head cone crushers, and rod mills are used after the normal stone crushing stages to reduce the stone to sand size. Screening or other classification, often a wet process, is then carried out to bring the product within grading specifications.

Production, Trade, and Consumption

	1954		1953	
	Short Tons	$	Short Tons	$
Production by provinces				
Newfoundland	1,873,510	1,163,298	1,908,187	1,023,622
Nova Scotia	1,187,086	1,173,120	1,523,083	1,459,770
New Brunswick	3,969,060	2,018,091	2,648,235	1,282,421
Quebec	30,865,750	13,992,308	26,694,125	11,630,482
Ontario	43,446,794	24,705,906	43,658,099	24,359,496
Manitoba	3,642,596	1,556,618	4,686,323	1,524,629
Saskatchewan	4,086,542	1,894,871	4,770,368	2,216,894
Alberta	7,058,884	5,149,745	7,651,261	5,097,720
British Columbia	9,330,328	5,230,564	7,494,268	4,890,367
Total	105,460,550	56,884,521	101,033,949	53,485,401
Production by type				
Sand				
Moulding sand			20,675	61,222
Building sand			8,619,698	6,683,894
Core sand			1,134	2,248
Other sand, etc			505,631	246,374
Total			9,147,138	6,993,738
Sand and Gravel				
Railway ballast			8,436,245	3,032,939
Concrete, road building, etc			66,125,694	32,228,212
Mine filling			3,007,909	1,074,757
Crushed gravel			14,316,963	10,155,755
Total			91,886,811	46,491,663
Total, by type	105,460,550	56,884,521	101,033,949	53,485,401
Exports of sand and gravel				
To: United States	305,831	324,633	367,962	348,119
Sweden	-	-	26	214
Total	305,831	324,633	367,988	348,333
Imports of sand and gravel				
From: United States	282,225	281,790	184,777	186,923
United Kingdom	1,624	5,293	2,530	3,190
Total	283,849	287,083	187,307	190,113
Apparent Consumption	105,408,568	56,846,971	100,853,268	53,327,181

Suitable manufactured sand has been produced from granite, sand stone, limestone and gravel. Almost any kind of stone that is essentially free from deleterious constituents such as clay, shale, or hydrous silica may be used to make manufactured sand. It is important that the shape of the particles be predominantly cubicle. Elongated or slab shaped particles do not allow the sand to pack closely and excess amounts of cement are required to fill the voids. Also sand having poorly shaped particles produces a "harsh" concrete mix that is difficult for the masons to "work".

Manufactured sand is used to make concrete both for plant-manufactured products and concrete construction. It is not used to make mortar or plaster since very plastic mixes are required for these phases of construction.

Manufactured sand for concrete is produced in Montreal. Plants to make sand for the St. Lawrence seaway and power project are under construction. While the bulk of sand consumed in Canada will continue to be derived from natural deposits, it is evident that manufactured sand will take an increasingly important part in meeting the needs in certain areas.

In the West where sand and gravel for concrete are scarce, six plants are operating or under construction for the production of lightweight aggregates.

Principal producers of sand and gravel are distributed among the provinces as follows:

Province	No. of Principal Producers*
Newfoundland	2
Nova Scotia	4
New Brunswick	3
Quebec	58
Ontario	230
Manitoba	15
Saskatchewan	31
Alberta	10
British Columbia	47
Total	400

* Does not include production by railway companies for ballast or production by counties and townships in Ontario for road use. From Dominion Bureau of Statistics.

Gravels

Gravels vary in composition and in size of component particles, and these factors determine suitability for various uses. In some cases large stones are crushed to reduce them to a suitable size. About 14 per cent of all gravel is washed or screened to remove excess fines or undesirable constituents.

Most of the gravel used for road work comes from pits in the vicinity of the work in progress. Movable plants are used to produce enough gravel to supply the immediate need.

Railway ballast pits also operate intermittently. In recent years, on main lines, there has been a tendency to replace gravel with crushed stone as ballast.

Sand

The amount of sand consumed follows the trend of building activity, as most of it is used for concrete, cement and lime mortar, or wall plaster. For these purposes the sand must be clean, that is, free from dust, loam, organic matter, or clay, and must contain but little silt.

SILICA

The production of silica minerals in Canada in 1954 was 1,742,951 short tons, a decrease of 2.4 per cent compared to 1953. Value showed a decrease of 23 per cent to $1,589,254. This drop in value was due mainly to decreased production of higher priced silica in 1954.

The silica requirements of the glass, chemical and other industries using high-purity silica sand are presently supplied by imports from the United States, Belgium, and other countries. However, recent developments in the Canadian silica picture indicate that Canada may soon be producing high-purity silica for her own use. The Canadian output of quartz, quartzite, and silica sand is used in the manufacture of silicon and ferrosilicon alloys, as a fluxing material in the metallurgical industry and for other purposes such as the manufacture of silica brick, as an ingredient in portland cement, for foundry use, etc.

Dominion Silica Corporation Limited completed, towards the end of the year, an intensive program of testing a silica property located 85 road miles north of Montreal near St. Donat, Quebec. The results indicated that there are large reserves of high-quality quartzite in this area. Rock from this location will be processed in Dominion's modern mill at Lachine to produce sand for glass manufacture and for use in the abrasives industry. Other high-quality silica products also will be produced.

Production and Trade

	1954		1953	
	Short Tons	Dollar Value	Short Tons	Dollar Value
Production				
Quartz and silica sand ..	1,742,951	1,589,254	1,785,574	2,070,617
	Thousands of brick		Thousands of brick	
Silica brick	2,143	474,635	3,720	712,371
	Short Tons		Short Tons	
Imports, silica sand				
From: United States ...	633,610	1,854,174	681,238	1,900,358
Belgium	21,687	28,176	21,314	26,657
Netherlands	441	980	--	--
United Kingdom.	124	668	669	1,423
Total	655,862	1,883,998	703,221	1,928,438
Exports, quartzite				
To: United States...	162,374	547,821	200,169	674,777

The sandstone quarry at St. Canut, near St. Jerome, Quebec, formerly operated by Canadian Carborundum Company, Limited, was acquired by Canadian Silica Corporation Limited of Toronto in September 1954. A plant is being erected at St. Canut by Canadian Silica for the purpose of producing silica flour from this sandstone. It is probable that silica sand for foundry and other uses will also be produced. Initial production is scheduled for August 1955.

Radius Exploration Limited has completed the construction of a small mill at a sandstone deposit near Ste. Clothilde, Quebec, which is about 30 road miles south of Montreal. Sandstone from this deposit will be used to produce poultry grits and other silica products.

Peace River Glass Company Ltd. of Edmonton, Alberta, has undertaken the development of a silica sand deposit located 10 miles north of the town of Peace River, Alberta. In 1954, sand from this deposit was shipped by rail to Edmonton, where it was processed and sold for oil well fracturing purposes. Future company plans call for the construction of a plant near Edmonton to manufacture glass fibre products, using sand from the Peace River deposit.

Producers

Nova Scotia

Dominion Steel and Coal Corporation, Limited, quarries quartzite from a deposit at Chegoggin Point, Yarmouth County: Rock from this deposit is shipped to Sydney, where it is used in the manufacture of silica brick.

Quebec

St. Lawrence Alloys and Metals Limited operates a sandstone quarry at Melocheville: Sandstone from this quarry is used at Beauharnois in the manufacture of ferrosilicon. Fine sand resulting from the breakdown of this sandstone during mining and milling operations is used as a foundry sand and in the manufacture of cement.

Ontario

Lorrain quartzite is quarried by the Electro Metallurgical Company of Canada, Limited, at Killarney, Georgian Bay, and by Canadian Silica Corporation Limited at Sheguiandah, Manitoulin Island. A large part of the production from these deposits is exported to the United States. Canadian consumption of quartzite from this area is used mainly for the manufacture of silicon and ferrosilicon, but a small percentage is shipped from Sheguiandah to Canadian Silica's grinding plant at Whitby, Ontario, where it is used to produce silica flour.

Algoma Steel Corporation Limited quarries quartzite from a deposit at Bellevue, north of Sault Ste. Marie, for use in the manufacture of silica brick for furnace linings.

Other Areas

Silica for metallurgical flux is quarried near Noranda, Quebec; Sudbury, Ontario; Flin Flon, Manitoba; and Trail, British Columbia.

Deposits of sand, sandstone, and quartzites which are potential sources of silica exist in all provinces, but most of these deposits are either too impure or too far from existing markets to warrant their development.

Uses

Quartz, quartzite, and, in some cases, sandstone and sand, are used as fluxes in smelting base-metal ores low in silica. Lump quartz, quartzite, and well-cemented sandstone are used in the manufacture of silicon and ferrosilicon.

Quartz and quartzite, crushed to pass an 8-mesh screen, are used in the manufacture of silica brick for furnace linings.

Sand, either naturally occurring or produced by crushing quartz, quartzite, or sandstone is used in the manufacture of glass, for the production of silicon carbide, for sand blasting purposes, for poultry grits, for the manufacture of silicates, etc.

Naturally occurring sand or sand produced by reduction of sandstone to grain size is used extensively in the foundry industry for moulding purposes.

Silica sand in increasingly large quantities is being used in the hydraulic fracturing of oil-bearing formations. This consists of pumping a viscous fluid containing suspended sand into the oil-bearing strata under pressure sufficient to cause fracturing and parting of the formation. When the pressure is released, the sand remains as a propping agent to hold the fracture open and to provide a permeable passageway for the flow of oil. The amount of sand used varies greatly but is generally from 5,000 to 15,000 pounds per treatment.

Silica flour, formed by grinding quartz, quartzite, sandstone, or sand to a very fine powder is used in the ceramic industry for enamel frits and pottery flint. It is also used as a filler in rubber and asbestos-cement products, as an extender for paint, and as an abrasive ingredient in soaps and scouring powders.

Quartz crystals free of flaws, and possessing the necessary piezoelectric properties, are used in radio-frequency control apparatus.

Specifications

Typical specifications for the most important uses of silica are given below:

1. Silica Sands

For Glass-making. Silica sand used in the manufacture of glass must be very pure. The silica content should be 99% and the iron content, for most types of glass, less than 0.04%. Other impurities such as alumina, lime, magnesia, and alkalies should be low. Grain size is very important, grains should be between 20 and 100 mesh with a minimum of coarse or fines.

For Silicon Carbide. Silica sand for use in silicon carbide manufacture should have a silica content of 99%. The iron and alumina contents should each be less than 0.10%. The grain size is generally somewhat coarser than that required for glass-making. All sand should be +100 mesh with most of it in the +48 mesh range.

For Hydraulic Fracturing. Sand used in the hydraulic fracturing of oil-bearing formations should be clean and dry and have a high compressive strength. The grain size of sand used for this purpose must be closely controlled and is generally between 20 and 35 mesh. The grains should be well rounded to permit of easy placement and to provide for maximum permeability.

For Foundry Use. Silica sands for foundry use may contain a greater percentage of impurities than do glass sands. They vary greatly in screen size and chemical composition depending upon the type of casting and foundry practice followed. These sands usually contain no material coarser than 20 mesh nor finer than 200 mesh, but percentage of fine to coarse must be varied greatly to produce all the types of foundry sand required by Canadian manufacturers. A rounded grain is preferred for the foundry industry.

For Making Sodium Silicate. This industry requires a sand with a silica content of 99% and an iron content of less than 0.10%. The grain size desired is generally -20+100 mesh.

For Sand Blasting. Sand-blast sand is usually quite coarse. The grain size varies from 8 mesh to 48 mesh in closely sized ranges. The physical properties of these sands such as shape of grains, friability, and hardness, are of great importance.

2. Lump Silica

For making Ferrosilicon. Quartz, quartzite, or well-cemented sandstone of high purity and in sizes varying from 6" down to 1" is used in the manufacture of ferrosilicon. The silica content should be 98% and the alumina content less than 1.0%.

As a Flux. Silica is used in metallurgical operations as a flux to produce a siliceous slag. The composition of the silica used is dependent upon the type of ore being fluxed.

For Making Silica Brick. Quartzite of high purity and crushed to 8 mesh is used in the manufacture of silica brick. The silica content should be above 97%, the alumina less than 1%, and the iron and alkali content low.

3. Silica Flour

For Ceramics. Silica content should be 98%. The iron oxide and alumina contents should each be under 0.10%. Size is generally all -325 mesh.

As a Filler. A white colour is usually very important. The size of material is generally all -150 mesh and finer. The silica content should be quite high but varies depending upon the industry.

Price

The price of silica varies greatly depending upon the location of deposits, the purity of the product, and the purpose for which it is required.

SODIUM SULPHATE (NATURAL)

Production of natural sodium sulphate in Canada in 1954 amounted to 165,521 tons as compared with 115,565 tons in 1953 and the record output of 192,371 tons in 1951. As before, the entire output came from Saskatchewan. Imports totalled 30,235 tons, about 8 per cent lower than in 1953, while exports rose nearly 330 per cent to reach a new high of 66,049 tons.

Large reserves of sodium sulphate occur in beds and in the form of highly concentrated brines in many lakes in Saskatchewan, Alberta, and British Columbia.

Production, Imports, and Exports of Sodium Sulphate, 1953-1954

	1954		1953	
	Short Tons	$	Short Tons	$
Production (shipments).....	165,521	2,547,586	115,565	1,681,258
Imports				
United States	19,112	308,986	21,476	331,886
United Kingdom	11,123	173,666	11,326	184,977
Total	30,235	482,652	32,802	516,863
Exports*				
United States	66,049	1,039,284	20,132	298,374

* From United States import statistics.

Domestic Producers

The producers of natural sodium sulphate in 1954 were: Ormiston Mining and Smelting Company Limited at Ormiston; Midwest Chemicals Limited at Palo; Sybouts Sodium Sulphate Company Limited at Gladmar; and Saskatchewan Minerals, Sodium Sulphate Division, at Chaplin. Late in the year, Saskatchewan Minerals took over the operations formerly conducted by Natural Sodium Products Limited at Bishopric and Alsask. Immediate plans call for doubling the capacity of the plant at Bishopric, including the installation of evaporators similar to those at Chaplin. Further increases are planned for 1956.

While production methods vary considerably, the general trend is towards the production of a higher-grade product by means of the crystallizing pond. In some lakes, the sodium sulphate occurs as an actual bed in a dried-up lake or under a saturated brine; in others, as a brine with little or no actual crystal beds. In late summer, the brine in all lakes is usually almost saturated and is pumped from the lake into an enclosed pond. After being subjected to more evaporation and the effects of cooler weather, the sodium sulphate crystallizes out and the excess brine is returned to the main lake. The crystal, or Glauber's salt, is collected and stockpiled. It is then fed to a dehydrating plant to remove the water of crystallization, which amounts to over 50 per cent of the weight of the crystal. A dehydrating plant usually consists of a simple rotary kiln and a crushing and screening plant. The finished salt, commonly known as "salt cake", is shipped in bulk. The product from this crystallizing pond method is usually purer than that produced from the mining of the salt beds with their other salts and silt.

Uses and Prices

The largest single use of sodium sulphate is in the sulphate process for making kraft pulp. Kraft pulp is used chiefly in the manufacture of brown wrapping paper and corrugated board boxes in which a high degree of strength is required.

Sodium sulphate is used in some of the synthetic detergent powders as a diluent and to improve the detergent action. It is also used in the manufacture of heavy chemicals, among which are sodium carbonate, sodium silicate, sodium sulphide, and sodium hydroxide.

Other minor uses of sodium sulphate are in the glass, dye, and textile industries. Small amounts are used for medicinal purposes, and for tanning.

The price of sodium sulphate varies considerably, depending upon the duration and size of contract and the purity of the salt cake supplied.

SULPHUR AND PYRITES

In 1954, Canadian production of sulphur in all forms reached an all-time high of 521,902 short tons compared to the previous peak of 428,013 tons in 1952. Recovery of sulphur as sulphuric acid and liquid sulphur dioxide amounted to 225,000 tons, compared to 172,200 tons in 1953. This increase is accounted for by the first complete year of operations for the sulphuric acid plant of The Consolidated Mining and Smelting Company of Canada Limited (Cominco) at Kimberley, British Columbia.

The year saw the near completion of a program to increase the production of sulphur in various forms, brought on by the sulphur scarcity of a few years ago. During the year the first Frasch process plant outside the United States was brought into production on the Isthmus of Tehuantepec at San Cristobal, Mexico. It is expected that the Isthmus will be capable of providing at least 500,000 tons of sulphur annually within a few years. Additional sulphur recovery facilities from salt domes were completed in 1954 in the United States.

Production, Trade and Consumption

	1954		1953	
	Short Tons	$	Short Tons	$
Production (sulphur content)				
By-pr. pyrites shipped ...	278,237		186,650	
Smelter gases	225,000		172,200	
Total.........	503,237	4,540,463	358,850	3,172,698
Elemental sulphur from natural gas (shipments)	18,665		16,072	
Total, all sulphur ..	521,902		374,922	
Imports				
United States	310,127	7,816,301	359,105	8,526,804
Exports				
Sulphur content of by-product pyrites				
United States	140,122	955,307	101,927	687,199
United Kingdom	25,922	388,300	13,989	141,023
West Germany	17,124	162,964	10,434	121,697
Netherlands	2,940	30,000	2,956	78,409
France..................	2,500	30,000	-	-
Mexico	-	-	302	5,900
Total	188,608	1,566,571	129,608	1,034,228

	1953[a]	1952
Consumption	Short Tons	Short Tons
Pulp and paper...........	258,172	290,607
Heavy chemicals[b]	257,679	248,879
Rubber goods	2,475	2,269
Explosives	2,094	2,271
Adhesives	85	72
Starch and glucose	256	328
Sugar refining	358	171
Petroleum refining	190	258
Asbestos products........	17	16
Fruit and vegetable preparations	4	5
Steel ingots..............	101	95
Miscellaneous chemicals..	3,235	3,193
Total	524,666	548,164

a Figures for 1954 not available.
b Includes smelter-gas sulphur used in making sulphuric acid.

Sulphuric Acid

The apparent consumption of sulphuric acid (basis 100% acid) in Canada reached an all-time high of 900,853 short tons in 1954 compared to 779,082 tons the previous year. Production was also reported at a new high of 922,673 short tons in 1954 compared to the previous high of 826,901 tons in 1953. Exports and imports of acid are negligible and in 1954 amounted to only 21,930 tons and 110 tons respectively.

Sulphuric acid is manufactured from stack gases by Cominco in plants at Trail and Kimberley, British Columbia, and by Canadian Industries Limited at Copper Cliff, Ontario. The latter company uses stack gases from International Nickel Company's smelter near by.

Aluminum Company of Canada Limited makes sulphuric acid at Arvida, Quebec, from sulphur dioxide gas derived from the roasting of zinc concentrates from Barvue Mines Limited at Barraute in western Quebec. The concentrates are flash-roasted at Arvida and the calcine is shipped to the United States for the recovery of the contained zinc. The acid is used in the Arvida operations.

Nichols Chemical Company Limited makes acid for sale at three plants in Canada from domestic by-product pyrite. These plants are at Barnet, British Columbia; Sulphide, Ontario; and Valleyfield, Quebec. Columbia Cellulose Company Limited makes acid for its operations at Prince Rupert, British Columbia, from by-product pyrite supplied by Britannia Mining and Smelting Company Limited at Britannia Beach.

North American Cyanamid Limited, Welland, Ontario, manufactures acid for its own use to make fertilizers. The company used only imported sulphur for acid production until late in 1954, when the Noranda operation at Port Robinson started production of elemental sulphur, sulphur dioxide gas, and iron sinter from its pyrite roasting plant: it now uses sulphur dioxide from the Noranda plant for making acid in addition to some imported sulphur.

Canadian Industries Limited at Hamilton, Ontario, makes sulphuric acid from imported sulphur for use in its fertilizer plant there, and for sale.

Dominion Steel and Coal Corporation Limited imports sulphur for acid manufacture at its steel plant at Sydney, Nova Scotia. Algoma Steel Corporation of Canada Limited at Sault Ste. Marie and The Steel Company of Canada Limited at Hamilton, both in Ontario, purchase acid for use in their steel operations.

Inland Chemicals (Canada) Limited announced late in 1954 that a contract had been let for the erection of a $1,000,000 sulphuric acid plant rated at 100 tons of acid per day adjacent to the Sherritt-Gordon refinery at Fort Saskatchewan, Alberta. The plant will burn sulphur recovered from sour natural gas in southern Alberta. Most of the acid produced will be used by Sherritt Gordon in the manufacture of ammonium sulphate fertilizer.

Production, Imports, Exports, and Consumption of Sulphuric Acid
1950 to 1954

(short tons of 100% acid)

Year	Production	Imports	Exports	Apparent Consumption
1950	756,110	332	44,417	712,025
1951	820,867	1,162	57,000	765,029
1952	816,270	85	33,135	783,220
1953	826,901	70	47,889	779,082
1954	922,673	110	21,930	900,853

The pattern of sulphuric acid consumption by industries in Canada shows that fertilizer manufacture accounts for about 63 per cent of the total, followed by heavy chemical industries, utilizing about 15 per cent of the total. The remainder is distributed over many other industries.

Consumption of Sulphuric Acid by Industries, 1952 and 1953
(short tons of 100% acid)

	1953	1952
Fertilizers	485,600	510,600
Heavy chemicals	124,400	103,300
Explosives	29,000	31,300
Non-ferrous metal smelting and refining	12,900(e)	12,900(e)
Textiles	30,200	28,000
Coke and gas	33,600	33,700
Petroleum refining	7,400	9,500
Leather tanning	2,100	1,900
Iron and steel	29,900	29,400
Electrical apparatus	5,700	5,700
Plastics	9,100	8,000
Soaps	10,400	8,700
Adhesives	300	500
Miscellaneous chemicals	3,000	2,100
Sugar refining	400	400
Pulp and paper	6,900	4,000
Vegetable oils	100	100
Total	791,000	790,100

(e) estimated

Liquid Sulphur Dioxide

Canadian Industries Limited makes liquid sulphur dioxide from smelter gases resulting from the oxygen flash smelting of copper concentrates by International Nickel Company at its Copper Cliff works. Rated capacity of the plant, which adjoins the smelter, is 90,000 tons of liquid sulphur dioxide a year, which is used by pulp and paper mills within economic rail haulage distance of the plant.

Pyrites in Canada

Pyrite shipments (sales) in Canada in 1954 had a sulphur content of 278,237 short tons compared to 186,650 tons in 1953. This would be the equivalent of approximately 580,000 tons of pyrite grading about 48 per cent sulphur. The pyrite is largely a flotation by-product of the treatment of base metal ores and brings about $4.00 a long ton f.o.b. the mine to producers. Shipments in 1954, as in the previous year, were reported from Noranda, Waite Amulet, Quemont, East Sullivan, Normetal, and Weedon mines in Quebec, and from the Britannia mine in British Columbia. Pyrite output of the major producers is generally sold by negotiation between producer and consumer for future delivery over a period of time.

The sulphur content of by-product pyrites exported from Canada in 1954 amounted to 188,608 short tons and was valued at $1,566,571 compared to 129,608 tons valued at $1,034,228 in 1953. Approximately 74 per cent of the exports went to United States consumers, the remainder going to the United Kingdom, West Germany, Netherlands, and France.

The plant of Noranda Mines Limited at Port Robinson, Ontario, for recovering sulphur, sulphur dioxide gas, and iron sinter from pyrite began operations late in 1954. The feed for the plant is at present obtained from Noranda's Horne mine at Noranda, Quebec, but will ultimately be obtained from the zinc-pyrite body of West Macdonald Mines Limited at Noranda, in which Noranda has the controlling interest. Ore from the West Macdonald mine, carrying about 80 per cent pyrite and low zinc values, is to be milled at the nearby Waite Amulet mine. The process, developed by Noranda after many years testing and pilot-plant operation, is essentially a method whereby most of the loosely held sulphur in the pyrite is volatilized by roasting and the residue from the roasting is sintered. Elemental sulphur is recovered in the first step and the sulphur dioxide gas driven off in the second step is used in the adjoining plant of North American Cyanamid for making sulphuric acid. The sintered residue is processed into a high-grade iron oxide sinter. It is expected that about 18,000 tons of elemental sulphur, 36,000 tons of sulphur as sulphur dioxide, and about 72,000 tons of iron sinter will be produced annually from the treatment of about 300 tons of pyrite concentrate daily. No shipments of elemental sulphur had been made from Port Robinson by the year's end.

Noranda Mines Limited, in addition to the operation outlined above, ships by-product pyrite to acid manufacturers in the United States and Canada from its Horne mine at Noranda. Pyrite reserves of the No. 5 orebody at the mine have been estimated at 100 million tons containing about 50 per cent pyrite with low copper values. The company will in 1955 also begin milling at its wholly owned subsidiary, Gaspé Copper Mines Limited, about 62 miles west of the town of Gaspé. Ore reserves, grading better than 1% copper with pyrite, have been outlined to ensure continuous operation of the mine for over 35 years at a milling rate of 6,500 tons per day.

Weedon Pyrite and Copper Corporation Limited; Waite Amulet Mines Limited; Normetal Mining Corporation Limited; East Sullivan Mines Limited; and Britannia Mining and Smelting Company Limited ship pyrite flotation concentrates obtained as a by-product in the treatment of base metal ores. The pyrite recovery and shipment by these companies is governed more by availability of markets than by the amount of pyrite recoverable.

Bravue Mines Limited at Barraute, Quebec, as mentioned earlier, ships zinc concentrate to Aluminum Company of Canada Limited at Arvida for flash roasting for recovery of the sulphur content as sulphuric acid. Barvue also has a potential recovery of about 200 tons of pyrite daily from its mining operations, but none has been made to the end of 1954.

During the year, Anglo-Newfoundland Development Company at Grand Falls, Newfoundland, built a plant to produce sulphur dioxide gas by burning pyrite flotation concentrate from Buchans Mining Company Limited at Buchans. The gas is used to make cooking acid for Anglo's pulp mill. It started operations early in 1955.

Early in 1955 seven pulp and paper mills in Canada were burning pyrite for all, or part, of their sulphur requirements. Four of these are in Quebec and one each in Newfoundland, Ontario, and British Columbia. Six of the mills use Dorrco Fluo Solids Systems for burning pyrite and one uses Freeman Flash Roasting equipment.

In addition to the sources of pyrite already outlined there are several other large potential sources in Canada. Brunswick Mining and Smelting Corporation Limited with mine near Bathurst, New Brunswick, and near ocean shipping, has large reserves of zinc-lead-copper ore carrying about 50 per cent pyrite. Company estimates of ore indicated by diamond drilling total more than 45,000,000 tons to relatively shallow depth in three orebodies. American Metal Company announced in 1954 the discovery, to the southwest of Brunswick's property, of a major lead-zinc-copper deposit from which substantial amounts of by-product pyrite could be recovered. Other deposits in Newfoundland, the Eastern Townships of Quebec, Ontario, and British Columbia are on record.

It is not likely that any pyrite deposit will be operated in the foreseeable future for pyrite alone. It is a low-priced commodity which it would not pay to mine and concentrate at present prices. The use of pyrite to replace elemental sulphur in paper mills and in the manufacture of sulphuric acid has become a matter of economics rather than one of necessity, as it was during the severe sulphur shortage of 1952.

Elemental Sulphur

There are no known deposits of elemental sulphur in Canada. Recovery of sulphur from the hydrogen sulphide in 'sour' natural gas is a development of recent years in Western Canada. In 1951, Shell Oil Company of Canada Limited at Jumping Pound began operation of a plant with a capacity for the treatment of 25 million cubic feet of gas daily, from which about 30 long tons of sulphur are recovered. A second plant at Jumping Pound, with a daily recovery capacity of 50 long tons, was brought into production by Shell in January 1955. Royalite Oil Company Limited completed its plant to treat natural gas from the Turner Valley field in 1952; daily capacity is 30 long tons of sulphur. The sulphur recovered at both places is marketed in Western Canada.

In 1954 shipments of sulphur from natural gas amounted to 18,665 short tons compared to 16,072 in 1953. Increased marketing of natural gas from Western Canada will probably result in increased production of elemental sulphur. One million cubic feet of hydrogen sulphide gas contains approximately 44.6 tons of elemental sulphur, of which about 90 per cent is recoverable. Large proven reserves of natural gas containing hydrogen sulphide occur in Alberta in many fields, the content ranging from 2, 4, and 8 per cent in the Turner Valley, Jumping Pound, and Pincher Creek fields respectively to over 30 per cent in others.

Anhydrite and Gypsum

Extensive deposits of anhydrite and gypsum in Canada, particularly in New Brunswick and Nova Scotia, constitute a large potential source of sulphur and its compounds. Although these minerals are not at present an economic source of supply in Canada, plants for the recovery of sulphur as sulphuric acid and the production of portland cement from anhydrite are in operation in England, on the Continent, and in India.

World Supply Situation

The continuing expansion in sulphur recovery since the scarcity of 1951-52 has resulted in a plentiful supply to meet all requirements in 1954. With the advent of Mexican salt-dome sulphur during the year and an expected further increase in output there, it is probable there will be more active competition in world markets over the next several years. However, this increased supply is not expected to affect recovery of sulphur where plant processing, gas purification, or prevention of atmospheric pollution would make such recovery advantageous or necessary. It might affect the recovery of sulphur, or its derivatives, from surface sulphur deposits, pyrite, and sulphate minerals.

Of an estimated 13,000,000 long tons of free world production in 1954, the United States produced about 6,700,000 tons, of which approximately 5,500,000 tons was derived from thirteen salt dome mines on the Gulf Coast. The remaining supplies were roughtly distributed evenly between recovery from other elemental sources, pyrite, and refinery and natural gases.

Uses

The table on consumption of sulphur in Canada, given earlier in the review, lists the major consuming industries. It shows that 49 per cent of the sulphur, or its equivalent, is used in the manufacture of pulp and paper, and a like amount in the manufacture of 'heavy chemicals', which consists almost entirely of the sulphur consumed in making sulphuric acid for the manufacture of fertilizers. The balance of the sulphur consumption is used in a host of industries and enters into the manufacturing processes of a wide range of goods.

In the United States large tonnages of elemental sulphur are consumed in such uses as rubber compounding, insecticidies, and paper manufacture, but about 80 per cent of it is converted into sulphur acid for industrial use. The end-use consumption pattern for sulphur in the United States has been estimated as follows:

Industry	Percentage of Total
Fertilizers	33.0
Chemicals	18.5
Pulp and paper	7.5
Paints and pigments	7.5
Iron and steel	7.0
Ground and refined uses	5.0
Rayon and fibres	4.5
Carbon bisulphide	4.5
Petroleum	3.0
Other chemicals and miscellaneous uses	9.5
Total	100.0

Prices

The Oil, Paint and Drug Reporter listed the following prices for Gulf Coast sulphur in the United States at the end of 1954:

In bulk, f.o.b. mines on contract basis, per long ton, $26.50.

In bulk to domestic and Canadian consumers, f.o.b. vessel, Gulf Coast ports, per long ton, $28.00 and $29.50.

In bulk for export, f.o.b. vessel, Gulf Coast ports, per long ton, $31.00 and $33.00.

Pyrite is quoted in the same journal, f.o.b. domestic and Canadian mines, per long ton, at $3.00 and $5.00.

Including transportation charges, prices of Gulf sulphur at Canadian consuming plants would range from $35.00 to $45.00 per long ton depending on consumer's location. The price paid for Canadian by-product pyrite is subject to negotiation between buyer and seller and information on prices is not readily available. However, pyrite at the producer's plant is a relatively low-price commodity and usually commands from $4.00 to $5.00 per long ton. Contracts usually call for 48% minimum sulphur content and low moisture and metallic impurities content.

TALC AND SOAPSTONE

Production (sales) of talc and soapstone in Canada in 1954 decreased slightly to 25,691 short tons, a drop of 6 per cent below 1953.

Production continued to come from the Eastern Townships of Quebec and from Madoc, Ontario.

Exports, constituting 14 per cent of total production, rose 23 per cent in volume over 1953 while imports, consisting mainly of special grades for the paint, ceramic and cosmetic trades, increased 36 per cent.

Talc and soapstone occur in numerous localities in Quebec and Ontario, in the Windermere mining division of British Columbia and adjacent portions of Alberta, on Vancouver Island and in the southern reaches of the Fraser River watershed.

In general, talc from the Eastern Townships of Quebec is high in iron, often low in carbonates giving low loss on ignition, and somewhat off colour. It is used mainly for roofing, insecticides, and other less exacting applications.

Madoc talc, which is low in iron and relatively high in carbonates, is used for paints, ceramics and other applications where prime white colour is of first importance.

Producers

Quebec

Broughton Soapstone and Quarry Company Limited, Broughton Station, continued to produce ground talc, soapstone blocks, bricks and crayons.

Baker Talc Limited, 301-215 St. James St., W., Montreal, with mine and mill near Highwater continued production of ground talc.

Ontario

Canada Talc Industries Limited, Madoc, operating the Conley and Henderson mines continued production of ground talc. The Henderson mine, a source of steatitic talc, has been rehabilitated in recent years after a period of idleness. The two mines are connected underground.

Production, Trade, and Consumption

	1954		1953	
	Short Tons	$	Short Tons	$
Production (Sales)				
Ground			27,258	266,504
Sawn soapstone blocks and talc crayons			150	19,251
Total	25,691	301,958	27,408	285,755
Imports				
From: United States	11,365	349,455	10,700	319,487
Italy	911	46,852	1,129	51,784
France	13	728	32	1,113
India	23	950	6	244
Total	12,392	397,985	11,867	372,628
Exports				
To: United States	3,292	44,382	2,778	35,802
Ecuador	222	2,885	117	1,274
Other countries	95	1,486	42	1,117
Total	3,609	48,753	2,937	38,193

	1953	1952
	Short Tons	Short Tons
Consumption		
Paints	7,838	7,264
Roofing paper	8,050	8,255
Pulp and paper	1,510	2,568
Rubber goods	1,620	1,617
Toilet preparation	424	807
Electrical apparatus	490	427
Clay products	2,164	1,164
Soap and cleaning preparations	81	206
Prepared foundry facings	82	47
Tanneries	5	20
Miscellaneous chemicals	8,557	7,638
Polishes and dressings	11	16
Coal tar distillation	694	133
Miscellaneous	324	534
Total	31,850	30,696

British Columbia

Geo. W. Richmond and Company, 4190 Blenheim St., Vancouver, continued production of ground talc for the roofing trade from imported materials.

Uses and Specifications

The roofing, insecticide, rubber, and paint industries account for the bulk of Canadian consumption. Lower-grade talc is used as a surfacing material and dusting agent for asphalt paper roofing, as a filler and dusting agent in rubber products, and as a polishing agent for wire nails, rice, peanuts, and other commodities. For paint use, colour, particle shape, packing index, and oil absorption are the principal factors. The ceramic trade demands prime white colour and the paper industry talc of high brightness, high retention in the pulp, low abrasiveness, and freedom from chemically active substances. For lubricants, talc must be soft, free from grit, and have high slip. Talc of high purity is demanded for the cosmetic and pharmaceutical trades. For preparations subject to heat treatment, such as asphaltic compounds, low ignition loss is of first importance.

Particle size generally specified for roofing purposes is through 48 to 80 on 200-mesh. For most other purposes the greater part is required to pass a 325-mesh screen.

Miscellaneous uses for talc include cleansers, plaster, polishes, plastics, foundry facings, linoleum and oilcloth, oil-absorbent preparations, textiles.

Steatite, the massive, compact form of talc is used in making ceramic electrical insulators.

Markets

Purchasers of crude talc for grinding purposes include Industrial Fillers Limited, Montreal, Que., and Geo. W. Richmond and Company, Vancouver, British Columbia.

Prices

The following is a summary of prices quoted by E. & M. J. Metal and Mineral Markets, December 16, 1954:

Per short ton f.o.b. works:

200-mesh - $10.50 - 15.00
325-mesh - $18.00 - 20.00

Canadian prices quoted by The Northern Miner, December 30, 1954, were as follows:

Per short ton f.o.b. Madoc, Ontario:

Filler grade	50 lb. bags	- $11.50 - 15.00
Cosmetic	"	- $26.00 - 50.00
Ceramic	"	- $17.50 - 26.00
Roofing	70 lb. bags	- $10.00 - 13.75

Tariffs

Canadian

	Crude or Ground	Micronized (under 20 microns)
British preferential	10%	free
Most favoured nation	15%	5%
General	25%	25%

United States

Talc, steatite or soapstone and French chalk

Crude and unground	1/8¢ per lb.
Cut, sawed or in blanks, crayons, cubes, discs or other forms	1/2¢ per lb.
Ground, powdered, pulverized or washed (except toilet preparations) valued per ton:	
Not over $14.00	
Talc and steatite or soapstone	8 3/4 % ad. val.
French chalk	17 1/2 % ad. val.
Over $14.00	17 1/2 % ad. val.

Note

Tariffs are subject to change at any time and should be verified through a customs agency at time of shipment.

Pyrophyllite

Pyrophyllite, a mineral similar to talc, but with alumina in place of magnesia, is adaptable generally to the same uses as talc. Pyrophyllite has been produced intermittently in Newfoundland from a large deposit near Manuels, Conception Bay. With the exception of a few sample shipments, there has been no production in recent years.

VERMICULITE

Canadian requirements of raw vermiculite are met by imports from the United States and the Union of South Africa. In 1954 imports from South Africa, which accounted for 27 per cent of the total, more than doubled in value over 1953, while those from the United States remained at about the same level. Consumption of vermiculite ore in 1953 rose 20 per cent in volume and 27 per cent in value over 1952. The total value of finished products increased 20 per cent in the same period.

Trade and Consumption

	1954		1953	
	$		$	
Imports, crude				
From:				
United States	275,041		294,680	
Union of South Africa ..	73,117		34,337	
Total	348,158		329,017	
	1953		1952	
	Short Tons	$	Short Tons	$
Consumption				
Ore used in miscellaneous non-metallic mineral industry	25,213	593,773	20,975	466,964
Products (particulars not available)..........		1,466,944		1,169,696

Description and Uses

Vermiculite is the name given to a group of micaceous, hydrated magnesium silicates which posses the unique property of expanding to many times their original volume on exposure to heat. Vermiculite resembles mica, from which it is considered to have been derived in most cases, but is usually distinguishable by its dull appearance and lack of elasticity. For practical purposes the only reliable method of identification is by the application of heat. Vermiculite, a secondary mineral, is generally associated with ultra basic rocks such as pyroxenite, and with crystalline limestone or dolomite, particularly in the vicinity of feldspathic intrusives. Colours range from black through brown and green to light buff.

The principal uses of vermiculite in the expanded form are as loose insulation in buildings, lightweight aggregate in concrete, plaster and asphaltic compounds, rooting medium, and soil conditioner. Its sound-proofing and fire-retardant properties, chemical inertness, low thermal conductivity, and low bulk density make vermiculite useful in fire-resistant wallboard, accoustic tile, sound-proof partitions and many other applications. It has been recommended also as a diluent in dry chemicals, a pigment and extender in paint, decorative filler in wallpaper, and absorbent.

Markets and Specifications

Raw vermiculite is generally sold as a sized concentrate ready for heat treatment. Foreign impurities should not exceed 5 per cent and total unexpandable material 10 per cent.

Size classifications according to end uses are approximately as follows: acoustic tile: minus 1/2" plus 3-mesh; loose insulation: minus 3-mesh plus 14-mesh; plaster and concrete aggregate and agricultural uses; minus 6- or 8-mesh plus 65-mesh.

Bulk densities of finished vermiculite products range from 5 to 7 pounds per cubic foot for loose insulation to 8 pounds or more for finer grades.

Firms engaged in exfoliating vermiculite in Canada with plant locations are as follows:

Name of Company	Plants
F. Hyde and Company, Limited, 2315 Cote de Liesse Road, Montreal 9, Que.	Montreal, Que. Toronto, Ont. St. Thomas, Ont.
Insulation Industries (Canada) Ltd., 1305 W. Georgia St., Vancouver, B.C.	Winnipeg, Man. Regina, Sask. Calgary, Alta. Vancouver, B.C.
Siscoe Vermiculite Mines Ltd., Dominion Sq. Bldg., Montreal, Que.	Cornwall, Ont. Toronto, Ont.
Vermiculite Insulating Limited, 5095 City Hall, Montreal, Que.	Montreal, Que.

Prices and Tariffs

Closing prices for 1954 published in E. and M.J. Metal and Mineral Markets, were as follows:

Vermiculite, per short ton, f.o.b. mines
Montana - $9.50 to $18.00
South African crude, per ton c.i.f. Atlantic ports - $30.00 to $32.00

Crude vermiculite enters both Canada and the United States free of duty.

WHITING AND WHITING SUBSTITUTE

Production of whiting substitute during 1954 amounted to 15,460 tons valued at $156,057, which is a slight decrease in tonnage over the previous year. Imports of true whiting during the same period also decreased. Production statistics include a quantity of finely ground off-colour limestone which is used as an industrial filler.

Whiting substitute is a term applied to a ground limestone, calcite, or marble, white in colour. Canadian producers commonly refer to it as marble flour or domestic whiting. It may also be prepared from a white marl although there has been no production in Canada from this source for several years. Quebec, Ontario, and British Columbia are the only producing provinces.

Industrial Fillers Limited, Montreal, quarries a white marble near St. Armand, Bedford County, producing a whiting substitute in their Montreal plant. Beale Quarries Limited, Vananda, Texada Island in British Columbia, prepare it from a white marble quarried there. Production in Ontario is restricted to an off-colour limestone which is ground, air-classified and marketed for uses which can accept an off-white product.

Although not produced in Canada, by-product whiting, a precipitated calcium carbonate, is obtained in some countries during the manufacture of caustic soda.

True whiting is prepared from chalk, a fine-grained, light-coloured stone composed of the calcareous residue of microscopic marine organisms. It is extremely white in colour and is finely ground and sized. True whiting is imported into Canada from Europe and the United States.

Production, Trade, and Consumption

	1954		1953	
	Short Tons	$	Short Tons	$
Production				
Stone processed for whiting substitute				
Marble	11,611	139,335	11,767	141,204
Limestone	3,849	16,722	5,146	39,908
Total	15,460	156,057	16,913	181,112
Imports				
Whiting, gilder's whiting, and Paris white				
From: United States	5,268	187,584	6,605	217,986
United Kingdom	4,117	57,069	4,292	54,930
Other countries	1,379	9,158	1,350	11,313
Total	10,824	253,811	12,247	284,229
Chalk, prepared				
From: United States		3,148		1,662
Miscellaneous--chalk, china, Cornwall or Cliff stone (ground or unground), and mica schist				
From: United States		2,151		1,827
Italy		200		--
West Germany		--		3,070
United Kingdom		--		1,353
Total		2,351		6,250
Consumption	1953		1952	
Ground chalk, whiting and whiting substitute				
Explosives	347		331	
Medical and pharmaceuticals.	28		28	
Paints	11,632		10,599	
Soaps	62		59	
Toilet preparations	13		3	
Electrical apparatus	464		297	
Enamelling	149		116	
Linoleum and oilcloth	5,968		6,592	
Rubber goods	6,646		5,840	
Tanneries	263		216	
Non-ferrous smelters	50[e]		50[e]	
Gypsum products	210		140	
Polishes and dressings	3		2	
Adhesives	44		32	
Asbestos products	662		365	
Miscellaneous chemicals	1,127		871	
Cement products	--		12	
Clay products	--		1	
Total	27,668		25,554	

e- estimated

Uses

There are a number of industries using whiting in their manufacturing processes. It is used in the manufacture of both oil and cold water paints; for the former it must be finely ground and free of certain impurities. It is also used in the manufacture of putty where low oil absorption is the characteristic desired. The rubber industry uses whiting as a filler, where it must be finely ground and contain only minor impurities. It is also used as a mineral filler in linoleum and oil cloth, in moulding plastics, polishes, cleaning compounds, and paper. The characteristics desired for many of these uses are proper particle size and shape, white colour, and an absence of grit.

The ceramic industry uses true whiting in glazing and the manufacture of whiteware.

Prices

In 1954, the price of whiting substitute per ton, bagged, ranged between $15.00 and $20.00 per ton f.o.b. plants.

FUELS

COAL

The Canadian coal industry continued to show the effect of increasing competition from other fuels; production at 14,913,579 tons was 6.2 per cent below that of 1953 and 22.1 per cent below the record 19,139,112 tons in 1950. Although the Maritime Provinces and Saskatchewan showed slight increases over 1953, Alberta's output decreased by about 18 per cent and that of British Columbia by almost 10 per cent, the reduction being mainly in the production of bituminous coals. Nova Scotia contributed about 39 per cent of the total, Alberta 33, Saskatchewan 14, British Columbia and Yukon 9, and New Brunswick 5.

Apparent consumption decreased from 38,140,497 tons in 1953 to 32,788,268 tons in 1954; over 85 per cent of the decrease was in imported coal, most of which was bituminous from the United States. Imports made up about 56 per cent of coal consumed, compared with 60 per cent in 1953. The decrease in consumption was due mainly to the use of fuel oil, diesel fuel, and natural gas in place of coal in domestic and building heating, railway use, and power production.

It is of interest to note that whereas the average value of coal produced in Canada showed a very slight increase from $6.46 per ton in 1953 to about $6.48 in 1954, imported coal showed a substantial decrease from $5.92 per ton in 1953 to about $5.62 per ton in 1954. This sharp decrease in value of imported coal parallels the 20 per cent decrease in imports.

About 34 per cent of the output in 1954 was produced by strip mining which is practised in all provinces except Nova Scotia. In Saskatchewan, practically the whole output is strip mined, in Alberta about 44 per cent, in New Brunswick 76 per cent, and in British Columbia about 18 per cent.

Production of Coal by Provinces and Territories[a]

(short tons)

		Bituminous	Sub-Bituminous	Lignitic	Total
Nova Scotia	1954	5,842,896	-	-	5,842,896
	1953	5,787,026	-	-	5,787,026
New Brunswick	1954	781,271	-	-	781,271
	1953	721,252	-	-	721,252
Saskatchewan	1954	-	-	2,116,740	2,116,740
	1953	-	-	2,021,304	2,021,304
Alberta	1954	2,402,826(b)	2,456,223	-	4,859,049
	1953	3,517,500(b)	2,399,974	-	5,917,474
British Columbia	1954	1,299,510	-	-	1,299,510
	1953	1,443,006	-	-	1,443,006
Yukon	1954	14,113	-	-	14,113
	1953	10,611	-	-	10,611
Total	1954	10,340,616	2,456,223	2,116,740	14,913,579
	1953	11,479,395	2,399,974	2,021,304	15,900,673
Value $	1954	81,233,732	11,404,832	3,961,702	96,600,266
	1953	87,799,281	11,088,139	3,834,455	102,721,875

(a) Coals classed according to A. S. T. M. Classification of Coal by Rank - A. S. T. M. Designation D388-38.

(b) Includes a small amount of semi-anthracite from the Cascade area.

Although the output per man-day in strip mining varies from about 5 to 23 short tons, depending upon thickness and type of cover and thickness of coal seam, it is in all cases greater than for underground mining. Considering the average for all provinces, the output in 1954 was about 12.5 tons per man-day for strip mining as against 2.6 for underground. It is of interest to note that per man-day production of strip coal showed a decrease of about 14 per cent from 1953, whereas underground mining showed an increase of almost 11 per cent. Increased mechanization largely accounts for the improved output from underground operations, whereas the decrease in per man-day output of strip coal might be due to a reduction in total output and to the fact that in the mountain regions of Alberta and British Columbia the most easily mined strip outcrops are being depleted and new workings must contend with heavier cover, and thus reduced throughput per man-day.

Production of Coal By Type of Mining, 1954

		Short Tons	Per Cent
Nova Scotia	- strip mines.....	-	-
	underground ...	5,842,896	100.0
New Brunswick	- strip mines.....	593,869	76.0
	underground ...	187,402	24.0
Saskatchewan	- strip mines.....	2,110,875	99.7
	underground ...	5,865	.3
Alberta	- strip mines.....	2,128,850	43.8
	underground ...	2,730,199	56.2
British Columbia	- strip mines.....	237,292	18.1
& Yukon	- underground ...	1,076,331	81.9
Canada	- strip mines.....	5,070,886	34.0
	underground ...	9,842,693	66.0

Average Output of Coal per Man-day for Canada

	1953	1954
Strip mines..................	14.541 tons	12.512 tons
Underground	2.359 tons	2,618 tons
All mines	3.503 tons	3,581 tons

Consumption of Coal(a) By Use.
Fiscal Years Ending March 31, 1954 and March 31, 1955

(thousands of short tons)

Use	Bituminous(b)	Anthracite	Briquettes	Total
		1953-1954		
Domestic	6,810	2,574	248	9,632
Industrial	14,350(c)	265(d)	-	14,615
Railroads	8,002	-	623	8,625
Coke & Gas	5,670	-	-	5,670
Water Transp.	486	-	-	486
Total	35,318	2,839	871	39,028
		1954-1955		
Domestic	6,554	2,445	250	9,249
Industrial	12,975(c)	265(d)	-	13,240
Railroads	6,330	-	643	6,973
Coke & Gas	4,715	-	-	4,715
Water Transp.	366	-	-	366
Total	30,940	2,710	893	34,543

(a) Canadian and imported: compiled by Dominion Coal Board
(b) Includes lignite (c) Includes coal used by mines.
(d) Includes some uses other than industrial.

Consumption of Canadian and Imported Coal
(Calendar Years)

	Canadian Coal[a]		Imported Coal[b]		
	Short Tons	% of Consumption	Short Tons	% of Consumption	Total
1952	16,749,316	40.5	24,603,789	59.5	41,353,105
1953	15,240,105	40.0	22,900,392	60.0	38,140,497
1954	14,466,212	44.1	18,322,056	55.9	32,788,268

a The sum of Canadian coal mine sales, colliery consumption, coal supplied to employees, and coal used in making coke and briquettes, less the tonnage of coal exported.
b Deductions have been made to take into account foreign coal re-exported from Canada and bituminous coal exwarehoused for ships' stores. Imports of briquettes are not included.

Imports of Coal for Consumption[a]
(short tons)

Country of Origin		Anthracite	Bituminous	Total
United States	1954	2,487,842	15,695,283[b]	18,183,125
	1953	2,650,193	20,027,273[c]	22,677,466
United Kingdom	1954	266,250	54	266,304
	1953	338,861	13,522	352,383
Union of South Africa	1954	790	-	790
	1953	-	-	-
Total	1954	2,754,882	15,695,337	18,450,219
	1953	2,989,054	20,040,795	23,029,849
Value $	1954	33,163,183	72,043,248	105,206,431
	1953	40,088,265	96,296,421	136,384,686

a From Trade of Canada: includes briquettes but does not include coal imported and subsequently sold for use on board ships.
b Includes 2,824 tons of lignite and 128,163 tons of briquettes.
c Includes 3,062 tons of lignite and 128,673 tons of briquettes.

Exports of Coal
(short tons)

Destination	1954	1953
United States	207,395	244,321
St. Pierre and Miquelon	11,585	10,928
Alaska	366	25
Total	219,346	255,274
Value $	1,716,435	1,999,908

Consumption of Briquettes

Apparent consumption of briquettes increased from 835,838 tons in 1953 to 962,131 tons in 1954. About 72 per cent of the amount marketed in Canada was used by the railways, mainly as locomotive fuel. Owing to increased conversion of steam locomotives from coal to oil and the resultant loss of markets for briquettes, one of the major producers of locomotive briquettes in Alberta ceased operation during the year. The Saskatchewan output, used entirely for domestic purposes, is made from carbonized lignite. The Alberta output is prepared from semi-anthracite coals of the Cascade area and medium-volatile bituminous coals of the Crowsnest and Mountain Park areas, and that of British Columbia from medium-volatile bituminous coals of the East Kootenay (Crowsnest) area.

Imports of briquettes from the United States in 1954 amounted to 128,163 tons, a decrease of 510 tons from 1953. These briquettes, used almost entirely for domestic purposes, are made from low-volatile bituminous coals and anthracite, alone or mixed.

Producing Areas

Nova Scotia and New Brunswick

Nova Scotia produces high- and medium-volatile bituminous coking coals in the Sydney, Cumberland, and Pictou areas and some non-coking bituminous coal from the Inverness area. New Brunswick output in 1954 came mainly from the Minto area; a small proportion originated in the Beersville area.

A large part of the production from the two provinces is used locally for industrial and domestic purposes; in 1954, 2,569,299 tons, approximately 39 per cent of output was shipped to central Canada both for commercial and railway use, compared to 1,861,834 tons in 1953.

Saskatchewan

Only lignite is produced, chiefly from the Bienfait, and Roche Percee fields in the Souris area. Approximately 53 per cent of the 2,116,740 tons produced in 1954 was shipped to Manitoba for domestic and industrial use.

Alberta

Alberta produces almost all types of coal, including a relatively small tonnage of semi-anthracite. Coking bituminous coal ranging from high to low volatile is produced in the Crowsnest, Nordegg, and Mountain Park areas. These are mainly railway and industrial steam coals, but commercial and domestic markets are also supplied. In the Lethbridge, Coalspur and Saunders, and several other areas of the foothills, lower-rank bituminous non-coking coals are produced. These are mainly domestic and commercial coals but the industrial and railway market for certain types of these coals is substantial. The coal in the Drumheller, Edmonton, Brooks, Camrose, Castor, and Carbon areas is classed as subbituminous and that in the Tofield, Redcliff and several other areas is on the border of subbituminous and lignite. These are mainly domestic and commercial coals, but increasing proportions are being used industrially. The Cascade area was the only field that produced semi-anthracite.

About 49 per cent of Alberta's coal output in 1954 was bituminous and 51 per cent subbituminous and lignite, mainly the former. Of the total production only about 7 per cent was shipped to central Canada for commercial and railway use. With increased conversion of locomotives from coal-burning to oil-burning, the only operating mine in the Nordegg area suspended work during the year, and the one remaining producer in the Mountain Park area curtailed output.

British Columbia

Bituminous coking coal, ranging from high to low volatile, is mined on Vancouver Island and in the East Kootenay (Crowsnest), Telkwa and Nicola areas. Small quantities of subbituminous coal have been produced in the Princeton field. In the Crowsnest area, the largest producing field, medium-temperature (by-product) coke is manufactured chiefly for industrial consumption. The briquetting plant which started operating during 1953, produced well over 150,000 tons of railway briquettes in 1954.

Beneficiation

Although the industry continues to suffer from the competition of other fuels, it has continued its efforts to improve the quality of its products by the use of modern methods of beneficiation such as cleaning, drying, dust-proofing, freeze-proofing, and the briquetting of fines.

A major problem continues to be the beneficiation of fines, both from the viewpoint of preparing a reasonably low-ash product and the production of a lump fuel that will find greater acceptance in the domestic and industrial markets. In this regard more equipment has been installed at certain Western collieries for the cleaning and drying of fines.

During the year the Mines Branch, Ottawa, in co-operation with industrial organizations, has experimented with the use of fine coal as a reductant in the smelting of minerals, the coal and fine mineral matter being mixed and agglomerated. These experiments have been very promising and further investigations are planned.

The activity in briquetting increased in 1954 in Western Canada in connection with the manufacture of briquettes for use as locomotive fuel. The marketing of briquettes has helped to improve the competetive position of the coal industry.

Competition

The data following suggest the extent to which oil and natural gas are replacing coal.

Fuel Consumed by Railway Locomotives,* 1943-1954

Year	Coal	Fuel and Diesel Oil	Estimated Heat Equivalent of Oil in Terms of Coal**	Estimated Heat Equivalent of Oil as a Percentage of Total Coal & Oil
	Thousands of Tons	Millions of Imp. gal.	Thousands of Tons	%
1943	11,987	79.0	538.6	4.3
1944	11,993	80.9	551.6	4.4
1945	12,084	78.3	533.8	4.2
1946	11,632	82.2	560.4	4.6
1947	12,331	86.7	591.1	4.6
1948	12,422	96.3	656.6	5.0
1949	11,444	139.3	949.7	7.7
1950	10,452	217.9	1,485.6	12.4
1951	10,505	260.4	1,775.4	14.5
1952	9,798	291.9	1,990.2	16.9
1953	8,323	308.2	2,101.3	20.2

* From Dominion Bureau of Statistics.

** Estimated in terms of coal at 13,000 B.T.U./lb., taking oil at 9.33 lb./gal. with a calorific value of 19,000 B.T.U./lb.

Preliminary surveys based on information received from the two main railways indicate a 20 per cent decrease from 1953 in coal consumed by locomotives. An increase of approximately 5 per cent is recorded in the use of fuel oil and diesel oil by locomotives. The decrease in coal consumption was partly due to decreased traffic. Conversion of steam locomotives from coal to oil has generally displaced more coal than has the use of diesel units.

The use of oil for domestic and building heating and of natural and manufactured gas for domestic, commercial, and industrial purposes continued to increase. Whereas the use of fuel oil has increased since 1947 by over 140 per cent, coal and coke consumption has decreased by about 32 per cent for the same period on a weight basis. During 1947 the oil consumed, estimated as the heat equivalent in terms of coal, amounted to 20.3 per cent of the total fuel used; in 1954 it amounted to over 42 per cent.

Consumption of Fuels for Domestic and Building Heating, 1947 to 1953

	Fuel Oil and Distillate[a]		Natural Gas[c]	Manu-factured Gas[c]	Coal & Coke[b]
	Gals.	Bbls.	M. cu. ft.	M. cu. ft.	Short Tons
1947	569,569,808	16,273,423	28,198,903	20,525,540	13,117,157
1948	596,263,716	17,036,106	30,824,172	21,570,466	13,429,436
1949	655,686,161	18,733,890	32,164,544	23,864,281	12,473,258
1950	863,447,542	24,669,930	40,004,435	20,363,572	12,653,394
1951	1,042,546,139	29,787,032	43,048,025	24,072,327	11,436,717
1952	1,220,237,423	34,863,926	43,328,304	22,527,092	10,515,475
1953	1,350,478,654	38,585,104	46,390,654	21,418,959	8,941,428

(a) "The Petroleum Products Industry", D. B. S.(b) The Coal Mining Industry "Sales of Coal & Coke by Retail Fuel Dealers", D. B. S. Not available prior to 1947.(c) The Crude Petroleum & Natural Gas Industry, D. B. S. Take for manufactured gas - domestic, house heating and commercial. Take for natural gas - domestic and commercial.

If the natural gas used in 1954 for domestic and commercial purposes were entirely replaced by coal it would require an equivalent of 2.2 million tons of 13,000 B. T. U. /lb. coal. The projected gas pipeline to central Canada will, undoubtedly, further seriously affect the demand for coal. Gas and oil are also strong competitors of coal in the production of power at central electric stations.

COKE

Production of coke from bituminous coal in 1954 was 3,411,628 tons compared with 4,252,833 tons in 1953 the decrease being mainly due to the temporary drop in steel production during the year. Coal processed for the manufacture of coke amounted to 4,664,657 tons of which 935,949 tons were of Canadian origin and 3,728,708 tons were imported from the United States. Petroleum coke produced at the refineries amounted to 249,000 tons compared with 238,663 tons in 1953.

Imports of coke totalled 542,505 tons, a decrease of 113,754 tons from 1953; exports also decreased from 200,017 tons in 1953 to 154,210 tons in 1954.

Most of the coke produced for the Canadian market is obtained from standard by-product coke ovens that process coal in large tonnages for use in producing steel and non-ferrous metals or as domestic fuel. Retort coke, a by-product of the gas industry, forms only a small part of the total coke production and is used largely to make carburetted water-gas for city use.

Production and Trade

	1954		1953	
	Short Tons	$	Short Tons	$
Production				
From bituminous coal				
Ontario	2,278,213		2,932,928	42,954,291
Nova Scotia, New Brunswick, Quebec and Newfoundland	865,888		1,032,762	17,675,957
Manitoba, Saskatchewan, Alberta, and British Columbia . .	276,527		287,143	3,541,501
Total	3,411,628		4,252,833	64,171,749
Pitch coke	-*		8,214	186,689
Petroleum coke	249,000**		238,663	1,935,086
Total production			4,499,710	66,293,524
Bituminous coal used to make coke				
Imported	3,728,708		4,653,235	48,657,658
Canadian	935,949		1,079,067	9,585,573
Total.....	4,664,657		5,732,302	58,243,231
Imports, all types				
United States	542,082	8,715,152	656,073	11,560,791
United Kingdom	192	4,833	186	4,979
Others	231	13,798	-	-
Total.....	542,505	8,733,783	656,259	11,565,770
Exports, all types				
United States	135,144	1,394,280	179,013	2,321,852
United Kingdom	11,392	497,181	-	-
Other countries	7,674	316,086	21,004	887,394
Total.....	154,210	2,207,547	200,017	3,209,246

* Not available
** Estimated

Several types of plant produce coke in Canada. They comprise seven by-product coke oven plants, one Curran-Knowles installation, three continuous vertical retort plants, and a coking stoker type of plant designed and operated by Shawinigan Chemicals Company, Shawinigan Falls, P.Q. Many of the smaller gas retort plants that were in operation in the earlier part of the century have been replaced by carburetted water-gas plants or propane units.

About 80 per cent of the coal used in the production of coke in Canada is processed at six plants in Eastern Canada, namely: Dominion Steel and Coal Corporation at Sydney, Nova Scotia, with rated annual capacity of 1,001,900 tons of coal; Montreal Coke and Manufacturing Company at Ville La Salle in Quebec, with rated annual capacity of 656,000 tons of coal (the company normally produces domestic coke and also supplies Montreal with gas); Algoma Steel Corporation Limited with a metallurgical coke plant at Sault Ste. Marie, Ontario, which has a rated annual capacity of 1,761,000 tons of coal; Hamilton By-Product Coke Ovens Limited at Hamilton, Ontario, with a rated annual capacity of 415,000 tons of coal; Dominion Steel Foundries Limited, with an annual capacity of 300,000 tons; and Steel Company of Canada Limited at Hamilton, with a rated capacity of 1,470,000 tons of coal a year.

NATURAL GAS

Estimated gross production of natural gas, less field waste, rose 19.7 per cent over 1953 to 120,888,412 M cu. ft. valued at $12,515,100 in 1954. Alberta supplied 89 per cent of the output. Saskatchewan's production amounted to 3,466,890 M cu. ft. or almost triple that of 1953. Ontario's output at 10,051,049 M cu. ft. remained at its customary level. Production in New Brunswick and Northwest Territories, the only other Canadian producers, is small and static. Large natural gas reserves have been developed in British Columbia but production has been withheld pending market outlets.

Large natural gas reserves are also being built up elsewhere in Western Canada and the matter of market outlets has become of primary concern to the industry. Reserves in Western Canada had climbed to at least 16 trillion cu. ft. by the end of 1954 and an annual rate of increase of 1 1/2 to 2 trillion cu. ft. is indicated for the next few years. Market uncertainties have restricted the search for natural gas to date but with increasing market incentive expansion of the industry can be expected to continue.

Westcoast Transmission Company Limited signed an agreement with United States gas companies which, subject to Canadian and United States Government approval, will provide for the marketing of natural gas from the Peace River area of British Columbia and Alberta in southern British Columbia and the Pacific northwest states. Plans were made by Trans-Canada Pipe Lines Limited for a gas pipe line from Alberta to Toronto and Montreal, but financing arrangements for the 2,200-mile line were incomplete at the end of 1954.

Development and Production

British Columbia

The most significant events of the exploration and drilling program in British Columbia in 1954 were the gas discoveries at Red Creek, West Buick Creek, Montney, and Nig Creek, all in the Peace River region.

During the year's drilling program 34 wells were drilled, of which 15 were completed as potential gas wells, 9 were abandoned, 2 were suspended, and 8 were still drilling at the end of the year. In all, 147,654 feet of drilling was done in 1954 compared with 196,227 feet in 1953 when 18 gas wells were completed. In December, 26, 169,020 acres were held under permit, licence and lease in the Peace River section of the Province, and 8 seismic crews were at work.

Although drilling began in the Peace River area in 1947, it was not until 1951 that major exploration programs were commenced. Aside from the Fort St. John field there were 6 areas in British Columbia by the end of 1954 that showed promise of developing into natural gas fields.

The Fort St. John field, site of the original Peace River area discovery in 1950, has the largest reserves. During 1954 the field was further extended by 4 successful outpost wells. Field development work has stressed experimental techniques in drilling and completion practices, the purpose being to provide high deliverability wells from production horizons characterized by high porosities, though medium permeabilities. Several wells in the field have open-flow potentials in excess of 20,000 M cu. ft. a day from Triassic formations. Favourable results have also been received in tests in formation of Permo-Pennsylvanian age. Ninety-seven wells in the field are capped and ready for operation when a pipe line is built.

Alberta

Eighty oil and gas fields recorded natural gas production in 1954. Although 80 per cent of the natural gas production came from 6 fields large increases over 1953 output took place in several other fields, particularly Fenn Big Valley, Golden Spike, Morinville, and St. Albert. The average wellhead price of the output was 7.5 cents per M cu. ft.

In 1954, forty-five wells were classified as new gas producers; 130 were suspended and classified as potential producers. At the end of the year 471 gas wells were capable of production, of which 427 were operating; 491 were capped. These totals exclude wells classified as crude oil wells, which account for over one-half of the current natural gas production. Drilling resulted in 14 gas wells and 126 potential gas wells, compared with 53 gas wells and 142 potential gas wells in 1953.

Exploratory drilling produced some important results in the foothills and adjacent regions of Alberta. It is in these regions that the major gas reserves of Turner Valley, Pincher Creek and Jumping Pound occur and thus they hold much promise for gas exploration. During 1954 the Savanna Creek structure, first mapped in 1937, was tested by Husky Northern Target Savanna Creek No. 1 well about 60 miles southwest of Calgary, and open-flow measurements up to 50,000 M cu. ft. a day were obtained. Natural gas was found in four zones in the depth range of 7,660 to 7,990 ft. in the Rundle group of Mississippian age. The Savanna Creek structure is west of the foothills and is the first within the Canadian Rockies to give evidence of oil and gas accumulation. Shell Home Sarcee No. 1 well, about 13 miles southwest of Calgary and 9 miles north of Turner Valley field, was rated as one of the most promising exploratory wells since the discovery of Pincher Creek in 1947. Drillstem tests of the Rundle formation in the depth range of 9,622 to 9,880 ft. ran as high as 5,000 M cu. ft. daily and the initial potential of the well was rated up to 50,000 M cu. ft. a day.

Several other wells in the foothills and adjacent areas obtained significant results. Shell Jumping - Unit 13 was classed as a one-mile northwest extension of the Jumping Pound field. Great Plains - Canadian Superior et al. Elkton 16-13 at Elkton, 41 miles northwest of Calgary, found 147 ft. of productive formation of Mississippian age, and during tests produced at an open-flow daily potential in excess of 30,000 M cu. ft., with distillate at the rate of approximately 50 barrels per million cu. ft. Two other wells a few miles north of the Elkton also tested favourably and follow-up drilling may result in new fields.

Within a radius of 60 miles of Edmonton 12 gas wells were classed as important discoveries. Several were also completed successfully in the Peace River and Sturgeon Lake areas. By far the greatest number of wells, however, were drilled in the southeastern part of the province, within short distances of the route of the proposed grid system which is planned as a supply line for Trans-Canada Pipe Lines Limited. At least 25 wells within easy reach of the route gave flows in excess of 1,000 M cu. ft. a day on drillstem tests from Lower Cretaceous formations. A further incentive to exploration of the Lower Cretaceous in eastern Alberta and to development of the reserves is the relatively low drilling cost. Wells can be completed for $50,000 to $100,000 contrasted with $500,000 and more for some of the deeper foothills wells.

In addition to 70 exploratory wells drilled during the year, 70 field wells as well as the 673 successful oil wells - many of which will yield gas in commercial quantities - enlarged the gas-producing potential of the province.

Saskatchewan

Natural gas production in 1954 came mainly from 8 wells in the Brock field, 6 in the Coleville field, 5 in the Unity field, and 10 in the Lloydminster field. At the end of the year 119 gas wells were capable of production, of which 33 were in operation.

Exploratory drilling resulted in 9 discoveries in 1954. All were made in the Brock-Coleville-Smiley area except the S.W.S. Tompkins 3-14 well in the Gull Lake area; 1954 discoveries and field development will further increase output. Wellhead prices averaged 9 cents per M cu. ft. The Frobisher light oil discovery in the southeastern corner of Saskatchewan also found gas. Possibilities of this field have yet to be ascertained. Saskatchewan's reserves of natural gas are not yet sufficient to meet the anticipated provincial demand for the next few years. The main resources are in the Coleville and Brock fields, which supply Saskatoon and nearby towns. Natural gas has also been found in or near most of the oil fields of southwestern Saskatchewan. Saskatchewan Government estimates placed total indicated reserves, including probable and possible categories, at 1,000,000,000 M cu. ft. at the end of 1954.

Manitoba

No gas reserves have been established as yet.

Northwest Territories

The small production comes from the Norman Wells field, which was discovered in 1920 and developed to its present stage during the second world war. It is used to meet local needs.

Ontario

Production has remained close to 10,000,000 M cu. ft. in recent years.

During the year 160 gas wells were successfully completed, of which 152 were development wells and 8 were wildcat. They had an average depth of 1,754 feet, and an average open-flow measurement of 1,763 M cu. ft. Lambton county wells gave the best tests; 23 wells averaged 11,500 M cu. ft. a day on open-flow measurement. The remaining wells, drilled in Haldimand, Halton, Huron, Kent, Lincoln, Middlesex, Norfolk, and Welland counties gave smaller yields.

At the end of 1954 Ontario had 3,703 gas wells and 2,140 oil wells, the average daily yields being much smaller than those of Western Canada.

The Consumers' Gas Co. of Toronto commenced changeover from manufactured gas to natural gas service in its Toronto system and made plans to take delivery of United States natural gas in 1955. Union Gas Company of Canada, Limited signed an agreement with Panhandle Eastern Pipe Line Company in the United States for an additional 15,500,000 M. cu. ft. of gas a year for distribution in its southwestern Ontario pipe line system. This agreement awaits United States Government approval.

New Brunswick

Natural gas is produced in the Stony Creek field, Albert county, where 42 of the 64 operating wells yield gas. No exploratory work of consequence has been done in New Brunswick in recent years. However, plans were made in 1954 to drill 6 wells on a Crown lease covering 10,000 square miles in the eastern half of the province.

Pipe Line Transportation

Trans-Canada Pipe Lines Limited

Following the merger of Trans-Canada Pipe Lines Limited and Western Pipe Lines in January 1954, the new Trans-Canada Pipe Line Limited proceeded with plans to supply markets in Eastern Canada via an all-Canadian route.

In May the Alberta Government announced that Trans-Canada had been granted permission to export natural gas from Alberta at the rate of 540,000 M cu. ft. a day up to a total of 4,350,000,000 M cu. ft. over a 27-year period. As part of the total allotment for that period, Trans-Canada has asked that 1,330,000,000 M cu. ft. be designated for export to United States at the Minnesota border.

The company obtained approval from the Federal Government in July to move Alberta gas 2,250 miles across Canada to Ontario and Quebec markets, Alberta and Federal Government permits being subject to the establishment of proof that the project can be financed.

The pipe line as planned in 1954 was to start at a point on the Alberta-Saskatchewan border east of the town of Princess, Alberta, and pass through or near Moose Jaw, Regina, Brandon, Portage la Prairie and Winnipeg and then through northern Ontario, south to Toronto, and east to Montreal.

In Alberta a collecting agency, Alberta Gas Trunk Line Company, has been organized to deliver gas to Trans-Canada. Representatives of the producers, utility companies, and the Alberta Government make up the board of directors of the company.

In April 1954, the Board of Transport Commissioners for Canada approved Trans-Canada's application to build a 76-mile, 20-inch line from Niagara River to Toronto to supply The Consumers' Gas Co. of Toronto with United States gas as a market build-up project. Built at a cost of $5,500,000, the line connects with facilities of Tennessee Gas Transmission Company at the Niagara River, 3 miles downstream from Lewiston, N.Y. It was completed in October.

In September a contract was signed with Northern Natural Gas Company of Omaha, Nebraska, calling for Northern Natural to purchase gas from Trans-Canada at the Manitoba-Minnesota border at the rate of 100,000 M cu. ft. a day for the first year and at 150,000 M cu. ft. starting the second year. By the end of 1954, however, most supply and market contracts had not been obtained by Trans-Canada and financing of the $300,000,000 project was therefore incomplete. The company received an extension to April 30, 1955 from the Board of Transport Commissioners for Canada and the Alberta Government, on the time limit set for financing.

Westcoast Transmission Company Limited

Although Westcoast Transmission Company Limited had approval from the Board of Transport Commissioners to export natural gas from the Peace River region to United States west coast areas, its application before the Federal Power Commission in Washington was turned down in June. In December 1954, however, agreements were signed by Westcoast Transmission Company Limited, Pacific Northwest Pipe Line Corporation and El Paso Natural Gas Company, which would provide for the delivery of 300,000 M cu. ft. of Peace River area gas a day from Westcoast Transmission Company to Pacific Northwest Pipe Line Corporation at Sumas near the British Columbia Washington border. This gas would be used in the Pacific Northwest system in Washington and Oregon and by El Paso Natural Gas for feeding into the distribution system of Pacific Gas and Electric Company in the San Francisco Bay area. Pipe Line plans made during the year involve: a 650-mile, 30-inch line from Dawson Creek, B.C., to Sumas, Washington, to be built by Westcoast at a cost of $142,000,000; Pacific Northwest's 1,450-mile, 22-to26-inch line from southwestern Colorado to join with the Westcoast line on the Washington-British Columbia border; and a line from Mountain Home, Idaho, to San Francisco, to be built by El Paso Natrual Gas Company.

The agreements signed by the three companies call for one of the largest expenditures in gas pipe line history. At a cost of some $400,000,000 a gas transmission system will be constructed to link all major populated areas west of the Rocky Mountains in United States and Canada with the gas-producing areas in the western half of the Continent, the Peace River area to be a major source of supply in the overall project. At the end of 1954, Westcoast Transmission Company was working on finaicial and construction plans and was preparing application to the Canadian and United States Governments for approval of its proposed pipe line project.

The company's plans also make provision for delivery of at least 50,000 M cu. ft. a day to disribution companies in central British Columbia, the lower mainland, and Vancouver.

Northwestern Utilities, Limited

In 1954 this company constructed a 40-mile, 12-inch pipe line costing $1,400,000 from the Bonnie Glen-Wizard Lake fields to transport initially 15,000 M cu. ft. a day of oil field residue gas to Edmonton. A 6-mile, 6-inch line from the Acheson field was also completed to permit the daily delivery of 3,000 M cu. ft. to Edmonton.

Saskatchewan Power Corporation

This company extended service along its Brock-Saskatoon pipe line to a number of small towns. It also laid a 30-mile, 10-inch line between the Brock and Coleville fields to increase the available supply of gas.

Proposed Union Gas Company Pipe Line

Union Gas Company of Canada Limited has drawn up plans for a major natural gas pipe line from gas storage fields in Lambton county to the vicinity of Oakville, in southwestern Ontario. The 160-mile line would pass through Hamilton, Guelph, Kitchener, Waterloo, St. Mary's and Stratford. It would be used to build up large markets in that part of the province in preparation for a pipe line from western Canada, and with its storage facilities in Lambton county would become an integral part of the general trans-Canada system.

Natural Gas Pipe Line Mileage

Natural gas pipe line mileage, by provinces, at the end of 1952, 1953, and 1954 is shown in the following table:

	Gathering and Transmission (in Miles)			Distribution (in Miles)		
	1952	1953	1954*	1952	1953	1954*
New Brunswick	20	20	20	65	65	65
Ontario	2,303	2,326	2,425	2,068	2,118	2,160
Saskatchewan	36	150	200	24	31	50
Alberta	1,262	1,466	1,540	1,349	1,503	1,615
	3,621	3,962	4,185	3,506	3,717	3,890

* Preliminary

Natural Gas Processing

At the end of 1954 eight "wet gas" processing plants were in operation, all in Alberta, with a total capacity of 331,500 M cu. ft. a day. Three of these plants are in Turner Valley field and there is one each in the Leduc, Jumping Pound, Bonnie Glen, Big Valley, and Acheson-Stony Plain fields.

Initial processing was started at the Bonnie Glen gas absorption plant by Texaco Exploration Company. Built at a cost of $7,000,000, the plant has a capacity of 20,000 M cu. ft. a day. In addition to dry natural gas, the plant produces natural gasoline, propane and butanes.

During the year Shell Oil Company of Canada, Limited enlarged the capacity of its absorption plant in the Jumping Pound field from 35,000 to 60,000 M cu. ft. a day. The sulphur extraction plant was also enlarged to raise the sulphur output from 30 to 80 tons a day.

Production of Natural Gasoline, Propane, Butane and Sulphur in Natural Gas Plants in Alberta in 1954

Field	Natural Gasoline (bbls.)	Propane (bbls.)	Butane (bbls.)	Sulphur (short tons)
Leduc*..........	93,843	314,229	219,521	
Turner Valley ...	508,613	160,357	-	10,334
Acheson	6,248	27,209	9,691	-
Big Valley.......	2,610	13,843	3,896	-
Bonnie Glen	6,060	13,479	12,081	-
Jumping Pound ..	56,190	-	-	11,986
Alberta total ...	673,564	529,117	245,189	22,320

* Includes production obtained from Golden Spike field condensate.

New Chemical Plants Using Natural Gas

During 1954 the $24,000,000 nickel refinery built by Sherritt Gordon Mines Limited at Fort Saskatchewan, Alberta, made its first shipments. The plant employes ammonia made from natural gas, and as a by-product operation produces 70,000 tons of ammonium sulphate fertilizer annually. Enlargement of the Canadian Industries Limited polyethylene plant at Edmonton was also completed. Consolidated Mining and Smelting Company of Canada Limited is expanding its ammonia production facilities at Calgary. When operating at capacity these three plants consume almost 30,000 M cu. ft. of natural gas daily.

Markets for Natural Gas

Natural gas sales by utilities to domestic, industrial, and commercial customers are summarized in the following table.

Sales of Natural Gas in Canada, 1954

	Volume M cu. ft.	Value $	Number of Customers As of Dec. 31, 1954
Eastern Canada			
Domestic	10,377,986	11,989,711	152,931
Industrial.............	2,090,933	2,230,511	1,231
Commercial	1,653,265	1,769,598	11,042
Miscellaneous	50,524	51,058	411
Total	14,172,708	16,040,878	165,615

	Volume M cu. ft.	Value $	Number of Customers As of Dec. 31, 1954
Western Canada			
Domestic	26,682,818	10,390,613	129,435
Industrial	28,183,791	4,751,029	554
Commercial	18,150,079	4,916,981	14,185
Miscellaneous	277,442	41,217	65
Total	73,294,130	20,099,840	144,239

Exports and Imports

Canadian 1954 natural gas exports totalled 7,148,347 M cu. ft. and were valued at $827,945. The only exporter was Canadian-Montana Pipe Line Company; its exports were made to Montana Power Company for use by Anaconda Copper Company. An agreement was signed which, subject to Canadian Government approval, would provide for the export of 20,000,000 M cu. ft. a year in place of the present allowable of 10,000,000 M cu. ft. with general distribution in the State of Montana being permitted.

Natural gas production in southwestern Ontario was supplemented by imports of 6,221,021 M cu. ft. having a value of approximately $2,027,200.

Natural Gas Production[a]

	1954		1953	
	M cu. ft.	$	M cu. ft.	$
Alberta[b]				
Turner Valley	27,131,642		27,103,751	
Viking Kinsella	22,218,424		17,861,187	
Jumping Pound	12,242,139		10,425,400	
Leduc-Woodbend....	10,947,269		10,473,926	
Medicine Hat	7,314,981		5,788,418	
Pakowki Lake.......	7,250,569		9,697,353	
Others	20,053,246		8,301,570	
Total	107,158,270	8,036,870	89,651,605	6,723,870

(a) 1954 production figures are preliminary. Values of production for Alberta and Saskatchewan were estimated by applying the average wellhead prices per M cu. ft. to the production figures quoted. For Ontario, New Brunswick, and Northwest Territories, average wholesale prices at collecting points were used.

(b) Production figures represent the total production less wastage due to flaring and other field losses.

	1954	1953
	barrels	
Saskatchewan[b]		
Coleville-Smiley	1,985,374	792,613
Lloydminster	892,684	843,843
Lone Rock	692,078	547,886
Success	337,992	123,980
Gull Lake	327,789	71,133
Dollard	217,405	24,587
Wapella	216,215	95,893
Fosterton	211,875	67,527
Midale	152,047	15,267
Cantuar	100,722	18,558
Frobisher	56,923	-
Others	226,804	196,601
Total quantity	5,417,908	2,797,888
Dollar value	8,940,000	3,833,107
Manitoba[c]		
Daly	1,212,123	
Virden-Roselea	622,224	
North Virden	161,110	
Whitewater	24,729	
Pierson	25,018	
Woodnorth	48,039	
Others	54,334	
Total quantity	2,147,577	653,514
Dollar value	5,820,000	1,714,806
Ontario[d]	411,407	299,685
Dollar value	1,382,326	994,835
Northwest Territories[d]	363,060	316,689
Dollar value	294,079	257,251
New Brunswick[d]	13,047	14,738
Dollar value	18,266	20,633
Canada Total	96,066,854	80,898,897
Dollar value	247,154,671	200,582,276

b "Monthly Oil & Gas Report", Prov. of Sask.
c "Crude Oil and Water Production Summary", Prov. of Man.
d Dominion Bureau of Statistics.

Tariffs

There is no Canadian tariff on crude-oil imports. The United States tariff on Canadian crude-oil exports is 5 1/4 cents per bbl. on oil testing under 25° A.P.I. gravity and 10 1/2 cents per bbl. on oil testing at or above that gravity.

Production of Crude Petroleum, 1953 and 1954
(In barrels of 35 Imperial gallons)

	1954	1953
	barrels	
Alberta[a]		
Redwater	24,895,984	23,281,597
Leduc-Woodbend	20,560,789	21,360,474
Bonnie Glen	6,960,330	5,550,715
Fenn-Big Valley	6,492,733	3,203,747
Joarcam	4,858,380	4,637,908
Wizard Lake	3,706,921	3,095,287
Acheson	2,756,232	2,497,850
Golden Spike	2,549,518	2,167,636
Turner Valley	2,137,907	2,404,967
Westerose	1,372,193	930,073
Excelsior	1,163,649	1,060,555
Lloydminster	1,101,235	1,059,552
West Drumheller	1,089,720	539,586
Stettler	897,168	438,041
Pembina	800,404	39,272
Malmo	697,053	671,785
Joffre	560,560	28,814
Duhamel	538,010	535,986
Glen Park	464,875	414,978
New Norway	339,990	325,142
Fairydell-Bon Accord	312,045	204,864
Drumheller	277,258	278,862
Cessford	267,319	87,150
Rimbey	226,961	42,784
Clive	202,844	148,919
Erskine	201,102	48,897
Chauvin	151,082	90,747
Wainwright	119,429	68,726
Conrad	117,230	126,170
Taber	114,078	66,779
Jumping Pound	109,424	96,033
Others	1,671,432	1,312,487
Total quantity	87,713,855	76,816,383
Dollar value	230,700,000	193,761,644

a "Oil and Gas Industry", P. & N.G.C.B., Prov. of Alberta.

Supply and Demand of all Oils

	1954	1953
	barrels	
New Supply		
Production		
Crude petroleum	96,066,854	80,898,897
Natural gasoline	673,564	602,368
Total	96,740,418	81,501,265
Imports		
Crude petroleum	78,772,277	79,477,820
Petroleum tops	111,394	2,149,648
Natural gasoline	581,117	788,862
Refined petroleum products	34,078,209	33,866,018
Total	113,542,997	116,282,348
Total supply	210,283,415	197,783,613
Daily average	576,119	541,804
Demand		
Domestic	204 030,509	185,565,660
Exports		
Crude petroleum....................	2,344,948	2,507,314
Refined products	718,122	352,412
Total demand	207,093,579	188,425,386
Daily average	567,662	516,234
Average daily domestic demand	558,988	508,399
Change in stocks	+ 3,189,836	+ 9,358,227
Stocks (end of year)		
Crude petroleum	21,774,154	21,423,225
Natural gasoline	6,632	5,702
Refined petroleum products	37,675,417	35,495,543
Unfinished products	4,793,854	4,135,751
Total	64,250,057	61,060,221

MARKETING

The Canadian oil industry made good progress in 1954 in the marketing of its growing crude-oil production. After 8 years of market growth the industry was, at the end of 1954, supplying practically all crude oil requirements between Vancouver and Toronto. During the year, British Columbia switched entirely to Canadian crude oil, and Ontario reduced its imports to one-fifth of its total requirements, with a further reduction indicated for 1955. As a result of this marketing progress, total Canadian refinery receipts of 169,452,850 bbls. included 92,679,819 bbls. of domestic crude as opposed to 76,773,031 bbls. of imports. Thus Canadian refinery receipts included 54.7 per cent domestic crude oil as compared with 46.0, 41.7 and 36.2 per cent in 1953, 1952, and 1951 respectively.

Degree of Petroleum Self-sufficiency

During 1954, Canadian refineries, utilizing domestic and imported crude, met 90 per cent of the total demand for liquid petroleum fuels. An analysis of imports and exports of crude oil and petroleum fuels in relation to domestic use of Canadian crude, shows that Canada was 51 per cent self-sufficient in liquid petroleum fuels in 1954. These fuels constitute somewhat more than 90 per cent of total petroleum product demand.

Trade

During 1954 Canada's imports of crude oil had a value of $212,497,187, and products imports had a value of $136,536,861. Exports of crude oil were valued at $6,317,578, and petroleum products at $3,407,035.

Of the total crude oil imports, 77 per cent came from Venezuela, 10 per cent from United States, 9 per cent from Arabia and 4 per cent from Trinidad. Crude oil exports were to United States, and petroleum products trade was principally with that country.

Consumption of Petroleum Products

Canada is now the world's third largest consumer of oil. One in every three Canadian homes is heated by oil. There is one motor vehicle for every four Canadians and there are three tractors for every four occupied farms.

Prices

During October the field price of most Western Canada light crude oils was lowered 9 cents per barrel, in order to meet the lower cost of competitive American crude at Sarnia, Ontario, Canada's principal price-basing point. A further 7-cent reduction took place early in 1955. At the end of 1954 prices for crude oil in Alberta's major producing fields, Leduc-Woodbend and Redwater, were $2.66 1/2 and $2.55 1/2 per barrel. Prices for comparable light-gravity oil in Manitoba were $2.53 in the Virden area and $2.61 in the Daly field.

Saskatchewan Pipe Line Co. constructed a 12,000-bbl. daily-capacity line from Smiley field 30 miles to the Interprovincial Pipe Line station at Ermine. The Wapella field in southeastern Saskatcehwan was linked to rail transportation by a 5-mile, 8-inch line. In Manitoba, an 11 1/2-mile line from Daly field to the Cromer station on the Interprovincial Pipe Line was completed early in the year and subsequently the system was extended to the Virden fields.

Oil-products Pipe Lines

A 625-mile, 8-inch pipe line for the transportation of liquid petroleum fuels was constructed over rugged terrain between Haines and Fairbanks, Alaska. The line crosses 293 miles of Canadian territory in British Columbia and Yukon. An expansion program increasing pumping facilities on the 195-mile Sarnia Products Pipe Line in Ontario raised its capacity from 37,000 to 55,000 barrels daily.

PROCESSING

At the end of 1954 there were 41 operating petroleum refineries in Canada with a total daily crude-oil throughput capacity of 544,750 barrels. The 1954 refinery expansion and modernization program continued the post-war trend to catalytic-cracking installation and also included construction of catalytic-reforming and other specialized units. Refinery expansion planned or under way in 1954 will add at least 40,000 bbls. to existing capacity during 1955.

Petroleum Refining Throughput Capacity by Regions

	1939		1946		1954	
Region	Capacity b/d	%	Capacity b/d	%	Capacity b/d	%
Maritimes	32,750	16.4	34,300	13.9	18,300	3.3
Quebec..............	64,500	32.2	71,000	28.9	171,500	31.5
Ontario	44,500	22.2	77,950	31.7	142,300	26.2
Prairies & N.W.T....	35,570	17.8	40,815	16.6	157,150	28.9
British Columbia.....	22,700	11.4	21,800	8.9	55,500	10.1
Total.....	200,020	100	245,865	100	544,750	100

Canadian Crude Oil as a Percentage of Refinery Receipts

Region	1936	1939	1946	1950	1954
Maritimes	0	0	0	0	0
Quebec	0	0	0	0	0
Ontario	1.5	0.4	0.5	1	80
Prairies & N.W.T....	23.0	37.0	52.5	99	100
British Columbia.....	0	0	0	0	88
All Canada	3.5	17.0	10.0	24.4	54.7

crude-oil lines and products lines in Canada. During the year 735 miles of trunk crude-oil lines were laid and 293 miles of products lines. As extensions of Canada's trunk-line system, 223 miles of line were laid in the United States. In addition three small gathering systems were installed and a start was made on the large Pembina field-gathering system.

Interprovincial Pipe Line Company

During 1954 this company completed another phase of its continuing construction program. At a cost of $51 million, 455 miles of 24-inch loop were installed in Canada and 196 miles of 26-inch loop were added to the system in the United States. No major construction is planned for 1955.

During 1954, Interprovincial Pipe Line crude-oil receipts were 67.6 million barrels, a 25 per cent increase over 1953. The benefit of the 30-inch Superior-Sarnia extension, constructed in 1953, is indicated by the fact that pipe-line deliveries of prairie oil to Eastern Canada in 1954 amounted to 31 million barrels whereas in the previous year only 23 million barrels had been transportation by tankers on the Great Lakes from Superior, Wisconsin.

Trans Mountain Pipe Line Company

During 1954, 27 miles of 20-and 11-inch pipe line were laid at a cost of $1,800,000 from the British Columbia-Washington border to Ferndale, Washington, where General Petroleum Corporation completed its new refinery in October. Total oil deliveries amounted to 14,522,087 bbls. or a daily average of 39,787 barrels.

The pipe line now serves one refinery at Kamloops, 3 at Vancouver and 1 at Ferndale.

Pembina Pipe Line Co. Ltd.

Late in 1954 this company completed a 72-mile, 16-inch transmission line from the town of Drayton Valley in the Pembina field to Edmonton with an initial daily capacity of 115,000 barrels. Construction of a large gathering system is under way.

South Saskatchewan Pipe Line Company

This company constructed a 153-mile, 16-inch line from Cantuar in the Swift Current area to Regina for the purpose of transporting medium-gravity crude oil from the Fosterton-Cantuar-Success group of fields to the Interprovincial Pipe Line for trans-shipment to St. Paul, Minnesota.

Other Crude-oil Pipe Lines

In Alberta a 2 1/2-mile, 4-inch line was laid from Rimbey field to railhead at Rimbey and a 2 1/2-mile southward extension was added to the Edmonton Pipe Line serving the Joarcam field. In Saskatchewan, Mid-

New Brunswick

As of December 31, 1954, there were 64 operating wells in the Stony Creek field, Albert county. This is the only field in New Brunswick, and the only activity during the year was the deepening of one well by 1,226 feet. Plans were made, however, for the drilling of a minimum of 6 wells on a crown lease covering 10,000 square miles in the eastern half of the province.

Reserves

The annual reserve compilation made by the Canadian Petroleum Association indicates that crude-oil reserve additions in 1954 were largely due to extensions and re-appraisals of previous discoveries rather than to new discoveries.

At the end of the year total crude-oil reserves stood at 2,207,614,000 bbls. of which 1,928,479,000 were in Alberta. Natural gas-liquids reserves in Alberta and British Columbia of 208,331,000 bbls. brought the total reserver of liquid hydrocarbons to 2,415,945,000 bbls.

Ten of Western Canada's 101 oil fields have ultimate reserves of at least 100 million barrels each and account for 75 per cent of the oil discovered. Formation of Devonian age contain almost 75 per cent of the reserves; Mississippian formations, almost 15 per cent; Cretaceous, about 10 per cent; and Jurassic about 3 per cent. As the Pembina field is developed, the Cretaceous will take on a much greater importance in reserve estimates. Almost 5 bbls. of crude oil were added to known reserves for every barrel produced in 1954.

Crude Oil Fields and Oil Wells - Prairie Provinces
(as of year's end)

	Oil Fields		Producing Wells		Wells Capable of Production	
	1954	1953	1954	1953	1954	1953
Alberta...........	65	60	4,583	4,000	5,070	4,480
Saskatchewan......	30	17	796	454	1,097	622
Manitoba..........	6	2	269	95	284	102
Total ..	101	79	5,648	4,549	6,451	5,204

TRANSPORTATION

Canada's two great pipe-line systems - Interprovincial Pipe Line and Trans Mountain Pipe Line - had their first full year of operation in 1954, carrying crude oil to principal Canadian markets in central Canada and on the Pacific coast and to small but significant American markets.

At the start of 1954 there were 3,794 miles of trunk and gathering been no oil and only minor gas production to date. Exploration results prior to 1954 revealed considerable natural gas but no oil.

During 1954 two oil discoveries were indicated. Texaco N.F.A. Boundary Lake No. 1, 35 miles northeast of Fort St. John, was reported to have recovered a small flow of oil from a formation of Triassic age and preparations were under way at the end of the year to complete what may be British Columbia's first oil well. Oil was also found in the Buick Creek No. 3 well, 40 miles northwest of Fort St. John, which was utimately completed as a gas well.

Northwest Territories

The year 1954 marked a new high in oil exploration. Preliminary estimates indicate that $700,000 was spent on geological mapping, $600,000 on drilling, and $500,000 on seismic programs. Six geological surface-mapping projects were carried on by oil companies in the Mackenzie River basin. This work was speeded up by the use of 5 helicopters throughout the summer mapping season. Five seismic parties were employed during the first few months of the year on permits north of 60^{o} latitude and between the Liard River on the west and Hay River on the east. Six wildcat wells were drilled and another one started, the aggregate depth being 18,684 feet. Five of the holes were less than 2,600 feet in depth but the sixth was carried to a depth of 8,233 feet. No discoveries were made.

Ontario

Southwestern Ontario continued to be the scene of the principal drilling activities in Eastern Canada. During the year, 45 oil wells and 160 gas wells were completed, and there were 169 dry holes. Total drilling in all wells amounted to 477,800 feet, or an average of 1,278 feet per well.

Ten of the 42 development oil wells were completed in Enniskillen township and one in Euphemia township, both in Lambton county, and the remainder in Aldborough township of Elgin county. The Lambton county wells had initial daily production rates of less than 5 barrels and the Elgin county wells averaged about 10 barrels. Wildcat drilling was generally distributed throughout southwestern Ontario, with the largest amount in Lambton county, where 56 wells were drilled.

Quebec

During 1954, Imperial Oil Limited carried out a geological and geophysical exploration program along the southern bank of the St. Lawrence River, between Montreal and Quebec City. The area under study comprises 600,000 acres and the 1954 program covered in a preliminary manner about one-half of this area.

The exploratory drilling which resulted in these discoveries took place throughout the southern third of the province, most emphasis being given to the Swift Current-Coleville area in the west and the Frobisher area in the southeastern corner. Discovery of the Frobisher field was possibly the most significant result of the year's exploration, as it is the first light-gravity oil field in the southeastern part of Saskatchewan. Several other discoveries were made in this southeastern section following the Frobisher success, and field assessment was under way at the end of the year, with particular interest being shown in the 39^{o} A.P.I. gravity oil discovery at Alida. In the southwestern part of Saskatchewan, the Instow medium-gravity discovery proved to be one of the most promising finds and is now one of 9 relatively new fields stretching southward from the major Fosterton-Success-Cantuar group of fields. Few of these new fields are more than 5 miles apart.

Development drilling was most active in the Smiley field, where 90 wells were successfully completed. This light-gravity field, only discovered in 1953, now has 117 oil wells capable of producing from the Viking sand.

Manitoba

Drilling activity during 1954 resulted in 8 oil discoveries, two of which became declared fields while four showed promise of early field or field-extension status.

These discovery wells all found production in a formation of Mississippian age. Average well depth was 2,350 feet.

Wildcat drilling resulted in two new fields - Pierson and Woodnorth. At the close of 1953 there were only two declared fields in Manitoba. The two new discoveries and field status for two areas discovered in 1953 brought the total number of declared fields to six at the end of 1954.

The Daly field, discovered in 1951, was extended further during 1954 and at the year's end had 139 of the province's 284 oil wells. Rapid development had taken place in all other defined fields except Whitewater. The East Cromer area was the scene of much drilling activity by the end of the year. The East Cromer and Woodnorth areas may be a southeast extension of the Daly field. Thus the principal Manitoba oil-producing area now stretches 17 miles southwest of Virden, 7 miles to the north, and 4 miles to the northeast of this town in the southwest corner of Manitoba.

The readily available market outlet for Manitoba oil production and the relatively low cost of well drilling have stimuated oil development in the past two or three years, and account for the fact that Manitoba showed a greater percentage increase in drilling activity and production than any other province in 1954.

British Columbia

Exploration has been largely centred in the Peace River area, where 25,002,407 acres were held by oil companies at the end of 1954. There has

In field-development drilling there was considerable activity in the Pembina field, although wet weather conditions slowed mid-year activities. The Upper Cretaceous Cardium sand reservoir, discovered in 1953, was drilled over a large area and indications of a width of some 26 miles along the strike and a down-dip extent of possibly 24 miles were obtained for the Cardium oil pool. Reservoir thickness ranges as high as 35 feet of net pay. At the end of 1954, there were 128 oil wells within the limits of Pembina field, all but 4 wells having been completed during the year. The importance of drilling activity at Pembina is demonstrated by the fact that about 30 per cent of all drilling rigs in Alberta were engaged in development and extension drilling in this area at the end of 1954. Drilling done to date indicates that the Pembina oil field is the biggest North American oil discovery of the past several years.

In the Sturgeon Lake area, drilling outlined three separate pools in the Upper Devonian Leduc reef discovered in 1952, but intensive drilling of this favourable area was being held in abeyance pending completion of arrangements for a pipeline outlet. No Devonian reef discoveries of established importance were made in Alberta during 1954.

The trend of Viking sand oil fields southeast of Edmonton was found to be continuous and the newly established Joarcam field now has a length of 24 miles. A discovery was made southeast of this field at Driedmeat Lake and development drilling was under way at the end of 1954 to extend the main trend.

The most extensive development drilling of Upper Devonian Nisku and Leduc oil pools took place in the Fenn-Big Valley field where continuity of the Nisku member oil pool has been indicated over a length of some 14 miles.

Devonian reef fields continue to supply a large part of Alberta's oil production, but sand reservoir occurrences of the broad stratigraphic type have become the principal objectives in exploratory work. Consequently the area immediately east of the foothills on the east flank of the Alberta syncline from southern Alberta northward to the Peace River region will be the scene of major activity in the immediate future.

Saskatchewan

Eighteen oil discoveries were made in 1954, 7 being field discoveries and 11 discoveries in other areas.

Field discoveries were made in the Coleville-Smiley, Frobisher, South Illerbrum, Instow, Success, and Midale fields. Other discoveries were made in the Alida, Bone Creek, East Gull Lake, Mervin, North Wapella, St. Florence, Sturgeon, Walter, Rosebank, Ralph, and Whitebear areas. The average depth of all of these discoveries was 3,615 feet. Ten of the wells found light-gravity crude, 6 were medium-gravity discoveries, and 2 were heavy gravity. Eight wells found production in formations of Mississippian age, 6 in the Cretaceous, and 4 in the Jurassic.

During 1954 there was greater emphasis on exploratory drilling than in 1953, when development drilling dominated.

Exploration Drilling in 1954

	Producers		Dry Holes	
	Number	Footage	Number	Footage
Alberta	152	762,846	279	1,409,073
Saskatchewan	65	232,318	303	1,133,571
Manitoba	19	49,590	86	229,658
British Columbia	14	79,744	12	70,286
Northwest Territories	0	0	6	18,688
Ontario	11	15,077	102	197,910
Total Canada	261	1,139,575	788	3,059,186

Of the 250 producing wells drilled in exploratory work in Western Canada, 151 were oil wells and 99 were gas wells. Twenty-seven per cent of all exploratory holes and 28 per cent of exploratory footage was successful. The average depth of exploratory holes in Western Canada was 4,258 feet. In Ontario, exploratory drilling resulted in 10 gas wells and 1 oil well; the average depth of exploratory wells was 1,885 feet.

Developments by Areas

Alberta

Exploratory drilling for oil was centred in 4 principal areas; west-central Alberta; west of Edmonton in the Pembina River-Edson area; in the vicinity of recent Sturgeon Lake discoveries and northwestward into the Peace River area; and in northern Alberta. The widespread drilling activity in southern Alberta was primarily a gas exploration program. In west central Alberta deep drilling was done on the flank of the Alberta syncline for the purpose of testing not only Cretaceous but also Mississippian and Upper Devonian objectives. The area west of Edmonton was the scene of considerable wildcat drilling carried on to test the Cardium sand. Northern Alberta drilling was not carried out on the scale of the previous two or three years.

A partial list of some of the most successful wildcat wells indicates the extent of exploratory drilling: Great Plains - Triad Muskey Gilwood 1-9, 170 miles northwest of Edmonton; Shell Reno 16-25, 200 miles northwest of Edmonton; Gulf Blue Ridge 5-14, 68 miles northwest of Edmonton; Canadian Fina-Cities Service Greencourt 6-7, 75 miles northwest of Edmonton; Gulf Thunder Lake 9-9, 17 miles east of the Greencourt well; Shell Peers 2, 85 miles west of Edmonton; Seaboard Banff Wimborne 7-9, 60 miles north-northeast of Calgary; Superior et al Garrington 11-7, 65 miles northwest of Calgary; H.B.-Amurex-Richfield-Medin 16-32, near Hespero 85 miles north of Calgary. These and a number of other indicated discoveries show promise of developing into productive fields but further drilling remains to be done to establish their status.

DEVELOPMENT AND PRODUCTION

Geophysical Activity

In Western Canada, geological and geophysical exploration and exploratory and field-development drilling were actively carried on in 1954, though not at the peak levels of a year or two ago. Weather conditions, delays in gas-marketing decisions, and problems of oil-market expansion retarded exploration activities to some extent.

Seismic operations, which account for close to 95 per cent of Canadian geophysical operations, have been declining since October 1952, the number of crew-months of seismic exploration in 1954 being 1,535 compared with 1,713 in 1953. Gravity work increased from 99 crew-months in 1953 to 108 in 1954. No magnetic field work in petroleum exploration was done in 1954.

Practically all of the geophysical activity is carried on in Western Canada, where 140 parties were operating at the end of the year. Alberta had about three-quarters of the crews, Saskatchewan about 28 crews, British Columbia had between 4 and 8, and Manitoba, 1 or 2.

Drilling Activity

Wells Drilled - Western Canada

	Oil Wells		Gas Wells+		Dry Holes		Total	
	1954	1953	1954	1953	1954	1953	1954	1953
Alberta	673	884	140	195	365x	479	1,178	1,558
Saskatchewan..........	346	330	21	22	363	293	730	645
Manitoba..............	234	68	-	-	90	21	324	89
British Columbia	-	-	15	18	11*	18	26	36
Northwest Territories.	-	-	-	-	6	10	6	10
Total Western Canada.	1,253	1,282	176	235	835	821	2,264	2,338

\+ Gas wells and potential gas wells.
x Includes 2 salt-water disposed wells.
* Includes 2 suspended wells.

Drilling Rigs and Footage Drilled - Western Canada

	1954		1953	
	Rigs in use at year-end	Footage	Rigs in use at year-end	Footage
Alberta...............	139	5,674,759	118	6,422,889
Saskatchewan	31	2,587,652	32	2,327,158
Manitoba	20	765,032	13	244,480
British Columbia......	8	147,654	8	196,227
Northwest Territories .	1	18,684	1	17,687
Total Western Canada..	199	9,193,781	172	9,208,441

Newfoundland

Peat moss is not produced in Newfoundland. Although deposits are available, they are close to the coast and their development would probably be handicapped by the same poor drying weather that is experienced in northern New Brunswick. In 1954, the Provincial Department of Mines started a survey of peat resources.

Price

The price of peat moss in 1954 varied from $27 to $43 a ton according to location.

Canadian peat moss continues to be in demand in the United States and it is sometimes difficult to fill all export orders. Some United States importers seem to be interested in developing peat bogs in Canada in order to have a source of supply.

PETROLEUM (CRUDE)

Crude oil production in 1954 reached a new high of 96,066,854 bbls., a 15.8 per cent increase over 1953. The value of production at $247,154,671 was, as in 1953, greater than that of any other mineral. The 1954 daily production average of 263,200 barrels was some 150,000 barrels below the daily potential reached at the end of the year. Alberta accounted for 91.3 per cent of the 1954 production, Saskatchewan, 5.6, and Manitoba 2.2. Small amounts were produced in Ontario, Northwest Territories, and New Brunswick. Manitoba recorded the greatest rate of growth, its 1954 production being more than three times that of the previous year. Saskatchewan recorded a two-fold increase. The large increase in Canadian production potential was due mainly to reserve extension in existing Alberta fields, but Saskatchewan led all provinces in the amount of reserves found in new areas. No major field discoveries were made in Canada during 1954 but a notable circumstance in the petroleum industry was the establishing of the 1953 Pembina discovery, about 65 miles southwest of Edmonton, as a producing field that shows promise of becoming one of the largest in North America.

Crude oil accounted for 17 per cent of the total value of Canada's mineral output as compared with 15 per cent in 1953 and 3 per cent in 1946, the year prior to the start of the present expansion.

All phases of Canada's petroleum industry showed stable growth in 1954. New records were set in petroleum production, refining, and sales. The various indices of growth in petroleum refining are indicative of a large and constantly expanding industry that enables each region of Canada to manufacture a major part of its petroleum products requirements. It appeared evident at the end of this eighth year of oil-industry expansion that a status of maturity was being attained. Co-ordination of growth in production potential with market expansion is now the industry's prime objective.

Producers

British Columbia

The peat operations in the Fraser River delta near New Westminster are the largest in Canada. Four bogs are being worked, namely: Pitt Meadows, Byrne Road, Lulu Island, and Delta (or Burns). From this small area, 13 companies in 1954 produced 51,000 tons, nearly two-thirds of the Canadian production. The largest producers are Industrial Peat Limited, Atkins and Durbrow Limited, and Lulu Island Peat Company Limited.

Manitoba

Western Peat Company Limited, the only producer, operates the Julius, or Shelley, bog about 50 miles east of Winnipeg.

Ontario

Two companies are in operation at present. Most of the output in 1954 was produced by Atkins & Durbrow (Eire) Limited at its plant near Port Colborne which operates a "milling" process as described above. The other producer, Humar Corporation Ltd., processes and sells humus from a bog near Dundas.

Quebec

The peat moss deposits being worked are mainly in the lower St. Lawrence region. Thirteen companies contributed to the output in 1953, but most of the production came from three, namely: Premier Peat Moss Corporation with operations at Rivière-du-Loup, Isle Verte, and Cacouna; Tourbières Rivière-Ouelle in the Rivière-du-Loup area; and Quebec Peat Moss Company, St. Guillaume.

New Brunswick

The most important peat moss deposits are in Northumberland and Gloucester counties on both shores of Miramichi Bay, and on Miscou and Shippigan Islands. Two companies produced peat moss in 1953, namely, Fafard Peat Moss Company at Pokemouche, and Atlantic Peat Moss Company, Limited at Shippigan and Shippigan Island. Production in northern New Brunswick is often handicapped by poor drying weather along the coast.

Nova Scotia

Annapolis Peat Moss Company, Limited, the only producer of peat moss, resumed operations on the Caribou bog near Berwich in 1954, employing the "milling" process already described.

Production and Trade

	1954			1953		
	Producers	Short Tons	$	Producers	Short Tons	$
Production						
British Columbia ..	13	51,493	1,954,222	13	47,756	1,657,726
Quebec	13	22,998	619,993	13	22,021	587,671
New Brunswick ...	2	8,200	242,000	2	8,323	246,946
Ontario	2	2,412	72,330	2	1,319	52,535
Manitoba & Nova Scotia	2	2,154	98,416	2	2,235	98,139
Total	32	87,257	2,986,961	32	81,654	2,643,017
Exports						
To: United States.		87,306	4,498,695		73,489	3,288,744
Other countries ..		27	1,257		20	1,011
Total		87,333	4,499,952		73,509	3,289,755

In British Columbia the harvesting of peat moss in largely mechanized, but considerable manual labour is still required for digging. One operation is almost completely mechanized; the peat is excavated by hydraulic jets and pumped to the plant, where it is dried by steam heat in a modified paper-making machine.

In Eastern Canada, generally, there is little mechanization, except in one bog in Ontario and one in Nova Scotia which use a "milling" process. In this process the peat is lightly harrowed to a depth of one or two inches, after which, under favourable weather conditions, it dries rapidly. It is then gathered by large-scale "vacuum cleaners" mounted on caterpillar treads. When the containers are full they are emptied into field railway cars which carry the peat to the mill for baling and shipment.

Dried peat has been used as fuel for many years, but the amount so used in Canada in recent years has been less than a hundred tons a year. The type of peat required for use as fuel is a well-humified grass or sedge peat rather than the partly humified sphagnum variety required for the preparation of peat moss. Some fuel peat has been produced in recent years at a small bog in Gads Hill Station, near Stratford, Ontario, but there has been no production from this source in the last two years. On the Burin peninsula in Newfoundland, peat fuel has been dug for local use.

One of the highlights of the peat industry in 1954 was the International Peat Symposium held in Dublin in July. Papers were presented by some 200 delegates from Canada, United States, Great Britian, Ireland, France, Holland, Germany, and the Scandinavian countries, covering all phases of peat technology and development.

	1954		1953	
	M.cu. ft.	$	M cu. ft.	$
Ontario	10,051,049	4,020,000	9,708,969	3,883,588
Saskatchewan[(a)]				
Unity			611,322	
Lloydminster			332,786	
Brock..............			271,731	
Others			206,289	
Total	3,466,890	312,000	1,422,128	127,992
New Brunswick				
Stoney Creek	183,547	136,200	177,112	131,368
Northwest Territories				
Norman Wells.......	28,656	10,030	26,109	10,199
Canada Total.......	120,888,412	12,515,000	100,985,923	10,877,017

(a) 1954 production has been corrected for wastage. No data on wastage is available for 1953, hence 1953 figures have not been corrected.

PEAT

Peat moss in widely distributed in Canada, but commercial production is confined to British Columbia, Manitoba, Ontario, Quebec, New Brunswick, and Nova Scotia. Eighty-five per cent of the 87,257 tons produced in 1954 came from the Rivière-du-Loup area of Quebec and the delta of the Fraser River in British Columbia. Practically all of the Canadian output is exported to the United States, where it is in competition with peat moss from Germany. The latest available figures show that, in 1954, 140,000 tons of German peat, valued at more than $4,000,000 was exported to United States, where it benefits by reduced freight rates from ocean ports. To meet this competition, the peat-moss producers in British Columbia have organized a co-operative selling organization, known as Canadian Peat Sales Limited.

Peat moss is the dead, slightly humified, fibrous moss found in peat bogs. When dried and shredded it has a high absorptive capacity, for which reason it finds wide use in the horticultural business both as a packing material and as a means of introducing humus into the soil, and in stables and poultry runs as litter.