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CONTENTS—*Concluded*

* Geological Survey of Canada.

** Director-General of Scientific Services.

NOTE:—The figures of production and trade are those published by the Dominion Bureau of Statistics unless otherwise stated. Market quotations are obtained chiefly from standard marketing reports issued in Montreal, New York, and London.

PREFACE

Preliminary separates of the 60 metals and minerals reviewed in this report were issued and made available to the interested public during the first half of 1953. Except where otherwise noted, the mineral production, trade and consumption figures are those supplied by the Dominion Bureau of Statistics.

The Branch acknowledges its indebtedness to all those who contributed data for the reviews and in particular to officials in the mineral industry and officers of the Dominion Bureau of Statistics.

John Convey,
Director, Mines Branch.

INTRODUCTION

Canada's mineral production in 1952 advanced to a new high of $1,285,000,000, an increase of $40,000,000 or 2·6 per cent over 1951, due chiefly to marked gains in crude petroleum and asbestos, the former rising to fourth place in value of Canadian minerals, displacing zinc. The non-metallics increased in value, but the metals declined $17,000,000 to $728,000,000 principally because of lower prices and the premium on the Canadian dollar. Outstanding gains in value and volume were also made by natural gas, cement and iron ore.

Despite the depressed condition of the gold industry, output showed a gain of 79,000 ounces to 4,471,725 ounces, although the value dropped from $162,000,000 in 1951, to $153,000,000. Coal production declined 1,000,000 tons to 17,600,000 tons, but increased nearly $400,000 in value to $109,420,000.

Output of crude petroleum increased 28 per cent from the previous year to a new high in excess of 61,000,000 barrels. A record $250,000,000 was spent on exploratory activity during the year and about $60,000,000 on the construction and extension of pipe lines and the expansion of refining and storage facilities. Canada's proven reserves increased by almost 500,000,000 barrels in 1952, half of which is attributed to finds in Alberta's Bonnie Glen-Pigeon Lake field. Canadian reserves at the end of the year stood at close to 1·7 billion barrels.

Throughout Alberta natural gas continued to be discovered, mostly in conjunction with crude oil and Canadian production rose by 8 million cubic feet, an increase valued at approximately $2,000,000. During the year permission was granted by the Alberta Government for the export of natural gas from the Peace River area.

Nickel production reached 278,000,000 pounds, practically all from the mines of The International Nickel Company of Canada Limited and Falconbridge Nickel Mines Limited in the Sudbury area, Ontario. The former company moved nearer to completion of its $150,000,000 expansion program to all-underground mining, with its six mines now covering more than 325 miles of such workings. Development at the Fecunis Lake deposits of Falconbridge Nickel Mines Limited on the northern rim of the Sudbury basin has already indicated the availability of 19,000,000 tons of copper-nickel ore. In Manitoba the Lynn Lake property of Sherritt Gordon Mines Limited was undergoing extensive development toward production. The winter move of many of the buildings of the town of Sherridon to the Lynn Lake property was successfully accomplished and rail and power facilities were ahead of schedule.

The decline of approximately 14 per cent in prices for lead and zinc was not only reflected in a drop in production value despite increased volume output, but tended to curtail development generally in the field. However, several marginal mines in British Columbia came into production. A notable development during the year was the discovery of large base metal deposits near Bathurst, New Brunswick.

Great interest in the search for and development of uranium deposits was maintained throughout the year, particularly in the Beaverlodge area, north of Lake Athabaska, Saskatchewan where the Crown-owned Eldorado Mining and Refining Limited was preparing its Ace and Fay properties for production scheduled to commence in 1953.

Canadian production of iron ore increased 600,000 long tons over the previous year, to 4,707,000 long tons, with major gains from new producers in British Columbia. Canada's position was further strengthened by expansion programs to increase production at Steep Rock and Michipicoten in Ontario and at the Wabana mine in Newfoundland, although some curtailment of output in the current year resulted therefrom, particularly at Wabana where the longest belt conveyor system in the world was being installed. Great strides were also made during the year in pre-production development of the Quebec-Labrador deposits and those at Marmora, Ontario.

Construction work on the Aluminum Company of Canada's giant Kitimat project in British Columbia continued on schedule, with initial production at a rate of 84,000 metric tons a year planned for 1954.

The gold industry, principal single source of Canadian dollar production in minerals for the past 23 years, continued to face the twin problems of high production costs and declining prices. Production increased, however, by about 79,000 fine ounces to a total of 4,471,725 fine ounces and Canada continued to hold second place in world output. The average price of gold during 1952 declined $2.58 an ounce to $34.27, due chiefly to the increased value of the Canadian dollar. Payments under the Emergency Gold Mining Assistance Act in 1952 were in excess of $10,850,000.

The outstanding gains made by asbestos, cement, sulphur and fluorspar reflected the continued high level of activity in the construction and chemical industries. Canada outranks any other country in the output of asbestos, producing approximately 66 per cent of the world total and exporting 73 per cent of its output to the United States.

Production of cement increased some 1,500,000 barrels over the previous year's record of 17,000,000 barrels. However, expansion of facilities in Ontario, Alberta, British Columbia, and new production in Newfoundland, still failed to meet the steadily growing domestic demand, and imports approximated 3,000,000 barrels. Value of Canadian cement output in 1952 increased $7,500,000 to $48,000,000.

METALS

ALUMINUM

Canada possesses no bauxite, the ore of aluminum, but produces, from imported ore, approximately 20 per cent of the estimated world output of aluminum. In 1952, output from plants of Aluminum Company of Canada, Ltd., Canada's sole producer, reached a new high of 499,810 short tons, compared with 447,095 short tons in 1951. The company reported that all available primary aluminum facilities of its plants in Canada were operated at maximum capacity during 1952. It operates reduction plants at Arvida, Shawinigan Falls, Isle Maligne, and Beauharnois in Quebec.

Imports of bauxite are derived from various sources, but the company obtains its major needs from its mines in British Guiana, which supplied over 2,000,000 tons in 1952. During the year the company brought two important new sources of ore into production to supplement the output from British Guiana. One of these is a new bauxite operation in the Los Islands off French West Africa, from which the first shipments were made to the company's alumina plants at Arvida in September. Shipments of about 300,000 tons of ore are expected in 1953 from this operation, which is conducted by a French subsidiary of Aluminium Limited, the parent company of Aluminum Company of Canada, Ltd. The other new source is in Jamaica, where the first alumina (aluminum oxide) to be produced in the Caribbean area was extracted in December by Jamaica Bauxites Limited, also a subsidiary of Aluminium Limited. This bauxite and alumina plant is being enlarged to reach an annual capacity of 165,000 metric tons by April, 1954. Output will be sufficient to support the planned first stage of aluminum production in British Columbia, and may be readily expanded.

Cryolite, used in the manufacture of aluminum is obtained from Greenland, and fluorspar from Newfoundland. Artificial cryolite is made at Arvida from Newfoundland fluorspar, and replaces much of the cryolite formerly imported from Greenland.

Production, Trade, and Consumption

	1952		1951	
	Short tons	$	Short tons	$
Production: Ingot	499,758		447,095	
Imports: Bauxite				
From: British Guiana	2,078,223	9,713,157	1,782,507	9,419,892
Trinidad	188,519	900,125	314,640	1,599,632
United States	87,908	1,485,043	139,612	3,149,235
French West Africa	54,230	295,180	—	—
Other countries	45,989	521,504	165,000	1,204,254
Total	2,454,869	12,915,009	2,401,759	15,373,013
Imports: Cryolite				
From: Greenland	2,202	361,525	3,858	593,517
United States	44	9,377	2,658	508,898
Total	2,246	370,902	6,516	1,102,415
Imports: Aluminum Products				
Semi-manufactured	—	2,820,042	—	3,387,455
Fully manufactured	—	6,403,419	—	8,109,502
Total	—	9,223,461	—	11,496,957

Production, Trade, and Consumption—continued

	1952		1951	
	Short tons	$	Short tons	$
Exports: Primary Forms				
To: United Kingdom	256,368	90,525,495	191,342	57,223,813
United States	116,007	37,249,238	105,479	34,533,614
Sweden	6,621	2,766,864	2,050	779,219
Netherlands	6,177	2,226,858	5,042	1,816,770
Australia	5,523	2,055,252	12,480	4,491,810
Brazil	4,157	1,492,450	9,893	3,409,342
Switzerland	3,744	1,309,166	5,087	1,702,836
W. Germany	3,110	1,154,017	5,033	1,798,968
Italy	2,544	899,374	3,060	1,028,159
Mexico	1,814	633,299	3,324	1,129,814
Union of South Africa	1,114	426,449	1,042	392,813
Other countries	5,411	2,005,003	10,582	3,712,259
Total	412,590	142,743,465	354,414	112,019,417
Exports: Semi-fabricated				
To: United States	9,648	4,352,618	7,721	4,216,292
India	1,620	768,351	1,659	731,236
New Zealand	1,553	771,513	139	78,218
Mexico	1,494	723,502	1,188	531,191
Brazil	1,492	832,753	1,068	539,917
Union of South Africa	1,365	718,045	63	29,040
Venezuela	1,180	693,349	39	21,684
Ireland	829	422,258	680	314,870
Cuba	532	318,370	177	129,097
Other countries	3,904	2,109,682	2,071	994,382
Total	23,617	11,710,441	14,805	7,585,927
Exports: Manufactured Products				
To: United States	—	2,686,862	—	1,079,805
Venezuela	—	2,297,510	—	561,606
Colombia	—	274,008	—	329,658
Costa Rica	—	266,999	—	89,362
Brazil	—	250,829	—	55,753
Dominican Republic	—	205,517	—	6,432
Israel	—	147,832	—	41
New Zealand	—	132,458	—	88,698
Other countries	—	970,244	—	1,714,812
Total	—	7,232,259	—	3,926,167
Exports: Scrap				
To: United States	2,700	431,519	3,575	1,146,894
Italy	618	184,873	—	—
W. Germany	93	21,718	—	—
Japan	44	12,061	—	—
United Kingdom	38	1,595	50	2,000
Other countries	—	—	326	99,030
Total	3,493	651,766	3,951	1,247,924
Domestic Consumption	90,286	—	86,241*	—

* Revised.

Canadian production is exceeded only by that of the United States. This situation is principally due to Canada's possession of an abundance of low-cost electric power within easy access of deep-sea waterways by which raw materials can be brought in at low cost.

Aluminum fabricating plants are located at Kingston, Toronto, and Etobicoke in Ontario, and at Shawinigan Falls in Quebec. The manufacture of aluminum products continues to grow, but by far the greatest amount of aluminum is still exported in the primary form as ingots, bars, blooms, rods, sheets, etc.

World Production

Total world production of primary aluminum was estimated to be 1,788,000 metric tons in 1951 (1952 figures not available) compared with approximately 1,494,000 tons in 1950. United States and Canada, the two largest producers, accounted for about 65 per cent of the the world total. Europe, excluding Russia and satellite countries, accounted for 20 per cent, Asia 2.5 per cent, and Russia, with its satellites, about 12.5 per cent. Despite the large increases in aluminum output over the past several years, construction of new facilities for increasing production were under way in many countries during 1952.

Development and Expansion

The great expansion of hydro-electric power and ingot facilities undertaken by Aluminum Company of Canada in 1950 and 1951 showed its first major result in 1952. The construction of two new hydro-electric power plants on the Peribonka River, with a capacity of 540,000 hp., brought the company's total installed generating capacity in Quebec up to 2,580,000 hp. New potlines of 45,000 metric tons annual capacity came into operation at the Isle Maligne reduction plant in the Saguenay district of Quebec. At the end of the year the company's reduction plants were operating at an annual rate of about 500,000 metric tons. This includes the 32,000-ton plant at Beauharnois, reopened in April, 1951, where electric power is purchased under contract.

A major expansion program of Aluminum Company of Canada is being carried on in British Columbia, where the great Kitimat-Kemano development involves the damming of the Nechako River, the driving of a ten-mile tunnel to the site of the power-house at Kemano, construction of fifty miles of transmission line to Kitimat, and the building of the reduction plant and port facilities at the latter point. Damming of the Nechako is completed, and on October 8, 1952, the gates of the diversion tunnel were closed and the water in the reservoir began to rise. The halfway mark has been passed in driving the tunnel, and the great cavern inside the mountain at Kemano, which will contain the power-house, is partly excavated. The route of the power line has been cleared, and erection of towers is proceeding. At Kitimat, steel for the reduction plant is being erected, and good progress in developing port facilities is reported.

The Kitimat plant is expected to come into production by the middle of 1954, with an initial output of 83,000 metric tons. This can be readily increased to 180,000 tons without substantial enlargement of the hydro-electric works or transmission lines. The project has been designed so that it may be expanded to an ultimate capacity of about 2,200,000 horsepower, with an annual output of 500,000 metric tons of aluminum.

Uses

The adaptability and usefulness of aluminum and its alloys in industrial applications is well known. It can be rolled into foil one-tenth the thickness of a sheet of newsprint, or cast into huge shapes. It can be drawn, extruded, stamped, spun, forged, machined, welded, and riveted. In addition to extreme workability and light weight, it possesses high electrical and thermal conductivity, good light and heat reflectivity, and resistance to corrosion.

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Approximate end-use consumption, as reported by a major United States producer, indicates that more than 50 per cent of the metal is used in building products, transportation, cooking utensils, and household appliances.

Aluminum is available to industry from fabrication plants as castings, forgings, sheet, a variety of rolled and extruded shapes, tubes, rods, wire, foil, and powder.

Prices

The price of aluminum in Canada throughout 1952 was 18 cents a pound, f.o.b. shipping point.

According to E and M J Metal and Mineral Markets Bulletin of December 25, 1952, the price per pound of aluminum in the United States, f.o.b. shipping point, for 30-pound ingots, purity 99 per cent plus, was 20 cents. From January to August 3rd the price had been 19 cents a pound.

ANTIMONY

Canada's antimony production is in the form of contained antimony in antimonial lead and certain other smelter products from the smelter of The Consolidated Mining and Smelting Company of Canada Limited at Trail, British Columbia. Requirements of metallic antimony are imported.

Generally reduced requirements in 1952, for industrial and defence purposes, resulted in a substantial reduction in the world price of antimony. A curtailment of world mine production resulted from these lower prices, and in the United States one of the principal producing mines and smelters was closed in August. Large world stocks of antimony built up in 1951 and preceding years were considerably reduced during 1952.

Production and Developments

British Columbia

Most of the production at Trail originates as a minor constituent of the lead-zinc ore mined at the Sullivan mine at Kimberley. The Trail smelter also treats ores from a large number of Canadian and foreign lead-zinc mines, many of which contain antimony in small amounts. Although the principal antimonial output at Trail is in the form of lead containing up to 25 per cent antimony, from time to time the company ships accumulations of flue dust and dore slag containing about 40 per cent antimony to foreign smelters that are better equipped to make recoveries from such material. In 1952, the company sold 1,195 tons of antimonial lead and unrefined antimonial products, compared to 3,016 tons of these materials in 1951.

Bralorne Mines Limited acquired operational control of the Gray Rock lead-antimony deposit on Traux Creek, Bridge River area. Considerable development at a new lower horizon at this property failed to disclose additional significant reserves of antimony ore. A sample shipment of about 7 tons of hand-sorted ore containing 53 per cent antimony was sent to Belgium.

New Brunswick

At Lake George, Prince William parish, York county, stibnite showings in quartz veins extend for over a mile in length and half a mile in width. The property has been developed by numerous shafts. In 1952, Quebec Metallurgical Industries Limited made a geological survey of the area, tested bulk samples from old dumps, and did some trenching that disclosed new vein intersections.

Other Provinces

Antimony-bearing deposits occur in Quebec, Nova Scotia, Newfoundland, and Yukon, but no developments thereon were reported in 1952.

Production, Trade, and Consumption

	1952		1951	
	Short tons	$	Short tons	$
Production				
Content of antimonial lead alloy, dore slag, and flue dust	1,165[1]	601,483	3,351	1,436,713
Imports, antimony metal				
From: Belgium	271	176,358	231	241,201
United States	244	179,313	343	343,806
United Kingdom	185	103,070	84	79,039
Czechoslovakia	114	34,050	—	—
Other countries	47	19,075	23	23,120
Total	861	511,866	681	687,166
Imports, antimony oxide				
From: United States	18	14,032	22	21,486
United Kingdom	69	43,577	29	21,420
Total	87	57,609	51	42,906
Imports, antimony salts				
From: United States	14	15,788	15	16,749
West Germany	1	1,245	—	—
Total	15	17,033	15	16,749
Exports, antimony content of antimonial lead	412	—	229	—
	1951 Short tons		1950 Short tons	
Consumption, antimony metal by industries[2]				
White metal foundries	632		907	
Electrical apparatus	72		68	
Silverware	20		8	
Brass foundries	16		14	
Total	740		997	

[1] The 1952 production consists only of antimony content of lead alloy and dore slag.
[2] Preliminary estimate of consumption in 1952 is 737 tons; the break-down by industries was not available at time of publication.

World Production

Canada's output of antimonial products is relatively small in terms of world production. In 1952, the principal producing countries were: Union of South Africa, 7,950 tons (contained antimony); Bolivia, 10,809 tons; Mexico, 6,098 tons; and United States, 1,859 tons. The last-named is the largest user. Texas Mining and Smelting Company, Laredo, Texas, the largest producer for refined antimony in the United States, treats ores from Bolivia and Mexico. The Idaho smelter of the Bradley Mining Company, which treated local ores for the most part, closed in mid-1952.

Uses and Consumption

Antimony is used chiefly to impart hardness and mechanical strength to lead. Electric storage batteries for cars and trucks annually absorb large amounts of lead alloyed with from 4 to 12 per cent antimony. It is also an important constituent in type-metal, babbitt bearing metal, solders, cable coverings, and foil for packaging.

Sulphides of antimony are used as pigments in paint and rubber manufacture. Antimony oxide is used for flame-proofing of paints, plastics, and textiles. In the United States about 58 per cent of the 14,000 tons of primary antimony consumed in 1952 went into non-metallic products and 42 per cent into metal products.

Prices

The price of antimony in the United States declined from 53.35 cents a pound in January to 37.97 cents a pound in December. The average Canadian price, estimated by the Dominion Bureau of Statistics, was 37.375 cents a pound, based on the average value of imported metal.

ARSENIC (ARSENIOUS OXIDE)

Arsenical ores are widely distributed throughout Canada in association with gold and silver, and with certain sulphide ores. Recovery of arsenic as arsenious oxide (As_2O_3), however, is confined to Beattie-Duquesne Mines Limited and O'Brien Gold Mines, Limited in Quebec and Deloro Smelting and Refining Company Limited in Ontario.

Production of 854 short tons of refined white arsenic (arsenious oxide) valued at $76,876 was reported in 1952, compared with 1,177 short tons valued at $129,435 in 1951. Domestic consumption in 1951 amounted to 252 tons compared with 293 tons in 1950. In 1951 there was a growing demand for arsenic because synthetic insecticides of the DDT group became scarce as a result of a general sulphuric acid shortage, and a pronounced return to arsenical insecticides resulted. However, towards the end of 1951 sulphuric acid again came into adequate supply, and the demand for arsenic lessened.

Production, Trade, and Consumption

	1952		1951	
	Pounds	$	Pounds	$
Production (refined As_2O_3)	1,708,351	76,876	2,353,362	129,435
Exports[1]	294,800	16,906	1,842,200	77,872
Imports[2]	19,249	3,521	35,231	7,773
Consumption	1951		1950	
Glass industry	362,426	—	384,079	—
White metal alloys	99,821	—	95,687	—
Insecticides and misc.	41,308	—	107,293	—
Total	503,555	—	587,059	—

[1] Comprise only refined white arsenious oxide and exclude arsenic content of gold ores exported.
[2] Arsenious oxide and arsenic sulphide.

Canadian Production

In Quebec, O'Brien Gold Mines, Limited and Beattie-Duquesne Mines Limited, in Cadillac and Duparquet townships respectively, are producers of crude white arsenic, which is recovered as a by-product in the roasting of arsenical gold ores. Production from the Beattie mine continued to be stored. The output of the O'Brien mine was shipped to Deloro, where it was refined to the white arsenic of commerce.

Deloro Smelting and Refining, the only producer of refined white arsenic in Canada in recent years, is essentially a cobalt-silver refinery; some arsenic is recovered in the smelting of the arsenical ores. Its main output is obtained from O'Brien, from silver-cobalt ores of northern Ontario and French Morocco, and from residues produced by Eldorado Mining and Refining Limited. Roasting capacity is about 100 tons of refined white arsenic per month.

Gold-arsenic concentrates produced by Bralorne Mines Limited, Kelowna Mines Hedley Limited, and other gold mines in British Columbia, are shipped for smelting and refining to Tacoma, Washington, but no payment is received for the contained arsenic and it is not included in the Canadian production figures.

World Production

United States is the leading producer and consumer of white arsenic, with production over the past decade ranging from a low of 10,211 short tons in 1946 to a high of 36,094 in 1944, according to the United States Bureau of Mines. Production in 1951 was 16,190 short tons. Mexico, Sweden, France, Japan, and Canada account for most of the remainder of the output, with many other countries supplying minor amounts. Total world output was estimated by the Bureau of Mines to have ranged in the last decade from a low of 40,785 short tons in 1949 to a high of 75,067 in 1944. World production in 1951 was estimated to be 56,218 short tons. These estimates do not include production from U.S.S.R. and other communist countries, with the exception of East Germany.

Uses

White arsenic is used chiefly in the manufacture of arsenical insecticides; in Canada, however, the chief use is as a decolourizing agent in glass manufacture. Arsenic is also used in the manufacture of sheep dip, poisoned baits, pharmaceuticals, acid-resistant copper, and antimonial lead alloys. Sodium arsenate is used as a weed killer. In the pharmaceutical field, arsenic compounds have been largely replaced by antibiotics such as streptomycin and penicillin.

Prices

According to E & M J Metal and Mineral Markets Bulletins, the price of barrelled refined white arsenic, minimum 99 per cent As_2O_3, in carload lots was $6\frac{1}{2}$ cents per pound until the middle of 1952. In August the price declined to $5\frac{1}{2}$ cents per pound and remained there until the end of the year.

BISMUTH

Canadian production of metallic bismuth declined in 1952, the output being about 26 per cent lower than in 1951. The metal production comes from residues occurring in the electrolytic refining of lead by The Consolidated Mining and Smelting Company of Canada Limited at Trail, British Columbia. There is a small production of bismuth oxychloride by Molybia Corporation Limited, which operates the La Corne property of Molybdenite Corporation of Canada Limited, La Corne, Quebec; it occurs as a by-product in the purification of molybdenite concentrate.

Since 1946 there has been a gradual increase in world production and in 1952 this was estimated to be about 1,750 short tons. The principal producing countries are Mexico, Peru, South Korea, Canada, United States, Japan, and the Union of South Africa.

Production, Exports, and Consumption

	1952		1951	
	Pounds	$	Pounds	$
Production, all forms				
British Columbia (metal)	142,246	320,053	191,471	451,872
Quebec (oxychloride)	20,127	27,171	23,827	56,232
Ontario (in ore)			15,000	35,400
Total	162,373	347,224	230,298	543,504
Exports				
Metal	33,646	—	89,585[1]	—
Oxychloride (bismuth content)	20,127	—	15,153	—
Total	53,773	—	104,738	—
Consumption				
Metal[2]	106,896	—	108,851	—

[1] Revised.
[2] Producer's domestic shipments.

Canadian Occurrences

Occurrences of bismuth in Canada are few. The metal occurs chiefly as a minor constituent of certain base metal ores, notably the lead-zinc-silver ore of the Sullivan mine of Consolidated Mining and Smelting at Kimberley, B.C., the principal producer. The La Corne mine in western Quebec, the only other producer at present, recovers a considerable amount of bismuth oxychloride as a by-product in producing molybdenite. The metal occurs with molybdenite at several other deposits in western Quebec, and is also associated with many of the silver-cobalt ores in the Cobalt district of Ontario.

The occurrence of cosalite (lead-bismuth sulphide) discovered on Lots 2 and 3, Marlow Township, Frontenac County, Quebec, in 1951 was further investigated by Lachance Mines Limited. While the economic possibilities of the deposit have not yet been determined, it is notable as being the first deposit of bismuth ore to be investigated in Canada.

Uses and Consumption

For many years the use pattern of bismuth has shown little variation. However, in 1952 the United States Naval Ordnance Laboratory developed a new permanent magnetic material composed of bismuth and manganese that exerts a force of 3,000 oersteds, the highest recorded for any known permanent magnetic material. The development of this material opens up a new field in the use of bismuth, as the growing importance of electronics and electronic devices is creating an increasing demand for permanent magnets.

Bismuth metal is extremely brittle, and for this reason is seldom used alone, but because of its low melting-point it is an important component in a number of low-fusible, non-ferrous alloys. The bismuth content of these alloys is usually from 40 to 60 per cent, with varying proportions of other metals such as tin, cadmium, lead, antimony, indium, and zinc. They are used for sprinkler plugs and other fire protection appliances; electrical fuses; low-melting-point solders; dental amalgams; and tempering baths for small tools. The tendency of bismuth to expand on solidification renders its alloys highly desirable for a number of applications. The metal finds a use in radar equipment and in the making of optical glass. In the industrial application of atomic energy it has an important use.

Bismuth salts are used extensively in pharmacy. Such salts must be of a very high degree of purity, and accordingly they are prepared from the pure metal. Those chiefly used are the subcarbonate, the subgallate, the subnitrate, and the subsalicylate. This use has increased considerably during the last three years.

The consumption of bismuth in Canada is from 50 to 60 tons a year, the principal consumers being: Canada Metal Company, Limited, Toronto; Federated Metals Canada, Limited, Merck and Company Limited, and Mallinckrodt Chemical Works Limited, Montreal.

Tariffs

United States tariffs on bismuth are as follows:

Bismuth metal—1⅞ per cent ad valorem.

Bismuth salts and compounds—35 per cent ad valorem.

Canadian tariff is as follows:

Bismuth, metallic in its natural state—free.

Prices

The average Canadian price, according to the Dominion Bureau of Statistics, was $2.250 a pound throughout the year.

CADMIUM

In 1952, production, exports, and consumption of cadmium were less than in 1951. Owing to reduced military requirements and increased world supply, the price of the metal dropped substantially during the year.

Production, Trade, and Consumption

	1952		1951	
	Pounds	$	Pounds	$
Production				
British Columbia and Yukon	834,235	1,835,317	1,179,752	3,161,735
Saskatchewan and Manitoba	114,352	251,574	147,168	394,410
Total	948,587	2,086,891	1,326,920	3,556,145
Exports				
To: United Kingdom	593,906	1,447,280	745,026	1,970,326
United States	15,126	22,936	5,399	14,519
France	10,864	31,066	33,600	111,075
India	448	1,300	—	—
Other countries	—	—	40,825	141,843
Total	620,344	1,502,582	824,850	2,237,763
Consumption				
Plating	224,667	—	—	—
Other	7,836	—	—	—
Total	232,503	—	290,000	—
Refinery Production by Principal Countries[1]				
United States	8,387,824	—	8,114,238	—
Canada	947,067	—	1,326,920	—
Italy	293,443	—	440,461	—
Australia (Tasmania)	506,980	—	432,100	—
Great Britain	335,081	—	321,592	—

[1] American Bureau of Metal Statistics, except for Canada.

Small amounts of cadmium sulphide occur with most zinc and some lead ores, and the metal often constitutes an important by-product in the recovery of lead and zinc. In Canada, it is recovered from the cadmium precipitate that results from purifying zinc electrolyte at the electrolytic zinc plants of The Consolidated Mining and Smelting Company of Canada Limited at Trail, British Columbia, and of Hudson Bay Mining and Smelting Company, Limited at Flin Flon, Manitoba. The cadmium refinery at Trail has a rated capacity of 700 tons of cadmium a year and the Flin Flon refinery 180 tons. Cadmium with a purity of 99·99 per cent can be produced at both refineries.

Most of the output of cadmium at Trail comes from zinc concentrate produced at the Sullivan lead-zinc mine at Kimberley, British Columbia. A number of other mines, both Canadian and foreign, ship zinc concentrate containing cadmium to the Trail plant for treatment. Among the more important of these were Reeves MacDonald Mines Limited, Canadian Exploration Limited, and Silver Standard Mines Limited, all in British Columbia, and United Keno Hill Mines Limited in Yukon.

Hudson Bay Mining and Smelting Company's cadmium production came from its copper-zinc mine at Flin Flon on the Saskatchewan-Manitoba boundary and from several smaller subsidiary mines near Flin Flon.

Most of the zinc ores mined in Eastern Canada probably contain cadmium in recoverable quantities. However, the zinc concentrates produced from these ores are exported, and since cadmium content is not reported no estimate can be made of the amount recovered therefrom.

Uses

Cadmium metal is used principally as a protective coating for iron and steel products. Where cost is not a prime factor, cadmium plating is preferred to zinc plating for the following reasons: (a) equal protection can be achieved with a thinner coating, (b) intricately shaped objects can be plated more uniformly, (c) cadmium retains its metallic lustre longer, (d) the metal has a higher resistance to atmospheric corrosion, and (e) the rate of deposition per unit of electric power is higher. Cadmium-plated articles include a wide range of parts and accessories used chiefly in aircraft, automobiles, household appliances, and military equipment.

In the white metal alloys industry, cadmium is used to make bearing metals for high-speed internal combustion engines. These bearing alloys contain about 98 per cent cadmium, alloyed either with nickel or with silver and copper.

Cadmium is also used in making low-melting-point solders and alloys for automatic sprinklers and fire-detection appliances.

The addition of up to one per cent cadmium strengthens copper wire without seriously reducing its electrical conductivity.

A new use has been reported in the field of nuclear physics, where cadmium is employed to control the temperature of certain types of atomic reactors.

Cadmium sulphide and cadmium sulphoselenide (red lithopone) are standard agents for imparting bright yellow and red colours to paints, inks, ceramic materials, rubber, and paper. Cadmium nitrate is used in white fluorescent lamp coatings, and the oxide, hydrate, and chloride are used in cadmium electroplating solutions. Cadmium bromide, chloride, and iodide are used in photographic printing processes. Cadmium stearate goes into the making of vinyl plastics.

Prices

The New York price of cadmium in commercial sticks dropped from $2.55 a pound to $2.00 a pound. The average Canadian price, estimated by the Dominion Bureau of Statistics, was $2.20 a pound.

CHROMITE

There have been no chromite shipments of Canadian origin since 1949, when 361 tons of stockpiled ore were shipped from the 'Montreal' pit of Union Carbide Company in the Black Lake District of the Eastern Townships, Quebec. Shipments of chromite from the Eastern Townships during World War II reached a peak of 29,595 tons in 1943.

Imports, Exports, and Consumption

	1952		1951	
	Short tons	$	Short tons	$
Imports (chromite)				
From: United States [1]	58,965	2,845,234	43,775	1,725,080
South Africa	33,469	327,072	55,569	445,484
S. Rhodesia	18,898	770,107	23,717	918,227
Turkey	16,731	754,645	11,090	419,853
Cuba	13,560	364,977	12,847	254,230
Philippine Is.	6,720	84,825	—	—
Totals	148,343	5,146,860	146,998	3,762,874
Exports (ferrochrome)				
To: United States	28,030	5,699,497	36,008	7,378,426
United Kingdom	16,046	6,578,476	7,327	2,740,828
Other countries	214	48,433	396	108,125
Totals	44,290	12,326,406	43,731	10,227,379
Consumption [2] (chromite)	145,908	—	126,940	—

[1] Country of origin not known.
[2] From Department of Defence Production; as at Dec. 31.

Chromite Occurrences in Canada

Quebec

Most of the chromite deposits in Canada from which production was obtained in the past are between Quebec City and Sherbrooke in the Eastern Townships of Quebec but no 'mine' production has been reported since 1947.

The old 'Montreal' pit in the Black Lake district in the Eastern Townships was reopened in 1941 by Union Carbide Company and was operated for the company by Orel Pare until it was closed in 1947. Small shipments from stock have been made by this company since that time. During World War II, production was also obtained from the Sterrett mine in Cleveland township and the Reed-Belanger property in the Black Lake district, both of which ceased operations in 1944. The Chromeraine mine, also in the Black Lake area, was operated for a short time in 1943 and 1944 by Wartime Metals Corporation. The Sterrett mine has been acquired by Albert Metals Corporation, Ltd., (a wholly-owned subsidiary of Ascot Metals Corporation Ltd.). Diamond drilling was carried out on the property in 1951, but no exploration or development was reported in the year under review.

Manitoba

Extensive low-grade chromite deposits were discovered in 1942 about 80 miles northeast of Winnipeg, in the Lac du Bonnet district. Ore reserves of the combined Page and Chrome deposits have been estimated at 10,000,000 tons to the 660-foot horizon. Test work conducted by the Hudson Bay Mining and Smelting Company Limited and the Mines Branch, Ottawa, indicate that the ore may be readily beneficiated to a chrome-iron ratio of 3:1.

While the deposits are not at present economically exploitable, they should prove of great value in assuring a supply of this essential mineral in case of emergency.

World Production and Consumption

Since World War II, production of chromite, of all grades, has risen from a low of 1,100,000 metric tons in 1945 to an estimated 2,800,000 metric tons in 1951. Russia has led the world in production of chromite for many years with an annual production ranging from 300,000 to 600,000 metric tons. When Russian chromite was no longer available to free world markets, following the outbreak of hostilities in Korea in June 1950, other major producing countries immediately took steps to increase output. Chromite production in Turkey was estimated at 600,000 tons in 1951, and was followed by the Union of South Africa (545,000 tons), the Republic of the Philippines (335,000 tons), Southern Rhodesia (300,000 tons), Yugoslavia (107,000 tons) New Caledonia (88,000 tons) and Cuba (79,000 tons). Minor amounts of chromite were produced in many other countries.

Turkey, Russia, and Southern Rhodesia are large producers of metallurgical-grade chromite. The Philippines, Southern Rhodesia, and Cuba supply high-grade refractory ores. The Union of South Africa is the chief source of chemical-grade ore.

The United States is by far the largest consumer of chromite of all grades, but is deficient in chromite reserves and depends almost entirely upon imports. In 1950, nearly 1,000,000 tons of chromite of all grades, averaging 42·4 per cent Cr_2O_3, was consumed in that country, according to the United States Bureau of Mines.

Occurrence of Chromite

Chromite ($FeO.Cr_2O_3$), the only commercial ore of chromium, has a theoretical composition of 68 per cent chromic oxide (Cr_2O_3) and 32 per cent iron oxide (FeO), but is never found of this purity in nature, as some of the iron and the chromium are replaced by magnesium and aluminum. It is a heavy (S.G. 4·6), opaque, shiny black or brownish-black mineral that can be scratched by a knife (H — 4·5), and has a pale chocolate-brown streak. Chromite is not magnetic, but is frequently found in association with magnetite, which is very magnetic and quite similar in appearance, except that its streak, or powder, is black.

Chromite is a common constituent of peridotite rocks and the serpentines derived from them and is often associated with asbestos. Its most common occurrence in Canada is in bands of dunite within serpentine masses in which it may occur as disseminations, blobs, small lenses, and more or less continuous narrow bands of disseminated ore separated by almost barren rock. Dunite, with which chromite is associated, is a fine-grained, grey-black, iron-magnesium rock which sometimes is mistaken for chromite. It has a dull appearance and on being scratched with a knife, or when powdered, is pale grey in colour rather than brown.

Uses

The uses of chromite are divided into three groups, namely metallurgical (by far the most important), refractory, and chemical.

The chromium content, the ratio of chromium to iron in the ore or concentrate, the amount of non-chromium bearing material in the ore, and the physical character of the ore are the chief factors determining the grade and use of the material.

The standard metallurgical-use chromite should contain a minimum of 48 per cent chromic oxide (Cr_2O_3) with a chromium to iron ratio of 3:1 or more and the material should be in lump form.

For special types of chrome addition agents such as Chrom-X, produced by Chromium Mining and Smelting Company Limited, Sault Ste. Marie, Ontario, lower-grade ores with a ratio 1·6:1 are being used.

Refractory chromite should contain 57 per cent or more of combined Cr_2O_3 and alumina (Al_2O_3), with the chromite forming approximately 35 per cent of the whole, and should be as low as possible in silica and iron. The ore should be hard and lumpy, not under 10-mesh, and the chromite should be present in an evenly, finely divided state rather than as coarse blobs with silicates.

There are no fixed limits for chemical-grade ore except those imposed by price and the effect of grade on plant capacity. In contrast to metallurgical and refractory ore, concentrates and fines are preferred, and a low chromium to iron ratio is not harmful provided the chromium content is high (44–46% Cr_2O_3). The silica content should be low.

Although the grades were named for the major uses, some interchange of grade is possible. Chemical ore has been used for metallurgical purposes, metallurgical concentrates and fines for chemical purposes, and metallurgical lump for refractory purposes.

Metallurgical Uses

Chromite finds its largest single use in the steel industry, mainly in making ferro-chromium for use in the manufacture of stainless and other alloy steels. Some chromite is used directly in the steel bath. Chromium increases hardness and shock resistance, and imparts high tensile strength and ductility to steels. Other metallurgical uses include the manufacture of certain cast-iron and non-ferrous alloys. The addition of chromium to cast-iron reduces the grain size greatly, increases its resistance to wear and corrosion, and reduces oxidation at high temperatures. There is no completely satisfactory substitute for chromium in stainless and other alloy steels, but some of the chromium can be replaced by molybdenum or manganese.

Refractory Uses

Refractory-grade chromite is manufactured into bricks for use as a neutral lining for furnaces. Most of these bricks are used in basic open-hearth steel furnaces. Because chromite refractories resist both acid and basic attacks at high temperatures, it is common practice to use a course of chromite bricks near the slag line in open-hearth furnaces, separating the silica bricks of the roof and side and the dolomite or magnesite bricks of the hearth and banks. Chromite is used with magnesia to make chrome-magnesia refractories.

Chemical Uses

The largest uses for chemical grade chromite are in the manufacture of pigments and the tanning of leather, with the surface treatment of metals being the next most important use. In all chemical uses, sodium bichromate is the primary chemical produced from chromite. Chromium metal is also produced from chemical-grade ore, with sodium bichromate being the intermediate product. The metal is finding increasing use in the production of high-temperature alloys, such as are used in jet aircraft engines etc. Sodium bichromate is used in cleansing, pickling, galvanizing, and red-dipping brass.

The Chromium-Consuming Industries in Canada

Although Canada's production of chromite is negligible, the availability of abundant electric power at reasonable rates has made possible the establishment of an extensive chrome addition agent industry. High and low ferrochrome is made by an electric furnace process for domestic consumption and export by Electro Metallurgical Company of Canada, Limited at its works at Welland, Ontario. Ferrochrome contains from 67 to 71 per cent chromium, with carbon ranging from a minimum of 0·03 per cent to a maximum of 2 per cent. Chromium metal for the non-ferrous industry is also made at Welland.

The Chromium Mining and Smelting Corporation, Limited, at Sault Ste. Marie, Ontario, produces, in electric open-arc furnaces, "Chrom-X" and other exothermic chrome addition agents from ores containing about 45 per cent Cr_2O_3 with a chrome-iron ratio as low as 1·6:1. This company, through American subsidiaries, operates plants at Riverdale (Chicago) Ill., Woodstock, Tenn., and Mead (near Spokane) Washington.

Canadian Refractories Limited in its plant at Kilmar, Quebec, produces a full line of chrome refractories for furnace lining from imported ores.

Prices

The E & M J Metal and Mineral Markets Bulletin of December 25, 1952, quoted prices for chrome ore (chromite), ferrochromium, and chrome metal as follows:—

(a) *Chrome ore*—per long ton, dry basis, f.o.b. cars, New York (December 27, 1951 prices in brackets)

1. *Indian and Rhodesian*

   48% Cr_2O_3, 3 to 1 ratio, lump.................................—$44 to $46 ($43 to $45)
   48% Cr_2O_3, 2·8 to 1 ratio, lump...........................—$40 to $42 ($40 to $42)
   48% Cr_2O_3, no ratio...—$32 to $33 ($31 to $32)

2. *South African (Transvaal)*

   48% Cr_2O_3, no ratio...—$34 to $35
   44% Cr_2O_3, no ratio...—$27 to $28

3. *Turkish*

   48% Cr_2O_3, 3 to 1 ratio, lump.................................—$55 to $56 ($53 to $54)

4. *Brazilian*

   44% Cr_2O_3, 2·5 to 1 ratio, lump...........................—$32 ($32)

5. *Indian*

   48% Cr_2O_3, 3 to 1 ratio, lump.................................—$53 to $54

(b) *Ferrochromium*—per pound of contained chromium 65 to 69% chromium (4 to 9% carbon), in lump form in carload lots, delivered to eastern U.S. zone—24¾ cents (21¾ cents), low carbon—34½ cents (30½ cents).

(c) *Chromium* (chrome metal)—per pound on 97% grade $1.23 ($1.12) for spot transactions; and $1.18 ($1.07) on contract basis.

Tariffs on Chrome Ore and Products

Chrome ore enters Canada and the United States duty free.

Ferrochrome under 3 per cent carbon, enters the United States at 12½ per cent ad valorem and with 3 per cent or more carbon enters at ⅝ cent per pound of chromium content.

COBALT

Owing to the improvement in the world supply of the metal, cobalt was, in the last quarter of 1952, removed from the list of metals under international allocation. Available returns indicate that world production of cobalt in 1952 was the highest on record. In 1951, the previous record year, the reported production was 8,500 metric tons. As stockpile requirements of the free nations are nearing completion, industry can expect to obtain its cobalt requirements more easily.

With the outbreak of hostilities in Korea in 1950, and the growing world tension as a result of the cold war, the demand for cobalt by the armament industries greatly increased. Civilian requirements for cobalt have also been rising since World War II, especially for use as an alloy component in engines designed to operate at high temperatures and in permanent magnets for electronic and other equipment.

The Federal Government in 1951 raised the price to be paid for cobalt contained in cobalt ores and concentrates in order to stimulate the search for, mining, and recovery of cobalt in the Cobalt-Gowganda area of Ontario. This resulted in a large increase of shipments of cobalt contained in both cobalt and silver ores.

Deloro Smelting and Refining Company Limited, Deloro, Ontario, acts as purchasing agent for cobalt ores for Government account at the incentive price. This price is to be paid either until 600,000 pounds of contained cobalt is in stock, or until March 31, 1954. It is expected that stockpile requirements will be completed early in 1953, after which the price paid for cobalt in concentrates will revert to the former prices as outlined later in the review.

The cobalt content of silver ores shipped to Deloro is purchased by the company for its own account.

Production and Trade

Figures secured by the Mines Branch indicate how greatly the production of cobalt from the Cobalt-Gowganda area of Ontario has increased since 1951. In that year the total quantity of cobalt in both cobalt and silver ores* and concentrates shipped from the area was 165·5 short tons, of which 14 tons went to the United States and the remainder to refiners in Canada. In 1952, shipments had almost doubled, 328 tons being sent out, all to Canadian refiners. It should be noted that these shipments to Canadian refiners are not included in the figures given in the table below, until processed and shipped from the refineries as metal, oxides, or salts.

* To determine if an ore is to be classed as a cobalt or a silver ore, an operator in the Cobalt-Gowganda area calculates which classification would give him the greater return. Usually, an ore or concentrate containing more than ten per cent cobalt is classed as a cobalt ore, and under ten per cent as a silver ore. There is, however, no hard and fast dividing line.

Production, Trade, and Consumption
(short tons)

	1952	1951
Shipments from Canadian ores[1] (contained cobalt)		
In concentrates exported	—	26
In metal, alloy, oxides, and salts	711	448
Total	711	474
Exports (contained cobalt)		
In concentrates		
To: United States	—	18
As metal, oxides, salts[2]		
To: United Kingdom	378	350
United States	149	73
Other countries	24	3
Total	551	426
Imports (gross weight)		
As cobalt concentrates		
From: United States	4,079	—
French Morocco[3]	3,391	1,844
Belgium	2	—
Total	7,472	1,844
As metal		
From: Belgian Congo[4]	19	48

[1] Not necessarily mined in year specified.
[2] Includes production from ores, concentrates, alloys, etc., but not cobalt contained in nickel oxide shipped to Clydach refinery of International Nickel or Falconbridge's Kristiansand refinery.
[3] For U.S. government account; treated at Deloro, Ont.; contains 10–15 % cobalt.
[4] Imported from Belgian Congo and re-exported to various countries.

Canadian Operations and Development

Ontario

Cobalt Area

The production of cobalt in this area, as in the Gowganda area, is closely associated with the production of silver. Since 1904, when production began, until a few years ago, the mining of silver was the prime concern of the operators, cobalt being regarded as a by-product. As a result, high-grade cobalt veins carrying low silver values were frequently left unmined, as it did not pay to mine them. However, in 1951, because of a substantially higher price for cobalt content, mine operators began to reappraise cobalt occurrences carrying low silver values. In 1952, three mines in this area were operated primarily for the production of cobalt, as against only one in the previous year. Silver-Miller Mines Limited, Silanco Mining and Refining Company Limited, and Mensilvo Mines Limited, from their respective LaRose, Agaunico, and Mensilvo mines and mills, were by far the largest shippers of cobalt concentrates for Government purchase. Other operators in the area recovering cobalt in conjunction with silver included Cobalt Lode Silver Mines Limited, Harrison-Hibbert Mines Limited, Shag Silver Mines Limited, Nipissing-O'Brien Mines Limited, and Cross Lake Lease.

The mill of United Cobalt Mines Limited treated ore from Harrison-Hibbert Mines and Shag Silver Mines, also from the LaRose Mine of Silver-Miller until its own mill came into operation in mid-1952.

Hellens Mining and Reduction Company Limited in 1952 operated its cyanide plant for the recovery of silver in tailings from former mining operations. Penn-Cobalt Silver Mines Limited reported the production of silver-cobalt concentrates at its Foster mine, where a 50-ton mill was built.

Cobalt Chemicals Limited began to rebuild the cobalt refinery, erected by Silanco in 1949, which was partly destroyed by fire in 1950. It is expected to begin operations in 1953 and at capacity will treat from 20 to 25 tons of cobalt concentrates daily. Operations are under the direction of Quebec Metallurgical Industries Limited, a Ventures-Frobisher subsidiary, with Silanco Mining and Refining having a minority interest. Feed will be drawn from mines of the Cobalt-Gowganda area as well as from mines within the Ventures organization.

The ore in the Cobalt camp occurs generally in calcite in narrow, fault-fissure veins a few inches wide and up to a few hundred feet long that are limited vertically to within a comparatively short distance (up to 300 feet) of the diabase-greenstone or diabase conglomerate contact. The cobalt ore minerals in the calcite veins, and sometimes disseminated in the enclosing rocks, consist largely of arsenides and sulpharsenides—smaltite ($CoAs_2$) and cobaltite (CoS_2, $CoAs_2$)—and are associated with arsenopyrite, native silver, and frequently with sulphides and sulpharsenides of nickel, copper, silver, lead, bismuth, and antimony.

Gowganda Area

Siscoe Metals of Ontario Limited.—This company, which operates the former Miller Lake-O'Brien mine near Gowganda, about 45 miles north and west of Cobalt, was again a major producer of silver concentrates containing cobalt and its 100-ton mill was in continuous operation during 1952. In milder weather the 500-ton flotation plant was operated to concentrate tailings from former operations that average about 4 ounces of silver to the ton. Development work in the mine continued satisfactory in proving up faulted extensions of formerly worked veins and in developing new ore on the deep levels.

Castle-Trethewey Mines Limited.—High-grade silver veins containing cobalt in this company's Capitol mine continued to provide feed for the 100-ton mill, which operated up to November. New ore disclosures on the deep levels of the workings (1100-1300 feet), which adjoin the Siscoe Metal's workings, were encouraging.

New Morrison Mines Limited continued development and exploration of its mine in Nicol Township not far from Siscoe Metal's holdings. The 25-ton mill at the Siscoe headframe was leased and ore was trucked intermittently from mine operations.

Sudbury Area

Cobalt occurs in minor amounts in the nickel-copper ores of the Sudbury area and is recovered from residues obtained in the electrolytic refining of nickel.

The International Nickel Company of Canada, Limited.—Since 1947, International Nickel has recovered cobalt from the electrolyte in its nickel refinery at Port Colborne, Ontario. The cobalt is recovered by mechanical precipitation as an impure oxide, and is shipped to the company's plant at Clydach, Wales. Production of contained cobalt in oxide form, shipped from Port Colborne in 1952, was 343 tons compared to 221 tons in 1951. Cobalt is also a constituent of the nickel oxide shipped directly from the Copper Cliff smelter to Clydach; it is recovered as oxide, but this is not reported as part of Canadian production.

Falconbridge Nickel Mines Limited.—The changeover of this company's Kristiansand (Norway) refinery to the chloride process was completed in March 1952. No cobalt was marketed in the first half of the year, but steady production began towards the end of the year. It is not reported as part of Canadian production.

Other Developments In Canada

Sherritt Gordon Mines Limited.—Sherritt Gordon's copper-nickel ores at Lynn Lake, Manitoba, contain minor amounts of cobalt which will be recoverable when refining operations commence in 1954. The company estimates that approximately 300,000 pounds of cobalt will be produced annually at its refinery now building at Fort Saskatchewan near Edmonton. Output of cobalt is under long-term purchase agreement with United States Defence Materials Procurement Agency.

Eldorado Mining and Refining Limited.—The concentrates shipped from Eldorado's mining operations at Great Bear Lake contain a small amount of cobalt. Following treatment of the concentrates at the company's radium-uranium refinery at Port Hope, Ontario, the cobalt-bearing residues are shipped to Deloro for recovery of the cobalt.

Sursho Mining Corporation.—The 1951 discovery of cobalt by this company about 185 miles north of Seven Islands and some 35 miles west of the railway being built to the Labrador-Quebec iron fields was explored by diamond drilling in 1952. Reports indicate the material was not of commercial grade.

World Production

Virtually all cobalt production is derived from the treatment of ores in which other metals, such as copper, nickel, iron, arsenic, lead, silver, and gold, are associated. Belgian Congo, Northern Rhodesia, French Morocco, United

States, and Canada (in that order) together contribute about 95 per cent of the world output. Union minière du Haut Katanga, in the Belgian Congo, and Rhokana Corporation, in Northern Rhodesia, produce cobalt from their copper operations. The estimated world production in 1951 was 8,500 tons compared to 7,100 tons in 1950.

Uses

At least 75 per cent of the cobalt produced is used in the metallurgical industry and most of the remainder in the ceramic industry. Its principal metallurgical use is in making permanent magnets and magnet alloy steels, followed by stellite alloys, which contain 40 to 50 per cent cobalt, 30 to 37 per cent chromium, and 12 to 17 per cent tungsten. Stellite alloys are used in high-speed, high-temperature, cutting tools and in die materials.

Many of the high-temperature alloys developed during World War II contain from 13 to 66 per cent cobalt. Capable of maintaining strength at high operating temperatures while resisting wear, these alloys are being used for various component parts of gas turbines, jet aircraft engines, and turbo-superchargers.

Cobalt is used in carbide-type alloys, welding rods, as a binder for tipping tools, in electroplating, and with other chemicals in nickelplating solutions as a preparation for chromium plating.

Cobalt oxide is used chiefly in the ceramic industry because of its fine colouring properties and is one of the best known groundcoat frits for porcelain enamels.

There are no satisfactory substitutes for cobalt in its principal uses.

Prices

Cobalt in Cobalt Ores or Concentrates

To encourage operators of the Cobalt-Gowganda areas of Ontario to search for and mine cobalt ores in the face of increased operating costs, the Canadian Government announced two price increases during 1951. The prices paid, per pound of contained cobalt, f.o.b. Cobalt, Ontario, with treatment charges to the purchaser's account, as of April and December, 1951, were:

Cobalt Content	*April*	*December*
7 to 7·99 %	$1.00	$1.20
8 to 8·99 %	1.15	1.50
9 to 9·99 %	1.30	1.80
10 to 10·99 %	1.40	2.00
11 to 11·99 %	1.50	2.00
12 % and over	1.60	2.00

The silver in cobalt ores containing the above percentages of cobalt is paid for at the rate of 50 per cent of the silver in the first 100 ounces and 75 per cent of all silver over 100 ounces, at current market prices.

Cobalt in Silver Ores or Concentrates

The price of cobalt contained in silver ore or concentrate paid by Deloro was substantially increased early in 1951 to the following schedule:

Cobalt Content	*Price per pound of contained cobalt*
Up to 2·99 %	0.15
3 to 3·99 %	0.25
4 to 4·99 %	0.35
5 to 5·99 %	0.50
6 to 6·99 %	0.65
7 to 7·99 %	0.80
8 to 8·99 %	0.95
9 to 9·99 %	$1.10

Freight from Cobalt to Marmora, Ontario, and smelting and refining charges on silver ores are charged to the seller's account.

The E & M J Metal and Mineral Markets Bulletin of December 20, 1951, quoted the following prices for cobalt metal and oxides (1950 prices in brackets):—

Cobalt metal, per pound, 97 per cent to 99 per cent cobalt, rondelles or granules, in 500-to 600-lb. containers $2.40 ($2.10) f.o.b. New York or Niagara Falls, freight collect.

Cobalt oxide, ceramic grade, 350-lb. containers, 70 to 71 per cent cobalt, $1.76 ($1.60) per pound east of the Mississippi.

Canadian prices, f.o.b. Deloro, are comparable to the E & M J quotations listed above.

COPPER

Production of copper in all forms totalled 258,038 tons, valued at $146,679,040. This is a 4·4 per cent decrease from 1951 output. Of the total tonnage, Ontario contributed 48·6 per cent, practically all of which came from the copper-nickel ores of the Sudbury area. Quebec was the next largest producer, with 26·7 per cent, followed by Saskatchewan (11·8) and British Columbia (8·1). Manitoba, Newfoundland, Nova Scotia, and Northwest Territories were other producers. There were nineteen principal producing mines located in seven of the ten provinces.

Output of refined copper from the refineries of the International Nickel Company of Canada, Limited, at Copper Cliff, Ontario, and Canadian Copper Refiners Limited at Montreal East, Quebec, was 196,320 tons compared with 245,466 tons in 1951. This sharp drop from the previous year was due to a four-months strike at the Montreal East refinery. Consumption was 130,347 tons, a decline from the 1951 figure of 134,183 tons.

Canada was the fourth largest producer of copper, the first three being the United States, Chile, and Northern Rhodesia. As a consumer Canada ranked fifth and as an exporter third.

Outside of the United States there was a general change in the copper situation from a shortage to a balanced position. The allocation control established in 1951 by the International Materials Conference was continued throughout the year.

Production and Exports

	1952		1951	
	Short tons	$	Short tons	$
Production, all forms[1]				
Ontario	125,343	70,973,056	128,809	70,861,789
Quebec	68,846	39,297,212	68,866	38,151,738
Saskatchewan	30,344	17,320,154	31,625	17,520,373
British Columbia	20,786	11,828,103	21,932	12,110,779
Manitoba	9,374	5,350,804	15,839	8,774,768
Newfoundland	2,959	1,689,079	2,899	1,606,233
Nova Scotia	383	218,663	—	—
Northwest Territories	3	1,969	1	536
Total	258,038	146,679,040	269,971	149,026,216
Production, refined[2]	196,320		245,466	
Exports in ingots, bars, slabs, etc.				
To: United States	52,630	33,248,986	28,843	15,758,548
United Kingdom	41,643	24,258,670	51,918	28,161,956
France	8,537	6,449,920	5,700	4,252,210
Brazil	2,835	1,855,978	2,688	1,459,393
India	2,582	1,516,867	3,649	1,941,091
Sweden	1,786	1,567,845	3,998	3,630,388
Australia	1,707	954,063	—	—
Other countries	1,955	1,553,988	5,036	3,819,269
Total	113,675	71,406,317	101,832	59,022,855
Exports in rods, strips, sheets, and tubing				
To: United States	10,878	7,911,943	4,166	2,374,086
Australia	2,857	1,999,288	97	87,695
Switzerland	2,492	2,019 252	3,017	1,786,706
Denmark	1,652	1,552,882	1,875	1,054,371
New Zealand	1,328	1,057,816	1,271	982,531
Cuba	1,038	1,027,126	275	260,154
Ireland	594	388,475	269	163,324
Other countries	1,988	1,610,065	2,321	1,489,561
Total	22,827	17,566,847	13,291	8,198,428
Exports in ore, matte				
To: United States	24,640	11,018,784	28,941	11,575,820
Norway	8,180	3,609,527	6,310	2,524,120
United Kingdom	1,127	495,055	1,044	417,440
West Germany	471	254,205	558	223,080
Other countries	19	10,253	—	—
Total	34,437	15,387,824	36,853	14,740,460
Consumption, refined	130,347		134,183[3]	

[1] Blister copper made from Canadian ore plus recoverable copper in concentrates, matte, etc., exported.
[2] Production from Canadian ore, foreign ore, and scrap.
[3] Revised.

Production and Developments

Newfoundland

Buchans Mining Company, Limited.—During 1952, the company treated 330,500 tons of copper-lead-zinc ore, from which 12,500 tons of copper concentrates, containing 2,937 tons of copper, were produced. These were shipped to the United States. A very substantial proportion of the mine production was from the Rothermere shaft, which was completed in 1951.

Falconbridge Nickel Mines Limited continued active investigations at the old Gull Pond, Rambler, and Tilt Cove properties.

Nova Scotia

Mindamar Metals Corporation, Limited.—The new 500-ton mill at the company's Stirling zinc-lead-copper mine in Richmond county came into operation in June and had produced 416 tons of copper by the year's end. The indicated ore reserves were estimated to be 780,000 tons averaging 8·0 per cent zinc, 1·8 per cent lead, and 0·9 per cent copper.

Quebec

Noranda Mines Limited.—Production from the Horne mine was 1,399,665 tons of ore, which yielded 25,380 tons of copper, 200,280 ounces of gold, 610,800 ounces of silver, and 147,000 tons of pyrite concentrates. The smelter treated 1,249,540 tons of ore, concentrate, and other copper-bearing materials, including custom ore yielding a total of 70,557 tons of anode copper. Anodes were refined by the company's subsidiary, Canadian Copper Refiners Limited, Montreal East. The copper-gold ore reserves of the Horne mine at the end of 1952 were 15,579,933 tons.

Gaspé Copper Mines Limited, a subsidiary of Noranda Mines, continued development of a large low-grade copper deposit in the interior of the Gaspé Peninsula. An ore reserve of 67,000,000 tons averaging 1·3 per cent copper has been indicated. A modern townsite was laid out during the year and plans were drawn for a plant designed to treat daily 6,500 tons of ore and for a smelter production of 125 tons of copper anodes. Power will be obtained from a hydro-electric development near Baie Comeau on the north shore of the St. Lawrence and delivered via 31 miles of submarine cable and 135 miles of surface transmission lines to the company's property by late 1954. Production is planned to begin early in 1955.

Waite Amulet Mines, Limited.—The Waite Amulet and the adjoining Amulet Dufault mines delivered to the mill 427,672 tons of copper-zinc ore, from which concentrate containing 14,530 tons of copper was recovered, as well as zinc, gold, silver, and pyrite concentrate. The East Waite mine came into production in May. Total ore reserves at the end of 1952 were 1,675,000 tons.

Quemont Mining Corporation, Limited.—The company, whose property adjoins Noranda's Horne mine, treated 775,218 tons of copper-zinc ore, which yielded 51,032 tons of copper concentrate containing 18,811,023 pounds of copper. A new orebody was located and outlined in detail by driving and diamond drilling. Four sub-level stopes were prepared in the No. 20 orebody and a substantial proportion of the mine production came from these in the second half of the year. No. 3 auxiliary shaft was completed to the 200-foot level. Ore reserves at the end of 1952 were 9,574,000 tons averaging 1·39 per cent copper, with additional zinc, gold, and silver content.

Normetal Mining Corporation, Limited.—During the year, 360,448 tons of ore were milled, yielding 30,079 tons of copper concentrate containing 12,641,063 pounds of copper. The copper concentrates were shipped to the Noranda Smelter for treatment. Underground development on the lower levels was continued. Pyrite recovery from the mill tailings commenced in March. Ore reserves at the end of the year were 2,637,400 tons averaging 2.63 per cent copper and 8·25 per cent zinc.

East Sullivan Mines, Limited.—East Sullivan treated 895,338 tons of ore, from which concentrates containing 28,487,553 pounds of copper were obtained. The copper concentrates were shipped to the Noranda smelter for treatment. At the end of 1952 the mine had 13 levels, the 1,950-foot being the bottom working level. Sinking operations were begun to lower the workings to 2,850 feet. Ore reserves at the end of the year were 4,330,000 tons, of which 3,830,000 tons were classed as proved ore. The average grade was 1·58 per cent copper.

Golden Manitou Mines, Limited.—Golden Manitou is essentially a zinc producer, but in 1951 the discovery of a copper-bearing zone, which by drilling indicated 1,000,000 tons averaging 2·5 per cent copper, has increased its copper-producing potentialities. These were further increased in 1952 with the finding on the upper levels of a new zone with an indicated copper content of 2·0 per cent. Exploration of these zones was actively carried out during the year.

Ascot Metals Corporation, Limited.—The company operated two mines, the Moulton Hill and the Suffield, in Ascot township near Sherbrooke. Milling was carried out at the Moulton Hill concentrator. During the nine months period February to October, 157,110 tons of ore were treated, of which Moulton Hill and Suffield supplied 64,483 tons and 92,627 tons respectively. The ore is zinc-lead-copper containing some gold and silver. Bulk copper-lead concentrate shipped to the United States contained 1,539,433 pounds of copper.

Weedon Pyrite & Copper Corporation, Limited.—Re-opening of the old Weedon mine, about 39 miles northwest of Sherbrooke, was continued. A new timbered headframe was erected and a 300-ton mill built. The mill went into production in November. There is an indicated ore reserve of about 500,000 tons averaging 2·5 per cent copper, 35 per cent sulphur, and 1·5 per cent zinc.

Other Developments in Quebec.—There was considerable activity in the Chibougamau area during 1952. Opemiska Copper Mines (Quebec) Limited began construction of a 400-ton daily capacity mill with production planned for 1953. Proved ore reserves are 1,054,000 tons averaging 4·82 per cent copper. Campbell Chibougamau Mines Limited completed about 1,000 feet of the 1,150 foot, 4-compartment shaft under construction. A 1,700-ton daily capacity mill is planned for production in 1955. A contract with the United States Defence Materials Procurement Agency was arranged for the sale of 63,200,000 pounds of refined copper over a two-year period after production commences. The ore reserves are 1,746,750 tons averaging 2·8 per cent copper and 0·106 ounces gold per ton. Chibougamau Explorers Limited carried out an active program of shaft sinking and diamond drilling.

A substantial tonnage of ore that could be mined economically by open-pit methods was developed. Surface mining was started, and by the end of the year over 500,000 tons of ore was available for open-pit mining. Total ore reserves at the end of 1952 were 3,824,000 tons with an average of 0·95 per cent copper.

Britannia Mining and Smelting Company, Limited.—During 1952, the Britannia mine produced 858,452 tons of ore, and 829,652 tons were treated in the company's concentrator. Copper concentrates produced totalled 23,171 dry tons, and 575 dry tons of copper precipitates were obtained from the treatment of mine waters. Both of these concentrates were shipped to the smelter of American Smelting and Refining Company at Tacoma, Washington.

As in the past several years, the zinc content of the ore produced exceeded the copper, and zinc concentrates totalling 25,609 dry tons were consigned to Black Eagle, Montana.

The Consolidated Mining and Smelting Company of Canada, Limited.—The company's Tulsequah Chief and Big Bull mines in the Atlin district produced 96,059 tons of zinc-copper-lead ore, which was treated in the concentrator of Polaris-Taku Mining Company Limited in the vicinity. The copper concentrates were shipped to Tacoma, Washington for smelting. Enlargement of the concentrator to 500 tons per day was almost completed at the end of 1952.

Other Operations and Developments in British Columbia.—The Vananda Mines (1948) Limited's mine on Texada Island and the Twin "J" mine of Vancouver Island Base Metals Limited closed down during 1952.

Exploration was conducted on a number of copper showings throughout the province. A recently discovered property in the area at the head of the Portland Canal disclosed copper mineralization over a large area.

Uses

Owing to its high electrical conductivity, copper finds its greatest utilization in the electrical industry. Over 50 per cent of the Canadian production of refined copper is used in this industry. A very substantial part of the remainder is consumed in brass, bronze, and other copper alloys, which are used in the manufacture of both industrial and household articles. Canadian domestic consumption of refined copper has increased by over 75 per cent since 1938.

Prices and Tariffs

The Canadian price of electrolytic copper f.o.b. Montreal or Toronto in carload lots was 27·800 cents per pound on January 1st. It decreased to 27·000 cents by May 1st and remained close to this price throughout May and June. At the end of June it increased to 29·500 cents, and this price remained in effect for the balance of the year, with the exception of a drop to 25·500 cents in the first week of August.

The United States domestic price was controlled at 24·500 cents throughout the year.

Suspension of the United States tariff of 2·00 cents per pound on copper was extended until June 30, 1954.

GOLD

Canada produced 4,471,725 fine ounces of gold, valued at $153,246,016, in 1952 compared with 4,392,751 fine ounces valued at $161,872,873, in 1951. The Mint price at Ottawa averaged $34.27 in 1952 compared with $36.85 in 1951, the lower price in 1952 being a result of the rise in value of the Canadian dollar.

Seven mines ceased operations during 1952, but the loss in production was offset by increases in the output of some of the larger mines, such as Lamaque in western Quebec and Giant Yellowknife in the Northwest Territories, and by the addition of Bonwhit and Hugh-Pam in Ontario to the list of producers.

Gold is, in value, the chief single contributor to Canada's mineral output. This country holds second place in world output, which, in 1951, the latest year for which figures are available, totalled 24,000,000 fine ounces.

With the greatly increased interest in base metals, prospecting for gold continued to decline. The few prospects now being explored are chiefly those adjoining established mines, and are being examined with a view to discovering extensions of known orebodies.

The cost-aid provided by the Emergency Gold Mining Assistance Act was partly offset by a decrease in the Mint buying price for gold, and as a result the Government proposes to introduce amending legislation in Parliament early in 1953, to provide for increased rates of assistance.

Production

	1952	1951
	fine ounces	
Ontario		
Auriferous quartz mines		
Porcupine	1,163,344	1,062,951
Kirkland Lake	417,382	454,986
Larder Lake	366,046	352,135
Patricia	321,763	349,404
Thunder Bay	120,051	137,291
Sudbury	40,837	23,717
Matachewan	40,144	41,984
Algoma	179	—
Miscellaneous	40	—
Total, auriferous	2,469,786	2,422,468
Base metal mines	43,905	40,511
Total	2,513,691	2,462,979
Quebec		
Auriferous quartz mines	771,795	724,878
Base metal mines	341,409	342,428
Total	1,113,204	1,067,306
British Columbia		
Auriferous quartz mines	216,652	223,142
Base metal mines	42,235	48,048
Placer operations	14,172	18,802
Total	273,059	289,992

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Production—continued

	1952	1951
	fine ounces	
Northwest Territories		
Auriferous quartz mines	247,338	212,211
Base metal mines	243	—
Total	247,581	212,211
Manitoba		
Auriferous quartz mines	118,214	126,867
Base metal mines	23,733	37,047
Total	141,947	163,914
Saskatchewan		
Auriferous quartz mines	2	—
Base metal mines	93,583	110,216
Total	93,585	110,216
Yukon		
Placer operations	78,519	77,504
Newfoundland		
Base metal mines	8,595	8,515
Alberta		
Placer operations	111	97
Nova Scotia		
Auriferous quartz mines	1	17
Base metal mines	1,432	—
Total	1,433	17
Total, Canada		
Fine ounces	4,471,725	4,392,751
Value	$153,246,016	$ 161,872,873
Average value per oz	$ 34·27	$ 36·85

Canadian Production

British Columbia

Five auriferous quartz mines operated during 1952: Bralorne Mines Limited and Pioneer Gold Mines of British Columbia Limited, in the Bridge River area, The Cariboo Gold Quartz Mining Company Limited, in the Cariboo district, Island Mountain Mines Company Limited, in the same area, and Kelowna Mines Hedley Limited at Hedley. Island Mountain is now on a salvage basis, and will be closed shortly.

Placer production was mainly from the underground placer mine of Noland Mines Limited, in the Atlin district. Operations at this mine were suspended indefinitely in the fall owing to high costs. Six base metal properties produced gold as a by-product.

Saskatchewan

All gold production of this province is obtained as a by-product from the Hudson Bay Mining and Smelting Company Limited mine at Flin Flon.

Manitoba

Production comes from Nor-Acmé Gold Mines Limited at Snow Lake, and San Antonio Gold Mines Limited in the Rice Lake district, and as a by-product from Hudson Bay Mining and Smelting at Flin Flon.

Underground development work was continued on the property of Forty-Four Mines Limited, from the adjoining workings of San Antonio.

Ontario

Two new mines, Bonwhit Mines Limited, and Hugh-Pam Porcupine Mines Limited, both in the Porcupine area, commenced production, shipping their ores to the mill of Broulan Reef Mines Limited, in the same area. Production from the province exceeded that for 1951, despite the closing down of Hasaga Gold Mines, Limited, in the Red Lake area, New Jason Mines Limited, in the Patricia district, and Chesterville Mines Limited, in the Larder Lake area.

Mining difficulties caused by rock bursts reduced the milling rate at Lake Shore Mines, Limited, in the Kirkland Lake area. Kerr-Addison Gold Mines Limited, in the Larder Lake area, found excellent ore by diamond drilling below its present bottom level, and Preston East Dome Mines, Limited, in the Porcupine area, and New Dickenson Mines Limited, in the Red Lake area, reported encouraging ore developments.

Five prospects are carrying on underground development, four of them from the workings of adjacent producing mines. Kirkland-Hudson Bay Gold Mines Limited and Hudson-Rand Gold Mines Limited are being explored from the Lake Shore mine; Midcamp Mines Limited, Porcupine area, from the Preston East Dome and Paymaster mines; and Central Porcupine Mines Limited, Porcupine district, from Coniaurum Mines Limited. New Mosher Longlac Mines Limited in the Long Lac area, is sinking a 3-compartment shaft in an effort to locate the westerly extension of the 'F' zone of MacLeod-Cockshutt Gold Mines Limited. The shaft is expected to be completed at 1,700 feet in 1953.

Buffalo-Ankerite Gold Mines Limited, in the Porcupine area, Little Long Lac Gold Mines Limited, in the Thunder Bay district, Toburn Gold Mines, Limited, and Teck-Hughes Gold Mines, Limited, in the Kirkland Lake area, and Matachewan Consolidated Mines Limited near Elk Lake are now operating on a salvage basis. Newlund Mines Limited, Kenora district, suspended underground development operations towards the end of the year to await more favourable conditions.

Quebec

The increase in output was due chiefly to the attainment by Lamaque Gold Mines, Limited, in the Val d'Or area, of its objective of 2,000 tons per day early in the year, and to the entry into production of the new 500-ton mill of Bevcourt Gold Mines Limited, in Louvicourt township, in mid-year. East Malartic Mines Limited, Fournière township, found good ore on the deeper levels, and Barnat Mines Limited, in the same area, increased production from its north zone.

In the Chibougamau area, Chibougamau Explorers Limited, La Dauversière and Rohault townships, completed a 600-foot shaft to open three levels. Diamond drilling showed 720 tons per vertical foot of ore averaging 0·42 oz. gold and 0·82 per cent copper. Campbell Chibougamau Mines Limited was sinking a 4-compartment shaft to a depth of 1,000 feet on the Merrill group in Obalski and McKenzie townships, where ore reserves are estimated at 1,050,000 tons averaging 0·15 oz. gold and 3·5 per cent copper to a depth of 750 feet.

Two of the smaller mines, Quesabe Mines Limited, Duprat township, and Heva Gold Mines Limited, Rouyn district, were closed because of failure to find new ore.

Newfoundland

Newfoundland obtains its gold output as a by-product from the copper-lead-zinc mine operated by Buchans Mining Company Limited near Red Indian Lake, in central Newfoundland.

Northwest Territories

Giant Yellowknife Gold Mines Limited, in the Yellowknife area, reached a milling rate of 700 tons per day at mid-year, which contributed largely to the 16 per cent increase in output from the Territories. Consolidated Discovery Yellowknife Mines Limited maintained a daily milling rate of 92 tons of ore averaging 1·12 ounces per ton, this being the highest-grade mill feed of any gold mine in Canada. Development of the company's deepest level, the 950-foot, shows ore of higher grade than mine average and greater tonnage per vertical foot. It is expected that hydro-electric power will reach the mine by May, 1953. The office, warehouse, and staff quarters were destroyed by a fire in October.

Salmita Consolidated Mines Limited, in the McKay-Courageous Lake area, has sunk a 2-compartment shaft to 125 feet, and expects to continue development work during the winter of 1952-53. Bulldog Yellowknife Gold Mines Limited, in the same area, and Indore Gold Mines Limited, in the Yellowknife area, are preparing to start sinking early in 1953. Negus Mines Limited, Great Slave Lake area, was closed on September 15.

Yukon

All gold comes from placer operations, of which the largest is that of The Yukon Consolidated Gold Corporation Limited. The company operates seven dredges in the vicinity of Dawson. Smaller operators are: Yukon Gold Placers, Limited; Clear Creek Placers Limited; Kluane Dredging Company; Yukon Explorations, Limited; and Burwash Mining Company Limited.

IRON ORE

Canada's production (shipments) of iron ore in 1952 (4,707,008 tons,[1] valued at $33,744,311) increased 11·3 per cent over production in 1951. Expansion at producing properties together with new developments indicate a continually increasing output during the years ahead.

As a part of its program of expansion Steep Rock Iron Mines Limited continued the dredging of silt from above its Hogarth ("A") orebody and speeded this up by the addition of a second dredge. Development of its Errington ("B") underground mine was continued also. At the Helen mine of Algoma Ore Properties, Limited, in the Michipicoten area, progress was made in the preparation for mining at greater depth. In Newfoundland, Dominion Wabana Ore Limited continued its program of underground mine modernization. In British Columbia, the main event was the bringing into production of the Texada Island magnetite deposits by Texada Mines Limited. The Argonaut Company Limited at Campbell River, B.C., increased its production of magnetite substantially and made a number of shipments to the Atlantic Coast of the United States. Production of iron and steel ingots by Quebec Iron and Titanium Corporation at Sorel, Quebec, increased twofold.

In the field of iron ore development and general exploration, 1952 was an exceedingly active year in Canada. In Labrador-New Quebec, Iron Ore Company of Canada continued with the construction of railway, terminal, power, dock, and townsite facilities at a rapid rate. At Marmora, in southeastern Ontario, the stripping of limestone overburden was commenced at a rate of about 30,000 tons per day. General exploration for iron ore was particularly active in New Quebec, in southeastern Ontario, and on the Pacific coast of British Columbia, but was not confined to those areas.

The outlook for 1953 with respect both to iron ore output from producing mines and exploration activity by producing and non-producing companies, is excellent. The major increases in iron ore production, however, will not take place until 1954 and 1955.

[1] All tonnage figures are in long tons, unless otherwise stated.

Production, Trade and Consumption

	1952		1951	
	Long tons	$	Long tons	$
Production (*shipments*)	4,707,008	33,744,311	4,179,027	31,141,112
Imports				
From: United States	3,666,729	24,196,991	3,294,883	21,329,066
Brazil	142,665	2,306,293	109,922	1,064,434
Liberia	1,005	15,581	8,242	182,775
Sweden	—	—	7,862	94,990
Great Britain	10	586	—	—
Total	3,810,409	26,519,451	3,420,909	22,671,265
Exports				
To: United States	1,795,113	11,395,824	1,950,632	13,121,180
Japan	709,206	5,546,177	101,218	821,501
Great Britain	629,468	3,680,527	692,707	3,796,025
West Germany	301,033	1,710,944	135,592	857,431
Total	3,434,820	22,333,472	2,880,149	18,596,137
Indicated consumption	5,082,597	—	4,719,787	—
Domestic production as a percentage of indicated consumption	92·6		88·5	

*Iron Ore Production (Shipments) in Canada By Properties**

	1952	1951	1950
Steep Rock (hematite)	1,274,666	1,325,889	1,216,613
Wabana (hematite)	1,477,153	1,540,176	1,044,237
Helen (sinter)	1,146,000	1,211,234	958,113
Quinsam Lake (magnetite concentrates)	551,812	101,371	—
Texada Island (magnetite concentrates)	209,016	—	—

* Preliminary 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 is imported from the United States. Most of British Columbia's output of magnetite concentrates was exported to Japan, but some was shipped to the Atlantic coast of the United States. Wabana iron ore supplied the steel plants at Sydney, Nova Scotia, and the remainder was exported to the United Kingdom and to West Germany.

Ore imported from Brazil and Liberia in 1952 was used as open-hearth lump ore at various plants.

Canadian Production

Newfoundland

Dominion Steel and Coal Corporation Limited.—Production of hematite by Dominion Wabana Ore Limited, wholly owned subsidiary of Dominion Steel and Coal Corporation, off Bell Island in Conception Bay, amounted to 1,420,789 tons during 1952. Shipments totalled 1,477,153 tons compared with 1,540,176 tons in 1951. The mechanization and modernization program, originally scheduled for completion in 1952, hampered operations and so resulted in the reduced output in 1952.

The main part of the mechanization program consists of the installation of a belt conveyor hoisting system, with the belt running up one side of No. 3 slope. As the program was progressing satisfactorily by the year's end, it is expected that production and shipments will increase substantially during 1953. The goal remains at 2,500,000 tons per year.

Quebec

Quebec Iron and Titanium Corporation.—The company shipped 237,990 short tons of ilmenite ore from its Allard Lake operations in 1952 to its experimental smelting operation at Sorel, Quebec and 5,050 short tons to outside customers. The average iron content of the ore was 39·65 per cent. Production of iron ingots, iron in the form of pigs, and steel ingots was 6,350, 4,710, and 20,880 short tons, respectively. The production of iron and steel ingots during 1951 totalled 15,554 short tons.

The company was able to commence primary crushing at the mine as a result of the completion of an electric power line which now connects the power station at Havre-St-Pierre to the mine near Allard Lake. Primary crushing had been carried out prevoiusly at Havre-St-Pierre, 27 miles from the mine. The shipping cycle for the 11,000-ton ore vessel "Mont Alta" has been reduced to a 4½ day turnaround.

At the experimental plant at Sorel a conveyor belt and dock facilities for the loading and shipment of titanium dioxide (TiO_2) slag by water have been installed. A new pig-casting machine has also been installed, so that the company's high-grade metallic iron may be produced in a size suitable for the primary iron and steel industry. Previously the by-product iron was produced in the form of iron and steel ingots. During 1952, furnaces No. 2 and 3 were placed in operation. With production from three ilmenite smelting furnaces, the two iron refinery furnaces will be required for refining operations and will not be available for steel production.

Ontario

Algoma Ore Properties, Limited.—The company's production comes from the Helen mine in the Michipicoten area. During 1952, shipments of sinter from the sintering plant at Jamestown totalled 1,146,000 tons as against 1,211,234 in 1951. Of this amount, 462,000 tons were shipped by rail to Algoma Steel Corporation at Sault Ste. Marie and 684,000 tons by vessel to lower lake ports.

At the Helen mine, the company carried on development of Blocks 3 and 4. Block 3 lies immediately below Block 1, which has supplied a large part of the underground output at the Helen. Block 4 lies below the mined-out Victoria open pit. The sink float plant, which beneficiated the siderite from the Victoria open pit before it was mined out, has again been placed in operation to treat lower grade ore from the easterly part of the Helen mine, where mining is being carried on at present.

Draining of the old worked-out Helen hematite mine has been commenced. This is being accomplished by diamond drill-hole through the west pillar, the drilling being done from the present Helen underground workings.

At the sinter plant at Jamestown, an expansion program is in progress, with production to be increased from 1,200,000 to about 1,600,000 tons per year. A fifth sintering machine—72-inch, Dwight Lloyd type—is being installed to handle the increased output of ore necessary to the expansion program.

The Helen siderite, as mined, contains about 35 per cent iron. The average analysis of "Algoma" sinter (natural) for 1951 was:

Iron	51·04%	Alumina	1·61%
Phosphorus	0·021%	Lime	2·81%
Silica	9·71%	Magnesia	8·32%
Manganese	2·86%	Moisture	0·98%

Steep Rock Iron Mines, Limited.—Shipments from steep Rock Iron Mines Limited in 1952 totalled 1,274,666 tons compared with 1,325,889 tons in 1951.

Steep Rock continued making preparations for the switch-over from open-pit to underground mining at the Errington mine ("B" orebody). Next year will be the last for production from Errington open pit and the first year of underground production in the Steep Rock area.

During the year shaft sinking was completed, and horizontal development carried out towards the orebody. The underground waste pass system was completed, and a start was made on raising the conveyor incline. The first of the underground pumps was installed in the pump station. The service building was completed and all shops are in operation. Although development openings had not reached ore by the end of 1952, and the exact characteristics of the orebody were not known, it is expected that block caving will be the mining method employed. Actual development in ore is expected to commence in March of 1953. It is also expected that Errington underground production will total about 200,000 tons during 1953 and open-pit about 750,000 tons.

Plans were finalized during the year on the location of all facilities for the Hogarth open pit, including crushing and loading plants, and railroad and power lines. Two concrete dams were constructed between Narrows Island and Drillers' Point to provide a retaining wall for the stockpile area and to ensure the safety of mining operations in the lake bottom. In addition, approximately 2,300 feet of the main road were relocated to provide right-of-way for railroad facilities. A new power line was constructed between Substation "G" and Substation "E" to bypass the planned railroad location. A haul road was commenced in July, to connect the Hogarth orebody with the present Float Ore road, and by the end of the year approximately 5,000 feet were completed. A start was made in November on the preliminary building of access roads and drill ramps in preparation for stripping operations early in 1953. By the end of the year about 29,000,000 cubic yards of lake bottom silt had been dredged from above Hogarth orebody. The original dredge, the "Steep Rock", with a 28-inch discharge line, worked throughout the year, and in October a second large unit, the "Marmion", with a 27-inch discharge line, was placed in operation. These two units with ancillary shore equipment constitute one of the largest integrated dredging plants operating on a single project.

Steep Rock plans to increase its production of hematite to 1½ million tons in 1953, 3 million tons in 1955, and 3½ million tons in 1956. All of this output will come from the Hogarth and Errington orebodies. During 1952, exploration was confined almost entirely to "G" zone, which lies between the Hogarth ("A") and Errington ("B") zones. Incomplete exploration of "G" zone has tentatively outlined an orebody 3,500 feet long with an apparent width of 125 feet. Present plans call for production from "G" ore zone by open-pit methods in 1957. No drilling was carried out on the eastern section of the property ("C" zone), under option to lease to Inland Steel Company, during 1952. Consideration is being given to the possible exploration of "E" zone in Southeast Arm of Steep Rock Lake, and also in West Arm of Steep Rock Lake. By 1957 or 1958, production may possibly reach 5½ to 6 million tons a year. The company contemplates an output of about 3 to 4 million tons annually from "C" ore zone when it is eventually placed in production by Inland Steel.

The final route of the western diversion channel of the Seine River was completed on May 1st.

Total proven and probable ore reserves at the end of 1952 were estimated officially, by the company, at approximately 80 million tons on the "A", "B", and "G" ore zones. This figure represents total reserves to average depth of only a few hundred feet on these deep-seated, replacement type orebodies. Ore reserve estimates on the extensive "C" ore zone are not available yet, but are believed to be large. Several other geological areas on the company's property remain to be explored.

The average analysis of Steep Rock ore for 1952, according to the company, was as follows:

	Seine River	Rainy Lake	Freeborn	Steep Rock Lump
	%	%	%	%
Iron (natural)	51·384	50·348	49·192	58·918
Iron	57·31	56·03	53·32	60·69
Phosphorus	0·026	0·026	0·032	0·019
Silica	6·68	8·26	11·16	2·97
Manganese	0·28	0·28	0·15	0·22
Alumina	1·49	1·72	1·90	1·08
Sulphur	0·032	0·037	2·48	0·040
Moisture	10·34	10·14	7·76	2·92

At Port Arthur, 145 miles east of Steep Rock Lake, a 600-foot extension to the ore docks is being constructed at a cost of $3,000,000. These expanded facilities will permit the simultaneous berthing of four ore boats, and will provide about 60,000 tons storage capacity. It is expected that construction will be completed by the spring of 1953. In preparation for handling increased shipments of ore, a centralized traffic control on 105 miles of single track and automatic block signals on 35 miles of double track, between Atikokan and Port Arthur, are being installed. Installation is to be completed in 1953.

British Columbia

The Argonaut Company, Limited.—The company continued the mining of magnetite from its Iron Hill mine at Quinsam Lake throughout 1952. Mine production totalled 953,530 tons of ore averaging about 41·4 per cent iron. Exports totalled 551,692 tons of magnetite concentrates averaging about 55·5 per cent iron, and domestic shipments totalled 120 tons. The mill tailings run about 20·4 per cent iron.

Shipments from this hillside, open-cut mine were mostly to Japan, but some ore was sent to Bethlehem Steel Corporation's plant at Baltimore, Md. The Iron River mine, about 7 miles distant from the Iron Hill mine, was investigated by Argonaut during 1951 and 1952, but no development had been commenced by the end of 1952.

No ore reserve estimate for either the Iron Hill or the Iron River deposit has been completed by the Company.

Texada Mines, Limited.—Texada Mines Limited acquired its magnetite property on Texada Island from Puget Sound Iron Company. Work on roads the mine camp at Gillies Bay, about 4 miles southeast of the mine, was commenced late in 1951. Ground preparation at the Prescott mine was commenced early in 1952. By April preliminary work was almost completed, and the mill, stockpile areas, and loading dock—all immediately adjacent on the Prescott mine—were almost finished. At the same time a development program was commenced at the "Lake" orebody about one mile distant.

The company's mill commenced to operate in April, being supplied with ore from the Prescott pit; ore production from the Lake pit commenced a month later. The first ship was loaded by May 17.

At both orebodies mining is done by open-pit methods and the benches are taken out in 20-foot lifts. There is considerable variation in the grade of ore as mined, but by blending the production from the two pits, and after beneficiation in the mill, the grade of the concentrate is kept within specifications. Beneficiation consists of crushing and magnetic separation, the product being handled by belt conveyor systems both to stockpile and to ocean-going steamers.

During 1952, exploration was confined principally to the investigation of Lake orebody by diamond drilling, but some surface mapping of other potential ore areas and surface outcrops was carried out. Total ore mined was 310,036 tons of which 181,990 tons came from Prescott pit and 128,046 tons came from Lake pit. Ore milled totalled 304,846 tons and magnetite concentrates shipped totalled 209,016 tons.

Exploration and Development

Labrador-New Quebec

Iron Ore Company of Canada.—Most of the effort during 1952 was expanded on the 360-mile railroad being constructed from Seven Islands to Knob Lake, and on docking facilities at Seven Islands. More than 115 miles of the heavy-duty 132-pound rail have been laid, and approximately 200 miles of the grading, including some 30 miles at the northern end of the line, have been completed. Every effort is being made to complete the railroad during 1953. Work on the giant ore docks and on the Federal Government dock is nearing completion, and these docks were already in partial use at the end of 1952.

The construction of staff houses, shops, warehouses, offices, etc., at Seven Islands was continued and will continue through 1953. Work was started on the water-power site at Ste. Marguerite River, which will supply power for the docks and the townsite at Seven Islands, and will be completed early in 1954. The transmission lines will be completed early in 1953.

Hollinger Ungava Transport, the air arm of the iron ore project, had the busiest year since its formation. This company now operates 16 aircraft, including 5 DC3's and 2 helicopters. Six light aircraft equipped with floats, skis, or wheels, are used for scouting, supervision, and servicing the many small survey and exploration parties. Several additional airstrips were constructed and put into operation during the year, bringing the total number of airfields built for the project to 13. During 1952 over 20,000 flying hours were logged, about 62,000,000 pounds of cargo were moved, 5,000,000 ton-miles were flown, and approximately 44,000 passengers were transported by air. These figures do not include material and personnel moved by the small aircraft.

Although the activities of the exploration and mining departments were dwarfed by the tremendous construction effort on other phases of the project, considerable work was accomplished in readying the mines for production. Ferriman No. 3 deposit in Quebec, and Ruth Lake No. 3 deposit in Labrador will be the first to be brought into production. Detailed drilling of these deposits, the average iron content of which is 60·5 per cent and 61 per cent respectively, was continued in 1952, and final plans of the pit layouts, location of the crushing and screening plants, etc., were prepared. Considerable test drilling was undertaken near Knob Lake to determine the best location for spur lines and for the mine townsite location. Test drilling for pit layouts and for townsite and spur line location amounted to 27,000 feet. The spur lines and ore-assembling yards at Silver Lake have been surveyed and will be graded next summer. Although work on the new Knob Lake townsite has already started, the major construction program on shops, warehouses, offices, and residences will not get under way until 1954.

The many geological parties employed during the 1952 field season mapped large areas and evaluated their ore possibilities. The company had three triangulation survey parties engaged in establishing ground control for the preparation of accurate base maps to be compiled from aerial photographs. Detailed aerial contour maps of some 30,000 acres in the vicinity of Knob Lake were completed early in 1952. Aerial photographs of some 1,500 square miles of ground were obtained by the associated concession companies.

Total expenditure on the iron ore project by the end of 1952 was $113,000,000 of which $62,000,000 was spent during 1952 for equipment, supplies, and labour. Total wages and salaries during 1952 was $18,250,000. The peak labour force was 6,300.

The year 1953 is expected to be another busy one in all phases of the project. Grading and track-laying will proceed at an accelerated rate. The ore-handling facilities at Seven Islands will be nearing completion by the end of 1953. The grading of the spur lines near the northern terminus will get under way as soon as conditions permit in the spring. Earth and rock stripping of the orebodies near Knob Lake will commence next summer, so that the deposits will be ready for mining as soon as the railroad is completed in 1954. Large diesel trucks, shovels, and other equipment required for stripping and other purposes will start to move by winter road from the end of steel early in the year. Work on the water-power site at Menihek will also be accelerated during 1953. The signal system and the power transmission line from Menihek to Knob Lake is expected to be completed in 1953. Preliminary work on the power sub-stations will also get under way.

The 20,000 square miles of territory in Quebec and the 3,900 square miles in Newfoundland will continue to be evaluated by geological and other exploration parties. The estimate of ore reserves remains at 417,707,000 tons, as no additional drilling for ore was done in 1951 or 1952.

New Quebec

Fenimore Iron Mines, Limited.—At the Fenimore concession, a total of 10,012 feet of diamond drilling was done during 1952, the object being to explore various showings of hematite-enriched material which have been found on the property. No commercial iron ore was revealed in the drilling, although considerable iron-enriched material was encountered. The concession is in the region of the Koksoak River.

In October, Fenimore announced the discovery of a large body of siderite at Gossan Hill on the Ungava concession. A detailed geological map of the area on a scale of 100 feet to the inch was prepared, and work was commenced in mid-December on a program calling for 10,000 feet of diamond drilling to explore the siderite body.

Geological mapping and prospecting were carried on along the 120-mile extent of the property. Considerable staking of claims took place during 1952 and the Fenimore property was extended to the north of Leaf Lake by a distance of about 23 miles. The company's holdings now consist of a 200-square mile concession, plus 724 claims.

Fort Chimo Mines, Limited.—This company, a subsidiary of Frobisher Limited, holds a concession located between the Norancon property to the south and the Fenimore property to the north, a distance of about 180 miles northwest of Iron Ore Company of Canada's Knob Lake deposits. The Fort Chimo property extends along the strike of the iron formation for about 60 miles.

During the past four field seasons, geological mapping and trenching programs were completed. In 1951 a detailed geological map of the iron formation was prepared and in 1952 many interesting locations were investigated. A deposit of manganiferous hematite was discovered about 4 miles south of the north boundary of the concession. Preliminary surface sampling by shallow trenches indicated an average content of 43 per cent iron, 7 per cent manganese, and 18 to 32 per cent silica, over substantial widths and lengths. Although the silica values are above the commercial limit for lean iron ore, the company considers the indications are of sufficient interest to merit further trenching and, possibly, drilling.

Quebec Labrador Development Company, Limited.—Quebec Labrador has carried out extensive exploration on its concession along the Kaniapiskau River in Ungava over the past several field seasons. Exploration during 1952 resulted in the discovery of two occurrences of high-grade iron ore, one known as the Newton-Copeland-Mitchell and the other the Carter-Birch-Stelle.

Great Mountain Iron Corporation.—This company holds 12 square miles of ground centring around Connelly Lake, 17 miles west of Fort McKenzie in Ungava. The claims have been maintained in good standing, but no work has been done since 1948.

Elsewhere in Quebec

United States Steel Corporation.—The Oliver Iron Mining Division of this company investigated the following areas in Quebec during 1952:

Matonipi Lake Area.—Mining claims staked in this area during 1951 and 1952 were explored by about 5,000 feet of diamond drilling during 1952. No iron ore of commercial grade was found, but additional drilling is planned for 1953. The area is about 250 miles northeast of Lake St. John.

Mount Wright Area.—Claims were staked during the spring and summer of 1952. Exploration will be continued in 1953. The area is about 16 miles west of the southwestern boundary of Labrador and Quebec.

Trent River Iron, Limited.—During 1952, the company, successor to Minnesota-Huron Iron Company, and a wholly owned subsidiary of W. S. Moore Company of Duluth, Minnesota, continued exploration of the old Bristol magnetite property, 35 miles northwest of Ottawa. One diamond drill hole was put down to obtain general information, and a 160-ton sample was taken for concentration tests. The results were very satisfactory and plans for mine production and plant layout were advanced to the draughting-board stage.

Gravimetric Surveys, Limited.—Gravimetric Surveys investigated a pronounced magnetic anomaly near Ste. Marguerite and continued exploration of iron ore occurrences in Gatineau and Buckingham counties.

Cyrus S. Eaton Interests.—These interests staked two large groups of claims in two main areas west of Ungava Bay, one area being about 15 miles west of Hope's Advance Bay and the other about 25 miles north of Payne Bay. Very large tonnages of iron-bearing material have been outlined as a result of investigations in 1952.

Ontario

Marmoraton Mining Company, Limited.—Bethlehem Mines Corporation, as lessee of the magnetite deposits at Marmora of its wholly owned subsidiary, Marmoraton Mining Company Limited, started a stripping program in 1952 for removal of the 20,000,000 cubic yards of limestone capping, averaging 130 feet in thickness, which overlies the iron ore deposits. The delivery of heavy equipment early in 1952 permitted operations to reach the goal of 30,000 net tons of stripping per day. It is expected that mining of the low-grade (under 40 per cent) iron ore will commence late in 1954. The deposits are about 32 miles east of Peterborough.

The construction of permanent repair shops, warehouses, change room, and offices was about completed by the end of 1952. Engineering plans are being prepared with a view to construction of the hoisting, crushing, and magnetic concentration plants during 1953 and 1954. The concentrator is being designed for an annual production of 500,000 net tons of concentrates, which will be agglomerated and shipped by rail to a new pier to be constructed on Lake Ontario, near Picton, Prince Edward county. Lake ore carriers will transport the product to Bethlehem Steel Company's plant at Lackawanna, near Buffalo, New York. The Federal Government has completed hydrographic surveys at the port site and construction is expected to get under way during 1953. No estimate of ore reserves has been released by the company.

United States Steel Corporation.—The Oliver Iron Mining Division of this company optioned about 5,400 acres of farm land near Simcoe just north of Lake Erie during 1951 and 1952. Drilling to explore these lands for iron ore beneath a cover of about 3,500 feet of Palæozoic rock was initiated during 1952. Two drill holes had been completed by the end of the year. Exploration will be continued during 1953.

Nipiron Mines, Limited.—This company holds, from the Ontario Government, two leases totalling 38 square miles and covering areas adjoining each other at Lake Nipissing and mostly under the water of the lake. An electromagnetic survey and a magnetometer survey were made from the ice on a small portion of the lake south of Iron Island during the winter of 1951–52. Charts were also made of the water depth in that area. This was followed by a drilling program consisting of ten drill holes with a total of 3,763 feet, the deepest hole being 912 feet. This program is to be continued in 1953.

The Steel Company of Canada, Limited.—During 1952, this company investigated about 250 properties, principally in Ontario, as possible sources of iron ore. Five properties were considered of sufficient interest to warrant taking up ground and 1,200 acres of land are held for further investigation. The company has leased a large magnetite property near Horwood Lake, about 105 miles northwest of Sudbury.

Algoma Ore Properties, Limited.—This company commenced investigations of the old Bluff Point, Campbell, Caldwell, and Martel magnetite properties near Calabogie, Ontario, in 1951. Its holdings comprise about 4,800 acres. During 1951, about 15,000 feet of diamond drilling was done on the ore zone in 35 holes to a maximum depth of 1,300 feet. This indicated a body of lean magnetite ore 2,300 feet long and 150 feet wide, having an average grade of about 25 per cent iron. During 1952, concentration tests were made on the ore.

Jalore Mining Company, Limited.—The company continued its exploration of the Ruth and Lucy properties in the Michipicoten area, confining investigations to a study of the details of the ore occurrence. The ore reserve estimate remains at 40,000,000 tons.

The company optioned and explored three magnetite prospects in the Peterborough area and one in the Kingston area. Geophysical work was done on the four prospects and three were drilled. No iron ore was found and no further work is contemplated.

Canadian-Cliffs Limited.—This company, with headquarters at Port Arthur was formed to carry out exploration for iron ore in Canada.

Dominion Gulf Company.—The company did exploratory work in Boston and Chambers townships.

Trent River Iron, Limited.—The company investigated several old and new iron prospects in southeastern Ontario during 1952, but found nothing of commercial interest. However, its Campbellford property, about two miles northwest of Campbellford, Ontario, has passed the prospecting stage. The property was optioned during 1951 and was surveyed by magnetometer during the same year. In 1952, ten diamond drill holes were put down along a single line outlining the orebody in one section. Drilling has been discontinued temporarily, but sufficient work was done to indicate a considerable tonnage of magnetite of concentrating grade. Since the ore is capped by about 400 feet of limestone, underground mining methods must be employed.

Frobisher Limited.—During the early part of 1952, a resistivity survey was completed on Frobisher Limited's property at Strawhat Lake, about 2 miles south of the main operations of Steep Rock Iron Mines. The results were sufficiently interesting to warrant the drilling of a number of vertical holes from the ice surface of the lake. About one-half of the lake bottom has been tested by drilling and further work is planned.

Prior to 1952, a deposit of high-grade manganiferous hematite was known to exist under about 30 feet of water at the east end of Strawhat Lake. The new drill holes succeeded in extending this zone to the northwest.

British Columbia

Quatsino Copper-Gold Mines, Limited.—Since the fall of 1950 a total of 7,750 feet of diamond drilling has been carried out at the company's Elk River magnetite property. A geological and magnetometer dip-needle survey, followed by prospecting, resulted in the discovery of four new ore zones. Diamond drilling on two of these zones and additional holes on the main ore zone have been responsible for an increase in ore reserve estimates to 1,045,137 tons of proven ore and 1,500,000 tons of indicated and inferred ore. The average grade is 57·6 per cent iron.

Canadian Collieries (Dunsmuir), Limited.—Canadian Collieries (Dunsmuir) Limited has optioned its Glengarry and Stormont claims to C. B. Aitchison Jr., of Japan. The claims are about a mile by foot-trail north of Head Bay on Tlupana Arm, Vancouver Island. Surface exploration and diamond drilling were carried out during 1951, when 68 vertical holes totalling 4,170 feet were drilled. Exploration of this and other prospects in British Columbia continued during 1952.

Primary Iron and Steel

In December, 1952, The Steel Company of Canada Limited blew in its new 1,400-ton-a-day blast furnace at Hamilton, Ontario, and brought four new 250-ton open-hearth furnaces into operation. Algoma Steel Corporation Limited has a blast furnace under construction at Sault Ste. Marie, Ontario, which will be blown in during 1953 and has also two 300-net ton basic open-hearth furnaces and one 20-net ton Bessemer converter under construction. Its new 1,175-to

1,400-net-tons-per-day sinter plant for flue dust and ore fines was brought into operation in 1952. The above two blast furnaces will increase Canada's pig-iron capacity to 3,637,050 net tons a year, as compared with 2,750,000 net tons in 1947 and with 2,100,000 net tons in 1942.

By installation of a new pig-casting machine, Canada Furnace Co. Limited at Port Colborne, Ontario, increased its pig-iron capacity to 283,600 net tons a year.

Iron and Steel Capacities of the Principal Companies Engaged in the Manufacture of Primary Iron and Steel in Canada[1]

	Annual Capacity					
	Blast furnaces		Open-hearth furnaces		Electric Furnaces	
	No.	Net tons	No.	Net tons	No.	Net tons
Dominion Steel & Coal Corporation Limited, Sydney, Nova Scotia	3	594,950	10	685,000	1	28,000
Algoma Steel Corporation Limited, Sault Ste. Marie, Ontario	5	1,057,500	12	820,000	—	—
Canada Furnace Company, Limited, Port Colborne, Ontatio	2	283,600	—	—	—	—
Dominion Foundries and Steel Company, Limited, Hamilton, Ontario	1	328,000	4	202,900	5	182,000
The Steel Company of Canada, Limited, Hamilton, Ontario	4	1,150,000	13	1,795,000	1	105,000
Total	15	3,414,050	39	3,502,900	7	315,000

[1] Thirty-two other companies produce carbon and alloy steel ingots and castings by means of open-hearth and electric furnaces; of these, eight companies produce over 20,000 net tons per year. Total capacity of the thirty-two companies is about 631,000 net tons per year.

Iron and Steel Scrap

Consumption of iron and steel scrap in Canadian steel furnaces and iron blast furnaces, for the first 10 months of 1952, totalled 1,742,124 net tons and 90,889 net tons respectively, compared with 1,711,377 net tons and 62,033 net tons for the corresponding period in 1951.

Statistics for Canadian consumption of scrap in 1952 are not available. Consumption in 1951 was 2,913,101 net tons, about 63 per cent of which was purchased scrap and the remainder home scrap. Steel furnaces consumed 2,106,714 net tons and iron blast furnaces 65,390 net tons in 1951.

Prices

Although prices of Canadian iron ores are, in general, negotiated by contract, Ontario 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.

On September 12, 1952, the United States Office of Price Stabilization, through ceiling price Regulation 169, increased the ceiling price of iron ore produced in Minnesota, Wisconsin, and Michigan, and delivered on or after July 26, 1952, by 75 cents a ton over ceiling prices established in January, 1951, by the office of Price Stabilization general maximum price regulation. The following quotations from the American Metal Market of December 31, 1952, are considered representative of 1952 year-end prices, but may be subject to penalties or premiums, according to the content of impurities, etc. Where unit price is quoted, one unit is equivalent to one per cent (1%) or to each 22·4 pounds (on long ton basis) of specified iron content.

Lake Superior Iron Ores

(After January 25, 1950, increases or decreases, if any, in Upper Lake rail freight, dock handling charges, and taxes thereon, are for buyers' account.) 51½ Fe, delivered Lower Lake ports, per long ton: (C.P.R. 169 effective Sept. 17, 1952 with prices retroactive to July 26, 1952.)

Old range Bessemer	$9.45
Old range non-Bessemer	9.30
Mesabi Bessemer	9.20
Mesabi non-Bessemer	9.05
High Phosphorus	9.05

Swedish Iron Ores, Atlantic ports, 60 to 68%, minimum:

Per unit, Spot	22·00c
Per unit, Long term	20·00c

Brazilian Iron Ores, 68-69%

Nominal	30·00c

Tariffs

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

LEAD

Canada's estimated production of 168,842 tons of lead was about 6·7 per cent greater than in 1951, but owing to a substantial drop in price the total value was less. The gradual decline from about 19 cents a pound that commenced in May reached a low of 12½ cents in October, and then increased slightly towards the end of the year. The decline caused a general curtailment of lead and zinc developments.

The smelter and refinery of The Consolidated Mining and Smelting Company of Canada, Limited, at Trail, British Columbia, is Canada's only plant for the production of refined lead. Lead ores or concentrates from most mines in western Canada and from several mines in Quebec were shipped to Trail for treatment. A small number of mines exported lead concentrate to foreign smelters. A substantial amount of lead concentrate from South America and elsewhere was imported for treatment at Trail.

Production, Trade, and Consumption

	1952		1951	
	Short tons	$	Short tons	$
Production, all forms				
British Columbia	129,385	41,894,771	127,764	47,017,311
Newfoundland	18,059	5,847,571	16,444	6,051,427
Quebec	10,520	3,406,353	7,756	2,854,323
Yukon	9,184	2,973,883	6,267	2,306,085
Nova Scotia	778	252,021	—	—
Ontario	902	291,979	—	—
Northwest Territories	14	4,443	—	—
Total	168,842	54,671,021	158,231	58,229,146
Production, refined (includes lead from imported ores)	177,389	—	162,001	—
Exports in Ore				
To: United States	9,718	2,669,903	7,585	2,421,705
Belgium	9,035	2,752,561	5,833	2,091,502
Western Germany	5,214	1,475,176	6,230	2,252,756
Total	23,967	6,897,640	19,648	6,765,963
Exports, refined lead, including scrap				
To: United States	105,755	33,119,977	60,888	21,579,460
United Kingdom	26,657	8,788,073	34,888	12,246,268
Brazil	1,240	482,228	4,702	1,976,951
Other countries	1,301	387,857	6,679	2,721,439
Total	134,953	42,778,135	107,157	38,524,118
Exports, lead manufactures				
To: Cuba	—	32,624	—	24,576
Venezuela	—	5,107	—	42,346
Other countries	—	29,165	—	35,477
Total	—	66,896	—	102,399
Imports, lead and lead products				
Tetraethyl compounds	—	9,270,084	—	8,996,288
Pigs and blocks	—	127,066	—	356,926
Manufactures, n.o.p	—	214,325	—	214,325
Litharge	—	231,159	—	217,243
Capsules	—	141,186	—	209,469
Miscellaneous	—	138,801	—	132,486
Total	—	10,122,621	—	10,126,737
Domestic consumption of refined lead				
Ammunition	2,958	—	2,758	—
Foil and collapsible tubes	3	—	80	—
Heat treatings	226	—	345	—
Oxides, paints, pigments	7,325	—	11,917	—
Solders	1,601	—	2,216	—
Babbitt metal	292	—	292	—
Type metal	22	—	97	—
Antimonial lead [1]	2,298	—	5,345	—
Cable covering	15,682	—	13,978	—
Pipes, sheets, traps, and bends	3,730	—	3,852	—
Block for caulking, etc	3,397	—	3,406	—
Batteries [2]	7,489	—	7,610	—
Miscellaneous	1,518	—	2,792	—
Total	46,541	—	54,688	—

[1] Lead content of antimonial lead.
[2] Pig lead consumed in battery makers' plants: does not include content of antimonial lead.

Production

British Columbia

The Sullivan mine at Kimberley, owned by The Consolidated Mining and Smelting Company, is Canada's principal source of lead and zinc. Both open-pit and underground mining methods are used, the underground workings reaching a depth of over 1,800 feet. About 10,000 tons of ore a day are mined and milled at the company's concentrator near Kimberley. Lead and zinc concentrates produced there are shipped to the company's lead smelter and zinc plant at Trail, where the refined metals are recovered. Extensive renovations and alterations to the lead smelter, begun in 1950, were continued. The company brought its Bluebell mine, on the east side of Kootenay Lake, into production in April at a milling rate of 500 tons of ore a day. An important new orebody was found at the Bluebell property.

A large number of small to medium lead-zinc mining companies operated in the province. Among the more important of these were Canadian Exploration Limited and Reeves MacDonald Mines Limited near Salmo; Base Metals Mining Corporation Limited with mines near Kaslo and Field; Giant Mascot Mines Limited near Spillimacheen; Violamac Mines (B.C.), Limited near Sandon; and Western Mines Limited at Ainsworth. Britannia Mining and Smelting Company Limited shipped lead concentrate for the first time from its large copper-zinc mine on Howe Sound. Silbak Premier Mines, Limited near Stewart acquired operational control of the neighbouring property of Indian Mines (1946) Limited and commenced milling ore from the Indian mine in the Silbak mill in April. Giant Mascot Mines increased mill capacity from 160 to 500 tons a day.

Ontario

Matachewan Consolidated Mines Limited commenced production of lead concentrates from the neighbouring Matarrow mine, using a part of its own mill equipment. The grade of Matarrow ore proved to be lower than had been indicated by exploratory drilling, and the operation was found to be uneconomic at the reduced price of lead.

Quebec

Lead concentrate was produced from the lead-zinc ores of New Calumet Mines Limited, Pontiac county; Anacon Lead Mines Limited, Portneuf county; Golden Manitou Mines Limited, Abitibi county; and Consolidated Candego Mines Limited, North Gaspé county. Ascot Metals Corporation Limited produced a bulk copper-lead concentrate from its Moulton Hill and Suffield Mines near Sherbrooke.

Montauban Mines Limited and United Lead and Zinc Mines Limited sank a 450-foot shaft and constructed a 500-ton mill on their adjoining properties immediately north of the Anacon Lead mine. Production from these properties on a joint basis was expected to commence early in 1953.

New Brunswick

A large deposit of lead-zinc ore was discovered about 25 miles southwest of Bathurst in the northern part of the province. Brunswick Mining and Smelting Corporation Limited was formed to develop the deposit. Exploration of several other lead-zinc occurrences was commenced in the area.

Nova Scotia

Mindamar Metals Corporation Limited brought its zinc-lead-copper mine at Stirling, Cape Breton Island, into production in April at a rate of 600 tons a day.

Minda-Scotia Mines Limited sank a 375-foot shaft to carry out underground exploration of its lead-zinc deposit in Colchester county. Operations were suspended late in 1952.

Newfoundland

Buchans Mining Company Limited, the only base metal mine in the province continued production of zinc, lead, and copper concentrates. A substantial portion of the ore output came from the new Rothermere shaft area of the Buchans property.

Northwest Territories

Pine Point Mines Limited, a subsidiary of Consolidated Mining and Smelting, continued diamond drilling exploration of its extensive lead-zinc deposits near Great Slave Lake.

American Yellowknife Mines Limited sank a 170-foot shaft on its lead-zinc property at O'Connor Lake and made a small test shipment of ore. Operations were suspended in December.

Yukon

United Keno Hill Mines Limited, Mayo district, increased its production of lead and zinc concentrates and silver precipitate. Substantial reserves of high-grade ore were established in new deeper levels at the Hector mine. Considerable development was carried out at other mines on the company's extensive property, particularly at the Onek mine. A 3,000 h.p. hydro-electric power development on the Mayo river was completed and electric power was made available to the mines in the Mayo district.

Mackeno Mines Limited, Yukeno Mines Limited, and Bibis Yukon Mines Limited, constructed a 150-ton mill to treat silver-lead ores from their properties, which adjoin those of United Keno Hill Mines.

Uses

The chief uses of lead are in storage batteries and cable covering. Other important uses are in tetraethyl lead compounds; bearing metal; babbitt metal; solders; ammunition; litharge; red lead and white lead.

While some important new uses for the metal have been established, such as in the field of atomic energy, the quantities involved so far have not been large.

From many of its outlets, such as storage batteries, the metal can be recovered when the article or application ceases to be serviceable. For this reason, scrap lead occupies an important place in lead fabrication.

Prices

The Canadian price of lead fluctuated between 19·5 cents a pound and 12·5 cents a pound. It was 13·75 cents a pound at the end of the year. The average price estimated by the Dominion Bureau of Statistics was 16·19 cents a pound.

MAGNESIUM

There are two producers of magnesium in Canada—Aluminum Company of Canada, Limited, at Arvida, Quebec, and Dominion Magnesium Limited at Haley, Ontario.

Early in 1952, Aluminum Company of Canada, announced it was increasing production from 1,000 metric tons per year to 4,000 metric tons. It is expected that the increased production facilities will be in operation by the summer of 1953. The electrolytic process is used at this plant and the raw material is granular calcined brucite, or magnesia, produced by the company from brucitic limestone near Wakefield, Quebec. The company operates a magnesium foundry at Etobicoke, Ontario.

Dominion Magnesium uses the ferrosilicon process—a batch process in which finely ground calcined dolomite mixed with finely ground ferrosilicon and fluorspar is heated to about 1,150°C. in horizontal, cylindrical retorts under vacuum. The magnesium metal is driven off as vapour and condenses in crystal form at the cool end of the retort. Dolomite is obtained from a quarry adjacent to the plant. Production capacity is 6,000 tons of magnesium per year if used exclusively for the production of magnesium, but for part of the time the plant is used to produce calcium.

Light Alloys, Limited, subsidiary of Dominion Magnesium, operates a foundry at Renfrew, Ontario, for the production of magnesium and aluminum castings. In September, 1952, the company opened a new government-financed foundry at Haley and transferred many of its operations to the new plant. In 1952, Electro-Reagents (Quebec) Limited, another subsidiary of Dominion Magnesium began construction of a plant at Beauharnois, Quebec, to produce ferrosilicon for the magnesium plant at Haley. This plant, which is scheduled to begin production in 1953, will have a rated annual capacity of 6,000 long tons of 75 per cent grade ferrosilicon. It will be managed by Chromium Mining and Smelting Corporation, Limited, on a fee basis.

The following foundries produce magnesium castings:—

Robert Mitchell Company, Ltd., Montreal, Que.
Aluminum Company of Canada, Ltd., Etobicoke, Ont.
Canadian Magnesium Products, Ltd., Preston, Ont.
Grenville Castings, Ltd., Merrickville, Ont.
Barber Die Castings, Ltd., Hamilton, Ont.
Light Alloys, Ltd., Renfrew and Haley, Ont.
Western Magnesium, Ltd., Vancouver, B.C.

World Production

Estimated world production of magnesium metal declined from a war-time peak of 238,550 metric tons in 1943 to a post-war low of 24,000 metric tons in 1946. A 1951 estimate by the U.S. Bureau of Mines was 79,000 metric tons, of which 37,086 tons were credited to the United States, 7,700 tons to the United Kingdom, 4,000 tons to Canada, and 875 tons to France. Figures on production in Russia are not available, but an estimate was included in the world total.

It is estimated that in 1952, with six government-owned magnesium plants in production, as well as Dow Chemical Company's Freeport, Texas, plant, about 105,000 tons of primary magnesium, about half of which was stockpiled, were produced in the United States.

Uses

The light weight of magnesium and its relatively good strength-weight ratio are the metal's outstanding characteristics, and determine its industrial applications. The major portion of semi-fabricated cast and wrought magnesium goes into aircraft, materials handling, transportation, printing, textile, and other basic industries. Increasing amounts of the metal are being used in aircraft frames and for airborne equipment. Commercial applications of magnesium in materials handling equipment, portable tools, ladders, commercial highway transportation, and some automotive die castings are expanding.

Magnesium alloyed with aluminum produces stronger structural shapes with no weight increase, and this accounts for the use of large quantities of the metal. On an average, about one pound of magnesium per hundred pounds of aluminum is used in alloys, and with increased production of aluminum much larger quantities of magnesium will be required. The metallurgical and chemical industries are calling for increasing amounts of magnesium for such purposes as the desulphurizing of metals, the manufacture of silicones, and addition to grey cast-iron to produce malleable iron.

The electro-chemical properties of magnesium are responsible for its increasing use in anodes as a means of diminishing corrosion, principally of iron and steel. These properties, together with its lightness, are leading to its substitution for zinc in the conventional storage cell; for instance, a magnesium pack battery designed for military use weighs only six pounds, as against sixteen for the conventional type.

The estimated relative United States consumption of magnesium in 1951 by fields of application or use, as compiled by the Magnesium Association, is shown in the following table:—

Application	*Percentage of Consumption*
Aircraft (airframes, wheels, engines etc.)	29·3
Aluminum industry	20·4
Electrochemical uses (underground anodes, fresh-water and sea-water anodes, etc.)	8·5
Ground transportation (trucks and trailers, automotive parts, etc.)	7·6
Machinery and tools (portable tools, business machines, etc.)	6·2
Chemical and metallurgical uses	6·0
Materials handling (skids, foundry equipment, concrete industry, etc.)	4·7
Electrical equipment (radar, radio, TV., etc.)	3·5
Magnesium powder	2·4
Consumer products (ladders and hand tools, furniture, sporting goods, etc.)	1·6
Textile industry	0·8
Printing and engraving	0·4
Miscellaneous and unclassified	8·6
Total	100·0

Prices

According to Canadian Chemical Processing, the average price of ingot magnesium in Canada during 1952 was about 34 cents per pound, f.o.b. Haley, Ontario. For the same period, the United States price remained at 24·5 cents per pound, f.o.b. producers' plants.

MANGANESE

There are no known deposits of metallurgical-grade manganese ore in Canada, or on the North American continent. During the two world wars, widespread searching by government survey parties and by private industry in both countries failed to disclose any such deposits. From time to time efforts have been made to utilize the bog manganese ores of New Brunswick, but no continuing production has resulted. Some surface work on what is described as a 'new showing' 12 miles from Bathurst, New Brunswick, was done in 1952 by a group headed by the M. J. Boylen interests of Toronto.

Canada imports all its requirements of manganese from the producing countries directly, or via the United States, and in 1952 imported 194,405 short tons compared with 222,082 short tons in 1951.

Manganese is an essential element in the manufacture of steel, both as a deoxidizer and as a desulphurizing agent. It is also widely used as an alloying agent in heavy-duty steels. Every ton of steel produced requires about 13 pounds of manganese, which is added to the mix in the form of ferromanganese, spiegeleisen, or silicomanganese. These addition agents are manufactured from metallurgical-grade (ferro-grade) manganese ore in carbon arc furnaces.

Although Canada produces no manganese ore, its production of manganese addition agents has averaged about 80,000 tons a year over the past few years, a development resulting from the availability of abundant electric power at reasonable rates. Over 85 per cent of the output of addition agents is in the form of ferromanganese, mainly high carbon content, with the remainder in the form of spiegeleisen and silicomanganese.

Imports, Exports, and Consumption

	1952		1951	
	Short tons	$	Short tons	$
Imports of manganese ore				
From: United States[1]	74,393	3,194,832	95,086	3,872,686
Gold Coast	63,112	2,741,404	88,687	3,594,529
Turkey	25,688	1,257,255	4,704	265,188
India	13,954	402,217	17,467	775,477
Union of South Africa	7,520	355,311	—	—
Other countries	9,738	322,703	16,138	570,131
Total	194,405	8,273,722	222,082	9,078,011
Exports of ferromanganese				
To: United States	29,501	5,515,812	66,570	11,201,549
Spain	830	180,059	—	—
Mexico	823	157,243	775	129,500
Other contries	136	30,109	163	31,178
Total	31,290	5,883,223	67,508	11,362,227
Consumption of ore				
Metallurgical grade	166,059	—	220,267	—
Battery grade	3,650	—	4,095	—
Total	169,709	—	224,362	—

[1] Country of origin not known.

Canadian Occurrences

There are no known commercial manganese deposits in Canada. It appears that the large residual-replacement types of deposit are confined to special climatic and rock conditions where rock decay is deep and thorough and the enclosing rocks are of higher manganese content than is usual. The major part of the world's supply of manganese is mined where such climatic conditions occur. In Canada, occurrences are limited chiefly to bog type deposits.

Small tonnages of manganese ore have been produced from time to time from several of the many bog deposits in New Brunswick, but there has been no continuing production. Bog deposits also occur in Nova Scotia, Manitoba, and British Columbia but they are of low and variable grade and lack sufficient tonnage and continuity to make them attractive economically. One of the larger bog deposits in New Brunswick (Dawson Settlement) has been estimated to contain 42,690 long tons of wet ore which on a dry basis would represent 13,120 long tons and would contain 3,280 long tons of manganese, according to analysis.

In Newfoundland, at Conception and Trinity Bays, deposits of the carbonate type of manganese (rhodochrosite) occur sporadically over a large area. The main manganese bed at Manuels River, Conception Bay, is only 0·7 feet thick, but the total thickness of manganiferous sediments is reported to be 17 feet and to consist of manganese and calcium carbonates, some manganese oxides, and many impurities such as barite, iron carbonate, and jasper. The associated sediments are red and green calcareous shales. The grade of ore over mining widths is too low (up to 10% Mn) for profitable extraction. Recoveries, after beneficiation, are only about 60 per cent in test work conducted to date.

Replacement type manganese deposits in Canada are best illustrated by those at the Hill 60 mine, Cowichan Lake, Vancouver Island, and at Markhamville in King's County, New Brunswick. At the latter, limestone is covered with 8 to 20 feet of residual clay in which are nodules and masses of manganese ore. In the underlying limestone, irregular patches of manganese ore follow the bedding and, in places, branch into pipes and veins.

Large tonnages of manganiferous iron ore averaging about 50 per cent iron and 7·9 per cent manganese have been reported as occurring in the 'Labrador trough'. However, there is no official confirmation of the discovery of manganese 'deposits' on the concessions held by Hollinger North Shore Exploration Company, Limited and Labrador Mining and Exploration Company Limited in Quebec and Labrador. Iron Ore Company of Canada, formed to operate the Quebec and Labrador iron deposits, reports, in its summary of ore estimates, 40,045,000 tons of manganiferous iron ore averaging 50·25 per cent iron and 7·70 per cent manganese indicated by drilling in the Quebec deposits, and 13,321,000 tons averaging 50·17 per cent iron and 7·45 per cent manganese indicated in the Labrador deposits.

World Sources

Estimated world production of manganese, in recent years increased steadily from 3,700,000 metric tons in 1946 to 7,000,000 metric tons in 1951. The output of Russia, the major world producer, is estimated to have been 2,500,000 metric tons during 1951. In past years, the United States obtained large tonnages of ferro-grade ore from Russia, but since that source of supply was cut off in 1950 other sources had to be found. The main suppliers of manganese ore to the free world since the outbreak of hostilities in Korea in June, 1950, have been India, the Gold Coast, Union of South Africa, and French Morocco in that order. Estimated output of ore, in metric tons, from these countries in 1951 was reported to be as follows: India—1,179,680; the Gold Coast—819,018; Union of South Africa—758,870; French Morocco—372,233. The manganese deposits of Nsuta, 39 miles north of Takoradi on the Gold Coast, are generally considered to be the largest single source of manganese ore in the world.

United States steel companies are actively exploring manganese deposits in the valley of the Amazon river in Brazil and that country may become a major supplier of ferro-grade ore.

Current United States requirements for manganese ore are about 2,000,000 tons a year, and estimated consumption of Russia is about 1,250,000 tons a year. The consumption of manganese in any country varies directly as the output of steel.

Uses and Specifications

About 95 per cent of the manganese consumed is used in the steel industry and the remainder in the manufacture of dry-cell batteries and chemicals. There are no satisfactory substitutes for manganese in its major uses. The consumption of manganese per short ton of steel manufactured is about 13 pounds, of which about 11·7 pounds is in the form of ferromanganese, one pound as silicomanganese, and the remainder as spiegeleisen and ore.

Specifications for metallurgical grade of manganese ore call for a minimum of 48 per cent manganese and maxima of 7·0 per cent iron, 8·0 per cent silica, 0·15 per cent phosphorus, 6·0 per cent alumina, and 1·0 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.

Manganese ore for battery 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. Canada annually consumes about 4,000 tons of this type of ore, which is imported mainly from the Gold Coast.

Manganese ore for chemical use contains 35 per cent or more manganese and is used to make manganese sulphate (fertilizers) and other salts used in the glass, enamel, paint-pigment, rubber, and pharmaceutical industries.

Prices

The E and M J Metal and Mineral Markets Bulletin of December 25, 1952 quoted the following prices for manganese ores and compounds:—

Metallurgical Grade

(1) On long-term contracts involving large tonnages prices are wholly nominal and a matter of negotiation.

(2) Indian ore—$1.20 to $1.22 per long ton unit of Mn, c.i.f. United States ports, duty extra, basis 46-48% Mn.

(3) West Africa and other sources—90-93¢ per long ton unit of Mn, c.i.f. United States ports, duty extra.

Chemical Grades

(1) Brazilian or Cuban, coarse or fine, minimum 80% MnO_2, carloads, in barrels——65–75¢ per long ton unit.

(2) Domestic (U.S.), 70–72% MnO_2——50¢ per long ton unit, f.o.b. mines.

Addition Agents

(1) Ferromanganese, 70–82% MnO_2, per gross ton——$225, f.o.b. shipping point, seaboard.

(2) Silicomanganese, carload lots, f.o.b. shipping point, freight allowed, 65–68% Mn:

maximum 1·5% C, 18–20% Si	11·4¢ per lb.
maximum 2% C, 15–17·5% Si	11·2¢ per lb.
maximum 3% C, 12–14·5% Si	10·9¢ per lb.

United States' Purchase Program of Domestic Ores and Concentrates

Sintered oxide ores and concentrates, or sintered carbonate ores and concentrates, purchased under the program must meet the following specifications:—

Manganese	40·0% minimum
Iron	16·0% maximum
Silica plus alumina	15·0% maximum
Phosphorus	0·3% maximum
Copper plus lead plus zinc	1·0% maximum

of which not more than 0·25 per cent may be copper.

Prices paid for individual lots of acceptable manganese concentrates are computed on a base price of $2.30 per long ton unit of manganese contained in shipments meeting the following specifications: 48 per cent manganese, 6 per cent iron, 11 per cent silica plus alumina, and 0·12 per cent phosphorus.

Tariffs

The following tariffs on manganese ores and products are in effect in Canada and the United States:—

Canada	*British Preferential*	*Most Favoured Nation*	*General*
Manganese ore	free	free	free
Ferromanganese (per lb. of contained Mn)	free	1 cent	1¼ cents
Silicomanganese (per lb. of contained Mn)	free	1½ cents	1¾ cents

United States

Manganese ore (over 10% Mn)—¼¢ per lb. on Mn content.

Ferromanganese	
Containing not over 1% carbon	15/16¢ per lb. on Mn content, and 7½% ad valorem.
Over 1% but under 4% carbon	15/16¢ per lb. on Mn. content
4% or more carbon	5/8¢ per lb. on Mn. content

NOTE: Ferromanganese under these tariffs must contain 30% or more manganese.

Manganese Metal—1⅞¢ per lb. on the Mn content and 15% ad valorem.

MERCURY

Of the approximately 25 minerals containing mercury, only one—cinnabar—is of commercial importance. Cinnabar is the sulphide of mercury, HgS, and contains by weight 86·2 per cent of mercury and 13·8 per cent sulphur.

The only known deposits of cinnabar in Canada are in the Omineca Mining Division of northern British Columbia. The over-all grade of the Canadian deposits is about 0·5 per cent mercury, and ore of such low grade is not normally exploitable economically. The deposits have not been worked since 1944. From 1940 to 1944 they turned out 4,152,196 pounds of mercury. This production came from two mines, the Pinchi mine of The Consolidated Mining and Smelting Company of Canada Limited, and the Takla mine of Bralorne Mines Limited.

These mines could supply Canadian requirements for many years. Production was suspended when supplies of Spanish and Italian mercury became readily available at greatly reduced prices. Shipments since that time have been from stocks remaining on hand.

Imports, Exports, and Consumption

	1952		1951	
	Pounds	$	Pounds	$
Exports				
To: United States	1,500	4,935	58,235	149,035
Imports				
From: United States[1]	136,349	370,901	308,027	767,141
Portugal	6,570	13,181	—	—
Mexico	1,520	3,943	—	—
United Kingdom	—	—	145	178
Total	144,439	388,025	308,172	767,319
Consumption				
Heavy chemicals	229,900	—	221,844	—
Pharmaceuticals and fine chemicals	26,600	—	36,404	—
Electrical apparatus	8,132	—	15,732	—
Gold mines[2]	6,000	—	6,000	—
Miscellaneous[2]	10,000	—	10,000	—
Total	280,632	—	289,980	—

[1] Country of origin not necessarily United States.
[2] Estimated.

World Production and Trade

The Almaden mine in Spain has been for more than two thousand years the world's chief source of mercury. Its ore, grading from 5 to 6 per cent mercury, is about five times as rich as that of its closest competitor—the Monte Amiata mine in Italy. Ore reserves are large enough to maintain the present annual output of 40–50,000 flasks of 76 pounds for the next 200 years.

The war-time price of more than $200 a flask led to production of mercury by a number of countries having deposits of low-grade ore. The post-war drop in prices, reaching a low of $71 a flask in 1949, caused most of the mines in these countries to close down. In 1951, the last year for which figures are available, Spain and Italy produced between 60 and 70 per cent of the total, with Yugoslavia, the United States, and Mexico mining practically all the remainder.

Uses

In recent years, large quantities of mercury have been used in the installation of mercury cells for the electrolytic production of caustic soda and chlorine—a process developed in Germany and introduced into the United States following World War II. After initial installation, the cells require only minor amounts of mercury for replenishment.

The electrical apparatus industry (including the mercury cell) is by far the largest user of mercury. The preparation of pharmaceuticals and the manufacture of industrial and scientific instruments come next. Large amounts are used in the manufacture of agricultural disinfectants and fungicides, and in the manufacture of anti-fouling compounds for use on ships' hulls. Mercury is also used as a catalyst; in dental preparations; in making detonators; in extraction of gold from its ores by amalgamation; and in general laboratory work.

Prices

At the beginning of 1952, the price per flask in the United States was about $218–220; it dropped as low as $170 during the year, but in December, 1952, had again reached a figure of $218–220, according to the E and M J Metal and Mineral Markets Bulletin.

MOLYBDENUM

The molybdenite content of shipments of concentrates from Canadian mine production amounted to 253 short tons valued at $409,831 in 1952, compared to 191 short tons valued at $228,958 in 1951. These shipments all came from La Corne mine of Molybia Corporation Limited (formerly Molybdenum Corporation of Canada, Limited) in western Quebec, and were marketed in Europe.

There are no plants in Canada for the conversion of molybdenite concentrate, into the various molybdenum addition agents (molybdic oxide, ferromolybdenum-calcium molybdate). Canadian requirements are imported from United States through Climax Molybdenum Company, for which Railway Power and Engineering Corporation is the Canadian distributing agent, and through Molybdenum Corporation of America, New York.

Molybdenum is one of the most important alloying metals used in the manufacture of steels for defence production purposes. The addition of molybdenum to steel imparts hardness, toughness, durability against fatigue, and resistance to corrosion and heat. Molybdenum steels are used in the manufacture of boiler-plate, armour-plate, rifle barrels, vehicle springs, and various parts in gas turbines, jet aircraft engines, and automobiles. It may also be substituted, in some uses, for tungsten, which is also of great strategic importance. Main suppliers of tungsten for many years have been China, Korea, and Burma but with the unsettled conditions in those countries the metal has been in very short supply and great stress was placed on available production of molybdenum following the outbreak of the Korean war in 1950.

Owing to its strategic importance, steps were taken in the United States to distribute molybdenum on an equitable basis, and to increase mine production of molybdenite concentrates. In the third quarter of 1951 the metal came under allocation by the International Materials Conference. With increased production during 1951 and 1952, both tungsten and molybdenum came into easier supply.

Production, Imports, and Consumption[1]

	1952		1951	
	Short tons	$	Short tons	$
Production (shipments)				
Contained MoS_2	253	409,831	191	228,958
Imports (from the United States)				
Molybdic oxide	260	537,356	283	553,222
Calcium molybdate (grouped with vanadium oxide and tungsten oxide for alloy steel manufacture)	84	270,444	31	50,230
Ferromolybdenum [2]	220	354,212	158	255,868
Consumption (contained Mo) [3]				
Molybdic oxide	239	—	196	—
Ferromolybdenum	111	—	127	—
Calcium molybdate	4	—	8	—
Total	354	—	331	—

[1] Dominion Bureau of Statistics except where noted.
[2] United States export statistics.
[3] Department of Defence Production.

Occurrences and Producers

There are many occurrences of molybdenite in Canada. Of the 300 to 400 known occurrences, practically all are associated with pegmatite dykes, and the molybdenite occurs as 'splashes' of flake material within the dyke. However, this type of occurrence seldom makes ore as tonnages and continuity are lacking. A deposit consisting of small disseminated flake in gneiss or schist associated with structural fault conditions would offer more opportunity for successful operation than one of the pegmatitic variety.

The deposit at La Corne, western Quebec, about 35 miles north of Val d'Or is of the latter type. The mine was developed to 550 feet with four levels and operated during World War II by Wartime Metals Corporation, a government agency. Molybdenum Corporation of Canada, Limited, during 1949 and the early part of 1950 re-treated stockpiled molybdenite concentrates carrying a high bismuth content and shipped about 110 tons of molybdenite concentrate and bismuth oxychloride. Molybia Corporation Limited in June, 1951, resumed underground mining operations on the 250-, 375-, and 500-foot levels. In 1952 an average of about 280 tons per day was treated in the company's mill. Feed came from the series of east-west veins, which are of lower grade than the north-south series which, according to management, are practically exhausted on the present levels. It is reported that diamond drilling to the 700-foot horizon has indicated vein and structural conditions similar to those existing on the upper levels. The company hopes to deepen the shaft and open two more levels at the 625- and 750-foot horizons, where the north-south veins of higher-grade material would be available for mill feed.

The Indian Molybdenum Limited mine, in Preissac township, Quebec, and the Moss Mine of Quyon Molybdenite Company Limited, near Quyon, Quebec, were closed in 1944, after being operated during the later war years.

Molybdenite occurs in association with copper at the New Ryan Lake Company's mine, about 4 miles northwest of Matachewan, Ontario. This company ships copper concentrates to Noranda Mines for smelting, and some test work has been done in an effort to make a satisfactory recovery of the molybdenite contained in these concentrates.

Exploratory surface work was conducted, toward the end of the year, on two molybdenite deposits in Quebec, a short distance north of Ottawa. One of these is near Shawville and the other is near Maniwaki, but work has not been completed and results are not known.

World Production

Data on world production, particularly Russian, are incomplete, but 90 per cent or more of production originates in the United States; Chile, Mexico, and Norway are the other chief sources. Production of molybdenum concentrates in 1952 was 24,471 short tons, more than the annual output during any year since 1943, when a peak production of 34,613 short tons of molybdenum in ores was reported, according to the Bureau of Mines, United States Department of the Interior. An estimated production of 43,258,900 pounds of contained molybdenum in concentrates was reported in 1952, compared with 38,855,000 pounds in 1951, and 28,480,000 pounds in 1950. Consumption of molybdenum in the United States in those years, as reported by the United States Bureau of Mines, was 32,715,000 pounds, 33,691,000 pounds, and 26,029,000 pounds respectively.

For many years, Climax Molybdenum Company was the chief United States producer of molybdenite concentrates, from ores mined at its Climax-Colorado, property. About 20,000 tons of ore, averaging 0·6 per cent molybdenite, 0·02 per cent copper, and low tungsten content, are mined daily from a large chimney-like deposit in Precambrian granite and schist. Cassiterite and pyrite are also recovered from milling operations. A large-scale expansion program is under way so that, by 1955, from 30,000 to 35,000 tons of ore can be mined daily.

Output of molybdenum as a by-product of copper operations began in 1936 at Bingham (Utah) and was followed at Santa Rita (New Mexico) in 1937, Miami (Arizona) in 1938, and Ely (Nevada) in 1941. The molybdenum content is commonly quite low in the ores of the large copper producers. It has been reported as averaging about 0·045 per cent molybdenite (MoS_2) in the Bingham deposit in contrast to 0·018 in the Santa Rita deposit. In 1947 molybdenite output from copper ores exceeded that from Climax operations for the first time.

The Questa (New Mexico) molybdenite deposits, owned by the Molybdenum Corporation of America and operated since 1919, consist of fissure-filled quartz veins lying within 100 feet of the hanging wall of a granite contact. The grade of ore mined has ranged from one to four per cent molybdenum, and annual output has ranged from 150 to 300 tons of contained molybdenum.

Uses

About 70 per cent of the consumption of molybdenum is in the manufacture of steels to which it is added as molybdic oxide, calcium molybdate, or ferromolybdenum. For this purpose the molybdenite concentrates are made into:

1. Ferromolybdenum, containing 50 to 65 per cent molybdenum.
2. Calcium molybdate, containing 45 to 50 per cent molybdenum.
3. Molybdenum trioxide (molybdic oxide), containing about 65 per cent molybdenum, formed into briquettes.

In general, when an entire open-hearth heat is to be alloyed to not over 0·8 per cent molybdenum, the addition is in the form of molybdic oxide or calcium molybdate, whereas ferromolybdenum is used when higher percentages of molybdenum are desired. Molybdenum is also used to intensify the effect of other alloying metals such as nickel, chromium, and vanadium. It can be substituted for tungsten, in some instances, to impart strength, toughness, and hardness to steels.

About 20 per cent of the molybdenum consumed by industry is used in gray iron and malleable castings, where it is added chiefly in the form of ferromolybdenum or the trioxide.

Most molybdenum alloy steels contain from 0·15 to 0·5 per cent molybdenum, but in some instances the percentage is considerably higher. High-speed tool steels, for example, contain up to 9 per cent molybdenum. Alloys containing up to 25 per cent molybdenum are being used in increasing amounts in jet-propulsion engines, turbo superchargers, and gas turbines. Molybdenum also increases the resistance of stainless steels to chemical action.

About 10 per cent of the consumption of molybdenum goes into various chemical, electrical, and ceramic industries. Molybdenum wire and sheet are used in the incandescent lamp and radio industries, and new alloys suitable for heating elements, electrical resistances, and contact points contain molybdenum. The salts of molybdenum are used in pigments, in vitreous enamels for coating steels and sheet iron, in welding-rod coatings, in lithographing and printing inks, and in many other applications.

A minor quantity of metal is made by reduction of the oxide or concentrate in the electric furnace. Many non-ferrous alloys with cobalt, chromium, manganese, tungsten, and vanadium, are made for use in stainless steels and high-speed cutting tools. Molybdenum is also used as a catalyst in the distillation of high-grade gasoline.

Market Specifications for Concentrates

A marketable molybdenite concentrate must contain not less than 85 per cent molybdenum sulphide (MoS_2) and copper, arsenic, and bismuth impurities must be held within very low limits. The prices of molybdenum concentrates are usually quoted by the pound of 90 per cent molybdenite at the mine. In deposits containing large, pure flakes of molybdenite (a typical pegmatite occurrence), a marketable grade can be obtained by hand picking, but such an operation would not be economical. Molybdenite ores usually respond well to flotation concentration.

Prices

On December 1, 1950, Climax Molybdenum Company announced the following prices for its products (corresponding prices for 1949 are shown in brackets):

Product	Price per pound contained molybdenum
Molybdenite concentrate	\$1.00 (0·90)
Ferromolybdenum	1.32 (1·10)
Molybdic trioxide briquettes	1.14 (0·95)
Calcium molybdate	1.15 (0·96)

There have been no price changes since those announced by Climax as above. All prices are f.o.b. Langeloth, Pennsylvania, except for the concentrate, which is quoted f.o.b. Climax, Colorado. The price of molybdenum ore per pound of contained molybdenite (MoS_2) on a basis of 90 per cent concentrate would be 60 cents, f.o.b. mine.

According to the E and M J Metal and Mineral Markets Bulletin of December 25, 1952, prices on other molybdenum products were as follows:

Molybdenum metal	
99% purity, per lb.	\$3.00
Ferromolybdenum	
f.ob. shipping point, per lb. of contained Mo	
55–65%Mo, powdered	1.41
55–65% Mo, all other sizes	1.32
Molybdic trioxide (MoO_3)	
Bagged, per lb. contained Mo	1.13
Canned, per lb. contained Mo	1.14

Tariffs

The tariffs on molybdenum and its compounds for Canada and the United States are outlined below:

Canada

	British Preferential	*Most Favoured Nation*	*General*
Calcium molybdate	free	free	5%
Molybdic oxide	free	free	5%
Ferromolybdenum	free	5%	5%
Molybdenum ore and concentrate	free	free	free

United States

Calcium molybdate, ferromolybdenum, metallic molybdenum, molybdenum powder, and all other alloys and compounds of molybdenum:

25 cents per lb. on Mo content and 7½ per cent ad valorem.

Molybdenum ore and concentrates:
35 cents per lb. on Mo content.

Bars, ingots, scrap, and shot containing over 50 per cent molybdenum, or molybdenum carbide:
25 per cent ad valorem.

Other forms, i.e. wire:
30 per cent ad valorem.

NICKEL

Production of nickel in all forms was 281,117,072 pounds, valued at $151,349,438, an increase of slightly more than 5,300,000 pounds over 1951 and about 6,900,000 pounds short of the 1943 peak year production. All but a small part of the output in 1952 came from the mines of The International Nickel Company of Canada, Limited and Falconbridge Nickel Mines Limited in the Sudbury area, Ontario. The remainder originated in silver-cobalt ores from the Cobalt area, Ontario, which were treated by Deloro Smelting and Refining Company Limited. About 55 per cent of the nickel produced was refined at The International Nickel Company's plant at Fort Colborne, Ont.

The mines of the Sudbury district produce about 85 per cent of the world nickel output. In addition to copper, the other main constituent of the ore, numerous by-products are obtained from the treatment of the Sudbury nickel-copper ores. These include platinum and metals of the platinum group, gold, silver, and minor quantities of cobalt, selenium, and tellurium, while from the smelter gases, liquid sulphur dioxide and sulphuric acid are produced.

The world supply of nickel continued to be tight during 1952, and the metal remained under allocation by the International Materials Conference. As a result of efforts to increase nickel production, the Nicaro nickel plant, Oriente Province, Cuba, was rehabilitated and brought into production with a projected output of 30,000,000 pounds of nickel a year. In the United States, plans were made to open up a nickel silicate deposit in Douglas county, Oregon. The program of modernizing the nickel mines of New Caledonia was carried out.

In Canada, expansion programs of the two producing companies were continued; construction of Sherritt Gordon's refinery at Fort Saskatchewan, Alberta, was started; several small mines in the Sudbury area were brought into production; and exploration was carried on at an accelerated rate in various parts of the country.

Production and Trade

	1952		1951	
	Short tons	$	Short tons	$
Production, all forms	140,559	151,349,438	137,903	151,269,994
Exports, by forms				
Matte or speiss	63,753	70,248,850	57,882	60,286,680
Oxide	1,211	1,060,737	944	802,064
Refined metal	77,058	79,672,175	72,357	75,600,713
Total	142,022	150,981,762	131,183	136,689,457
Exports, by destination				
To: United States	95,292	99,849,500	88,394	92,415,560
United Kingdom	30,951	33,744,999	31,342	32,323,665
Norway*	15,193	16,692,071	11,255	11,744,952
Japan	288	264,037	—	—
Brazil	122	134,441	61	66,312
Chile	43	46,690	23	23,726
Belgium	35	47,878	28	30,472
Italy	24	48,356	17	17,470
Australia	20	20,484	18	18,974
Other countries	114	133,306	45	48,326
Total	142,022	150,981,762	131,183	136,689,457

* For refining and re-export only.

Activities at Producing Mines

The International Nickel Company of Canada, Limited.—Ore mined from underground and surface in 1952 was 13,248,593 tons, the highest tonnage produced in the company's history. Ore lifted from underground was 10,196,068 tons compared with 7,780,143 tons in 1951 and with 5,733,269 tons in 1950. Production of nickel in all forms amounted to 249,017,358 pounds, an increase of over 5 million pounds compared with 1951.

Good progress was made in the extensive program of underground development and general expansion of operations. New ore was blocked out for surface mining at Frood-Stobie and open-pit operations will be continued for a further period.

At the Stobie mine the new No. 8 shaft was completed and the main shaft deepened. Deepening the main shaft and sinking of a new internal shaft at the Levack mine was completed, and the deepening of the Garson shaft was continued. Underground development in the six mines of the company now totals more than 325 miles.

Ore reserves at the end of 1952 attained an all-time high of 256,355,903 tons having a combined nickel-copper content of 7,795,326 tons.

Falconbridge Nickel Mines, Limited.—All phases of the company's expansion program were continued. Production, which in 1952 was over 28,000,000 pounds, will be increased to 35,000,000 pounds by 1954. Work at the Hardy Mine was nearing completion at the end of the year. The steel headframe was erected and the shaft fully equipped. A fourth converter was installed at the smelter. Numerous additions to the company's refinery at Kristiansand, Norway, were completed.

At Fecunis Lake in the Levack area, a large new orebody was discovered. Extensive exploration was begun and initial results indicate over 10,000,000 tons of copper-nickel ore with an average grade equal to the main Falconbridge orebody. Plans were laid for opening up this deposit.

East Rim Nickel Mines, Limited.—In October, East Rim Nickel Mines Limited began shipping development ore, reaching a rate of 3,000 tons in November. The ore is shipped to the Falconbridge mill for concentration, pending the completion of the company's own 500-tons-per-day mill, which is expected to begin treating ore in the early fall of 1953.

Development and Exploration

Sudbury Area, Ontario

Milnet Mines Limited began sinking a 400-foot shaft. Mining will be at a rate of 300 tons daily and the ore will be shipped to the Falconbridge mill for concentration. Nickel Offsets Limited carried on underground development and began the erection of a mill with a capacity of 300 tons per day.

Active exploration was carried out on a number of other properties in the Sudbury Basin area.

Western Ontario

In the Kenora district, Quebec Nickel Corporation Limited carried out surface exploration and diamond drilling on a nickel-copper deposit near Werner Lake. An indicated orebody of over 1,000,000 tons averaging 2·0 per cent combined nickel and copper was disclosed.

A nickel-copper prospect near Emo in the Rainy River District was diamond drilled by Ventures Limited and Falconbridge Nickel Mines Limited, joint owners of the property.

Eastern Quebec

A deposit of nickel-zinc-copper in Rolette township, Montmagny county, Quebec, is under development by Eastern Metals Corporation Limited. Construction of a three-compartment, 600-foot shaft was begun. Initial diamond drilling indicated an orebody estimated to be over 800,000 tons with an average nickel content of 0·81 per cent.

Manitoba

The development of the Lynn Lake mine of Sherritt Gordon Mines Limited continued to progress; major underground work consisted in preparation of the 'A' orebody for mining. Foundations for the mill were completed, and erection of the plant was begun. The Laurie River power development was completed in September, and by the end of the year work on the 147-mile railway extension from Sherridon was ahead of schedule. Steel reached the Churchill River and the three bridges were completed. Construction of the refinery at Fort Saskatchewan, Alberta, was begun.

Production is scheduled to commence late in 1953. The nickel concentrate will be shipped to Fort Saskatchewan for refining. The first shipments of copper concentrate will go to Noranda for smelting, but both copper and nickel will ultimately be refined at Fort Saskatchewan.

There has been no reported increase in ore reserves, which at the end of 1950 were estimated at 14,055,000 tons, averaging 1·223 per cent nickel and 0·168 per cent copper.

In the Mystery Lake area, Cross Lake Mining Division, about 30 miles north of Thicket Portage station on the Hudson Bay branch of the Canadian

National Railway, extensive exploration of an enormous body of low-grade ore was carried out by Berens River Mines Limited and by Canadian Nickel Company Limited, a subsidiary of The International Nickel Company of Canada, Limited.

British Columbia

Western Nickel Limited acquired the old Pacific Nickel Mines property near Choate, B.C., and began an active development program to increase the existing ore reserve of 1,200,000 tons averaging 1·10 per cent nickel and 0·50 per cent copper.

Yukon

A discovery of a nickel-copper deposit was made in the Kluane Lake district, near the Alaska Highway. This property, known as the Wellgreen, is held by Hudson Bay Exploration and Development Company, Limited, a subsidiary of Hudson Bay Mining and Smelting Company, Limited. Initial diamond drilling has indicated 67,000 tons of ore averaging nickel 1·96 per cent, copper 1·33 per cent, cobalt 0·056 per cent, platinum 0·078 ounce per ton and palladium 0·053 ounce per ton.

Northwest Territories

Rankin Inlet Nickel Mines Limited carried out diamond drilling and further exploration of its property near Rankin Inlet on the west shore of Hudson Bay, Northwest Territories. From work done in 1952 the following ore reserves are estimated:—

High grade	245,000 tons	5·03% Ni	1·15% Cu
Medium grade	90,000 tons	1·97%	0·73%
Low grade	100,000 tons	1·25%	0·51%

At Ferguson Lake, Keewatin district, Canadian Nickel Company is carrying out extensive exploration on nickel-copper showing on a 1,152-square-mile concession.

Uses

Over 60 per cent of the free world's annual output of nickel is consumed in the United States, the principal uses being in the manufacture of stainless steel, special ferrous alloys, and nickel cast-iron. From 40 to 50 per cent is used in this group and between 25 and 30 per cent is used in non-ferrous alloys such as Monel metal, Inconel, nickel-silver, brass, and bronze, also in malleable nickel. Electro-plating accounts for about 18 per cent and the balance is used in high-temperature and electrical resistance alloys, catalysts, ceramics, and miscellaneous applications.

Prices

The Canadian price at the beginning of 1952 was 56·90 cents per pound. On or about February 7, the price declined to 55·25 cents per pound, owing to the strengthening of the Canadian dollar. This price prevailed until September 11, when there was a further decline to 54·00 cents per pound. This price was in effect until the end of the year.

In the United States the price was 56·50 cents per pound for the entire year.

The United States has an import tariff of 1¼ cents per pound on nickel.

PLATINUM AND PLATINUM METALS

Canada produces about one-half of the annual world output of the platinum metals, practically all of its production being a by-product from the nickel-copper ores of the Sudbury district in Ontario. Canadian production of the platinum metals in 1952 amounted to 279,724 fine ounces valued at $18,475,901, compared with 318,388 fine ounces valued at $22,492,622 in 1951.

The remainder of the world supply comes from Russia, Transvaal, Colombia, and East Griqualand. Russia's output is estimated at about one-half that of Canada. The United States is the largest consumer of platinum metals.

Canada's platinum metals are chiefly derived as a by-product from the treatment of the nickel-copper ores of The International Nickel Company of Canada, Limited and Falconbridge Nickel Mines Limited in the Sudbury area, Ontario. International Nickel recovers the platinum metals, together with gold and silver, as anode residues which are shipped to the company's precious metals refinery at Acton, near London, England, for treatment. The refined platinum metals from Acton are sold on world markets, the greater portion being sent back to this continent for use in the United States. A large part of the shipments to the United States is routed via Canada, which explains the substantial Canadian imports of the metals. Falconbridge Nickel ships the matte from its smelter at Falconbridge to the company's refinery at Kristiansand, Norway, where the precious metals are recovered from anode residues.

Production and Trade

	1952		1951	
	Fine oz.	$	Fine oz.	$
Production[1]				
Platinum	122,317	10,916,792	153,483	14,542,515
Palladium, rhodium, ruthenium, iridium and osmium	157,407	7,559,109	164,905	7,950,107
Total	279,724	18,475,901	318,388	22,492,622
Exports				
Platinum metals as concentrates to U.K. refinery[2]	—	17,386,276	—	15,301,795
Platinum metals refined and semi-processed:[3]				
To: United States	—	12,919,157	—	14,928,891
Other countries	—	223,679	—	109,524
Platinum, old and scrap:				
To: United Kingdom	—	4,900	—	17,585
United States	—	92,767	—	771
Total	—	13,240,503	—	15,056,771
Imports				
Platinum and platinum metals, refined and semi-processed[4]				
From: United Kingdom	—	17,073,798	—	16,990,357
United States	—	1,135,765	—	935,346
Other countries	—	76,116	—	779
Total	—	18,285,679	—	17,926,482

[1] The annual Canadian output of platinum metals, as recorded by the Dominion Bureau of Statistics, does not correspond with the annual amount recovered from ore treated. The reason is that the anode residues containing these metals are gathered at irregular intervals, and the accumulations of these residues at the refineries are shipped to the precious metals refinery at Acton, near London, England, at similarly irregular intervals.

[2] Platinum metals contained in concentrates shipped to England for refining. Canada does not produce any refined platinum or platinum group metals.

[3] These exports are actually imports from the United Kingdom, but were originally derived from the concentrates shipped there from Canada for refining.

[4] See preceding note for origin.

Consumption

The Canadian consumption of platinum metals is relatively small. The United States is the principal consumer, and an idea of the relative amounts used annually can be gained from the table that follows.

Platinum Metals (fine ounces) Used in the United States in 1952
(From The American Bureau of Metal Statistics)

	Platinum	Palladium	Other platinum metals	Total	Percentage of total amount used
Electrical	80,324	110,883	3,221	194,428	43.3
Chemical	124,938	25,403	8,621	158,962	35.4
Dental and medical	17,080	30,473	228	47,781	10·6
Jewellery and decorative	1,607	35,730	3,986	41,323	9·2
Miscellaneous	2,577	738	3,595	6,910	1·5
Total	226,526	203,227	19,651	449,404	100·0

Uses

Until 1950, the jewellery and decorative trades were the chief consumers of the platinum metals. In 1952, however, as indicated in the above table, the electrical industry ranked first. Their particular properties have made these metals increasingly important to industry. For the past two years, the sales of palladium have paralleled those of platinum, indicating the growing importance of this metal.

During 1952, the United States demand for platinum for military and industrial purposes exceeded the supply and is likely to continue at a high level, with no present indication of an over-supply. Supplies of palladium have been adequate.

Electrical

The numerous electrical applications of the platinum metals are based chiefly on their resistance to oxidation, sulphidation, spark erosion, and high temperatures, and to their good mechanical properties. Platinum, either pure or hardened with ruthenium or iridium, is used for contacts in voltage regulators, thermostats, and relays; for thermocouples (platinum and rhodium-platinum); precision resistance thermometers (pure platinum); spark plug electrodes (4 per cent tungsten-platinum and palladium-ruthenium-platinum alloy). Reflectors for searchlights and projectors are rhodium-plated.

Chemical

Mainly because of their high catalytic activity, and their resistance to corrosion, to oxidation at high temperatures, and to molten oxides and silicates, the platinum metals are used extensively in the chemical industry. Their chief catalytic use (platinum or platinum alloyed with 10 per cent rhodium), is in the production of nitric and sulphuric acids. Palladium and platinum are excellent catalysts for both hydrogenation and dehydrogenation. Chemical laboratories use platinum for crucibles, electrodes, and other equipment, and development of micro-chemical techniques has resulted in many new uses for the metal.

Jewellery

Platinum with 5 per cent to 10 per cent iridium or 5 per cent ruthenium, and palladium with 5 per cent ruthenium.

Decorative

Platinum for decorating glassware and porcelain; platinum or palladium as leaf for book stamping and embossing. Rhodium for plating glassware and silverware; platinum or palladium for medals and awards.

Alloys

Rhodium, iridium, ruthenium, palladium, copper, gold, and nickel are the elements most commonly added to platinum, seldom over 25 per cent and usually 10 per cent or less. Iridium and ruthenium increase the strength and hardness of platinum at room temperatures. Rhodium gives alloys resistance to oxidation at high temperatures.

Prices

Since July, 1952, a uniform ceiling price of $93 per troy ounce has applied to platinum in the United States, on small lot sales, and $90 on wholesale lots. The prices of the other metals in the platinum group were as follows: osmium, $200 per ounce troy; iridium, $200 per ounce troy, sponge or powder, until October, the price being $185-$200 for November and December; palladium, $24 per ounce troy; rhodium, $125 per ounce troy; ruthenium, $90 to $93 per ounce troy—all prices f.o.b. New York (E & M J Metal and Mineral Market quotations).

The above prices, converted into Canadian funds, pertain to Canada as well.

SELENIUM

Selenium occurs in very low concentrations in certain deposits of copper sulphide and gold ores from which it is recovered as a by-product. Canadian production comes from the anode slimes accumulated in the electrolytic refining of copper.

Selenium is an important strategic metal, and supplies during 1952 were inadequate to meet fully the military and civilian requirements of the free world.

The two Canadian producers are Canadian Copper Refiners Limited, (a subsidiary of Noranda Mines Limited), Montreal East, Quebec, and The International Nickel Company of Canada, Limited, Copper Cliff, Ontario. Canadian Copper Refiners has the largest selenium plant in the world. At this plant selenium is recovered from the refining of copper anodes produced at the Noranda smelter, Noranda, Quebec, from copper ores of that area and from blister copper produced by Hudson Bay Mining and Smelting Company, Limited, Flin Flon, Manitoba. Selenium recovered at the Copper Cliff refinery originates in International Nickel's extensive copper-nickel deposits in the Sudbury area.

Production and Trade

	1952		1951	
	Pounds	$	Pounds	$
Production				
Quebec	78,830	256,198	165,575	536,463
Manitoba & Saskatchewan	81,622	265,272	134,619	436,165
Ontario	81,578	265,129	82,409	267,005
Total	242,030	786,599	382,603	1,239,633
Exports				
Metal and Salts				
To: United Kingdom	133,369	490,629	166,956	498,022
United States	109,840	395,836	201,956	799,058
India	600	7,066	1,000	2,296
Other countries	312	1,170	561	1,869
Total	244,121	894,701	370,473	1,301,245

The United States and Canada are the principal world producers.

Selenium is marketed in two basic forms—as a powder, and as shot or pellets. Canadian producers' shipments to domestic markets amounted to nearly 12,000 lbs. in 1952, while in 1951 they were about 14,000 pounds.

Uses

Owing to its electro-positive characteristics, selenium has a number of specialized uses, the most important being in the manufacture of dry-plate rectifiers for radio, television, and signal equipment. The demand in this field is increasing rapidly. A unique property of the metal is its change of electrical conductivity on exposure to light. This property is utilized in photo-electric cells for a variety of automatic applications, also in television equipment and in sound film.

The next most important use is in the manufacture of glass, to which selenium imparts a red or ruby colour when used in moderate amounts; it is also used, in very small amounts, to neutralize undesirable colour due to the presence of iron.

Small additions of selenium to rubber promote resistance to heat, oxidation, and abrasion. It is used also as an antioxidant in lubricating oils; for fat hardening; as a catalyst in the petroleum industry; in coal hydrogenation; as a pharmaceutical product for skin diseases; and for making certain types of inks and insecticides.

Selenium dioxide is used as a catalyst in the production of cortisone and in a number of compounds, particularly accelerators for vulcanizing rubber. Ferro-selenium (about 50 per cent selenium) is used in the manufacture of stainless steels.

Other compounds have a limited use in photographic toning baths and in paint pigments with a colour range from orange to maroon.

Prices

The average Canadian price for selenium black powder, 99·5 per cent pure, in 1952 was from $2.90 to $3.40 a pound. The price of pellets was slightly higher.

SILVER

Canada's production of 25,222,227 ounces of silver was about two million more than the amount produced in 1951 and was larger than in any year since 1930. Most of the output came from the treatment of base metal ores, but there was a considerable production from the silver-cobalt mines of Ontario. The exports of silver bullion were slightly less than in 1951; exports of silver in ore and concentrate, however, were greater by about one million ounces.

The price of silver declined about 5 cents during the year to a low of 81 cents an ounce in December.

Operations and Developments

British Columbia

The Sullivan lead-zinc-silver mine at Kimberley, owned and operated by The Consolidated Mining and Smelting Company of Canada, Limited, is one of the principal sources of silver in Canada. The Sullivan ore is treated near the mine and the concentrates are shipped to the company's plant at Trail, where the silver is recovered from tank slimes that accumulate in the electrolytic refining of lead bullion. A substantial part of the output of the silver refinery at Trail, which amounted to 12,965,511 ounces in 1952, was obtained from the custom treatment of ores from over 100 Canadian and foreign mines.

Torbrit Silver Mines Limited, in the Cassiar district, was the second largest silver producer in the province. Its output of silver bullion and silver in concentrate was 2,346,650 ounces.

Other important producers were Silver Standard Mines Limited, near Hazelton; Highland Bell Limited, Beaverdell, and Violamac Mines Limited, near Sandon.

Production, Trade, and Consumption

	1952		1951	
	Fine oz.	$	Fine oz.	$
Production by provinces				
British Columbia	7,784,964	6,502,002	8,342,414	7,887,752
Ontario	6,491,124	5,421,387	4,520,094	4,273,749
Quebec	4,536,247	3,788,673	4,154,290	3,927,881
Yukon	4,028,551	3,364,646	3,442,788	3,255,156
Saskatchewan and Manitoba	1,591,663	1,329,357	2,067,482	1,954,804
Newfoundland	638,524	533,295	534,519	505,388
Other Provinces & N.W.T.	151,154	126,243	64,238	60,737
Total	25,222,227	21,065,603	23,125,825	21,865,467
Production by sources				
Base metal ores	19,670,011	—	19,433,360	—
Gold ores	688,489	—	712,716	—
Silver-cobalt and silver ores	4,845,148	—	2,959,988	—
Placer gold operations	18,579	—	19,761	—
Total	25,222,227	—	23,125,825	—
Imports, unmanufactured				
From: United States	145,898	128,210	27,561	26,616
Mexico	—	—	1,002,738	802,523
United Kingdom	—	—	20,000	19,037
Total	145,898	128,210	1,050,299	848,176

Production, Trade, and Consumption—continued

	1952		1951	
	Fine oz.	$	Fine oz.	$
Imports, manufactured				
From: United Kingdom	—	394,510	—	572,846
United States	—	139,184	—	193,827
Denmark	—	18,402	—	41,765
West Germany	—	7,669	—	11,252
Other countries	—	27,366	—	25,249
Total	—	587,131	—	844,939
Exports, ore & concentrate				
To: United States	3,304,865	2,637,553	2,188,073	1,855,379
Belgium	140,538	113,946	100,057	90,624
West Germany	96,623	75,295	125,158	113,946
Other countries	4,422	3,582	—	—
Total	3,546,448	2,830,376	2,413,288	2,059,949
Exports, bullion				
To: United States	14,928,413	12,617,692	14,610,558	13,678,466
Other countries	102	111	770,718	741,192
Total	14,928,515	12,617,803	15,381,276	14,419,658
Exports, manufactured				
To: United States	—	81,908	—	165,832
Other countries	—	5,381	—	13,816
Total	—	87,289	—	179,648
Consumption				
Coinage	4,245,889	—	3,483,876	—
Sterling silverware	1,156,206	—	1,702,378	—
Anodes for plating	1,116,538	—	907,431	—
Silver nitrate	1,082,761	—	1,165,589	—
All other uses	430,479	—	714,361	—
Total	8,031,873	—	7,973,635	—

Manitoba and Saskatchewan

Hudson Bay Mining and Smelting Company Limited at Flin Flon shipped about 40,000 tons of blister copper containing 1,588,574 ounces of silver. It treated 385,307 tons of copper concentrate, residues, and ores produced from its Flin Flon mine and also 19,538 tons of copper concentrate containing precious metals from its subsidiary, Cuprus Mines Limited, 7½ miles northeast of Flin Flon.

Other silver production came from Nor-Acme Gold Mines Limited and San Antonio Gold Mines Limited, both in Manitoba.

Ontario

The price of $2.00 a pound paid by the Federal Government in 1952 for cobalt stimulated production at the silver-cobalt mines of Cobalt and Gowganda. The output of 4,845,000 ounces of refined silver from these mines was considerably more than in 1951. Most of the output was shipped as high-grade concentrates to Deloro Smelting and Refining Company Limited at Deloro, Ontario, or to the United States. Cobalt concentrate containing about 140,000 ounces of silver was also shipped to Deloro. About 600,000 ounces were contained in low-grade silver concentrate which was shipped to the smelter of Noranda Mines Limited, Noranda, Quebec.

The principal silver producers in the Cobalt area were Silver-Miller Mines Limited, Cobalt Lode Silver Mines Limited, Silanco Mining and Refining Company Limited, and Hellens Mining and Reduction Company Limited, and in the Gowganda area, Sisco Metals of Ontario Limited, and Castle-Trethewey Mines Limited.

The International Nickel Company of Canada Limited sold 1,076,327 ounces of silver which it recovered from the treatment of its copper-nickel ores in the Sudbury district.

The 40 gold mines in Ontario operating in 1952 produced 407,767 ounces of silver as a by-product. Hollinger Consolidated Gold Mines Limited was the largest of these producers, with a silver output of 92,719 ounces from its Hollinger and Ross mines.

Quebec

Noranda Mines Limited, the principal producer, had an output from its copper smelter at Noranda of 71,407 tons of copper anodes containing 2,395,300 ounces of silver. Of this amount 610,800 ounces is estimated to have originated from the company's Horne mine at Noranda. The remainder came from copper concentrates shipped to the Noranda smelter by Waite Amulet Mines Limited, Normetal Mining Corporation Limited, Quemont Mining Corporation Limited, and East Sullivan Mines Limited, all in Abitibi county, and from silver concentrate shipped from mines in the Cobalt and Gowganda areas of Ontario.

Other silver production in the province came from the zinc-lead or zinc-lead-copper ores of New Calumet Mines Limited, Anacon Lead Mines Limited, Golden Manitou Mines Limited, Ascot Metals Corporation Limited, Consolidated Candego Mines Limited, and from the 17 gold mines that were in production in Quebec in 1952.

Barvue Mines Limited, near Barraute, Abitibi county, constructed a 6,000-ton concentrator and commenced production in November at about 50 per cent capacity. The Barvue orebody is estimated to contain about 18,000,000 tons averaging 3·3 per cent zinc and 1·13 ounces of silver per ton.

New Brunswick

A large base metal deposit containing about 2 ounces of silver per ton was discovered about 17 miles southwest of Bathurst. Brunswick Mining and Smelting Corporation Limited was formed to develop the property. Considerable exploration was also carried out at a number of zinc-lead-copper properties in the northern part of the province, where silver is known to be present in the ore.

Nova Scotia

In April, Mindamar Metals Corporation Limited commenced production of concentrates containing silver at its property on Cape Breton Island.

Newfoundland

Buchans Mining Company Limited shipped copper, lead, and zinc concentrates containing about 638,524 ounces of recoverable silver.

92728—6½

Yukon

United Keno Hill Mines Limited, in the Mayo district, produced lead and zinc concentrates and silver precipitates containing over 4,500,000 ounces of silver. Most of the production came from the Hector mine where exploration on two new levels disclosed the downward extension of the Hector orebodies with a significant increase in grade. The company also carried out considerable exploration on the Calumet, No Cash, and Onek mine sections of its property with encouraging results. Consideration was given to building a new 300-ton mill to treat ore from the Onek mine.

Mackeno Mines Limited, Yukeno Mines Limited, and Bibis Yukon Mines Limited adjoining the United Keno Hill property jointly constructed a 150-ton mill on the Yukeno property. Production of lead and zinc concentrates with a high silver content was commenced in April 1953.

Construction of a hydro-electric plant on the Mayo river was completed and electric power became available to mines in the Mayo district.

Canadian Silver Refineries

Plants for the production of fine silver are listed below:

Quebec

Canadian Copper Refiners Limited, Montreal East.

Ontario

The Royal Canadian Mint, Ottawa.
The 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

Much of the world's silver production is minted into coins. Ornaments, jewellery, sterling silver, and plated ware are other long-established uses.

Increasing amounts of silver are being consumed in the electrical field, especially in low-resistance conductors both for industrial use and in scientific equipment. The use of brazing alloys containing 50 to 80 per cent silver has also expanded in recent years.

Silver nitrate is used chiefly in the preparation of light-sensitive emulsions for use on photographic film.

The metal is usually marketed either 'pure' (99·99% Ag) or as sterling silver—925 parts silver and 75 parts copper per thousand. The pure metal may be bought in bars weighing about 1,000 troy ounces, or in granulated or powdered form; sterling is usually sold as sheets or wire.

Prices

The price of silver in Canada in 1952 was based on the New York price paid for foreign silver, but it fluctuated in relation to the value of the Canadian dollar in terms of United States currency. The Canadian price declined gradually from 89·75 cents an ounce in January to 81 cents an ounce in December. The average Canadian price in 1952, estimated by the Dominion Bureau of Statistics, was 83·52 cents an ounce.

TELLURIUM

Tellurium, like selenium, occurs in extremely small concentrations in certain copper and gold ores, and sometimes in ores of lead. It usually occurs in much smaller amounts than selenium, and when the two metals are found together the relative proportions may be as low as one part tellurium to thirty parts selenium.

The two Canadian producers are Canadian Copper Refiners Limited (subsidiary of Noranda Mines Limited) Montreal East, Quebec, and The International Nickel Company of Canada, Limited, Copper Cliff, Ontario. Tellurium is recovered from copper anode slimes together with selenium, from which it is separated by a chemical process and produced as metal electrolytically. It is sold as powder or as cast metal.

Production

	1952		1951	
	Pounds	$	Pounds	$
Manitoba and Saskatchewan	325	552	2,612	4,806
Ontario	5,710	9,707	6,301	11,594
Total	6,035	10,259	8,913	16,400

The market is limited and the greater part of the Canadian output is exported to the United Kingdom.

Uses

Tellurium is used chiefly as an additive to lead and copper. It improves the ductility of lead, and increases the hardness and improves the machining qualities of copper without impairing its electrical conductivity. It is used in small amounts as a chill inducer to prevent shrinkage in iron castings. It improves the durability of rubber; produces bluish or brownish tints in ceramics and glass; and its compounds are utilized in toning baths in photography.

Prices

The Canadian price during 1952 was $1.75 per pound.

TIN

Canadian production of tin dropped to 95 long tons valued at $253,581, compared with 155 long tons valued at $494,073 in 1951. The production of metallic tin was discontinued in Canada at the end of 1952, and arrangements were made for the shipment of tin concentrates to the Texas City smelter, Texas, United States, for refining. Since early in 1942 when the first tin was produced in Canada, 3,410 long tons have been turned out. The small domestic production is derived as a by-product from the 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.

World production of tin during 1952 was 171,000 long tons, an increase of 3,500 tons over 1951. Prices remained fairly stable during the year.

In spite of the disturbed conditions, Malayan tin production was only a few hundred tons under that for 1951. The nationalization plans of the Bolivian Government resulted in the three principal tin-mining companies being taken over by the Government in October. Production fell sharply, and the negotiations for long-term contracts for the sale of concentrates to the United States remained unsettled. Tin controls in the United States continued in force during 1952.

Over 80 per cent of the world production of tin comes from Malaya, Indonesia, Bolivia, Belgian Congo, Thailand, and Nigeria.

Production, Trade, and Consumption

	1952		1951	
	Long tons	$	Long tons	$
Production	95	253,581	155	494,073
Imports, tin and allied products, blocks, pigs, and bars				
From: Malaya	2,165	5,822,781	3,025	9,092,210
Belgium	735	1,966,570	875	2,754,492
Netherlands	459	1,222,182	40	130,411
United States	313	830,714	1,456	5,065,427
United Kingdom	237	644,323	734	2,513,818
Italy	40	108,815	—	—
Bolivia	—	—	5	20,470
Total	3,949	10,595,385	6,135	19,576,828
Imports, tin plate				
From: United States	896	158,185	773	124,021
United Kingdom	391	134,858	758	235,226
Total	1,287	293,043	1,531	359,247
	Pounds		Pounds	
Imports, tin foil				
From: United States	2,585	3,702	8,192	13,098
United Kingdom	194	167	113	125
Total	2,779	3,869	8,305	13,223
Imports, Babbit metal				
From: United States	37,500	22,636	21,500	19,017
United Kingdom	3,200	2,084	8,500	4,946
Total	40,700	24,720	30,000	23,963
	Long tons		Long tons	
Consumption				
Tin plate and tinning	2,517	—	2,678	—
Solder	1,080	—	1,203	—
Babbit metal	212	—	421	—
Brass and bronze	225	—	310	—
Tin foil and collapsible tubes	31	—	32	—
Miscellaneous	125	—	87	—
Total	4,190	—	4,731	—

Canadian Occurrences

No tin deposits of economic grade have been discovered in Canada, although numerous minor occurrences of cassiterite (SnO_2) have been recorded. These are in the New Ross area, Lunenburg county, Nova Scotia; in the Sudbury and Thunder Bay districts, Ontario; in the Lac du Bonnet district, southeastern Manitoba; in southern British Columbia; in the Mayo district, Yukon; and in the Yellowknife area, Northwest Territories. Except for cassiterite from some creeks in Yukon and cassiterite and stannite ($Cu_2S.FeS.SnS_2$) associated with certain base metal ores in southern British Columbia, Canadian occurrences are found in pegmatite dykes.

Uses and Consumption

The major uses of tin are in tin plate and solder, about 60 per cent and 26 per cent respectively being consumed in these products in Canada in 1952. Tin is also used as a constituent of babbit metal, bronze, and type metal; in tinning; in chemicals; and as foil and collapsible tubes. For foil and collapsible tubes aluminum has replaced tin to a large extent.

The demand for electrolytic tin plate continued to increase, and the output in 1952 was almost 50 per cent of the total tin-plate production. Experimental runs were successfully carried out in producing differential electrolytic tin plate. By adjusting the current density of the anodes in the tin-plating tank, a deposit equivalent to 1·0 pound per base box on one side and a deposit equivalent to 0·25 pound per base box on the other are deposited simultaneously. Commercial production of differential plate is anticipated in 1953. Canada was the fourth largest producer of tin plate in 1952.

Prices

The Canadian price of tin f.o.b. Montreal or Toronto fluctuated during the year between a low of $1.15 per pound and a high of $1.27 per pound. The average price for December was $1.175.

In the United States a ceiling of $1.215 was fixed by the Reconstruction Finance Corporation, which continued to be the sole distributor during the year.

TITANIUM

Shipments of ilmenite from the Allard Lake deposits in eastern Quebec in 1952 to the experimental plant of Quebec Iron and Titanium Corporation at Sorel, Quebec, totalled 266,410 short tons compared with 372,112 short tons in 1951. Total production at Sorel was approximately 42,141 tons of titanium dioxide concentrate (electric smelter slag) containing 30,805 tons of titanium dioxide—approximately double the 1951 production. There continued to be a small production of ilmenite from the St. Urbain area of Quebec.

Dominion Magnesium Limited at Haley, Ontario, continued its experimental pilot-plant work on the preparation of titanium metal powder from imported refined titanium dioxide. Shawinigan Chemicals Limited was also engaged in titanium research. In the United States, many intensive titanium-metal and titanium-alloy research programs are being conducted by government agencies and by industry. Large volume production of titanium metal awaits the development of a cheap extraction method.

Ilmenite ($FeTiO_3$), rutile (TiO_2), and sphene ($CaTiSiO_5$—also called titanite) are the most abundant of the independent titanium minerals. The principal ores are titaniferous magnetite, ilmenite, and rutile. Rutile contains up to 60 per cent titanium and is the more desirable ore, but ilmenite, which contains about 32 per cent titanium (52·7 per cent TiO_2) is cheaper and more plentiful. For industrial purposes the only distinction between ilmenite and titaniferous magnetite is in the titanium content. Ore classed as ilmenite generally carries 18 to 24 per cent and upwards of titanium, with from 1·6 to 2·6 times as much iron, while titaniferous magnetite seldom carries more than 15 per cent titanium, and the ratio of iron to titanium usually runs from 4.0:1 to 6.0:1[1]. Rankama and Sahama[2] state that possibly more than 90 per cent of the total quantity of all titaniferous constituents of igneous rocks consists of ilmenite. Sphene may contain up to 41 per cent TiO_2; it is mined as an ore of titanium in Kola Peninsula, U.S.S.R.

[1] Robinson, A.H.A.: Titanium; Mines Branch, Ottawa, Publication No. 579, 1922, p.20.
[2] Rankama, K. and T. G. Sahama: Geochemistry; University of Chicago Press, 1950.

Production, Trade and Consumption

	1952		1951	
	Short tons	$	Short tons	$
Production				
Ilmenite				
Allard Lake area	266,410[1]	—	372,112	—
St. Urbain area	51	459	1,674	9,790
Total	266,461	—	373,786	—
Titanium dioxide concentrate				
From Allard Lake ilmenite, smelted at Sorel	42,141	—	19,643	—
Titanium dioxide content of above	30,805	1,238,103	14,123	738,577
Imports				
Titanium dioxide and pigments containing not less than 14% titanium				
From: United States	21,469	5,365,582	26,052	6,838,500
United Kingdom	2,736	1,090,786	3,596	1,623,779
Total	24,205	6,456,368	29,648	8,462,279

	1951	1950
	Short tons	Short tons
Consumption		
Paint industry		
Titanium dioxide (TiO_2)	8,333	7,946
Extended TiO_2 pigments	12,752	13,796
Polishes and dressings industry, TiO_2	121	127
Pulp and paper industry, TiO_2	503	797
Rubber goods industry, TiO_2	558	540
Linoleum industry, TiO_2	1,430	1,328
Misc. non-metallic mineral products, TiO_2	202	209
Primary iron and steel industry, ferro-titanium	164	143

[1] Ore received at Sorel.

Production

Quebec Iron and Titanium Corporation.—Shipments of ilmenite ore during 1952 from the Allard Lake operations of the Quebec Iron and Titanium Corporation, according to the company, were 237,990 gross tons to its experimental smelting operation at Sorel and 5,050 gross tons to outside customers. The average content of the ore was 35·02 per cent TiO_2 and 39·65 per cent Fe.

Production of TiO_2 slag at Sorel during 1952 was 37,850 gross tons—approximately double the 1951 production. Shipments of slag, at 34,850 gross tons were more than seven times greater than 1951 shipments. TiO_2 content of the slag runs about 70 per cent.

Production of by-product iron ingots, iron in the form of pigs, and steel ingots amounted to 6,450, 4,710, and 20,880 gross tons respectively. Production of iron and steel ingots during 1951 totalled 15,554 short tons.

Quebec Iron and Titanium Corporation was able to commence primary crushing at the mine, as a result of the completion of an electric power line which now connects the power station at Havre-St-Pierre to the mine near Allard Lake. Primary crushing had been carried out at the port of Havre-St-Pierre, 27 miles distant from the mine. The shipping cycle between Havre-St-Pierre and Sorel for the 11,000-ton ship "Mont Alta" has been reduced to a $4\frac{1}{2}$ day turnaround.

At its experimental ilmenite smelting plant at Sorel, Quebec Iron and Titanium Corporation has installed a conveyor belt and dock facilities for the loading and shipment of TiO_2 slag formerly shipped by rail. The slag, which is actually a TiO_2 concentrate, is sold on an experimental basis to titanium pigment producers in the United States. A very small quantity, however, was exported to the United Kingdom in 1952. A new pig-casting machine has been installed so that the company's high-grade metallic iron may be produced in a size suitable for the primary iron and steel industry. Previously, the by-product iron was produced in the form of iron and steel ingots. During the course of the year, furnaces No. 2 and No. 3 were placed in operation. With three ilmenite smelting furnaces in operation, the two iron-refining furnaces will be required for refining operations and will not be available for steel production.

As no further work has been done in delimiting the orebodies in the Allard Lake area, estimates of ore reserves remain in the general neighbourhood of from 125 to 150 million tons of ilmenite.

Exploration

St. Lawrence Iron & Titanium Mines, Limited.—In 1951, this company leased from American Titanic Iron Company Limited the old Coulombe and Furnace ilmenite deposits in the St. Urbain area, Charlevoix county, Quebec. The property comprises an area of about two square miles. During 1951 the company made a dip-needle survey of the East and West Coulombe and Furnace sections and drilled 26 diamond drill holes during the fall of that year to test the dip-needle anomalies. On the basis of this work, the company has estimated its ore reserves at 1,300,000 tons of proven ore containing a minimum of 37 per cent TiO_2. In addition, drilling indicated large tonnages of low-grade, disseminated ore. During 1952 concentration tests were made on the low-grade material.

Titanium Development Corporation.—The company holds 142 acres of ground in Beresford township, Terrebonne county, Quebec. The claims lie on the side of "Titanium Mountain", immediately adjoining the property on which the old Ivry mine is located. Exploration work consisted of a rough dip-needle survey during 1951 and a magnetometer survey followed by 4,029 feet of diamond drilling during the spring of 1952. On the basis of this work, the company has estimated its ore reserves at 2,859,000 tons of proven ore with an average grade of 30·84 per cent TiO_2.

Terrebonne Titanium Company Limited—Terrebonne Titanium Company holds a mineral property (ilmenite and titaniferous magnetite) of 39 lots with an approximate area of 3,900 acres in Wexford township, Terrebonne county, Quebec, about 55 miles northwest of Montreal. During November, 1951, the company conducted a limited diamond drilling program of 4 holes to test the surface showings. A dip-needle survey was made during the summer of 1952.

Other Occurrences of Ilmenite in Canada

In addition to the Coulombe and Furnace ilmenite deposits, there are at least three other known deposits in the St. Urbain area of Quebec, namely, the General Electric, Bignell, and Joseph Bouchard (or Glen) deposits. Ilmenite was discovered 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 meet the demand created by the interruption of shipments from India.

Also in Quebec, titaniferous magnetite occurs near Desgrosbois about 55 miles northwest of Montreal; near St. Charles Village, Bourget township; near the Bay of Seven Islands; in the Natashquan iron sands; and in the Chibougamau district. It occurs also at Mine Centre, Ontario; near Burmis, Alberta; and near St. Georges, Newfoundland. Titanium-bearing minerals have been reported near White Bay, on the northeast coast of Newfoundland.

World Production

World production of rutile, according to the United States Bureau of Mines, amounted to about 42,000 metric tons in 1951, of which 33,718 came from Australia, the largest producer. The next largest producer is the United States. In Australia, the rutile is mined from black sand deposits along the east coast. In the United States, it is produced from black sands in Florida. Smaller amounts of rutile originate in Brazil, French Cameroons, French Equatorial Africa, India, and Norway.

World production of ilmenite for 1951, according to the United States Bureau of Mines, is estimated at 800,000 metric tons. Chief producers were: United States, 486,099 metric tons; India, 143,174; Norway, 105,000; Malaya, 42,341; and Canada, 19,235. United States production in 1952 is estimated at 537,000 short tons. About one-half of the United States production comes from the Tahawus mine in New York state, about one-third from black sand deposits near Starke and Jacksonville in Florida, and the remainder from Idaho, North Carolina, and Virginia. 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 of ilmenite at Allard Lake, Quebec. Norway's output comes principally from deposits south of Stavanger. Ilmenite is also produced from black sands in Australia and Malaya, and in Brazil, Egypt, Portugal, Senegal, and Spain.

In the United States, about 98 per cent of the total consumption of titanium-bearing minerals in 1951 was in the pigment industry. Pigments were produced in 1952 by American Cyanamid Company, Calso Chemical Division, Bound Brook, New Jersey; Chemical and Pigment Company Division of Glidden Company, Baltimore, Maryland; E. I. Du Pont de Nemours and Company Wilmington, Delaware; and the National Lead Company, New York, New York. Production of commercial titanium sponge in 1952 came from plants operated by the E. I. Du Pont de Nemours and Company at Newport, Delaware; Titanium metals Corporation of America at Henderson, Nevada; and the Crane Company at Chicago, Illinois.

In the United Kingdom, Imperial Chemical Industries commenced the production of titanium sponge from titanium tetrachloride. Reduction of the titanium sponge is carried out at Widnes, and the ingot and wrought forms are produced at Wilton. Annual output is on a scale of about 11 tons per year and most of it is used by aircraft engine manufacturers.

Uses

Titanium oxide (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. A small amount of titanium is used in the iron and steel industry as ferrotitanium and ferro-carbontitanium, to purify and strengthen 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 titanium pigment industry. It should be noted, also, that this production is mainly for defence purposes, and that the widespread use of titanium metal awaits the developmnt of a cheap method of extracting it from its ores.

Titanium oxide, in the natural form of rutile, is used commonly as a coating for welding rods. Crystals of titanium oxide, 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 hard ingredients of "carbide" high-speed cutting steels, usually mixed with tungsten carbide.

Because of its high strength-weight ratio, titanium metal has a special application in supersonic aircraft, and about three-quarters of the metal being made is going into air compressors for jet aircraft engines. It is used also in alloys of stainless and heat-resisting steels, where the size of the product is small. Certain alloys with cobalt and nickel are used as filaments in vacuum tubes.

At the National Metal Exposition in October, 1952, at Philadelphia, Pennsylvania, a model of the United States Air Force J-47 engine highlighted the uses of titanium in blades, casings, compressor wheels, and other components. Titanium was displayed also in the following forms: 0·38 caliber paratrooper's pistol, filters, cutting tools, and valves and other machine parts. An organic bonding agent ideal for low-heat bonding of titanium was shown, and parts drawn from commercially pure titanium were demonstrated.

The following table, prepared by the United States Bureau of Mines, shows the consumption of ilmenite and rutile in the United States in 1951, by products. It indicates the relative size and economic importance of the principal titanium-consuming industries.

Consumption[1] of Ilmenite and Rutile in the United States in 1951 by Products

Product	Ilmenite		Rutile	
	Gross weight	Estimated TiO_2 content	Gross weight	Estimated TiO_2 content
Pigments (manufactured titanium dioxide) [2], [4]	703,068	367,937	[3]	[3]
Welding-rod coatings [2]	258	130	11,708	10,834
Alloys and carbide	10,024	4,962	2,939	2,752
Ceramics	—	—	265	248
Miscellaneous	13	8	2,315[5]	2,184[5]
Total	713,363	373,037	17,227	16,018

[1] Short tons.
[2] "Pigments" include all manufactured titanium dioxide, of which 1,770 tons were used in welding-rod coatings in 1951.
[3] Included in "Miscellaneous" in order to avoid disclosures of individual company operations.
[4] Including a mixed product containing altered ilmenite, leucoxene, and rutile used to make pigments and metal.
[5] Includes rutile used by metal and fibre glass industries.

Metal Technology

The metal has many desirable qualities. It melts at about 1,800°C, can be rolled, drawn, or forged, and has a specific gravity of 4·5 (iron is 7·8). It has excellent corrosion resistance, except to certain acids. The tensile strength of the annealed metal is 82,000 pounds per square inch; cold-worked to 50 per cent reduction, the tensile strength is 126,000 p.s.i. However, the task of extracting the metal from the ore is made difficult by the tendency of molten titanium to devour every substance it touches. If it is allowed to absorb air, the metal becomes impure and brittle. It will quickly attack refractory brick, normally used to line metal-smelting furnaces, as its melting point is higher than that of the brick.

Production of ductile titanium from titanium ores is still undergoing rapid development. Changes are frequent, but the Kroll process, developed by the United States Bureau of Mines, is still the basis of present metallurgical practice. Titanium chloride is produced by the chlorination of titanium ores and is then purified by distillation. In an inert atmosphere (generally helium) in a carefully cleaned reaction chamber, the purified titanium chloride is reacted with molten magnesium exothermically to produce liquid magnesium chloride and sponge titanium. The magnesium chloride is drawn off to electrolytic cells for dissociation into magnesium and chlorine for re-use. The titanium sponge is broken up for removal from the crucible, and is leached with hydrochloric acid and washed with water. It is crushed and is then consolidated by powder metallurgy techniques or is melted in inert-gas induction or electric arc furnaces.

Prices

At the beginning of 1952, market quotations per gross ton of ilmenite containing 56-59 per cent TiO_2, f.o.b. Atlantic seaboard, were \$16 to \$18 nominal. Quotations increased to \$16 to \$20 in March and \$18 to \$20 in April, and they remained at \$18 to \$20 throughout the remainder of the year.

At the beginning of 1952, market quotations for rutile, guaranteed minimum 94 per cent concentrates, were 5¼ to 6¼ cents per pound, but they decreased on January 3 to 3½ to 4½ cents per pound. Increases in price quotations took place at the end of January to 4 to 5 cents per pound, in March to 5 to 7 cents per pound, in April to 6 to 8 cents per pound, in September to 7 to 8 cents per pound and in November to 7 to 8½ cents per pound. They remained at 7 to 8½ cents per pound for the remainder of the year.

Ferrotitanium, low carbon, according to E and M J Metal and Mineral Markets of December 25, 1952, was quoted as follows:

Ferrotitanium, low carbon, per pound of Ti contained:
25%, 0.10%C, \$1.50; 40%, 0.10%C, \$1.35; f.o.b. destination east of the Mississippi River.

Canada and the United States have no tariffs on titanium ores.

Canada

The following tariff exists on titanium oxide imported into Canada

British preferential	free
Most favoured nation	12½%
General	15%

United States

The following tariff exists on imports into the United States of:

Titanium alloys	20%
Titanium metal	20%
Ferrotitanium	12½%
Titanium oxide	15%

TUNGSTEN

Canada is becoming a leading producer of this vital alloying element. There was no production before World War II, but following the discovery of scheelite at the Emerald mine near Salmo in southern British Columbia in 1942 the Federal Government produced about 400 tons of tungsten concentrate up to the autumn of 1944, when the mine and mill were closed. The mine was later reopened, and in 1952 shipments of scheelite, mainly from this source, amounted to 747 short tons of contained tungstic oxide (WO_3).

Upon the outbreak of hostilities in Korea in 1950, and the subsequent loss to the free world of the main sources of tungsten in China, Korea, and Burma, alternative sources of supply were sought. Steps were taken by the National Production Authority (N.P.A.) in the United States to increase domestic production and also to find additional sources there by setting floor and ceiling prices on tungsten. On April 5, 1951, it was announced by the United States Government that domestic scheelite ores with a minimum content of 60 per cent WO_3 would be purchased at $65 per short ton unit f.o.b. mine. Available world supplies of tungsten were brought under allocation by the International Materials Conference in the third quarter of 1951. These supplies have gradually increased, and all controls were removed in the last quarter of 1952. Prices of tungsten concentrates on world markets have declined, and by the end of 1952 were lower than the United States floor and ceiling prices outlined above.

Placer Development Limited, through its subsidiary, Canadian Exploration Limited, is becoming one of the chief suppliers of tungsten in the free world. In December, 1952, the mill was operating at about 300 tons per day on ore being drawn from its original Emerald orebody in the Salmo area, from the Dodger orebody, which was discovered in 1951 about half a mile east of the Emerald, and from the Feeney orebody north of the Emerald.

There are no plants in Canada for the conversion of tungsten concentrates to ferrotungsten, the usual addition agent. However, high-grade scheelite concentrates may be added directly to the steel bath because of the comparative ease with which calcium enters the slag. Atlas Steels Limited, Welland, Ontario, purchases scheelite concentrates carrying a minimum of 60 per cent WO_3 (70 per cent preferred) for the manufacture of alloy steels. Limits on the content of impurities such as sulphur and phosphorus are quite low and frequently concentrates must be chemically treated to meet rigid specifications.

Kennametal Incorporated, Latrobe, Pennsylvania, built an ore-dressing and electric smelting works at Port Coquitlam, British Columbia, to manufacture tungsten carbide. Tungsten concentrates for this plant are obtained from mines in British Columbia. The parent company operates a similar plant at Latrobe and has distributed its products through a Canadian subsidiary, Kennametal of Canada Limited, for many years.

Production, Trade and Consumption

	1952		1951	
	Short tons	$	Short tons	$
Shipments				
Scheelite (gross wt)	1,886	—	1.3	—
Wolframite "	—	—	0.7	—
Total WO_3 content	747	4,488,237	1.4[5]	7,098
Imports, scheelite[1], [2]				
From: Brazil	28	243,527	28	150,493
United States	1	6,190	—	—
Total	29	249,717	28	150,493
Imports, ferrotungsten[3]				
From: United States	190	1,407,586	411	1,978,987
Portugal	33	284,415	17	138,269
United Kingdom	23	114,813	—	—
Other Countries	—	—	76	492,143
Total	246	1,806,814	504	2,609,399
Exports, scheelite, contained W[4]				
To: United States	383	—	—	—
United Kingdom	157	—	—	—
Total	540	—	—	—
Consumption, contained W[4]				
Scheelite	90	—	100	—
Ferrotungsten	165	—	} 190[6]	—
Carbide, powder, wire etc	31	—		—
Total	286	—	290	—

[1] In addition to the imports of scheelite as shown, there was an import shipment of 2,724 short tons valued at $98,401 from Siam.
[2] The WO_3 content of the imports is not known.
[3] The W content of the ferrotungsten imports is not known.
[4] From the Department of Defence Production.
[5] The WO_3 content of two tons of ore.
[6] Ferrotungsten and tungsten powder only.

Production and Developments in Canada

Production

Canadian Exploration, Limited.—On October 1, 1952, this company purchased from the Federal Government the Emerald mine tungsten ore reserves and mill. By December, 1952, treatment rate had risen from about 200 tons per day in January to about 300 tons. Ore reserves are estimated to contain a minimum of 1,000,000 tons averaging just under one per cent WO_3, making this one of the most important sources of tungsten in the free world.

The original Emerald orebody occurs in a limestone-dolomite trough which is underlain by granite. This form of occurrence is typical of scheelite, which is usually found in lime rocks close to a granite contact. The orebodies occur as lenses near the base of the plunging trough and are spread out over a considerable distance somewhat like beads on a string. Paralleling this formation and slightly to the east several flat-lying beds of lead-zinc ore, which extend for almost a mile in length, are found: these bodies constitute the Jersey mine. Underlying the lead-zinc orebody is the company's new Dodger tungsten orebody. Another new orebody—the Feeney—lies north of the Emerald. Scheelite is found in association with quartz and pyrrhotite within the ore zones. Minor pyrite and some molybdenite are also present.

Western Tungsten Copper Mines, Limited.—Western Uranium Cobalt Mines Limited, the above company's predecessor, leased the Red Rose mine south of Hazelton, British Columbia, from Consolidated Mining and Smelting Company in 1951. This mine was operated by the latter company during World War II, and at the time of closing estimated ore reserves amounted to about 15,000 tons averaging 1 per cent WO_3. The mill was rebuilt in 1951 and is rated at 150 tons per day capacity. The company made regular shipments of concentrate throughout 1952 and reported 190,608 pounds of concentrates in the first half of the year. Exploration and development have indicated much higher reserves than were stated in company reports at the time of closing.

Hollinger Consolidated Gold Mines, Limited.—During World War II, this company treated about 53,000 tons of scheelite, from which 266,000 pounds of tungsten were recovered. During 1951, mining and milling of a limited tonnage of scheelite ore was resumed, and shipments to a value of $7,578 were made. Figures on 1952 operations are not available, but additional small tonnages were probably treated. In the Hollinger mine, scheelite occurs in association with gold-bearing zones, in some places in sufficient quantity for the economic recovery of tungsten. During World War II, Hollinger treated ores from several nearby mines for recovery of tungsten.

Scheelite occurs in most of the producing gold mines in Ontario and Quebec, but is seldom found in sufficient quantity to warrant extraction except in times of emergency.

Developments

Black Diamond Tungsten Limited drove an adit on its wolframite occurrence about 12 miles east of Atlin, British Columbia. In 1951, the company, a subsidiary of Transcontinental Resources Limited, reported reserves indicated by trenching and drilling at 281 tons per vertical foot averaging slightly under 1 per cent WO_3 in No. 1 and No. 5 zones combined. In the same province, Tungsten of British Columbia Limited, Cariboo Hudson Gold Mines (1946) Limited, and Major Explorations all reported work on their properties.

Yukon Tungsten Corporation Limited drove an adit on its wolframite prospect near mile 710 on the Alaska Highway. Bordulac Mines Limited drifted on gold-tungsten-bearing veins on its Dasserat township property in Quebec. Carnegie Mines Limited reported surface work on its Tully Lake wolframite occurrence in New Brunswick.

World Production

Annual world production of tungsten declined from the 1943 war-time peak of about 61,000 tons of concentrate containing 60 per cent WO_3 to a low of about 19,000 tons in 1946, when prices dropped to below $18 a short ton unit of WO_3. With higher prices in 1950, world production climbed to an estimated 30,100 tons of concentrate containing 60 per cent WO_3.

In normal times China produced about 60 per cent of the world's requirements, with Korea and Burma providing an additional 15 to 20 per cent. The loss of Chinese and Korean production as a result of the situation in Korea, and that of Burma because of unsettled conditions in that country, has made it necessary for consumers to look elsewhere for supplies. Increased production in recent years has come from the United States, Tasmania, Portugal, Bolivia, and Brazil. Many other countries supply minor amounts of tungsten concentrates. Canada will be among the major suppliers of tungsten when the Emerald, Dodger, and Feeney orebodies, near Salmo, British Columbia, are in full production.

United States production of tungsten concentrates declined from about 11,000 tons WO_3 in 1943 to about 3,000 tons in 1949. From this point production rose to 4,820 tons in 1950 and since then some mines that had been closed down reopened and nearly all of the producing mines increased their production rates. Many companies operate scheelite properties in California and North Carolina, which rank first and second respectively in United States production. Climax Molybdenum Company recovers wolframite as a by-product from its molbdenite mill tailings at Climax, Colorado.

Ores of Tungsten

Wolframite $(FeMn)WO_4$

Wolframite, the principal ore of tungsten, is a dark brown to black, heavy mineral containing 76·4 per cent WO_3 (tungstic oxide) when pure. It has a black to dark reddish-brown streak and occurs frequently in crystals somewhat tabular in shape, or in crystal aggregates. The most extensive deposits are in the Nanling belt in Kiang-si, Kwangtung, and Hunan provinces in China, formerly a source of over 60 per cent of the annual world output. Large deposits of wolframite also occur in Korea and Burma.

Scheelite $(CaWO_4)$

Scheelite is a heavy, fairly soft mineral, usually buff but sometimes white in colour, with a dull lustre, containing 80·6 per cent WO_3 when pure. It is the common ore mineral of tungsten in Canada, but most of the numerous Canadian occurrences are small. Scheelite is commonly associated with quartz and frequently occurs in patches in gold-bearing quartz veins in Canadian gold mines. It can be readily detected in the dark by its brilliant, pale bluish-white fluorescence under ultra-violet light. When scheelite occurs in quartz it can be identified in the field by its colour (usually buff), heavy weight, and its relative softness (it can be scratched with a knife). Iron-stained white rocks, particularly quartz, might be mistaken for scheelite, but quartz will scratch glass while scheelite will not. Brownish-buff ankerite (iron carbonate) and buff calcite might be mistaken for scheelite, but both effervesce when pulverized and treated with hydrochloric acid. Massive, white scheelite closely resembles barite, which is also a heavy, relatively soft mineral.

Uses

Tungsten, in its major uses, has no satisfactory substitute; above all other ferro-alloying metals it is indispensable in its military applications. It is used chiefly as an alloy ingredient in the manufacture of high-speed tool steels such as are necessary in the production of precision military equipment. It is the hardest metal used by industry, and the ability of its alloys to retain this hardness even at high heat makes it invaluable in high-speed cutting tools. Tungsten-steel tools maintain a sharp cutting edge at working temperatures far above those that ruin carbon-steel tools.

The use of tungsten alloys in gas-turbine and jet-propulsion applications is due to its ability to give increased strength at high operating temperatures as well as an increase in corrosion resistance. Tungsten carbide cores are used in the manufacture of armour-piercing shells, particularly anti-tank projectiles, as this material maintains its hardness even at a bright-red heat.

The pure metal is used for lamp filaments, and in contact points for electrical circuits in many devices such as aeroplane magnetos, telephones, and thermostats. It enters into the manufacture of armour-plate, propeller blades, and armour for submarine cables. Its compounds are used to flameproof and waterproof materials. Tungstic acid is one of the ingredients used in processing toluol to TNT.

Stellite, a non-ferrous alloy, contains 10 to 15 per cent tungsten with higher percentages of chromium and cobalt, and is manufactured in Canada by Deloro Smelting and Refining Company Limited at Deloro, Ontario. The rapid expansion in the manufacture of tungsten carbide for drill bits used in mining and excavation work requires increasingly large amounts of tungsten.

Prices

Prices of WO_3 per short ton unit have varied from a low of about $8.00 to nearly $70 during the 1910-1950 period. The United States in 1951 established floor and ceiling prices of $60 and $65 respectively per short ton unit of WO_3 on domestic ores for a guaranteed period of time. These prices were responsible for lifting world tungsten prices to comparable levels until late in 1952, when the improved supply situation brought about lower prices in world markets. During 1952 the Defence Materials Procurement Agency in the United States entered into some long-term purchase agreements with producers at prices ranging from $55 to $60 per short ton unit of WO_3.

Prices of tungsten ores (scheelite and wolframite) are quoted on the basis of contained short ton units of WO_3 (a short ton unit—20 pounds—of WO_3 contains 15·86 pounds of tungsten). A short ton of 70 per cent concentrates would therefore contain 1,400 pounds, or 70 units, of WO_3 and, at a quoted price of $65, would bring 70 x 65, or $4,550. An ore containing 0·9 per cent WO_3, assuming 80 per cent extraction, would be worth 0·9 x 0·80 x 65, or $46.80 per ton.

According to the E and M J Metal and Mineral Markets of December 25, 1952, the United States prices of tungsten, as concentrate, metal, and addition agent were as follows:—

Tungsten ore:	per short ton of WO_3 domestic concentrates of known good analysis, basis 60 per cent; ceiling price established at $65, effective April 6, 1951.
	Foreign ore prices, nominal. Ore for forward delivery $51.50 to $52.50 per short ton unit, f.o.b. port of shipment.
	Western high-grade scheelite concentrate, $65 per unit, f.o.b. mine.
	North Carolina, high-grade concentrate, $65 per unit, f.o.b. mine.
Tungsten metal:	per lb. 98·8 per cent min., 1,000 lb. lots $5.85. Hydrogen-reduced 99·9 per cent plus, $7.75.
Ferrotungsten:	per lb. of W. contained, 75-85 per cent W, $4.85

Tariffs

The tariffs on tungsten and tungsten products entering Canada and the United States are as follows,—

Canada
Tungsten ore, metal, or acid—free

United States
Tungsten ore or concentrate 50 cents per lb. on W content.

Ferrotungsten and all alloys of tungsten 42 cents per lb. on W content and 12½ per cent ad valorem.

Tungsten carbide, tungsten metal, and combinations or mixtures containing tungsten carbide or tungsten, 42 cents per lb. on W content and 25 per cent ad valorem.

URANIUM*

Figures for production of uranium in Canada may not be published, but the following account of the main activities for the year is presented.

The outstanding feature of the year was the great amount of work done in preparing the Ace mine of Eldorado Mining and Refining Limited, north of Lake Athabasca in Saskatchewan, for production, which is expected to commence in April, 1953, and the large amount of work done by private companies in the same region. Important work was also done in several other parts of the country.

At the end of 1952 it was estimated that 645 radioactive properties or unstaked occurrences were known in Canada. By far the greater part of these contain uranium rather than thorium. Some properties contain many individual occurrences, and the total number of such occurrences is estimated to be more than 3,000. Too much importance should not be attached to the large totals because many of the occurrences may be of doubtful value, although a reasonable number are worthy of exploration and doubtless some will eventually be productive. The large total of known deposits indicates that a mere uranium discovery is no longer newsworthy. In fact, some of the discoveries that in the past have received greatest publicity have proved to be insignificant, and a few were based only on the use of faulty Geiger counters.

Saskatchewan

Goldfields Region

The Goldfields (Beaverlodge) region, immediately north of Lake Athabasca, was the most active uranium area in Canada in 1952. The chief operation was that of the government-owned Eldorado Mining and Refining Limited, where about 800 men were employed underground and in surface construction in preparation for production in 1953. Underground exploration was carried on at 6 privately owned properties, and diamond drilling at 21. New pitchblende discoveries were made on at least 16 other private properties staked during the year, chiefly in the Milliken Lake part of the region.

A feature of the year was the termination of the concession system in the district. In 1949 the Saskatchewan Government withdrew the unstaked part of the Goldfields region from staking, and issued concessions to expire March 31, 1952, after which the holders of concessions were to be allowed to

* Much of the information in this review is contained in a paper by the author presented at the annual western meeting of the Canadian Institute of Mining and Metallurgy in Winnipeg in October, 1952.

retain part of the ground as claims, and the remainder was to be opened for general staking. Some of the concessions were abandoned prior to the end of March, 1952, and on August 4 of that year the ground not retained by the concession holders was opened for general staking. About 1,000 claims were staked, bringing the total number in the region to about 3,000, in about 175 groups. There has not been time for the new owners to do much work, but a few discoveries have been reported on some of the recently staked claims.

Freight for the area proceeds from the railhead at Waterways by barge along the Athabasca River to various points on Lake Athabasca. A twelve-mile road from Black Bay to the Eldorado camp at Beaverlodge Lake was built in 1951 by the Saskatchewan Government, and branch roads to several of the main properties have been constructed. The Federal Department of Transport built a large air-strip near Beaverlodge Lake in 1951, and regular passenger, express, and freight services are now in operation.

Three new communities are growing up—one at the Eldorado camp, one, named Bushell, at Black Bay, and the townsite of Uranium City laid out about midway between them by the provincial authorities.

Eldorado Properties

The Eldorado company has about 200 claims in the Goldfields region. Most of these are in a large block extending about 9 miles along the St. Louis fault which, to date, is the most important structural control of mineralization in the district. In previous years the company did much prospecting and diamond drilling, which resulted in many pitchblende discoveries. The total of drilling on all Eldorado holdings in the district, including that done in 1952 and including drilling from underground workings as well as from the surface, is about 200,000 feet. Three of the main groups of showings were explored underground in previous years; the Martin Lake showings, near the west end of the main block of claims, were explored from an adit in 1948 and 1949; underground work on the Ace showings has been done continuously since late 1949, when sinking of an inclined shaft was begun; and the Eagle showings were explored from a shaft in 1950 and 1951. The work at the Ace was particularly encouraging, resulting in the discovery of two main orebodies, the west one being the larger. The company announced in 1951 that it was possible to forecast an operation with a minimum of 500 tons a day, with good prospects of a larger tonnage. Plans were then made to deepen the Ace shaft to permit exploration below the second level, to sink an operating shaft, and to build a treatment plant.

Much work has been done on two other promising zones in the vicinity—the Fay zone, about 3,000 feet southwest of the west end of the main Ace zone, and the Ura, a little west of the Fay. Diamond drilling gave such favourable indications that a five-compartment shaft, the Fay, has been sunk, and lateral work to explore the Fay zone is in progress. The Fay shaft is being connected with the Ace mine at the sixth level, with a view to making the Fay the hoist shaft, the Ace will then be used as a service shaft. Construction of the necessary buildings and treatment plant at the Fay site is well advanced.

The showings at Martin Lake are being actively developed. The ore will be trucked to the Ace plant for treatment.

Private Properties.

In previous years underground exploration was done at two separate places on the Nicholson property, at the Eagle-Ace property of Nesbitt-LaBine Uranium Mines Limited, and on the Leonard showings of Rix Athabasca Uranium Mines Limited. Of these, only the Eagle-Ace was explored in 1952. Rix Athabasca Uranium Mines sank a shaft to permit exploration of its Smitty showing on two levels; this showing is about a mile north of the Leonard adit. Nesbitt-LaBine Uranium Mines began an adit on its ABC claims near Melville Lake. These claims include the Nesbitt showing, and the adit was planned to explore beneath this showing at a depth of about 225 feet. Late in 1952, pitchblende was reported to have been intersected about 750 feet from the portal.

Consolidated Nicholson Mines Limited announced recently that work done before operations were suspended indicated that available ore in the No. 4 shaft area amounted to 12,209 tons having an average uranium oxide content of 0·34 per cent (uncut) or 0·24 per cent (cut). The company stated that it hoped to mine this ore and ship it to the Eldorado plant for treatment, and that additional exploration would be done when operations were resumed.

Beaverlodge Uranium Mines Limited, Pitch-Ore Uranium Mines Limited, and National Explorations Limited reported late in 1952 that underground exploration had begun on their Bar, Pitch-Ore, and Pat groups, respectively.

Deposits on 23 privately owned properties were diamond drilled in previous years. Drilling was continued on 10 of these properties in 1952, and was commenced on 11 additional properties. Much of this drilling was done close to the St. Louis and Black Bay faults. The properties drilled in 1952 were the ABC, Alan & Gail, Ath, Bar, Chum, Ed-Bon, Ed & Tom, Ike, Jam, Mike, Pat, Pitch-Ore, Radiore, Row, and WW claims groups, and the following former concessions, CC-1, CC-2, CC-3, FF-1, MM, and PP.

Much staking and prospecting were done in the Milliken Lake section of the Goldfields region and discoveries were reported to have been made on 14 claim groups. Milliken Lake is in the centre of Crackingstone peninsula, which lies between the Lodge and Black bays of Lake Athabasca. The concessions that formerly covered this peninsula were abandoned some time ago and prospectors were free to stake there in 1951, when a few claims were recorded. Almost the entire peninsula and neighbouring islands are now staked. Late in 1952 diamond drilling was begun on the Ed-Bon group of Gunnar Gold Mines Limited.

Stony Rapids-Porcupine River Region.

In this region, about 120 miles east of Goldfields, the main activities were in the Charlebois Lake section, and at Middle Lake, near Stony Rapids.

At and near Charlebois Lake several deposits of uraninite-bearing pegmatite and migmatite have attracted attention because they are large and because the average uranium content appears to be greater than that of most pegmatites. Diamond drilling of some of the deposits was continued this year by Charlebois Lake Uranium Mines Limited and Dee Explorations Limited. The former stated recently that work on its main properties, the Row and Mike groups, indicated 3,445 tons per vertical foot, averaging 0·076 per cent U_3O_8 equivalent, for an average width of 32·6 feet. The company intends to continue exploration of these deposits next season.

At middle Lake an unusal deposit consisting of autunite in sandstone of the Athabasca series was found late in 1951 and was diamond drilled by Dee Explorations Limited in 1952.

The Nisto property at Black Lake was inactive during the year.

La Ronge Region.

Diamond drilling was continued by La Ronge Uranium Mines Limited on showings on its former concession north of Lac la Ronge. The company staked a large block of claims covering parts of this concession.

In September, 1952, a discovery was reported to have been made near Nunn Lake, which is north of Lac la Ronge. A discovery known as the Claus and Ford was reported from this locality in 1949 and the new discovery is understood to be on the same ground. This property has been acquired by La Ronge Uranium Mines Limited.

Northwest Territories

The centre of activity for uranium in the Northwest Territories is the Eldorado mine at Port Radium, Great Bear Lake. The crushing plant and concentrator were destroyed by fire in November, 1951, but were rebuilt quickly despite severe winter handicaps. A leaching plant for treating tailings, and a plant for making acid, were completed in the spring of 1952. It was reported that the new mill and leaching plant would probably increase production by 75 per cent.

In its 1951 annual report, the company states that ore reserves are being well maintained, and that there are significant indications of new orebodies on the tenth and eleventh levels of No. 2 vein. An internal shaft is being sunk to explore these indications at depth. The company is continuing the diamond drilling and underground developement of the three claims held by Ventures Claims Limited that are contiguous to Eldorado's Port Radium property, by arrangement with their owners.

At Hottah Lake, about 60 miles south of Great Bear Lake, Indore Gold Mines Limited did underground exploration on its Pitch 8 group, where pitchblende was found along the contracts of a diabase dyke. Driving of an adit to explore this showing was begun in 1951 and three bulk samples taken underground are reported to have shown 0·27, 0·24, and 0·25 per cent U_3O_8. A total of 622 feet of drifting and crosscutting was reported. The company stated recently that radioactivity had been noted along a second dyke that had been traced on the surface for more than 500 feet. Machinery for a 20-ton mill was transported to the property in 1951 and assembled in 1952. The company stated that production was begun late in 1952 and that it intended to increase the capacity to 50 tons a day.

In August, 1952, Ridley Mines Holding Company began underground exploration of the "C" vein on its Rex property, near the East Arm of Great Slave Lake. An adit was driven for about 100 feet to intersect the vein about 40 feet below surface, and drifting along the vein was reported to have begun. In the same region, Radiore Uranium Mines Limited recently announced a pitchblende discovery on the Stark group, which is under option from Basile Bay Base Metal and Uranium Development Company. A channel sample across 9·2 feet is reported to have shown 3·36 per cent U_3O_8, 0·36 per cent cobalt, 0·30 per cent copper, and 0·23 per cent nickel. Radioactivity surveys and trenching have begun. The Stark group is understood to be restaking the Rag group, where pitchblende was found a few years ago. Also in the same region, American Yellowknife Gold Mines Limited optioned the G. M. group and began surveys and trenching on a uranium discovery made a few years ago.

British Columbia

Surface work and diamond drilling were done at the Rexspar property about 70 miles north of Kamloops. The Rexspar group of 90 claims includes the former Smuggler property, where fluorite-celestite showings were drilled in 1942. Occurrences of uraninite and bastnasite were found more recently and the property is being drilled and bulk sampled in the hope of establishing a combined fluorite-uranium-rare earths operation. Exploration was also reported to have been done on a radioactive discovery on the Verity group, 23 miles north of Blue River. Some uranium has been found at the Red Rose and Rocher DeBoulé mines in the Hazelton area, and although the main efforts have been toward the production of tungsten at the former and of copper at the latter, some attention has been paid to the possibility of recovering uranium.

A few discoveries were reported from other parts of the province, chiefly the Lardeau region.

Manitoba

In previous years discoveries of radioactive pegmatites were reported from Herb Lake, Manigotagan, Bird River, and Rennie regions, but no work was reported in 1952. A few additional pegmatitic discoveries were reported from Manitoba in 1952, chiefly from the Herb Lake region, where encouraging results were reported from surface sampling of a pegmatitic contact zone on the Gamma group.

Ontario

There was much less activity in 1952 than during the previous few years. Nothing more than assessment work appears to have been done in the Sault Ste. Marie region, where about 5,000 claims were staked in recent years following the discovery of pitchblende at the Camray property in 1948. Many pitchblende occurrences were found in the region during the next few years, and three were explored by substantial amounts of underground work and were afterwards closed. This has led to at least a temporary decline in activity in the region and the mining recorder at Sault Ste. Marie stated recently that about 3,000 of the claims have been abandoned.

Several prospectors and companies were active in the Grenville sub-province of the Canadian Shield, which lies east of Georgian Bay. This region is noted for the occurrence of numerous radioactive pegmatites, and a few additional occurrences were reported during 1952. Two deposits found in other years near Wilberforce were diamond drilled, interest being taken in the rare earths content of the deposits as well as in the uranium content. Near Bancroft, diamond drilling was done on the property of Faraday Uranium Mines Limited, and detailed surface work was begun on the Kemp and Burns properties. In November, 1952, a discovery on the Manitou Islands in Lake Nipissing was announced, and Inspiration Mining and Development Limited was said to have acquired an interest in the property.

Quebec

The Grenville sub-province continues in Quebec, north of the Ottawa and St. Lawrence Rivers, and like its counterpart in Ontario contains many occurrences of radioactive pegmatite. One of these, the old Maisonneuve mine 110 miles north of Montreal, was reported to have been explored by bulldozing and trenching. This property is now held by South State Uranium Mines Limited.

In the Gaspé region, further surface exploration was reported to have been done on the Cross Point property where pitchblende was found a few years ago in a lead-silver deposit.

ZINC

Canada's production of 371,802 tons of zinc in 1952 showed an increase of 9 per cent over 1951, owing chiefly to new or increased production of zinc concentrates from mines in eastern Canada. The production of 223,139 tons of slab zinc by Canada's two electrolytic refineries was also slightly greater than in the preceding year. Export of refined zinc was about 14 per cent greater than in 1951, while the export of zinc contained in ore and concentrate was greater than in any preceding year. Domestic consumption, however, was less.

Commencing in May, the price of zinc declined steadily from about 20 cents a pound to 12 cents a pound in December. Reduced prices had an adverse effect on exploration and development generally, but nevertheless several new mines came into production and one new orebody of significant importance was located.

Production, Trade and Consumption

	1952		1951	
	Short tons	$	Short tons	$
Production, all forms[1]				
British Columbia	174,288	60,861,359	168,756	67,164,754
Quebec	94,898	33,138,567	86,363	34,372,439
Saskatchewan & Manitoba	61,784	21,574,670	54,685	21,764,530
Newfoundland	30,517	10,656,475	28,469	11,330,799
Yukon	5,535	1,932,853	2,839	1,130,121
Nova Scotia	4,408	1,539,298	—	—
Ontario	372	130,063	—	—
Total	371,802	129,833,285	341,112	135,762,643
Production, slab zinc[2]	223,139	—	218,578	—
Exports, refined metal				
To: United Kingdom	87,167	33,455,858	55,415	20,432,293
United States	70,934	23,188,461	84,281	30,925,225
France	3,372	1,547,493	1,626	941,978
India	2,681	1,505,112	1,949	1,224,559
Other countries	2,710	1,613,049	2,861	1,899,714
Total	166,864	61,309,973	146,132	55,423,769
Exports, ore[3]				
To: United States	149,223	28,231,783	94,530	14,087,417
United Kingdom	13,544	3,046,185	31,978	7,376,617
France	11,796	1,742,417	2,364	561,848
Belgium	7,191	1,471,341	9,679	2,185,199
Other countries	—	—	16,042	2,942,014
Total	181,754	34,491,726	154,593	27,153,095
Exports, scrap, dross and ashes (gross weight)				
To: United States	3,036	427,363	209	30,362
Belgium	444	37,607	1,785	325,805
United Kingdom	49	5,494	100	21,654
West Germany	25	7,017	36	26,288
Other countries	73	4,271	2,380	687,861
Total	3,627	481,752	4,510	1,091,970

Production, Trade and Consumption—continued

	1952		1951	
	Short tons	$	Short tons	$
Exports, zinc manufactures				
To: United States	—	204,650	—	543,326
Other countries	—	215,346	—	237,849
Total	—	419,996	—	781,175
Imports, zinc and zinc products				
Blocks, pigs, bars, plates	—	194,032	—	665,381
Strip, sheets	—	421,759	—	1,063,228
Dust	—	113,957	—	121,993
Zinc manufactures N.O.P	—	1,777,968	—	2,003,771
Slugs or disc	—	332,612	—	407,005
Zinc chloride	—	22,171	—	51,132
Zinc sulphate	—	143,394	—	189,449
Zinc white	—	226,247	—	220,021
Lithopone	—	481,466	—	1,189,717
Total	—	3,713,606	—	5,911,697
Consumption[4]				
Electro-galvanizing	422	—	924	—
Hot-dip galvanizing	22,843	—	22,505	—
Zinc diecasting alloys	7,887	—	11,538	—
Brass and bronze	11,992	—	10,858	—
Other alloys	1,793	—	926	—
Rolled and ribbon zinc	1,257	—	2,975	—
Zinc dust	—	—	158	—
Zinc oxide	5,189	—	9,748	—
Miscellaneous	326	—	1,166	—
Total	51,709	—	60,798	—

[1] Includes zinc estimated as recoverable from concentrate exported.
[2] Includes zinc recovered from imported concentrate.
[3] Zinc contained in ore and concentrate exported.
[4] Consumption 1951 revised; 1952 figures preliminary.

Developments at Producing and other Properties

British Columbia

The output of 161,357 tons of refined zinc by The Consolidated Mining and Smelting Company of Canada Limited at Trail was 3,156 tons less than in 1951, owing chiefly to power shortage caused by drought in the last part of the year. An addition to the electrolytic zinc refinery designed to increase the daily output capacity from 425 tons to 490 tons was almost completed. The company's Sullivan lead-zinc mine at Kimberley continued to supply most of the zinc concentrate treated at Trail, 2,699,533 tons of ore being milled compared with 2,533,212 tons in 1951. A considerable part of the ore came from new open-pit operations designed to recover large pillars which were left during former mining of the upper levels. The company's Bluebell mine on Kootenay Lake was brought into production in April at a rate of 500 tons a day to produce lead and zinc concentrate for shipment to Trail, and the construction of a 1000-ton concentrator at its H. B. mine near Salmo neared completion. On the west coast, Tulsequah Mines Limited, subsidiary of Consolidated Mining and Smelting, increased the capacity of the mill used to treat ore from the Tulsequah Chief and Big Bull zinc-copper-lead mines to 500 tons a day.

Owing to power shortage, Consolidated Mining and Smelting did not accept for custom treatment as high a percentage as usual of the zinc concentrate production from British Columbia mines, with the result that exports to zinc plants in the United States were higher. The following were among the more important zinc concentrate producers:—

Company	*Mine location*
Britannia Mining and Smelting Company Limited	Howe Sound
Canadian Exploration Limited	near Salmo
Reeves MacDonald Mines Limited	near Salmo
Sheep Creek Gold Mines Limited (Zincton)	Slocan District
Sheep Creek Gold Mines Limited (Paradise)	near Invermere
Base Metals Mining Corporation Limited (Field)	Field
Base Metals Mining Corporation Limited (Cork Province)	near Kaslo

Mastodon Zinc Mines Limited, near Revelstoke, constructed a new 150-ton mill and commenced production in August. However, operations were suspended early in 1953.

Sunshine Lardeau Mines Limited, at Camborne, brought the Spider lead-zinc mine into production in May after completing the installation of a 50-ton mill.

In the Portland Canal district the property of Indian Mines (1946) Limited was brought into production by Silbak Premier Mines, Limited. The lead-zinc ore was treated in the Silbak Premier mill two miles distant from the property.

Manitoba and Saskatchewan

Hudson Bay Mining and Smelting Company, Limited, together with its subsidiary Cuprus Mines Limited, produced 61,783 tons of refined zinc at its electrolytic zinc plant at Flin Flon. This was about 7,000 tons more than was produced in 1951, the increase being due to the output of zinc oxide from a new slag-fuming plant which was put into operation in 1951. The slag-fuming plant treats zinc-bearing slag from the copper smelter, the zinc content of which is enriched by the addition of zinc plant residue containing about 25 per cent zinc. Zinc oxide fume containing 25,732 tons of zinc was produced and delivered to the zinc plant. At the company's mine, which straddles the Manitoba-Saskatchewan boundary at Flin Flon, 1,559,081 tons of copper-zinc ore were hoisted; 118,610 tons of zinc concentrate were produced, compared with 137,963 tons in 1951.

Underground development at the company's Schist Lake copper-zinc mine 3½ miles south of Flin Flon was continued, and about 3,800 tons of development ore was shipped to the concentrator at Flin Flon. Hudson Bay Mining and Smelting is developing several other deposits in the Flin Flon area, but these are reported to be essentially copper orebodies containing little or no zinc.

At Cuprus Mines Limited, 7½ miles northeast of Flin Flon, 85,955 tons of ore were milled and 8,460 tons of zinc concentrates were shipped to the zinc plant at Flin Flon.

Ontario

Matarrow Lead Mines Limited, near Matachewan, was brought into production in June under the operational control of Matachewan Consolidated Mines Limited. A relatively small quantity of lead and zinc concentrates was produced from Matarrow ore in the Matachewan Consolidated mill. The operation was found to be uneconomic and the property was closed late in the year.

Ontario Pyrites Company Limited carried out extensive underground and diamond drilling exploration at its Errington and Vermilion Lake properties 18 miles northwest of Sudbury. Over 4,000,000 tons of ore averaging 3.7 per cent zinc and 1·3 per cent copper were outlined at these properties. Metallurgical tests are being carried out on the ore to determine the most suitable method of treatment.

Geneva Lake Mines Limited installed a 150-ton mill at its zinc-lead property at Lake Geneva 40 miles northwest of Sudbury. Commencement of production was deferred, however, pending an improvement in metal prices.

Quebec

Zinc concentrates, as well as concentrates of copper or lead, were produced by the following companies.

Company	*Mine location*
Anacon Lead Mines Limited	Portneuf county
Ascot Metals Corporation Limited	Sherbrooke
Barvue Mines Limited	Abitibi county
Consolidated Candego Mines Limited	North Gaspé county
East Sullivan Mines Limited	Abitibi county
Golden Manitou Mines Limited	Abitibi county
New Calumet Mines Limited	Pontiac county
Normetal Mining Corporation Limited	Abitibi county
Quemont Mining Corporation Limited	Abitibi county
Waite Amulet Mines, Limited	Abitibi county
Harrison Drilling and Exploration Company Limited	Abitibi county

Barvue Mines Limited, near Barraute in western Quebec, commenced tuning in its new 6000-ton concentrator in November at about 50 per cent capacity. The Barvue deposit, estimated to contain 18,000,000 tons averaging 3·3 per cent zinc, is being mined by open-pit methods.

Normetal, as a result of the development of several of its ore zones containing relatively high zinc values, was the largest zinc producer in the province in 1952, with an output of 21,833 tons of zinc contained in concentrate.

Waite Amulet commenced stoping in its new East Waite mine in May, and production from this section of the property amounted to 900 tons a day in December. The company produced 16,033 tons of zinc contained in concentrate from 240,511 tons of ore.

Harrison Drilling and Exploration Company suspended production from a small zinc orebody on the property of Eldona Gold Mines Limited in August.

Normal production was maintained at the other mines noted above, most of which exported their zinc concentrate to the United States.

Adjoining the north of Anacon Lead Mines property, United Lead and Zinc Mines Limited and Montauban Mines Limited jointly completed the construction of a 500-ton capacity mill and sank a shaft to a depth of 510 feet. Production of zinc concentrate at these properties, originally scheduled to commence in January 1953, was deferred.

In North Gaspé county, Federal Metals Corporation continued exploration on some of the many zinc-lead occurrences on its extensive property. Hydro-electric power was expected to be available at this property by 1955.

New Brunswick

The discovery of a large deposit averaging 5 per cent zinc with small amounts of lead, copper, and tin was made by M. J. Boylen interests of Toronto, adjoining a previously worked iron ore deposit about 17 miles southwest of Bathurst. Brunswick Mining and Smelting Corporation Limited was formed to develop the property.

To the north and west of Bathurst, exploration of a number of zinc-lead-copper occurrences was continued with encouraging results.

Nova Scotia

Mindamar Metals Corporation Limited revived production at the Stirling mine near St. Peters, Cape Breton Island, which had been idle about 20 years. A new 500-ton mill was constructed and put into operation in April The mine workings were deepened from 500 feet to 1000 feet.

Minda-Scotia Mines Limited suspended underground exploration of its zinc-lead property in Colchester county.

Newfoundland

Buchans Mining Company Limited, at Buchans in the central part of the province, milled 330,500 tons of ore and produced 63,000 tons of zinc concentrate containing 56 per cent zinc. A substantial portion of the ore output came from the new Rothermere shaft area of the property.

Northwest Territories

Pine Point Mines Limited, a subsidiary of Consolidated Mining and Smelting continued the exploration of its large zinc-lead deposit at Pine Point. Encouraging results were obtained from more closely spaced drilling and the sinking of an exploration shaft was started. A 70-mile truck road was built to connect the property to the Mackenzie highway at Alexandra Falls.

On the B.B. property north of McLeod Bay, Great Slave Lake, Joe Indian Mountain Metal Mines Limited was reported to have outlined by exploratory drilling over one million tons of ore averaging 10 per cent zinc.

American Yellowknife Mines Limited sank a shaft to a depth of 170 feet and made a small test shipment of development ore from its lead-zinc property at O'Connor Lake. Operations were suspended in December.

Yukon

United Keno Hill Mines Limited, Mayo district, increased its production of lead and zinc concentrate. Substantial reserves of high grade ore were established in new deeper levels at the Hector mine. Considerable development was carried out at a number of other mines within the company's extensive property.

Hudson Bay Exploration and Development Company, Limited diamond-drilled a large silver-lead-zinc deposit on the Canol Road with encouraging results. Exploration of this property, known as the Tom claims, will be continued.

Uses

Of the wide range of industrial uses for zinc the more important are galvanizing, die-casting, and the manufacture of brass products. In the United States about 833,000 tons were consumed in 1952; in the United Kingdom, the second largest consumer, 255,604 tons were used.

92728—7½

Zinc is marketed in grades which vary according to the content of impurities such as lead, iron, and cadmium. In North America the principal grades produced are "Special High Grade", used chiefly for die-casting; "Regular High Grade", used for brass manufacture, and "Prime Western", used for galvanizing. In Canada, zinc is refined by the electrolytic process only, by which most "Special" and "Regular High Grade" zinc is produced. To fill orders for "Prime Western", Canadian producers debase the product by the addition of lead to meet consumer's specifications.

Galvanizing is the application of a thin coating of zinc to iron or steel to prevent rust corrosion. The zinc is usually applied by hot-dipping methods, but for certain purposes electro-plating is used.

Zinc-base alloys are used extensively for die-casting complex shapes, especially automobile parts. They are prepared from special high grade electrolytic 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.

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 dry-cell battery cups, also for articles exposed to corrosion, such as weather-stripping, fruit-jar sealer rings, boiler plates, and hull plates: zinc wire is used in making brake linings. Zinc dust is used to precipitate gold and silver from cyanide solutions, in making zinc salts and compounds, in purifying fats, and in making dyes. Zinc oxide is used in compounding rubber and in making paint, ceramics, inks, matches, and many other commodities. Among the more industrially important compounds of zinc are the carbonate, chloride, stearate, sulphate, and sulphide, as well as lithopone, a mixture of zinc sulphide and barium sulphate.

Prices

During 1952 the Canadian price of Ordinary Electrolytic (Regular High Grade) zinc decreased from 21·35 cents a pound in January to 13·55 cents a pound in December. Prime Western grade zinc decreased in price over the same period from 20·00 cents to 12·20 cents. The average price of all zinc in Canada, as computed by the Dominion Bureau of Statistics, was 17½ cents a pound.

INDUSTRIAL MINERALS

ABRASIVES (NATURAL)

(1) Corundum

Corundum consists of aluminum oxide (Al_2O_3) and is, with the exception of the diamond, the hardest mineral known. There has been no production in Canada since October, 1946, when treatment of the tailings at the disposal dump on the Craigmont property, Renfrew county, Ontario, was completed. From 1944 to the close of operations, approximately 2,600 tons of concentrate containing 1,726 tons of fine corundum were shipped to American Abrasive Company at Westfield, Mass., the only dealer in natural corundum in North America.

Several deposits containing corundum are known to occur in the nepheline syenite belt, which is about 100 miles long and six miles wide and crosses Haliburton, Hastings, and Renfrew counties in eastern Ontario. However, these deposits are small and scattered, with a corundum content rarely reaching ten per cent or averaging more than five.

In 1951 Ortona Gold Mines Limited, Toronto, optioned the Monteagle property, on which occurs a large deposit of a nepheline-feldspar mixture containing, according to engineer's reports, about 5 per cent fine-grained corundum and some fine muscovite mica. The deposit outcrops on the east bank of the York River in Monteagle township, about 9 miles northeast of Bancroft, eastern Ontario. Towards the end of 1951 beneficiation test work to obtain clean, marketable products was begun by Ortona in the Mines Branch laboratories. The testing of this material was continued in 1952.

Production and Trade—Corundum

Canada imported 125 tons of corundum, valued at $31,066 and ranging from fine to coarse grain, in 1952, compared with 80 tons valued at $19,907 in 1951. Imports enter Canada via United States from the Transvaal, Union of South Africa, the chief world producer for the past 30 years.

Uses and Prices—Corundum

Grain corundum is used in making grinding wheels, and very coarse grain is used in 'snagging' wheels. Both types of wheels are used in the metal trades, where the hardness of corundum, coupled with its characteristics of fracturing into sharp cutting edges, makes it an ideal cutting tool. The finest corundum (flour grades) is used for fine-grinding lenses.

Quotations on crude corundum imported into United States varied from $90 to $110 per ton, according to grade. A minimum corundum (Al_2O_3) content of 90 per cent is desired. Prices of prepared grain vary considerably according to mesh size, and during 1952 remained at levels that prevailed the previous year, namely: for natural corundum, per pound, size 8 to 60 inclusive, 8½ cents; 70 to 275, 9½ cents; 500, 28 cents; 850 to 1000, 45 cents; 1,200 to 1,600, 65 cents; and 2,600, 70 cents.

(2) Emery

True emery is an intimate mixture of corundum and magnetite, with or without hematite, and varies in hardness and toughness according to the amount of iron oxides present. Emery is massive, nearly opaque, and dark grey to blue-black with a reddish tint depending upon the amount of hematite present. The iron oxide is physically inseparable from the corundum, and while it detracts from the efficiency of emery as an abrasive, it adds to its polishing action. The grain shape of emery is more or less round and for this reason its cutting action is slight: it is, in fact, more of a polishing agent than a cutter.

Commercial emery has not been found in Canada, although some deposits of corundum east of the Madawaska river in Ontario are so intimately mixed with magnetite that they are practically a coarsely crystalline emery.

The three main emery-producing countries of the world are Greece, Turkey, and United States. Grecian (or Naxos) emery contains approximately 65 per cent corundum with about 25 per cent iron oxides, mostly magnetite. Turkish emery approaches that produced in Greece in corundum content and quality. American emery, most of which comes from the states of New York and Virginia, and is the softest of the three, contains about 45 per cent of iron oxide.

Total Canadian imports of emery in bulk, crushed, or ground state amounted to 599 tons valued at $54,566 in 1952, compared to 461 tons valued at $50,624 in 1951. A large part of the United States production of about 5,000 tons a year is consumed as the 'nonskid' agent in concrete and asphalt floors in industrial plants owing to its marked resistance to wear and its non-skid nature. The balance of the output, together with imports from Greece and Turkey, is used in abrasive products such as grinding wheels, abrasive sticks, and coated papers.

American first-grade emery ore in 1952, f.o.b. New York, was priced at $12 per ton, and grain emery f.o.b. Pennsylvania, at 10 cents per pound for Turkish and Naxos grain, and 6½ cents per pound for American grain. These prices were the same as in 1951.

(3) Garnet

Over 85 per cent of the world output of garnet comes from deposits which are owned and operated by Barton Mines Corporation near North Creek, New York. The product from these deposits is regarded as the world standard for abrasive garnet. Production in United States has averaged about 8,000 tons of all grades during the past few years.

Niagara Garnet Company, Limited owns a garnet deposit near River Valley, Ontario, that has been operated intermittently over the past several years. Production has been small and has amounted to only a few tons of flour grades and graded grain which have been sold to United States consumers. The garnet, which is found in a band of mica schist, occurs in crystals ranging from ¼ inch to 4 inches in diameter. Preliminary concentration by crushing and trommel-screen sizing is done at the pit site. This concentrate is trucked to Sturgeon Falls, 40 miles away, where it is prepared for market by crushing and sizing to garnet grain or to flour grades of garnet. The quarry was not operated in 1952.

Consumption and Uses—Garnet

Canadian consumption of garnet grain, for making 'sandpapers' has risen to about 450 tons annually from the 350-400 tons consumed a few years ago.

The Canadian manufacturers of garnet abrasive papers import graded grain from the United States. In 1952, the three companies that manufactured such papers were: Canada Sandpapers Limited, Preston, Ontario; Minnesota Mining and Manufacturing Company, Ltd., London, Ontario; and Behre-Manning Company, Limited, Brantford, Ontario. The last two companies continued garnet paper manufacture following the breakup of Canadian Durex Abrasives Company, Ltd., which in former years manufactured garnet papers in the Brantford plant that is now operated by Behre-Manning.

Consumers in the United States over the past several years have used from 6,000 to 8,000 tons annually of all types. Most garnet produced is used for making coated abrasive papers, but the use of garnet in sandblasting is increasing. Flour grades (minus 350 mesh) are used in fine-grinding precision lenses.

Prices—Garnet

The cost of ungraded garnet concentrates suitable for sandpapers was about $95 per ton f.o.b. New York at the end of 1952. Prices of other garnet products ranged up to $160 per ton, with the superfine powders in 5 to 10 micron size used for lens grinding selling for approximately $200 per ton. These prices were the same as in 1951.

(4) Grindstones, Oilstones, Pulpstones, etc.

Materials suitable for these stones occur in certain sandstone beds in Nova Scotia, New Brunswick, and on the coast of British Columbia. Although many years ago the output was considerable, it is now small, because demand is almost negligible owing mainly to competition from artificial abrasives.

Read Stone Company, Limited, of Sackville, New Brunswick, has quarried small amounts of stone from its quarries near Stonehaven in recent years. Bay of Chaleur Grindstone Company at Clifton, New Brunswick, last reported small shipments in 1950. This company obtained its material at low tide on the Bay of Chaleur near Grand Anse.

The use of pulpstones of natural sandstone in the log grinders of pulp mills has been largely displaced by the use of an artificial abrasive in the form of segmental pulpstones built of bonded silicon carbide grit. Most of these are supplied by Norton Company of Canada Limited, Hamilton, Ontario. Pulpstones supplied by Canadian Carborundum Company, Limited, to Canadian firms are made in its United States plant and imported into Canada. About 800 artificial pulpstones are in use in Canadian pulp and paper mills, with about 300 in stock at the various mills. Some segmental pulpstones of artificial abrasive material are exported.

Natural grindstones valued at $27,376 were imported from the United States in 1952 compared with $43,176 in 1951. Whetstones, sticks, files, and blocks of natural abrasives valued at $21,798 and weighing 51,373 pounds were imported from the United States in 1952, compared with 41,489 pounds at $14,422 in 1951.

(5) Pumice and Pumicite (Volcanic Dust)

Volcanic dust or pumicite is a natural glass or silicate, pulverized by volcanic explosions and thrown into the air in great clouds which ultimately settle into beds varying from a few inches to many feet in thickness. The dust occurs as finely divided powder of a white to grey or yellowish colour and is composed of small, sharp, angular fragments of highly siliceous volcanic glass.

Pumice is a highly cellular, glassy, volcanic rock or lava which is formed in the vicinity of volcanoes as porous blocks of a white or light grey colour. It has the same composition as normal rhyolites, and when ground has the same appearance and character as pumicite.

Widespread deposits of volcanic dust occur in Saskatchewan, Alberta, and British Columbia, but owing either to thinness of beds, or remoteness from markets, there has been no production for many years.

Volcanic dust is used in Canada mainly for making scouring and cleansing aids. Lightweight building blocks composed of pumice aggregate and cement mixture are made at several block plants in British Columbia. The pumice aggregate is imported from nearby Oregon and Washington at prices ranging from $6 to $9 a short ton, f.o.b. Vancouver plants.

In United States increasing amounts of pumicite and pumice are being used as concrete admixture and concrete aggregate. Pumicite is also used as a carrier or filler for insecticides, and as a cleaning and scouring agent in soaps and powders.

Imports are grouped with a number of similar products (pumice, pumicite, volcanic dust, lava, and calcareous tufa) and in 1952 were valued at $110,369 compared with $128,957 in 1951. Most of these imports came from United States.

From time to time quotations on pumice and pumicite are found in trade journals, but generally these quotations are wholly nominal and prices paid for these materials depend on the quantities purchased, on purity, and on the use to which it is put. Pumice-stone, per pound, f.o.b. New York, or Chicago, packed in barrels, was 6 to 8 cents per pound for lump and 3 to 5 cents per pound for powdered (pumicite or volcanic dust).

(6) Grinding Pebbles

Extremely hard, tough, and rounded pebbles, usually of flint, are used in cylindrical or conical mills for the grinding of ores and minerals, mainly of a non-metallic nature, where iron contamination from the usual steel grinding balls would prove detrimental.

Grinding pebbles were produced in the past in several localities. Production in recent years, however, has been confined to Alberta, where W. May produces pebbles from deposits at Elkwater and ships them to several Canadian mining and milling companies.

ASBESTOS

Canada's production of chrysotile asbestos in 1952 exceeded by more than $7,000,000 the record established in the previous year. Shipments of 929,339 tons were valued at $89,254,913 compared with 973,198 tons at $81,584,345 in 1951. Higher prices at the mines and a greater production of the longer grades of milled fibre accounted for the increased production value. Demand for fibre of spinning quality continued at a peak, although the supply of some of the shorter grades exceeded requirements until mid-year.

Although Canada maintains her position as the leading producer of asbestos, output elsewhere—notably in Southern Rhodesia and the Union of South Africa—has been increasing. In 1952, Canada's production was approximately 66 per cent of the world total. As in the previous year, most of the output came from the Eastern Townships of Quebec and the remainder from northern

Ontario. Since the Canadian demand for chrysotile asbestos is small, production is largely exported, over 73 per cent of exports in primary form going to the United States.

Search for new deposits and exploration of known occurrences continued actively. New properties in both Quebec and British Columbia are being prepared for early production. The deposit at McDame Mountain in British Columbia promises to be an important source of fibre of spinning quality. Other chrysotile deposits are known in British Columbia and Newfoundland, and minor occurrences have been reported in Saskatchewan and Manitoba.

Canada's present production consists entirely of chrysotile asbestos. There are no known commercial deposits of amosite or crocidolite in this country. However, fibrous tremolite, actinolite, and anthophyllite do occur in several places. Fibres of these varieties generally lack the strength so characteristic of chrysotile and, although often long, are unsuitable for the textile industry. However, they offer higher resistance to acids and are used in filtration. During World War II, there was a small production of tremolite fibre from eastern Ontario.

Production and Trade

	1952		1951	
	Short tons	$	Short tons	$
Production (shipments)				
Crude	741	726,827	748	568,725
Milled fibres	351,644	58,822,472	333,001	49,399,632
Shorts and refuse	576,954	29,705,614	639,449	31,615,988
Total	929,339	89,254,913	973,198	81,584,345
Exports of crude				
To: United States	371	334,308	464	358,875
Other countries	321	370,612	196	189,528
Total	692	704,920	660	548,403
Exports of milled fibres				
To: United States	192,440	30,690,024	199,168	29,106,915
United Kingdom	36,576	6,878,791	30,707	4,585,368
France	18,349	3,145,104	16,373	2,815,133
Belgium	13,263	2,411,315	13,466	2,149,550
Australia	10,919	1,763,653	10,435	1,531,480
West Germany	9,614	1,504,953	4,940	733,833
Japan	7,065	1,350,954	7,668	1,053,404
Mexico	4,729	792,578	5,125	808,092
Colombia	4,549	853,451	2,337	374,949
Other countries	42,314	7,256,107	34,375	5,695,845
Total	339,818	56,646,930	324,594	48,854,569
Exports of shorts and refuse				
To: United States	465,800	22,551,058	512,433	24,592,389
United Kingdom	20,614	878,394	38,023	1,666,600
France	18,961	1,435,206	17,620	1,193,360
West Germany	14,130	994,951	9,165	630,026
Belgium	10,900	820,201	11,986	814,267
Other countries	31,143	2,477,888	27,833	2,033,217
Total	561,548	29,157,698	617,060	30,929,859

Production and Trade—continued

	1952		1951	
	Short tons	$	Short tons	$
Exports of manufactures[1]				
To: United States	—	606,618	—	742,263
Brazil	—	144,316	—	187,735
Cuba	—	75,827	—	110,853
Mexico	—	87,685	—	24,463
Colombia	—	52,009	—	9,700
Indonesia	—	31,533	—	36,846
Venezuela	—	30,418	—	386,131
Other countries	—	236,729	—	—
Total	—	1,265,135	—	1,497,991
Imports of manufactures[2]				
Packing	—	222,539	—	259,644
Brake linings for motor vehicles	—	313,765	—	627,797
Clutch facings for motor vehicles	—	521,443	—	275,921
Other brake linings and clutch facings	—	109,078	—	105,429
Miscellaneous asbestos manufactures	—	2,231,536	—	2,159,662
Total	—	3,398,361	—	3,428,453

[1] Brake linings, clutch facings, packings, roofing, and other manufactures.
[2] In 1952, 80% of imports came from U.S.A.

Production

Quebec

In the Eastern Townships seven principal companies mined asbestos in the vicinities of Thetford Mines, Black Lake, East Broughton, and Danville.

The leading producer, Canadian Johns-Manville Company Limited, operates the Jeffrey mine at Asbestos near Danville. This is the world's largest asbestos mine; most of the current production is derived from underground block caving. The company is expanding and modernizing its facilities at Asbestos; it is replacing the present milling plant and sinking a second production shaft to handle additional ore from underground.

Asbestos Corporation Limited has four producing mines, King and Beaver at Thetford Mines, British Canadian at Black Lake, and Vimy in Coleraine township. Underground mining is practised at the King; the others are open-pit operations. Adjacent to Vimy, the company is developing the Normandie mine on a recently discovered deposit and is erecting a 5,000-ton-per-day mill; production is expected in 1954.

Johnson's Company Limited operates an underground mine at Thetford Mines and an open pit at Black Lake. A new and enlarged mill is under construction at the latter property and is expected to be in production in 1953.

Bell Asbestos Mines Limited has converted its operation at Thetford Mines to underground mining. Flintkote Mines Limited and Quebec Asbestos Corporation Limited work deposits a few miles east of Thetford Mines and at East Broughton respectively. Nicolet Asbestos Mines Limited operates at St. Rémi de Tingwick. Dominion Asbestos Mines Limited plans production in 1953 from a deposit near St. Adrien in Ham township, Wolfe county.

Lake Asbestos of Quebec Limited, a subsidiary of American Smelting and Refining Company formed during 1952, commenced exploration of United Asbestos Corporation Limited's deposit at Black Lake. Material from a large bulk sampling program is being treated at Coleraine in a mill owned by Continental Asbestos Company. Exploratory and development work proceeded at a number of other properties in 1952.

Reserves of asbestos in the Eastern Townships are sufficient for many years' operation, despite continuous production since 1878. Core-drilling to depths of 1,700 feet has shown fibre comparable in quality to present production. Several deposits of lower-grade asbestos-bearing rock occur in the area. Chrysotile is found generally in veins one-half inch and less in width with an occasional vein up to five inches in width. In occurrences of this type, the fibres run directly across the vein, so that vein width is indicative of fibre length: most of the production comes from such veins. In some cases, however, the fibres may run longitudinally along a fissure, and may overlap to some extent; such fibre usually occurs in fault veins, and is known as slip fibre. Asbestos from the East Broughton area is largely of this type.

Ontario

East of Matheson in Munro township, northern Ontario, Canadian Johns-Manville mines asbestos by the open-pit method. The fibre is of a harsher texture than that normally recovered in Quebec and is of value in the manufacture of asbestos cement products.

Prospecting for other deposits continued in northern Ontario, with several companies participating. A small production was reported by Van-Packer Mines of Canada Limited from a deposit in Deloro township.

British Columbia

Cassiar Asbestos Corporation Limited continued development of the McDame Mountain deposit in northern British Columbia. First shipments of fibre recovered from the talus slope are expected early in 1953. Underground development has indicated the existence of substantial quantities of fibre of excellent spinning quality.

Newfoundland

Newfoundland Asbestos Limited continued work on a deposit of the mineral near Bluff Head on the west coast. A mill is under construction.

World Review

It is estimated that world output of all varieties of asbestos in 1952 was close to 1,500,000 tons. Many countries contribute to this production, but in most instances the quantity is small. Africa, however, mines substantial quantities of the world's supply and the Union of South Africa, Southern Rhodesia, and Swaziland are important producers.

The Union of South Africa is the sole source of amosite and the chief source of crocidolite, although increasing amounts of chrysotile also are recovered. Production in 1952 was estimated at 130,000 tons, of which 62,000 tons was amosite, 43,000 crocidolite, and 25,000 chrysotile.

Shabanie Mines, Southern Rhodesia, is the source of much of the world's supply of low-iron fibre, which is important for electrical uses. Production from Southern Rhodesia was estimated at 84,500 tons in 1952.

92728—8½

The United States mines chrysotile in Vermont and low-iron chrysotile in Arizona. Other states currently produce varying amounts of the amphibole varieties.

Russia has large deposits of chrysotile, but definite information on current output is lacking. However, certain grades of fibre are exported to other European countries.

Uses and Prices

Asbestos is used in many industries for a number of applications. The longer-fibre grades are manufactured into asbestos textiles, packing, insulation, and friction-resistant materials such as clutch facings, brake bands, etc. The medium grades are used in asbestos-cement products such as pipe, tile, millboard, siding, shingles, roofing, and asbestos paper.

Uses for short-fibre material include protective coatings, plastics, lubricating greases, and special industrial fillers having characteristics acceptable for numerous applications.

In 1952, there were increases in the price of most grades of Canadian asbestos. According to the E & M J Metal and Mineral Markets Bulletin of December 20, 1952, prices f.o.b. mine were as follows:

	Per short ton
Crude No. 1	$960—1,500
Crude No. 2	$595—900
Spinning fibre	$321—514
Shingle stock	$150—200
Paper stock	$109—137
Waste	$ 77
Shorts	$ 35—70

BARITE

Primary production of crude and ground barite (barytes; barium sulphate) in Canada in 1952 again showed a marked increase over the previous year, with 136,002 short tons against 98,113, or an increase of 39 per cent. Almost the entire production was exported, 63 per cent as crude. Canadian Industrial Minerals Limited accounted for most of the output; Mountain Minerals Limited contributed the remainder.

Production, Trade and Consumption

	1952		1951	
	Short tons	$	Short tons	$
Production (mine shipments)				
Crude	85,742	711,292	51,619	444,175
Ground	50,260	809,870	46,494	687,742
Total	136,002	1,521,162	98,113	1,131,917
Imports (ground)				
From: United States	1,014	34,571	842	30,409
West Germany	379	8,353	152	5,038
United Kingdom	52	1,564	2	105
Italy	—	—	72	1,919
Total	1,445	44,488	1,068	37,471
Exports				
Crude	85,041	—	49,261	—
Ground	49,085	—	45,729	—
Total	134,126	—	94,990	—

Production, Trade and Consumption—continued

	1951	1950
	Short tons	Short tons
Consumption		
Paints	1,219	1,457
Rubber goods	375	589
Glass	212	265
Oil wells	1,976	—
Miscellaneous	366	1,821
Total	4,148	4,132

Canadian Production

Nova Scotia

Canadian Industrial Minerals Limited, Walton, Hants county, continued to produce crude barytes for the chemical trade and ground barytes for industrial filler, paint, and drilling mud. The Walton deposit, regarded as the largest single barytes deposit in the world outside of Germany, is developed by shaft to 399 feet and by surface excavations. A stripping program that has made available a million tons of ore for open-pit operations was completed during 1952. Grinding capacity is 400 tons per day.

British Columbia

Mountain Minerals Limited with mines at Parson and Brisco, in the Columbia Valley, and grinding plant at Lethbridge, Alberta, continued production of white barytes, principally for the filler trade.

World Sources

The United States is by far the largest producer of barytes, contributing over half the world output. Other leading producers are Germany, the United Kingdom, Canada, Italy, France, Argentina, and India.

Uses and Specifications

Barite is used chiefly as a component of drilling muds and as a pigment and extender in paints. Smaller quantities are used as fillers in the manufacture of asbestos products, linoleum, paper, and textiles; in glass-making to improve brilliancy and cutting properties; as a heavy medium in sink-float processes; and as a component of cement coatings designed for underwater protection of pipes, etc. It is also used in the production of various compounds of barium, such as the carbonate, used to reduce 'dry house' scum on bricks, as a flux in the ceramic and enamelling trades and as a pharmaceutical; and the chloride, used as a pigment in lithographic inks, in the purification of brine and water, and as a mordant in dyeing. Barium hydrate, phosphate, oxide, sulphide, stearate, and chloride also find wide use in the chemical industry.

For drilling muds, barite must have a minimum barium sulphate content of 95 per cent, a minimum specific gravity of 4·2 and, must not contain soluble salts; 98 per cent or more must pass a 325-mesh screen.

For the paint and rubber trades, barium sulphate content must be at least 95 per cent, and the material must grind to a pure white colour. The glass trade requires relatively pure barite, and the iron oxide percentage, in particular, must not exceed 0·04. For chemical use, barium sulphate must be at least 95 per cent, and the material must not contain more than about 3 per cent silica and one per cent iron oxide.

Statistics pertinent to the trade and consumption of barium compounds in Canada are shown in the following table:

	1952		1951	
	Short tons	$	Short tons	$
Imports of barium compounds				
Lithopone(70% $BaSO_4$)				
From: United States	2,678	410,596	5,053	852,723
United Kingdom	384	58,026	1,420	228,292
Other countries	93	12,844	438	108,702
Total	3,155	481,466	6,911	1,189,717
Blanc fixe (precipitated $BaSO_4$)				
From: West Germany	123	7,231	105	10,112
United States	65	10,436	111	11,942
Other countries	24	1,614	155	16,476
Total	212	19,281	371	38,530
	1951		1950	
	Pounds		Pounds	
Consumption of main barium compounds in the chemical and allied products industry				
Barium chloride	305,244		155,629	
Barium nitrate	175,744		119,776	
Barytes	2,721,999		3,282,691	
Blanc fixe	488,109		531,195	
Lithopone	13,175,750		9,727,558	

Markets

In Canada, white barytes, crude, minimum 97 per cent $BaSO_4$, is purchased by Industrial Fillers Limited, Montreal, Que.

In United States, buyers of crude barytes quoted by U.S. Bureau of Mines include Southwark Manufacturing Company, Camden, N.J. and National Lead Company, Titanium Division, New York, N.Y.

Prices

Canadian market quotations on crude barytes are not available. However, declared unit prices of crude and ground shipments in Canada for 1952 were $8.30 and $16.10 per short ton respectively.

Final United States quotations, as published in E & M J Metal and Mineral Markets Bulletin, were as follows:-

Georgia—f.o.b. mines	
Crude, jig, and lump	\$13.00 to \$13.50 per long ton
Beneficiated	\$16.00 to \$18.00 per net ton in paper bags.
Missouri	
Water-ground and floated	\$37.60 per ton, f.o.b. works
Crude ore, min. 94% $BaSO_4$, less than 1% iron	\$10.40
Crude ore, min. 94% $BaSO_4$, less than 1% iron	\$10.15

Tariffs

Canada

British preferential	free
Most favoured nation	25% ad valorem
General	25% ad valorem

United States

Crude and unmanufactured	$3.00 per long ton.
Ground or otherwise manufactured	$6.50 per long ton.

BENTONITE

Canada's output of bentonite all came from Pembina Mountain Clays Ltd. in Manitoba, and Alberta Mud Company, Ltd. The latter company reported small shipments from Gordon L. Kidd and Aetna Coal Company, in Alberta. The 1952 production was valued at $388,542, compared with $499,556 for 1951. The sources were substantially the same in both years.

Imports of bentonite, all from the United States, were valued at $460,734, compared with $374,200 in 1951.

Production, Trade and Consumption

	1952 $	1951 $
Production, processed bentonite [1]	388,542	499,556[2]
Imports, activated bentonite From: United States	460,734	374,200
	1950 Short tons	1949 Short tons
Consumption		
Oil-well drilling [3]	16,000	15,000
Petroleum refining	8,663	8,421
Steel foundries	3,168	3,092
Iron foundries	1,854	1,800
Miscellaneous mining	596	—
Soaps and cleansers	563	871
Vegetable oils (bleaching)	428	—
Pulp and Paper	272	182
Miscellaneous	—	200
Total	31,544	29,566

[1] Includes both ground natural and activated bentonite.
[2] Revised.
[3] Estimates only.

Occurrences and Production

Manitoba

All of the output of activated bentonite in Canada is produced by Pembina Mountain Clays, Ltd., with plant in Winnipeg. The clay (bentonite) is mined, coarse ground, and dried at Morden and shipped to Winnipeg for activation. It is estimated that by the end of 1952 total output of crude bentonite had reached 85,000 tons.

Bentonite occurs near the base of the Pembina member of the Vermilion River formation which is of Upper Cretaceous age. This bentonite horizon is very pronounced from the United States border northwestward to Miami, (about 65 miles southwest of Winnipeg) and extends for a distance of approximately 35 miles. Beyond this, sporadic occurrences of bentonite have been reported in the Vermilion River formation all along its trend to the northwest across Manitoba, a distance of approximately 250 miles.

Alberta

Many occurrences of both swelling and non-swelling bentonite have been reported in the southern part of the province, the most important being in sedimentary rocks of Upper Cretaceous age.

Thin beds of swelling bentonite of good quality occur in the No. 1 coal seam being mined in the vicinity of Drumheller. The Aetna Coal Company shipped such material to the Alberta Mud Company, Ltd., which processes bentonite for distribution to Canadian markets. The company also received similar material that is strip-mined by Gordon L. Kidd north of Drumheller.

Bentonite deposits have been noted on the McLeod River southwest of Edson, in the Bearpaw formation on the St. Mary River south of Lethbridge and also the portion flanking the Cypress Hills south of Medicine Hat; and south of Camrose. It is associated in small amounts with the coal mined in the Edmonton district.

Saskatchewan

Save for test shipments to the Resources Utilization Branch of the Saskatchewan Department of Natural Resources, no bentonite has been mined in Saskatchewan. The branch has conducted active research on the bentonites of the province.

Both swelling and non-swelling types are widely distributed in the Upper Cretaceous and Tertiary sediments in southern Saskatchewan, especially in the Cypress Hills and Wood Mountain areas. The results of tests and beneficiation indicate that bentonites suitable for drilling mud, bonding foundry sands, and decolourizing purposes are all available.

British Columbia

Non-swelling bentonite occurs in gently dipping Tertiary sediments up to 15 feet thick at Princeton and Quilchena. The larger occurrences are located at Quilchena Creek, about 2 miles south of the Quilchena post office; at the outskirts of Princeton on Copper Mountain Railway; and about 5 miles south of Princeton on the same railway. The mineral rights on these deposits are held by Quechon Cattle Company Limited of Quilchena, Princeton Properties Limited, Vancouver, and H. Knighton, of Princeton, respectively.

Uses

Bentonite is used chiefly in controlling the viscosity of oil well drilling muds, as the bonding agent in foundry-sand moulds, and in decolourizing mineral and vegetable oils.

It is also used in smaller amounts as a filler in paper, rubber, and other products; as a detergent in soaps and cleaners; as a coagulant for clarifiying wines, honey, and turbid waters; as a stabilizer in various hydraulic cements and emulsions; 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 seepage around foundations of buildings. Bentonite is used also in bonding and plasticizing ore briquettes for smelting and ceramic bodies. 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 facilitate sowing. Considerable quantities of swelling bentonites 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.

Prices and Tariffs

The price of bentonite varies within wide limits, depending upon the grade of the material and the amount of processing it has been given. Activated bentonite, for bleaching of mineral and vegetable oils, costs from $60 to $80 per short ton in bulk carload lots, delivered to eastern Canadian points. Prices for Alberta crude bentonite remained unchanged from 1951 prices at $5.50 per short ton at the mine. The selling price of processed Alberta bentonite remained at $40 per ton f.o.b. Calgary plant. The price of processed bentonite in 1952, f.o.b. Montreal or Toronto, ground to 200-mesh, in bags, was $42 per short ton, according to trade journals.

Wyoming and South Dakota standard 200-mesh bentonite sold for $12.50 per ton, f.o.b. plant bagged in carload lots. Oil well grade bentonite sold for $14.00 per ton, f.o.b. plant bagged in carload lots. Special grades in dust form were quoted as high as $90.00 per ton. Powdered Mississippi bentonite sold for $14.00 per ton, bagged, in carload lots, f.o.b. plant.

Tariffs on bentonite entering Canada and the United States in 1952 were as follows:

Canada (Dept. of National Revenue)	
Not further processed than ground	free
Activated, when imported for use in refining of oils:	
British preferential	10% ad valorem
Most favoured nation	10% ad valorem
General	25% ad valorem
United States (Tariff Commission)	
Unwrought and unmanufactured	37½¢ per ton
Wrought or manufactured	81¼¢ per ton
Artificially activated	⅜¢ per lb. and 15% ad valorem

CEMENT

Despite the expansion in productive capacity which started in 1947, the demands for cement during 1952 continued to exceed available domestic supplies. By the end of 1951, annual capacity had been increased by 5,320,000 barrels, which it was expected would be adequate for domestic requirements. With increasing activity in almost all fields of construction, however, demand continued to exceed supply. Consumption for 1952 showed an increase of 11·1 per cent over the previous year. This necessitated the importing of 2,913,981 barrels of cement, most of which came from the United States.

Canada produced 18,520,538 barrels of cement, valued at $48,059,470, compared with 17,007,812 barrels, valued at $40,446,288 in 1951.

Cement plants are operating in British Columbia, Alberta, Manitoba, Ontario, Quebec, New Brunswick, and Newfoundland. Five companies with a total of 25 kilns are engaged in processing Portland cement, while a sixth imports and grinds clinker for producing white cement.

Production, Trade, and Consumption[1]

	1952		1951	
	Barrels of 350 lbs.	$	Barrels of 350 lbs.	$
Production	18,520,538	48,059,470	17,007,812	40,446,288
Exports				
To: United States	3,200	16,062	1,485	7,223
Other countries	1,106	4,624	1,105	5,163
Total	4,306	20,686	2,590	12,386
Imports				
From: United States	1,459,743	5,057,973	1,033,043	3,900,867
United Kingdom	696,700	1,888,222	862,783	2,317,176
Belgium	506,888	1,370,796	390,192	1,101,132
West Germany	207,230	626,687	39,735	120,407
Other countries	43,420	124,503	1,676	8,277
Total	2,913,981	9,068,181	2,327,429	7,447,859
Imports, clinker				
All from United States	48,132	153,383	45,812	157,202
Apparent consumption [2]	21,430,213	—	19,332,651	—

[1] Dominion Bureau of Statistics.
[2] Exclusive of clinker imported.

Canadian Producers

The raw materials for making cement—high-calcium limestone and clay—are fairly widely distributed. The presence of silicon, aluminum, and calcium is essential: where silicon is not present in the clay in adequate amounts, sandstone is added to make up the deficiency. The materials are ground, blended either dry or as a slurry, and then burned to form a clinker, usually in a long rotary kiln. This clinker, when ground with minor amounts of gypsum (added to control the setting time), is Portland cement.

Canada Cement Company Limited is the largest producer in Canada. It operates wet process plants at Exshaw, Alberta; Fort Whyte, Manitoba; Port Colborne and Belleville, Ontario; Montreal and Hull, Quebec; and the only dry process plant in Canada at Havelock, New Brunswick. New kilns have been installed at Exshaw and Belleville, and at the latter, storage, mixing, and batching facilities capable of accommodating an additional unit have been installed.

British Columbia Cement Company, Bamberton, Vancouver Island, has almost completed a large expansion program. The fourth and largest kiln is now in operation, increasing plant capacity by about 50 per cent to 1,500,000 barrels a year.

In Ontario, St. Mary's Cement Company, St. Mary's, began installation of a third kiln. When this comes into operation in 1953, the plant capacity will be increased from 1,300,000 to 2,000,000 barrels a year. At Paris, Medusa Products of Canada, Limited, grinds imported clinker to produce white cement.

Le Ciment Québec, Inc., with its plant at St. Basile, 30 miles west of Quebec, has a capacity of 400 barrels daily, which will be increased early in 1953 when a second kiln comes into operation. A third, larger kiln is expected to come into production later in 1953.

North Star Cement, Limited, Corner Brook, Newfoundland, Canada's newest producer, came into production in May, 1952. The plant has a rated capacity of 600,000 barrels annually.

Uses

The demand for cement and cement products continues to increase, the construction industry being the largest user. About 20 per cent of total output is taken by the concrete products industry, which is growing steadily. Among finished products now being turned out, in addition to ready-mix concrete, are concrete blocks and pipes, artificial stone, chimney blocks, laundry tubs, and burial vaults. In 1951, this industry used 3,905,827 barrels of cement, valued at $12,679,089, to turn out finished products with a value of $52,441,096. Of this total, ready-mix concrete accounted for $17 million, concrete blocks a like amount, and pipe (drain, sewer, water, culvert) $8 million. The industry was carried on in 427 plants; Ontario accounted for 54 per cent of production, Quebec 28 per cent, Alberta 7 per cent, British Columbia 5 per cent, while the remaining 6 per cent was distributed over the other provinces.

Prices

Transportation costs enter largely into the cost of cement to the consumer and this accounts in large part for the variation in price in different localities. At the end of 1952, the average price per bag ($87\frac{1}{2}$ lbs.) ex warehouse, in small lots was: St. John's, Nfld., $1.50; Halifax $1.35; Saint John $1.20; Quebec $0.95; Montreal $1.03; Ottawa $1.17; Toronto $1.25; Winnipeg $1.17; Regina $1.60; Calgary $1.25; Edmonton $1.50; Vancouver $1.20.

CLAY AND CLAY PRODUCTS

Total value of clay products manufactured in Canada in 1952 was $40,629,124, compared with $40,475,960 in 1951. Although production from domestic clays increased in 1952, that from imported clays decreased. Imports of clay products also showed a decrease in value of 14 per cent.

Expansion and plant modernization have been rather general in the structural clay products industry. The adoption of tunnel-kiln firing to improve efficiency is continuing, and better control methods have lessened production costs and improved products. In the Toronto-Hamilton area, even with the expanded production capacity, the demand for brick and tile has far exceeded the supply.

In plants manufacturing refractories, production facilities have been expanded in most cases. The demand for refractories, essential in defence production, continues at a high level.

Clays used by industry comprise: common clay for structural items; stoneware clay for sewer pipe, flue linings, and stoneware (artware, kitchen bowls and crocks, etc.); fireclay for refractories; china clay and ball clay for porcelains, sanitary ware, tableware, floor and wall tile, etc. Large quantities of china clay are used by the paper and rubber industries also.

Common clays are found in all provinces; stoneware clays and fireclays in Saskatchewan, British Columbia, and to a lesser extent in Nova Scotia. China clay is not at present produced in Canada, but there is some production of ball clay in Saskatchewan. Imports of clay in 1952 were valued at $2,770,318, more than half of which went for china clay.

Production, Imports, and Exports

	1952	1951
	$	$
Production from domestic clays		
Clays, including bentonite	532,754	635,444
Clay products		
From: Common clays	19,997,038	18,888,415
Stoneware clays	3,615,951	3,229,684
Fireclays	675,163	620,429
Other products	140,622	153,684
Total	24,961,528	23,527,656
Production from imported clays		
From: Stoneware clays	889,265	736,803
Fireclay	2,153,421	2,101,515
China clay	12,624,910	14,109,986
Total	15,667,596	16,948,304
Grand Total	40,629,124	40,475,960
Imports of clay		
Fireclay	406,169	502,025
China clay	1,455,792	1,697,816
All others, including activated, filtering, and bleaching clays	908,357	804,224
Total	2,770,318	3,004,065
Imports of clay products		
From: United States	20,126,684	21,983,083
United Kingdom	12,969,697	16,265,501
Other countries	1,488,536	2,039,727
Total	34,584,917	40,288,311
Exports of clay		
To: United States	36,728	34,752
Other countries	2,316	424
Total	39,044	35,176
Exports of clay products		
To: United States	1,084,260	968,843
Brazil	262,441	384,464
Belgium	150,251	103,093
Union of South Africa	122,309	72,809
Sweden	121,718	36,433
Other countries	702,761	937,062
Total	2,443,740	2,502,704

Canadian Production

Common Clays

Clays or shales suitable for the production of good quality brick and tile are not plentiful in Canada, although good brick clays occur at points not too distant from the more thickly populated areas in all provinces. However, because of the greatly increased demand for structural clay products, sources of new and better raw materials are constantly sought. Surveys sponsored in recent years by both government and commercial agencies have unearthed many new deposits, at some of which new plants have been established. Other deposits discovered have enabled the manufacture of improved products by existing plants. The Mines Branch of this Department carries out evaluation tests on samples submitted from all parts of Canada, and also conducts field tests in connection with development of new deposits.

There has been great demand for lightweight concrete aggregate. "Haydite" (shale bloated by heat treatment) is produced in a large plant near Toronto, but the demand exceeds the supply. As a result of investigations carried out by the Mines Branch, numerous clays and shales throughout Canada have been found to be satisfactory for the production of lightweight aggregate, and reports on these investigations in the prairie provinces, Ontario, and the maritime provinces are available. Owing to the trend towards lightweight concrete construction, as well as the diminishing supply of suitable cinders, this work has assumed increased importance. During 1952, plans were made for establishing two new plants, one in Alberta and one in Ontario, for the production of lightweight aggregate from material that has been found to have suitable bloating characteristics.

Stoneware Clays

The largest Canadian production of stoneware clays is in southern Saskatchewan, particularly in the vicinity of Eastend. 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 the local wells. Tableware (including vitreous hotel ware) is also being 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, are utilized on a rather large scale for making sewer pipe, flue liners, and other stoneware products.

Stoneware clays and moderately refractory fireclays that occur near Shubenacadie and Musquodoboit, Nova Scotia, have been used for the production of pottery, certain stoneware products, and low-grade refractories, but have not been developed extensively for ceramic use. Stoneware clays or semi-fireclays occur also near Williams Lake and Chimney Creek Bridge in British Columbia, and near Swan River and Pine River, Manitoba, but they are difficult of access and have not been exploited extensively. Ontario and Quebec import their requirements of stoneware clays.

Fireclays

Two large plants and a few small ones make fireclay refractories from domestic clay. Firebrick and other refractory materials are made on a large scale at a plant about 50 miles south of Vancouver from the high-grade, moderately plastic fireclay that is extracted by underground mining from the clay beds in the Sumas Mountain. Other smaller enterprises have been established in this area in recent years for the manufacture of refractories or like products from material obtained from the Sumas Mountain 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. Small amounts of the most refractory clays in the deposits near Shubenacadie, Nova Scotia, have been used for refractory purposes by the steel plant at Sydney, and some of the Musquodoboit clay has been used for the production of stove linings, as well as for foundry purposes.

Other production of fireclay refractories (firebrick, high-temperature cements, plastic refractories, etc.) particularly in Eastern Canada, is from imported clays.

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.

Following the discovery of large deposits of kyanite in Ontario and British Columbia, efforts are being made to develop an economical method of recovery, as kyanite is in great demand for certain types of refractories, and is in short supply on this continent.

China and Ball Clay

China clay (kaolin) has been produced commercially only in the vicinity of St. Remi d'Amherst, Papineau county, Quebec, where a large plant was established some years ago to refine the kaolinized material found there into high-grade china clay, and to recover washed silica sand as a by-product. However, this project was abandoned in 1948 because of mining and operational difficulties.

There are several other smaller deposits of kaolin in Quebec, but none has been developed. One of these is near Point Comfort, Thirty-one Mile Lake, Gatineau county, the others being near Brebeuf, Lake Labelle, and Chateau Richer.

The clay deposits in northern Ontario (see "Fireclays" above) contain material that may be classified as crude china clay, and in British Columbia parts of the extensive clay deposits that occur along the Fraser River, about 25 miles above Prince George, consist of high-grade crude kaolin. However, their distance from industrial centres has prevented development.

The Saskatchewan Government is continuing its extensive program of exploration of the ball clay and other 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 United States.

China clay imported from England or United States is used to make electrical and other porcelains, sanitary ware, tableware, ceramic floor and wall tile, etc.

Prices

Average prices for various kinds of clay are difficult to obtain, because of the variability in quality. An approximate indication of the 1952 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 is small, practically all of the domestic requirements being met by imports from United States. Output, which comes from Nova Scotia and British Columbia, totalled 28 short tons in 1952 compared with 91 tons in 1951.

Most of the more than 300 known occurrences of diatomite in Canada are of the bog type, and the processed material from them is not suitable for the major uses. Large, undeveloped deposits of dry, compact diatomite of Tertiary age occur in the Cariboo area of central British Columbia, but transportation difficulties have hindered their development. Material from these deposits is suitable for all uses to which diatomite is put, except filtration.

Production, Trade, and Consumption

	1952		1951	
	Short tons	$	Short tons	$
Production (sales)	28	1,074	91	3,428
Imports				
From: United States	15,799	557,086	21,067	709,332
Other countries	89	6,864	2	101
Total	15,888	563,950	21,069	709,433
*End-use Consumption**				
Filtration	6,091	—	7,937	—
Fertilizer dusting	5,699	—	7,509	—
Fillers	1,017	—	1,673	—
Insulation	165	—	160	—
Miscellaneous	107	—	95	—
Total	13,079	—	17,374	—

* Based on information supplied to the Mines Branch by distributors and consumers.

Canadian Deposits

Diatomite consists of microscopic, siliceous, skeleton remains of diatoms, a form of algae.

The bog-type material is of Recent (geologically) fresh-water origin and occurs as a grey to brown to black mud or ooze in the swamps and lake bottoms of northern Nova Scotia, southern New Brunswick, and the Muskoka area of Ontario, and also in the bogs of northwestern Quebec. The largest known freshwater (swamp) deposit in Canada occurs at Digby Neck, Nova Scotia.

The material of Tertiary age occurs in dry, compact beds and is very light in weight with relatively low moisture content. It is from white to cream in colour. The Tertiary freshwater deposits near Quesnel in the Cariboo area of British Columbia extend for many miles along the Fraser River, are compact, and, in places, are up to 40 feet thick. Small amounts of this diatomite have been marketed for insulation purposes, and tests have shown the material to be suitable for nitraprill coating if the moisture content is brought under five per cent.

World Production

United States is the world's leading producer and consumer of diatomite, with an average annual production for the three-year period 1949-51 of 274,070 short tons, valued at $7,577,119. Owing to a prolonged strike at the Lompoc, California, operations of the Johns-Manville Corporation, which lasted from

March to November, a serious supply shortage existed during 1952 in the United States and Canada for filter-aid and other grades of diatomite. Production of diatomite comes from four states; California, Oregon, Nevada, and Washington, California being the leading producer. Most of the output comes from two companies: Johns-Manville Corporation (Celite products) from deposits at Lompoc, California; and Great Lakes Carbon Corporation, Dicalite Division (Dicalite products) from deposits near Bradley in California, Terrebonne in Oregon, and Basalt in Nevada. Quincy Corporation operates deposits in Quincy, Washington. The United States reserves of high-quality diatomite are adequate for all requirements for many years to come.

Many other countries, including Denmark, Germany, Algeria, the Union of South Africa, France, and Japan, produce diatomite.

Uses

Diatomite is one of the more important industrial minerals, and is indispensable in industrial processes involving filtration. It has for years occupied an important place in such industries as sugar refining, liquor distilling, dry cleaning, syrup making, municipal water filtration and purification, and gold milling. More recently, it has been used in making mobile military water-purification units and in the manufacture of antibiotics. Another important industrial use is as a filler in the paint, paper, rubber, soap, and textile industries.

Diatomite is used as a fertilizer dusting agent in coating ammonium nitrate prills (nitraprills) by The Consolidated Mining and Smelting Company of Canada Limited, in its plants at Warfield, British Columbia, and Calgary, Alberta, and by North American Cyanamid Limited in its plant at Welland, Ontario. Since the diatomite coating is highly porous, it tends to absorb moisture, thus preventing the nitraprills from caking and sticking together, or from packing when the bags of fertilizer are stacked. Specifications for this use call for uncalcined diatomite of 95 per cent minus 325-mesh with less than five per cent moisture content.

Some Canadian bog diatomite (calcined) has been used in making lime-diatomite insulation bricks by a Toronto firm, which used processed material from Digby Neck, Nova Scotia. A similar brick is made by Fairey & Company, Limited, Vancouver, from Tertiary diatomite from the Quesnel area.

Minor amounts of diatomite are consumed in concrete admixtures, insecticide, insulation materials, metal polishes, etc.

The United States Bureau of Mines reports that in the United States filtration accounts for about three-fifths of the total consumption; fillers for about one-quarter, insulation, about one-tenth; and all other uses, including abrasives, the remainder. In Canada, filtration uses accounted for 46·6 per cent of the total consumption in 1952, the nitraprill coating requirements accounted for 43·5 per cent, the fillers for 7·8 per cent, and the remainder was consumed in insulation materials, insecticides, polishes, etc.

Prices

Diatomite varies widely in price according to the type and the quantity purchased. Prices of different grades have not changed materially over the past several years. Filtration grades, f.o.b. Toronto or Montreal, varied from $100 to $160 per ton in ton lots, with filler grades somewhat lower at $75 to $110 per ton. Diatomite for nitraprill coating, insulation, concrete, and other purposes varied from $30 to $60 per short ton f.o.b. producers' plant. Diatomite purchased in small lots for insecticide carriers, metal polishes, etc., ranged in price up to $200 per ton. Imported diatomite insulation bricks vary from $50 to $250 per thousand according to grade, source, and insulating properties.

FELDSPAR

Production of feldspar in Canada in 1952 fell to 20,267 short tons compared to 40,749 tons in 1951, a decrease of 50·3 per cent. Exports, mainly to United States, amounted to less than a third of the export volume of 1951. The entire Canadian production came from Quebec and Ontario, with Quebec providing the greater part.

Production, Trade, and Consumption

	1952		1951	
	Short tons	$	Short tons	$
Production				
Quebec	16,645	293,007	28,000	425,370
Ontario	3,622	37,628	12,749	125,727
Total	20,267	330,635	40,749	551,097
Imports				
All from United States	165	3,769	194	4,915
Exports				
To: United States	6,330	52,499	19,003	150,614
Other countries	30	2,400	829	23,207
Total	6,360	54,899	19,832	173,821

	1951 Short tons	1950 Short tons
Consumption		
Clay products	6,786	6,911
Cleansers	3,127	2,831
Enamelling	1,660	1,849
Abrasives	32	9
Glass	3,484	4,286
Total	15,089	15,886

Canadian Producers

Quebec

Canadian Flint and Spar Company Limited, Ottawa, with mines in Derry, Portland West, Templeton, and Buckingham townships was the principal producer. E. Wallingford Limited, Perkins, G. Biglow and R. Biglow, operating in Derry township, and others, contributed to the output.

The grinding plant of Canadian Flint and Spar Company Limited continued to produce ground spar for the domestic trade. Bon Ami Company, Limited, Montreal, continued to grind feldspar for its own use.

Ontario

Wallace Cameron, operating in Murchison township, Canadian Flint and Spar Company operating the Richardson mine in Bedford township, and McDonald mine in Monteagle township were the only recorded producers.

Uses and Specifications

For ceramic purposes feldspar must be low in iron and other colouring oxides. For whiteware porcelain, and glass, the iron (Fe_2O_3) content should not exceed 0·06 per cent.

Both potash and soda spar, regardless of colour, are used for ceramic purposes, but the demand for soda spar is limited and subject to fluctuation. Either variety may be accepted for cleanser use. High-quality potash spar usually commands the best prices.

Dental spar is high-quality potash spar selected by the trade according to its firing characteristics. Iron content (Fe_2O_3) should not exceed 0·10 per cent in any case and is preferred lower. Freedom from tourmaline and other minerals that may leave coloured specks in the fired product is essential.

Markets, Prices, Tariffs

Canadian Flint and Spar Company Limited is the principal purchaser of crude feldspar of all grades in Canada. Bon Ami Company, Limited, purchases white spar for cleanser use. Buyers of Canadian ceramic grade spar in United States include Consolidated Feldspar Corporation, Rochester, New York, and Shenango Pottery Company, New Castle, Pennsylvania. Buyers of dental grade include Myerson Tooth Corporation, Cambridge, Massachusetts; Dentists' Supply Company, New York City; and Universal Dental Company, Philadelphia, Pennsylvania.

Prices for No. 1 crude feldspar in 1952 ranged up to $10.00 per short ton f.o.b. rail. The average declared unit value of crude shipped to United States was $8.29 per short ton compared with $7.92 in 1951. Final 1952 quotations for ground pottery grade, f.o.b. Toronto or Montreal, bagged, carload lots—$24.20 per short ton; less than carload lot—$26.40 per short ton.

Feldspar of all classes entered Canada free of duty.

The duty on crude feldspar entering United States (effective June 6, 1951 by the Torquay Agreement) was 12½ cents per long ton and on ground feldspar 7½ per cent ad valorem.

FLUORSPAR

Production of fluorspar in Canada in 1952 reached a new high of 82,187 tons valued at $2,523,408, compared with 74,211 tons valued at $2,189,875 in 1951. Approximately 99 per cent of the output came from Newfoundland and the remainder from Ontario. A further increase may be expected in the near future, in view of the proposed large increase in the production of aluminum in Canada, and in line with a recent agreement made by one of the companies with the United States Government for large tonnages of fluorspar. Exports, all to the United States, amounted to 18,675 tons, a decrease of 13 per cent from that of the previous year. Imports totalled 22,714 tons, an increase of nearly 177 per cent above the 1951 total, and came mainly from Mexico, United States, Spain, and Western Germany.

Production, Trade, and Consumption

	1952		1951	
	Short tons	$	Short tons	$
Production (shipments)				
Newfoundland	81,283	2,484,943	67,925	1,966,477
Ontario	904	38,465	6,286	223,398
Total	82,187	2,523,408	74,211	2,189,875
Imports				
From: Mexico	11,790	298,199	2,670	74,663
United States	5,229	185,997	1,360	55,113
Spain	1,761	77,285	2,292	74,249
West Germany	1,597	51,910	—	—
Other countries	2,337	71,577	1,866	35,095
Total	22,714	684,968	8,188	239,120
Exports [1]				
To: United States	18,675	—	21,461	—
	1951		1950	
Consumption				
Heavy chemicals and non-ferrous smelters	33,266	—	29,620	—
Steel furnaces	23,374	—	21,800	—
Glass	586	—	484	—
Enamelling and glazing	300	—	229	—
White metal alloys	—	—	4	—
Total	57,526	—	52,137	—

[1] From United States Imports of Merchandise for Consumption, U.S. Dept. of Commerce.

Developments at Producing Mines

Ontario

The Madoc area in Hastings county continued to supply all of the production in Ontario. Output in 1952 amounted to 850 tons as compared with 6,286 tons for the previous year. The Perry mine of Reliance Fluorspar Mining Syndicate Limited, about 2 miles south of Madoc, was the only producer in 1952, although the company's Rogers mine, located one-half mile northwest of the Perry mine, made several shipments from ore stock piled during the previous year. The Perry shaft, a two-compartment, 170-foot, vertical shaft, was sunk during the early part of the year, and levels were established at 75, 120, and 170 feet below the surface. Approximately 500 feet of drifting and several hundred feet of crosscutting were done before mining operations were suspended in late August.

No further work was done on the property of Cardiff Fluorite Mines Limited near Wilberforce, Haliburton county, since the completion of its exploration and development program in March, 1951.

Newfoundland

Although fluorspar is known to occur elsewhere in Newfoundland, all commercial deposits found to date occur in the vicinity of St. Lawrence, a town on the southeast coast. Most of the veins occur within 6 miles of St. Lawrence

Harbour, and between sea-level and an altitude of 400 feet. St. Lawrence Corporation of Newfoundland Limited and Newfoundland Fluorspar Limited are the two producers.

Production of St. Lawrence Corporation came from 5 mines in 1952, with the Iron Springs mine supplying about 50 per cent of the total production. The other producing mines, in order of importance, were: Number Two, West Extension, Lord and Lady, and Grassy Gulch. As in former years, all ore was treated in the mill located about one mile west of St. Lawrence. This mill contains two complete units—a gravity unit, used mainly to turn out a coarse metallurgical grade, and a flotation unit that produces an acid-grade concentrate. Output in 1952 totalled 25,450 short tons of concentrates, consisting of 3,300 sub-metallurgical, 7,400 metallurgical, and 14,750 acid-grade, compared with 27,201 tons in 1951, consisting of 6,074 sub-metallurgical, 6,899 metallurgical, and 14,228 acid-grade. Shipments amounted to 26,850 tons compared with 30,726 tons in 1951, and consisted of 3,300 tons sub-metallurgical and 8,950 tons metallurgical to steel plants in Canada and United States, and 14,600 tons acid-grade to United States. The acid-grade flotation concentrates were shipped to an affiliated company, St. Lawrence Fluorspar, Incorporated, at Wilmington, Delaware, where they were dried before reshipping to the chemical and ceramic industries.

As a result of an agreement made in July, 1952, with the Defence Materials Procurement Agency, production of St. Lawrence Corporation Limited and St. Lawrence Fluorspar, Incorporated, will be increased by approximately 50,000 tons of acid-grade fluorspar per year. The contract extends over a period of 4 years, or until 150,000 tons of acid-grade concentrates have been produced. This represents a considerable increase in annual production and calls for extensive additions and improvements to the existing mining and milling plants of the companies concerned. To start this expansion program, which includes the erection of a 400-ton sink-float plant at St. Lawrence and a 300-ton flotation mill at Wilmington, Delaware, the United States Government has agreed to advance the companies up to $1,250,000. The output is slated for defence and other essential industrial uses.

Production of Newfoundland Fluorspar Limited, a subsidiary of Aluminum Company of Canada, Limited, is derived from the Director mine, one and one-half miles west of St. Lawrence. This vein, discovered in 1937, averages 25 feet in width, and has an average calcium fluoride content of 70 to 80 per cent. It is, without doubt, the most important deposit located to date in the St. Lawrence area. All ore was treated in the recently erected heavy-media separation plant at the Director mine and yielded 62,300 tons of metallurgical and sub-metallurgical concentrates compared with 42,457 tons in 1951; it consisted of 42,300 tons of heavy-media concentrates and 20,000 tons of fines. Shipments totalled 55,222 tons compared with 42,065 tons in 1951, and consisted of 52,152 tons of metallurgical and sub-metallurgical grade to Arvida, Quebec, and 3,070 tons of metallurgical grade to the steel plants of Canada.

Fluorspar Reserves in Newfoundland

Newfoundland's reserves of fluorspar are very large and can be classed as among the most important in the world. Over 24 veins have been located, none of which has been completely traced longitudinally or vertically. However, fluorite mineralization is known to extend for as much as 3 miles longitudinally, and at depths of over 600 feet no significant changes are noted in grade or width.

The fluorspar veins in Newfoundland are steeply dipping, ranging from vertical to 65 degrees with a few minor exceptions, and vary in width from a few inches to more than 40 feet. The 'higher-grade' veins, averaging between four and 5 feet in width, have a CaF_2 content of at least 95 per cent, and silica content of 1 to 4 per cent, while the 'lower-grade' veins average between 15 and 20 feet in width, have a CaF_2 content of about 75 per cent, and a silica content of 10 to 15 per cent.

Other Occurrences

Fluorspar deposits occur also in Ross township, Renfrew county, Ontario; in Huddersfield township, Pontiac county, Quebec; in the Lake Ainslie district, Cape Breton Island, Nova Scotia; and at the Rock Candy mine of The Consolidated Mining and Smelting Company of Canada Limited, near Grand Forks, British Columbia.

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 hydrofluoric 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 $2\frac{1}{2}$ 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

Prices received for fluorspar vary widely, and the following quotations can serve only as a general guide to prices obtained by producers and dealers in Canada. The prices for various grades of fluorspar can be ascertained only by direct negotiation between buyer and seller.

In 1952, quotations in Canadian Chemical Processing were confined to ceramic grade, 95 per cent grade, in bags; quotations opened in January at $4.90 to $5.65 per 100 pounds, and by August had increased to $5.80 to $6.55, where they remained for the balance of the year.

In United States, quotations in the E & M J Metal and Mining Markets Bulletin indicate that prices for all grades remained unchanged during 1952. Based on effective units of CaF_2 and f.o.b. Kentucky-Illinois mines, prices for metallurgical grade were as follows: 70 per cent and over $43 per ton; under

60 per cent, \$40 to \$41; and pellets, 60 per cent, \$34. "Effective units" are computed as the actual CaF_2 content less $2\frac{1}{2}$ times the percentage of contained silica. Acid-grade fluorspar, 97 per cent CaF_2, bulk, carload lots, remained at \$60, f.o.b. mines. Ceramic grade fluorspar, 95 per cent CaF_2, calcite and silica variable, 0·14 per cent Fe_2O_3, was quoted at \$45 per ton bulk, and \$48.50 per ton in 100-lb. bags, f.o.b. Rosiclare, Illinois. Foreign fluorspar, metallurgical grade, duty paid, c.i.f. U.S. ports, was quoted at \$38 to \$40 per short ton; and acid-grade, duty paid, was quoted at \$60 to \$62.

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

Production of granite, all forms, in 1952 showed a 28 per cent increase in tonnage and 22 per cent increase in value compared with that of 1951, the previous record year. Granite used as concrete aggregate, road metal, break-waters, etc., accounts for over 98 per cent of the tonnage, but little more than 65 per cent of the value. The remaining tonnage is used as building stone and monumental stone.

The term 'granite' as applied to commercial stone includes practically all igneous rocks, as well as metamorphic rocks of igneous origin, that may be quarried for use as building, monumental, or crushed stone. A large part of Canada is underlain by such rocks, but to be economically productive granite must have certain qualities such as strength, uniformity, colour, etc., and the deposits must be near transportation facilities and markets.

Quebec is the granite province of Canada because of the proximity of the granite areas to population centres and transportation facilities. Ontario produces a considerable tonnage of crushed granite. Small quantities are produced in all other provinces with the exception of Alberta and Saskatchewan.

Canadian Producers

In Quebec, grey granite is the principal rock quarried; it comes from many districts, including Rivière-à-Pierre, St. Samuel, St. Sébastien, Stanhope, Scotstown, St. Gérard, and Stanstead. Black granite is produced in the Lake St. John district and in the Noranda area; dark bluish-grey in the Mount Johnson area about 40 miles east of Montreal; and red in the Grenville, Guenette, and Lake St. John districts.

In Nova Scotia, grey granite is produced in the Nictaux and Shelburne areas, and black from the Shelburne area.

New Brunswick has deposits of red, black, and grey granite of good quality. Red granite is produced in the Antinouri Lake and Bathurst districts; and grey in the Hampstead area.

In Ontario, black granite is being produced at River Valley. The red granite quarry at Vermilion Bay did not operate during the year. Some development work was done on the red granite near Lyndhurst.

In Manitoba, small amounts of grey and black granite are quarried intermittently near the Manitoba-Ontario boundary for the Winnipeg market.

British Columbia has widespread occurrences of granite in varied colours, one of the best known building stones being the andesite from Haddington Island. The grey granite from Nelson Island is also used extensively in building.

Production, Exports, and Imports

	1952		1951	
	Short tons	$	Short tons	$
Production				
Monumental granite				
Rough	18,282	356,122	16,641	289,119
Dressed	24,403	2,180,484	25,345	2,357,349
Total	42,685	2,536,606	41,986	2,646,468
Rubble and riprap, concrete aggregate, road metal, etc	2,447,401	4,790,416	1,908,578	3,367,653
Total	2,490,086	7,327,022	1,950,564	6,014,121
Exports, granite and marble (unwrought) To: United States	1,839	40,411	3,715	89,001
Imports, granite				
Rough				
From: United States	—	65,109	—	95,374
Sweden	—	44,244	—	32,578
Finland	—	19,604	—	10,047
Brazil	—	753	—	—
Norway	—	484	—	8,563
Total	—	130,194	—	146,562
Sawn				
From: United States	—	32,212	—	25,679
Sweden	—	15,532	—	10,080
Finland	—	8,410	—	3,237
Other countries	—	1,770	—	2,803
Total	—	57,924	—	41,799
Manufactures				
From: West Germany	—	46,765	—	61,577
Sweden	—	40,146	—	75,017
Finland	—	35,683	—	26,646
United Kingdom	—	33,719	—	351
United States	—	25,845	—	10,594
Other countries	—	—	—	1,888
Total	—	182,158	—	176,073

Uses

Granite is usually quarried in Canada for use as building or monumental stone and in both cases there is a large amount of waste in the quarries. Some of the large irregular blocks are used as riprap to strengthen breakwaters and causeways against heavy washes or currents, while some of the smaller pieces are crushed for concrete aggregate or used as poultry grit, paving blocks, or curbstones. However, these uses for granite waste are extremely limited compared to the amount of granite produced. Granite as a building stone is used chiefly for ornamental purposes, forming the outside facing of the lower portion of many buildings.

Some of the granite produced in Canada has good export possibilities, especially the red and black varieties, which are much in demand as monumental stone in United States.

GRAPHITE

Production of natural graphite in 1952 increased 30 per cent in volume and 11 per cent in value over 1951. Eighty-three per cent of finished products went to the United States, the remainder being consumed in Canada.

Total unmanufactured imports, which increased slightly in value over the 1951 total, came chiefly from Mexico, the United States (mainly exports of material produced elsewhere), and Norway.

Principal world sources are Madagascar (large flake), Ceylon (plumbago), and Mexico (amorphous). Norway, for some years a minor producer, is listed for the first time as a source of Canadian imports.

Artificial graphite is produced by Electro-Metallurgical Company of Canada Limited, Welland, Ontario.

Canadian Production

Canadian graphite, chiefly small flake and amorphous, has come in the past from widely scattered deposits in the crystalline limestones and gneisses in the general region of Ottawa and from adjacent sections of eastern Ontario and western Quebec. Graphitic shales and schists are of frequent occurrence in the Maritime Provinces and in British Columbia. Deposits have also been reported from many other areas.

For some time past, the sole producer in Canada has been the Black Donald mine near Calabogie, Ontario. This mine, operated by a division of Frobisher Limited, has been in continuous production since 1906. A dam excluding the lake water from the western portion of the ore zone has been completed, and as a result all known ore reserves are available for mining. Exploration for new sources of ore has given encouraging results, particularly on the Kirkham property in Bedford township, 25 miles north of Kingston.

Production and Trade

	1952		1951	
	Short tons	$	Short tons	$
Shipments by types				
Amorphous foundry grades	1,765	180,322	1,327	162,401
Dust grades	81	14,812	38	5,083
High-grade lubricating and pencil grades	194	60,598	204	63,683
Total	2,040	255,732	1,569	231,167
Shipments by destination				
United States and other countries	1,686	—	1,152	—
Domertic market	354	—	417	—
Exports, crude and refined				
To: United States	1,685	191,344	1,148	155,769
Australia	1	219	2	558
Other countries	—	—	2	209
Total	1,686	191,563	1,152	156,536

Production and Trade—concluded

	1952		1951	
	Short tons	$	Short tons	$
Imports, unmanufactured				
From: Mexico	—	59,123	—	47,354
United States[1]	—	32,213	—	22,557
Norway	—	6,117	—	2,786
Other countries	—	205	—	24,028
Total	—	97,658	—	96,725
Imports, ground and manufactured[2]				
From: United States	—	410,107	—	466,392
United Kingdom	—	15,650	—	7,332
Other countries	—	8,893	—	2,787
Total	—	434,650	—	476,511
Imports, crucibles				
From: United Kingdom	—	120,028	—	95,535
United States	—	93,401	—	119,762
Total	—	213,429	—	215,297

[1] Mainly imports by U.S.A. from other countries.
[2] Excluding crucibles.

Uses and Specifications

The iron and steel industry accounts for a high percentage of the consumption of graphite. This industry uses it in the form of crucibles, foundry facings, and other refractories. Graphite is used as a pigment and protective element in corrosion-resistant paints and polishes; as a conductive filler in dry batteries; in lubricants exposed to high temperatures or corrosive conditions; in 'lead' pencils; in corrosion-resistant pipes and fittings, used largely by the chemical industry; for impregnating wood or metal surfaces in oil-less bearings; and as a dry lubricant for lead shot, explosives, and fertilizers. More recently, considerable quantities of graphite have been used as a moderator in atomic piles.

Artificial graphite made by electric furnace treatment of petroleum coke or anthracite is used in the manufacture of electrodes, brushes, and other special shapes, and in powdered form competes with natural amorphous graphite, particularly where high purity is essential (as in dry batteries), also in paints, polishes, foundry facings, boiler compounds, etc.

Natural graphite is selected for its various uses according to type (flake, crystalline, or amorphous), carbon content, and mesh size. To some extent the different types of graphite are interchangeable and are utilized largely according to users' preferences.

There is no universal code of specifications, but those for No. 1 crucible flake usually call for 85 to 90 per cent graphitic carbon, through 20-mesh, on 60- to 90-mesh, and those for lubricating flake call for 95 per cent carbon. For other purposes carbon content may run as low as 50 per cent.

Canadian consumption of graphite by industries for 1950 and 1951 was:

	1951	1950
	Short tons	Short tons
Consumption		
Iron and steel	1,553	1,270
Paints	72	52
Electrical apparatus	310	346
Heavy chemicals	332	268
Prepared foundry facings	223	220
Polishes	24	33
Brass and bronze foundries	42	30
Total	2,556	2,219

Markets

All forms of graphite, from high-grade refinery products to mine lump, are potentially salable. Although small quantities of plumbago (massive crystalline variety) have been produced from the fissure-vein type of deposit from time to time, none has been offered for sale in Canada in recent years. Crystalline flake, which occurs generally in the disseminated type of deposit, requires concentration to meet market standards.

Buyers of all types of graphite in United States include Joseph Dixon Crucible Company, Jersey City, New Jersey, and Chas. Pettinos, New York, N.Y.

Prices

Final Canadian quotations as published by Canadian Chemical Processing, November, 1952, were as follows:

Various grades—6½¢ to 90¢ per lb.
Plumbago, s.t. extra—8½¢ to 20¢ per lb.

Final United States quotations as published by E & M J Metal and Mineral Markets Bulletin Dec. 4, 1952, were as follows:

Per lb., carload lots, f.o.b. shipping point

Crystalline flake

85—88% C, crucible grade—13¢
96% C, special and dry use —22¢
94% C, normal and wire drawing —19¢
98% C, special for brushes, etc.—26½¢

Amorphous, natural, for foundry facings, etc.
Up to 85% C—10¢

Per ton c.i.f. New York
Madagascar Standard grades 85 to 87% C—$200 per ton
Special mesh—$230 to $260
Special grade 98% C—nominal

Per metric ton, f.o.b. point of shipment (Mexico)
Amorphous—$9 to $16 depending on grade

Tariffs

Canada

	British	Most Favoured Nation	General
Crucibles	free	15%	15%
Graphite not ground or otherwise manufactured, graphite flake	free	5%	10%
Graphite, ground, and manufactures of, n.o.p., graphite foundry facings	15%	20%	25%
Graphite bearings for cars			
—not made in Canada	free	free	30%
—made in Canada	free	17½%	30%

United States

Amorphous	5% ad valorem
Crystalline: lump, chip, and dust	7½% ad valorem
Crystalline flake:	
Under 2¾¢ per lb.	0·4125¢ per lb.
2¾¢ per lb. but not over 5½¢ per lb.	15% ad valorem
Over 5½¢ per lb.	0·825¢ per lb.

GYPSUM AND ANHYDRITE

The output of crude gypsum in 1952 showed a decrease of about 5·6 per cent from that of 1951—3,590,783 tons compared with the 3,802,692 tons in 1951. Value, however, was up 11·1 per cent—$6,538,074 as against $5,880,853. Exports amounted to 2,763,829 tons, which was 77 per cent of Canadian production in 1952. The remainder of the output is used in the manufacture of plasters and wallboards, and in the cement industry.

Gypsum, or hydrous calcium sulphate, is found in every province except Prince Edward Island and Saskatchewan. Production of crude gypsum in 1952 came from Nova Scotia, the chief producer, followed by Ontario, Manitoba, New Brunswick, British Columbia, and Newfoundland. The output of gypsum products in Alberta and Quebec was from raw materials obtained from other provinces.

Anhydrite, or anhydrous calcium sulphate, is of little commercial importance in Canada. Production came chiefly from quarries in Nova Scotia, where removal of the anhydrite is frequently necessary in mining gypsum.

Production and Trade

	1952		1951	
	Short tons	$	Short tons	$
Production, crude gypsum				
Nova Scotia	2,969,312	4,373,842	3,190,030	4,107,822
Ontario	278,992	1,060,429	262,581	672,276
Manitoba	130,934	473,841	134,704	509,276
New Brunswick	110,183	333,638	109,469	328,407
British Columbia	92,702	241,443	105,908	263,072
Newfoundland	8,660	54,881	—	—
Total	3,590,783	6,538,074	3,802,692	5,880,853
Exports, crude and ground gypsum, plaster of Paris, and wall plaster				
United States	2,763,611	2,851,703	3,016,810	3,112,662
New Zealand	200	3,630	2,027	3,509
Other countries	18	177	9,669	17,670
Total	2,763,829	2,855,510	3,028,506	3,133,841
Imports, gypsum, wall plaster, plaster of Paris				
United States	13,150	281,245	17,124	346,852
United Kingdom	166	7,347	255	7,531
Total	13,316	288,592	17,379	354,383

Gypsum

Nova Scotia

Canadian Gypsum Company, Limited, the largest producer in Nova Scotia, operates quarries at Wentworth, near Windsor in Hants County. The gypsum is shipped 7 miles by rail to Hantsport; from there it is taken by boat to United States Gypsum Company's plants on the eastern seaboard of the United States.

National Gypsum Company (Canada), Limited, operates quarries for export purposes at Walton in Hants County and at Dingwall in Victoria County. The output is shipped by water to company-owned plants in the United States. A small percentage of the production from Dingwall is shipped to gypsum plants in Quebec and to cement plants in eastern Canada.

Windsor Plaster Company, Limited, produces gypsum from a small quarry near Brooklyn for its plaster mill in Windsor. Victoria Gypsum Company, Limited, operates a quarry at Little Narrows; the gypsum produced is exported to the United States and the West Indies.

Ontario

Gypsum, Lime and Alabastine, Canada, Limited, at Caledonia, and Canadian Gypsum Company Limited, at Hagersville, manufacture a wide variety of gypsum plasters and wallboards from gypsum beds underlying their plants.

Manitoba

Gypsum, Lime and Alabastine, Canada, Limited, and Western Gypsum Products Limited produce gypsum plasters and wallboards at Winnipeg. The former company obtains gypsum rock from its quarry at Gypsumville, and the latter from a mine at Amaranth, both in Manitoba.

British Columbia

Gypsum, Lime and Alabastine, Canada, Limited, produces gypsum plasters and wallboards at its New Westminster plant from gypsum rock obtained from the company quarry at Falkland. Rock from the same quarry is shipped to Calgary, Alberta, for processing.

Columbia Gypsum Products Incorporated continued development of the gypsum deposits at Windermere, exported some gypsum to the company plant at Spokane, Washington, and sold to buyers in Alberta.

The Alan Howard Company continued to produce crude gypsum from a deposit near Mayook, about 7 miles northwest of Warden, British Columbia. This gypsum is shipped to the plant of Canada Cement Company at Exshaw, Alberta.

Alberta

Gypsum, Lime and Alabastine, Canada, Limited produces gypsum plasters at its plant in Calgary from gypsum obtained from the company's quarry at Falkland, British Columbia.

Western Gypsum Products Limited at its plant in Calgary produces plasters and wallboards from gypsum obtained from the company's mine at Amaranth, Manitoba.

New Brunswick

From deposits of gypsum near its Hillsborough plant, Canadian Gypsum Company Limited produces all grades of plaster and wallboard, including high-quality plasters for specialized uses.

Quebec

Gypsum, Lime and Alabastine, Canada, Limited, produces plasters and wallboard, at its Montreal East plant, from gypsum obtained from Dingwall, Nova Scotia.

Newfoundland

Development of the large deposits of gypsum on the west coast of Newfoundland in the Bay St. George area was begun in 1952. Production in 1952 amounted to 8,100 tons, which was processed in a new factory erected in 1951 by the Provincial Government at Humbermouth near Corner Brook. This plant started production in May, 1952. One section of the plant is used to manufacture gypsum plaster, while the other is for the manufacture of gypsum wallboard and lath. Capacity of the plaster mill is about 200 tons per day, and that of the wallboard mill about 250,000 square feet daily.

Uses

Calcined gypsum is the principal component of plasters and wallboards. When heated at a low temperature, gypsum gives off three-quarters of its water of crystallization. The resulting product, known as plaster of Paris, sets quickly to a hard, porous mass when water is added. Plaster of Paris, as such, has only limited uses, as in moulding work, where quick setting is required, or in ceramic work, where its porous properties are essential. To make plasters and wallboards, certain materials are added to plaster of Paris as retarders and fillers. This gives the final products a longer setting period and greater strength than the original plaster of Paris. Special products are made also from calcined gypsum, such as acoustic boards, partition tile, fire-resisting walls, insulating tile, etc. Gypsum is added in small quantities to Portland cement, where it acts as a retarder in the setting time of the cement.

Gypsum, in ground form, has a limited use as a fertilizer for black alkali soils.

Anhydrite

Production of anhydrite in Canada is limited to quarries where its removal is essential to the continued production of gypsum. Anhydrite has as yet few uses; it is used to a limited extent as a soil conditioner. It is, however, a potential source of sulphur compounds, and is being used for this purpose in several plants in Europe.

Prices

Canadian Chemical Processing of November, 1952, quotes a nominal price for gypsum as $4.00 to $5.00 per ton, f.o.b. plant.

IRON OXIDES (OCHRES)

The production of natural iron oxides in Canada during 1952, originating entirely in the province of Quebec, totalled 11,487 tons, valued at $194,922. The tonnage figure is slightly smaller than for the years 1951 and 1950, when production was 13,342 tons and 13,696 tons respectively. In Quebec, the principal producing iron oxide deposits are located in Champlain and St. Maurice counties, within 20 miles of Trois-Rivières. Some of these deposits have been in continuous production since 1886. To the end of 1952, the total production of natural iron oxides in Quebec amounted to 423,309 tons valued at $5,158,278.

The only Canadian producer of calcined iron oxides is Sherwin-Williams Company of Canada, Limited, which operates a calcining and grinding plant at Red Mill, Quebec, based on crude iron oxide mined at Red Mill and Champlain in Quebec. There is only one producer of synthetic iron oxides in Canada; Northern Pigment Company Limited, at its New Toronto, Ontario, plant, manufactures iron oxide pigments from scrap iron by the ferrite process.

Ochres, siennas, and umbers are forms of iron oxide commonly used as pigments. Ochre is a pulverulent iron oxide, usually containing varying amounts of impurities in the form of clay, sand, and organic matter. Brown and yellow ochres consist of limonite or goethite, and red ochres of hematite. Sienna is a brownish orange-yellow clay, coloured by iron and manganese oxides. Umber is a chestnut-brown to liver-brown hydrated ferric oxide containing manganese oxide and clay. As it occurs naturally, it is called *raw* umber, and when heated to produce a reddish brown colour, it is called *burnt* umber.

It is of interest that the largest consumer of iron oxide in Canada is the manufactured-gas industry, which uses about 75-80 per cent of the total Canadian consumption as a gas-cleaning agent. The amount consumed for this purpose during 1951 (figures for 1952 are not available) was 10,310 tons. In addition, the paint industry consumed 2,946 tons of calcined iron oxide and 249 tons of ochres, siennas, and umbers.

Iron oxide pigments are used as colouring agents and fillers in imitation leather, shade cloth, shingle stain, paper, and cardboard. They are used as pigments in linoleum, floor title, oilcloth; in wood stains and wood fillers; and in cement, stucco, mortar, and brick. They are used, also, in the manufacture of jeweller's rouge. Siennas and umbers are used in wood stains and wood fillers.

Production, Trade, and Consumption

	1952		1951	
	Short tons	$	Short tons	$
Production (sales)				
Natural (crude and calcined)				
From: Quebec	11,487	194,922	13,342	262,277
Imports (ochres, siennas, umbers) [1]				
From: United States	909	51,435	1,173	72,032
United Kingdom	89	5,305	161	9,010
Other countries	—	—	136	2,587
Total	998	56,740	1,470	83,629
Exports (natural & synthetic iron oxides)				
To: United States	2,761	298,146	2,918	347,252
Mexico	123	20,418	93	15,888
France	53	10,177	89	14,603
Other countries	123	21,873	546	72,202
Total	3,060	350,614	3,646	449,945

	1951		1950	
	Short tons	$	Short tons	$
Consumption in specified industries				
Coke and gas industry	10,310	—	11,624	114,138
Paint industry				
Calcined iron oxide	2,946	467,059	2,453	378,423
Orchres, siennas and umbers	249	50,851	268	51,514

[1] According to United States export statistics, ochres, umbers, siennas and other forms of iron oxides exported from United States to Canada totalled 2,546 short tons valued at $288,382 in 1952, and 2,528 short tons valued at $282,136 in 1951. Most of these are synthetic iron oxides for use in the paint industry.

Occurrences and Production

In Quebec, there are extensive deposits of iron oxide in St. Maurice and Champlain counties adjacent to the north shore of the St. Lawrence River, northward from Lake St. Pierre and the city of Trois-Rivières. According to John A. Dresser and T. C. Denis[1]:

"The iron in these deposits was originally present in ferromagnesium minerals, and in other iron minerals such as pyrite and magnetite, in the granitic and other rocks of the Laurentian highlands. As the result of complete or partial solution of these minerals, the waters draining the highlands are iron-bearing, and where they enter lakes, or where they have spread over the flat, low-lying foreland, their iron content has, in course

[1] Dresser, John A. and T. C. Denis: "Geology of Quebec"; Quebec Department of Mines, Geological Report No. 20, Vol. III, Economic Geology, p. 488, 1949.

of time, been precipitated and converted eventually to ferric hydroxide, with which there is usually associated some clay, sand and vegetal matter. The deposits that were formed in bogs and marshes are seldom more than three feet thick. In lakes that have survived, they are continually accumulating, and from some of these lakes the material has been dredged repeatedly, with intervals of several years to allow new deposits to form. - - - -

"- - - - - the deposits from which the whole of the present production of ochre is obtained are adjacent to the north shore of the St. Lawrence River, lying within a belt which, from Trois-Rivières, extends southwest for ten miles to Point-du-Lac, Saint Maurice county and northeast for a somewhat greater distance to Batiscan, Champlain county. The ochres occurring along this belt are high-grade iron oxide, most of the calcined material containing about 90 per cent Fe_2O_3, so that they have approximately the composition of goethite, $Fe_2O_3\ H_2O$.

"On the south shore of the Saint Lawrence, across from Trois-Rivières, there are extensive deposits of ochre but they are, in general, relatively thin and have rarely been worked."

Numerous other occurrences of a quality equal to those in the present producing belt are known, but are less favourably situated for present exploitation.

During 1952, as in past years, the output included both crude air-dried iron oxide and calcined oxide, the largest output being in the form of crude, uncalcined oxide. Sherwin-Williams Company operates two "mines" and a calcining plant at Red Mill in Champlain county. The "ore", after calcining at a high temperature, is finely pulverized in ball mills, the product being used as a pigment in the paint and other industries, and as a polishing material for plate glass, lenses, prisms, etc. The crude, air-dried iron oxide is produced by the other operators for use in the manufactured-gas industry as a purifying agent. Because crude iron oxide has a relatively low value, its exploitation is governed by nearness to market.

In Manitoba, the large deposits near Grand Rapids and Cedar Lake remained undeveloped owing to lack of markets.

In Saskatchewan, the principal deposit of possible economic interest is at Loon Lake, 32 miles from St. Walburg on the Canadian National Railway.

In British Columbia, there was no production of iron oxide during 1952. The Alta Lake deposit, formerly operated for the B.C. Electric Company, was considered mined out in 1949 and has been inactive ever since. The Lomong (International Lead and Iron) deposit near the Pend d'Oreille river in south central British Columbia did not ship any iron oxide in 1952. Bog iron suitable for the manufactured-gas industry occurs in the Peace River district but has not been mined.

Prices

Canadian Chemical Processing, March, 1952, quoted the following Canadian prices.

Synthetic iron oxide, domestic, per lb.	
Red	10½¢
Yellow	8¾¢
Brown	6¼¢
Synthetic iron oxide, imported, per lb.	
Black	9 to 11¼¢

There were no market quotations during 1952 for crude or calcined iron oxide, but crude air-dried iron oxide sells at a price of from $4-5 a ton, f.o.b. mine, and calcined iron oxide from $80-100 a ton, depending upon grade.

Tariffs

Canada

	British Preferential	Most Favoured Nation	General
Ochres, ochrey earths, siennas, and umbers	5%	15%	15%
Oxides, fireproofs, rough stuff, fillers, colours, dry	12½%	17½%	22½%
Stains and oxides for colouring enamels and pottery glazes	free	20%	22½%
Colours and pigments for colouring roofing granules	free	free	22½%

United States

Iron oxide and hydroxide pigments:	
Synthetic	10% ad valorem
Other	20% ad valorem
Ochres:	
Crude or not ground	⅛¢ per lb.
Ground or washed	⅜¢ per lb.
Siennas:	
Crude or not ground	1/16¢ per lb.
Ground or washed	¼¢ per lb.
Umbers:	
Crude or not ground	1/16¢ per lb.
Ground or washed	3/16¢ per lb.

LIME

Production of lime in Canada during 1952 declined in both quantity and value from the peak production of 1951. The decline is principally attributable to reduced consumption by the chemical industry, the building trades, and the pulp and paper industry. Canadian output of both quick and hydrated lime amounted to 1,175,786 tons, valued at $13,613,221 compared with 1,241,041 tons valued at $14,082,520 in 1951.

Limestone deposits suitable for lime production occur in all provinces except Prince Edward Island. The limestones vary in type and quality, and few are suitable for the production of the white chemical grades of lime.

High-calcium lime is produced in British Columbia, Alberta, Quebec, and Newfoundland, and both dolomitic and calcium limes are available in Ontario, Manitoba, and New Brunswick.

Although lime-burning plants are located in seven provinces, Ontario contributes more than half the output, and Quebec more than one-third. Apart from its use as a building material, lime is a very important raw material in a number of major industries. The country's lime-making facilities are, therefore, largely concentrated near the main industrial areas of these two provinces.

There are in Canada approximately 45 lime plants with 150 kilns ranging in size and type from small pot kilns to large, oil-fired, rotary kilns. Several plants using lime as a raw material maintain their own kilns.

92728—10

Lime is not commonly an item of international trade, since limestone deposits and production facilities are distributed fairly widely. In Canada, however, there is a small trade adjacent to the international boundary. On the west coast some lime is exported to the United States and on the east coast it is imported from that country.

Production and Trade

	1952		1951	
	Short tons	$	Short tons	$
Production by type				
Quick-lime	912,143	10,677,367	982,689	11,387,428
Hydrated lime	263,643	2,935,854	258,352	2,695,092
Total	1,175,786	13,613,221	1,241,041	14,082,520
Production by provinces				
Newfoundland	436	19,952	436	17,533
New Brunswick	19,837	366,457	20,954	369,681
Quebec	408,522	4,056,100	460,842	4,612,387
Ontario	622,279	6,921,062	619,769	6,921,916
Manitoba	46,973	750,009	53,024	778,490
Alberta	30,006	415,348	30,670	395,452
British Columbia	47,733	1,084,293	55,346	987,061
Total	1,175,786	13,613,221	1,241,041	14,082,520
Imports, quick-lime				
From: United States	16,609	167,709	14,620	156,869
United Kingdom	83	2,488	84	2,561
Total	16,692	170,197	14,704	159,430
Exports				
To: United States	23,145	372,676	35,463	533,461
Other countries	34	828	23	700
Total	23,179	373,504	35,486	534,161
Producers' Shipments to Industries[1]				
Pulp and Paper mills	203,861	2,664,446	232,463	2,813,208
Metallurgical	224,122	1,885,316	201,047	1,585,596
Building trades	159,397	2,800,831	171,267	2,651,185
Sugar refineries	31,763	389,173	21,247	279,285
Glass works	10,091	111,142	11,730	145,892
Agriculture	13,587	195,176	14,709	199,584
Sand lime bricks	11,985	142,932	13,437	144,397
Miscellaneous industrial	479,330	5,047,993	541,261	5,960,803
Other consumers	41,650	376,212	33,880	302,570
Total	1,175,786	13,613,221	1,241,041	14,082,520

ertain industries, production of lime is an integral part of the process.

Uses and Marketing

Lime is marketed both as the oxide (quick-lime) and in the slaked (hydrated) form. The former accounts for 78½ per cent of the output and is shipped in bulk as lump or as pebble either in bulk or containers. Part of the output is crushed and pulverized, in which case it is bagged. The hydrate, which is a dry, slaked form with a fineness of 95 per cent or more passing a 325-mesh sieve, is sold in containers, usually multi-wall bags. Lime is the cheapest and most plentiful alkali chemical, and as such is used widely for control of acidity and as a causticizing agent. It is essential in the production of calcium carbide, calcium cyanamide, soda-ash, and other chemicals. Large quantities are used by the pulp and paper industry and in metallurgical operations. In the latter it is used both in the production of steel and in the concentration of ores. It is a constituent in the manufacture of glass and is used in the refining of sugar.

In the building trades lime is used both in the preparation of mortar and in plastering. It is also a component of sand-lime bricks.

In the agricultural field, lime is used to control soil acidity and correct calcium deficiency of soils. as well as in spray mixtures and dusting compounds.

Prices

Location of plants and quality of lime are factors effecting the prices. According to Canadian Chemical Processing, the price of lump quick-lime, f.o.b. plants in carload lots, ranged from $10.75 to $11.00 per ton in December, 1952, with high-calcium hydrate of lime in 50-lb sacks selling for $16.00 to $17.00 per ton in carload lots.

LIMESTONE—GENERAL

Quarry production of limestone during 1952 for all uses other than the manufacture of cement and lime reached a new high with an output of 15,957,799 tons valued at $22,319,143 compared with 15,531,948 tons at $20,901,704 the year previous.

Except for about 65,000 tons used as dimensional stone by the building industry in 1952, almost all limestone quarried in Canada was marketed as crushed stone for a variety of uses. It is also an essential raw material in several industries. Occurrences of limestone are widespread, and it is quarried in all provinces except Prince Edward Island and Saskatchewan. Ontario and Quebec together contribute almost 90 per cent of the limestone marketed in Canada.

Composition of Canadian limestones ranges from high-calcium through magnesian to dolomite, and includes both argillaceous and siliceous varieties. There are large deposits of brucitic limestone and magnesitic dolomite, some of which are being worked. There is, however, a scarcity of high-calcium stone that meets exacting modern chemical and metallurgical specifications and that is economically accessible. With increasing demand for stone of this quality, it may be necessary to resort to beneficiation of impure deposits or to underground mining where overburden is too thick for economical quarry operation.

Since limestone is plentiful and is a relatively low-cost commodity, international trade is virtually non-existent. There are, however, localities where geographic and economic factors favour export of minor amounts of stone to the United States. In other localities similarly small amounts are imported.

92728—10½

Uses

Because of its physical characteristics, the ease with which it may be quarried, and its availability, limestone is used for a variety of purposes. It is used as dimensional blocks for building construction, as a raw material in the manufacture of cement and lime, and in powdered form as an industrial filler. Most of the limestone quarried in Canada is sold as crushed rock for use as a coarse aggregate in concrete, as a road-building material, and for the ballasting of railway lines. These last uses in 1952 accounted for 12,279,559 tons or 77 per cent of the crushed limestone output.

It is important as a flux in metallurgical operations, especially in making iron and steel. It is one of the basic materials in the sulphite process for making paper. It is used in refining sugar, and is a constituent in glass manufacture. The chemical and metallurgical industries used 1,816,139 tons in 1952.

Limestone is also marketed in ground form in varying degrees of fineness for use as a filler in various industrial processes; white stone of high quality is ground and marketed as whiting substitute. Agricultural limestone, a form of ground limestone, is used to correct acidity in soil and to correct calcium and magnesium deficiency. Canadian sales for this purpose amounted to $1,185,252 in 1952.

Production and Consumption

	Short tons	
	1952	1951
Limestone—general		
By provinces		
Newfoundland	455,554	462,894
Nova Scotia	117,895	102,460
New Brunswick	113,580	142,948
Quebec	6,459,829	6,240,553
Ontario	7,818,958	7,531,536
Manitoba	239,615	382,928
Alberta	22,773	13,310
British Columbia	729,595	655,319
Total tonnage	15,957,799	15,531,948
Total value	$22,319,143	$20,901,704
By uses		
Structural[1]	64,805	83,035
Metallurgical	1,312,508	1,075,398
Glass-making	30,191	20,471
Sugar refining	8,934	56
Pulp and paper	440,780	441,900
Other chemical uses	23,726	8,742
Pulverized, agricultural and fertilizer	461,930	567,300
Pulverized, other	87,045	84,312
Rubble and riprap	1,222,961	492,597
Concrete aggregate	4,873,693	5,140,100
Road metal	6,342,270	6,928,410
Rail ballast	1,063,596	673,935
Other uses	25,360	15,692
Total tonnage	15,957,799	15,531,948
Total value	$22,319,143	$20,901,704
Manufacture of cement	4,513,625	4,246,501
Manufacture of lime	2,131,563	2,164,298

[1] Includes building, monumental, and ornamental stone, flagstone, and curbstone.

A high-purity dolomite is used in Canada as a source of magnesium in the thermal ferro-silicon process. Another magnesium process uses magnesia recovered from brucitic limestone.

At Dundas, Ontario, dolomite is dead-burned for use as a refractory in basic open-hearth steel furnaces. Magnesitic dolomite mined at Kilmar, Quebec, and magnesia recovered from brucitic limestone at Wakefield, Quebec, are used in the manufacture of basic refractories in this country. An argillaceous form of dolomite is used in Canada in the manufacture of rock wool.

The price of limestone varies according to geographical location, quality, and use. When marketed as a concrete aggregate or road-building material, the price at the quarry is often as low as $1.50 per ton.

LIMESTONE—STRUCTURAL

During 1952 there was a substantial decrease in the production of structural limestone in Canada: 63,473 tons valued at $2,465,198 were quarried, compared with 80,833 tons valued at $2,709,907 for 1951. Declines in production were reported from Quebec, Ontario, and Manitoba.

In contemporary construction, the principal market for structural limestone is in the erection of the larger types of buildings, Stone for this purpose must be heavily bedded, free from cracks and flaws, and easily worked; it must also have suitable colour and texture, and weathering qualities that will resist the severe conditions of the Canadian climate. The stone comes from the quarries in either large mill blocks or sawn slabs. These are shipped to stone-dressing plants, where slabs or special shapes, cut to exact dimensions, and requiring no further dressing on the job, are turned out. Occurrences of limestone suitable for structural use are not frequent in Canada, and a considerable quantity is therefore imported, chiefly from the United States.

A number of small quarries produce smaller, hand-trimmed stone in the form of sills, lintels, and facing blocks for use in residential and small building construction; this type of quarry is common in Quebec.

The principal areas in Quebec where building limestone is quarried are at St. Marc des Carrières, Portneuf County, and in the vicinity of Montreal. In both cases the stone is of a grey colour. At St. Marc the three quarrying firms have dressing plants for the production of finished stone. In the Montreal area there are several quarries producing hand-trimmed stone used as facing in residential construction.

Near Queenston, in the Niagara district of Ontario, a heavily bedded deposit of the Lockport formation is quarried for the production of mill blocks. The stone is in silver grey and variegated buff and grey colours. It is used principally in the construction of large public buildings.

At Tyndall, in Manitoba, a limestone mottled in buff and grey is quarried by two firms. It is used for both exterior and interior construction, and takes a very pleasing finish when polished.

Prices

The price of quarry blocks for structural limestone depends on quarry location, size and grade of stone, and ease of quarrying. A typical price is in the order of $2.50 per cubic foot at the quarry.

Production and Trade

	1952		1951	
	Short tons	$	Short tons	$
Production of limestone for building purposes[1]				
New Brunswick	200	500	200	400
Quebec	30,057	1,672,943	38,119	1,640,004
Ontario	27,917	371,742	35,396	421,564
Manitoba	5,299	420,013	7,118	647,939
Total	63,473	2,465,198	80,833	2,709,907
Imports of building stone[2]				
From: United States	24,594	391,563	17,283	284,759
United Kingdom	218	2,958	824	12,952
Italy	2	284	7	307
Total	24,814	394,805	18,114	298,018
Exports of building stone unwrought[2]				
All to United States	235	5,553	295	1,205

[1] Value of production refers to stone marketed as mill blocks or in finished condition by the quarry and does not include the value of work done on the stone by cut-stone contractors.

[2] Except granite and marble.

MAGNESITE AND BRUCITE

Canadian production of magnesia in 1952 in the form of calcined brucite granules and magnesitic dolomite amounted to $2,715,266, a slight increase over 1951. The output is used principally in the manufacture of basic refractories and metallic magnesium.

The two deposits of magnesia minerals currently worked in Canada are in the province of Quebec, north of the Ottawa River. At Kilmar, Argenteuil County, a deposit of magnesitic dolomite is worked to supply raw material for the basic refractories made by Canadian Refractories Limited. The rock is mined underground, crushed, and then beneficiated in a heavy-media separation plant to control impurities and supply a uniform product. The latter is calcined to a dead-burned clinker in a rotary kiln and is processed into a variety of basic refractory products for use in open-hearth steel furnaces and for other metallurgical applications. The company manufactures basic brick of various types and shapes, ramming mixtures, basic high-temperature cements, and various other specialized refractory materials.

The Aluminum Company of Canada, Limited works a deposit of brucitic limestone near Wakefield, Quebec, for the recovery of magnesia and lime. Brucite, a hydroxide of magnesium, is distributed through the rock as granules in a matrix of calcite. The magnesia is used in the production of basic refractories, where a high-magnesia product is required, as a raw material for the production of magnesium, and in certain industrial processes. The lime is distributed to the building, metallurgical, and pulp industries, and also finds other uses.

Other deposits of brucitic limestone occur near Wakefield, and it is found also near Bryson, Quebec, and Rutherglen, Ontario, and on West Redonda Island in British Columbia.

Although magnesite and hydromagnesite occur at several locations in western Canada, mostly in British Columbia and the Yukon, they are generally either not extensive or are remote from transportation, and consequently are not worked. The more important of these deposits occur at Marysville, near Cranbrook, British Columbia, and are owned by The Consolidated Mining and Smelting Company of Canada, Limited.

Hydromagnesite occurrences near Atlin and Clinton, British Columbia, have been worked intermittently.

Production and Trade

	1952		1951	
	Short tons	$	Short tons	$
Production[1]				
Magnesitic dolomite and brucite	—	2,715,266	—	2,437,773
Imports				
Dead-burned and caustic calcined magnesite				
From: United States	8,824	444,958	4,745	334,511
Norway	1,236	52,754	1,542	70,262
United Kingdom	191	16,732	109	10,291
India	27	3,715	124	15,543
Total	10,278	518,159	6,520	430,607
Magnesite fire-brick				
From: United States	—	652,090	—	484,248
United Kingdom	—	4,950	—	8,768
Total	—	657,040	—	493,016
Magnesia alba and levis[2]				
From: United States	1,231	216,204	894	210,121
United Kingdom	113	45,155	61	21,284
Total	1,344	261,598	955	231,405
Magnesia pipe covering				
From: United States	—	181,167	—	78,424
United Kingdom	—	49,927	—	41,592
Total	—	231,094	—	120,016
Magnesium sulphate				
From: West Germany	1,020	23,365	1,928	41,609
United States	988	44,537	944	43,614
United Kingdom	111	6,485	127	7,642
Netherlands	66	2,032	66	2,140
Total	2,185	76,419	3,065	95,005
Magnesium carbonate and magnesium oxide				
From: United States	3.708	303,746	3,222	278,594
United Kingdom	107	13,313	1,163	115,394
Total	3,815	317,059	4,385	393,988
Exports				
Basic refractory materials, dead-burned				
To: United States	2,887	163,967	3,667	178,747
Other countries	73	3,750	1,235	75,302
Total	2,960	167,717	4,902	254,049

[1] Does not include value of secondary products such as refractories, but does include value of a small amount of magnesium metal.
[2] There was also imported 100 pounds of this material, valued at $239, from France.

Uses

In addition to its use in refractories and as a source of magnesium metal, magnesia is used to correct magnesium deficiency in the soil, part of Canadian production being shipped to the citrus-growing areas of the United States for this purpose. It is used to prepare magnesium bisulphite for a recently developed process of paper making. It also enters into the preparation of magnesium oxychloride and oxysulphate cements, and is used in magnesia insulation. It finds wide use in a number of chemical processes. Used as a neutralizer for sulphuric acid, in place of lime, it produces free-flowing solutions, owing to the superior solubility of magnesium sulphate over calcium sulphate.

MARBLE

While the 1952 production of marble was down, the value showed a fairly substantial increase: shipments for 1952 totalled 57,637 tons valued at $524,783, as compared with 63,982 tons valued at $492,820 in 1951.

Practically all the producing quarries are located in Quebec and Ontario. The latter province accounts for approximately 60 per cent of Canadian production.

Marble in this country is quarried principally for marketing in crushed and ground forms to supply a variety of uses. It is sold as chips for terrazzo flooring, as an aggregate in stucco dash and artificial stone, as poultry grit, to the pulp and paper industry, and for making whiting substitute.

In both Ontario and Quebec there are occurrences which are worked for the production of mill blocks. Marble quarried in this form is sawn, shaped, and polished for decorative use in building construction. However, most marble of the latter type is imported from the United States, Italy, Belgium, and France. Imports are in the form of mill blocks or sawn slabs, which are finished to specification in Canadian marble-dressing plants.

Production

	1952		1951	
	Short tons	$	Short tons	$
Ontario	30,638	211,105	38,113	196,986
Quebec	26,999	313,678	25,637	289,334
British Columbia	—	—	232	6,500
Total	57,637	524,783	63,982	492,820

Imports, 1952[1]
(Dollars)

	United States	Italy	Belgium	France	Other countries	Total 1952	Total 1951
Rough marble	24,022	49,035	8,913	2,883	3,822	88,675	103,930
Sawn marble	64,550	52,991	4,520	—	—	122,061	200,820
Marble for tombstones	57,439	311	—	—	—	57,750	54,009
Marble manufactures	11,169	5,645	768	1,038	1,169	19,789	59,176
Ornamental marble for churches	452	48,614	—	217	—	49,283	18,092
Total	157,632	156,596	14,201	4,138	4,991	337,558	436,027

[1] In addition to the above, mosaic flooring material to the value of $341,190 was imported in 1952. Part of this is prepared marble.

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 Orford Marble Company Limited is working an occurrence of serpentine marble in red, green, and grey. Both mill blocks and terrazzo chips are produced. This marble has been used recently as an interior decorative stone in the construction of several public buildings.

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.

From time to time a brown marble is produced from the building-stone quarries at St. Marc des Carrières, Portneuf County.

Ontario

Mill blocks and terrazzo chips are produced from a black marble by Silvertone Black Marble Quarries Limited, St. Albert Station, 30 miles southeast of Ottawa.

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. Verona Rock Products Limited, Verona, 20 miles northwest of Kingston, and Bolenders Limited, north of Haliburton at Eagle Lake, produce poultry grit and stucco dash from white crystalline limestone.

Pulverized Marble Products, Limited, quarried crystalline dolomite from a deposit on the outskirts of Kaladar in Lennox and Addington county for the production of plaster aggregate.

Manitoba

There are a number of undeveloped occurrences of highly coloured marbles along the Hudson Bay and the Flin Flon branches of the Canadian National Railway and at Fisher Branch, 100 miles north of Winnipeg.

British Columbia

There is a small production of white marble from this province for use as stucco dash and for making a whiting substitute in the manufacture of putty. Other occurrences of marble are known.

Prices

The price of marble varies widely according to size, quality, colour, and pattern.

MICA

Primary production (sales) of mica of all classes in Canada in 1952 decreased 59·4 per cent in volume and 56·6 per cent in total value below 1951 levels. Unmanufactured exports, all to the United States and Japan, declined 35·8 per cent in volume and 67·6 per cent in value, while imports of all classes (including manufactures) declined 25·4 per cent in value.

Canadian Producers

Ontario

North Bay Mica Company Limited, operating the Purdy mine at Eau Claire, was again the only regular producer of sheet muscovite in Canada.

Producers of phlogopite included F. J. Powers, Stanleyville, operating in North Burgess township, and Messrs. Blackburn Bros. operating in Loughborough township.

Suzorite Company, Limited, Cornwall, continued to produce ground mica from suzorite rock on hand. This material was obtained from a large deposit in Suzor township, Laviolette county, Quebec.

Quebec

Producers of phlogopite included Messrs. Blackburn Bros., Cantley; E. Wallingford, Perkins; A. and C. Poirier, Wilsons Corners; and others operating in the Gatineau-Lièvre River area.

British Columbia

Geo. W. Richmond and Company and Fairey and Company Ltd., Vancouver, continued to grind mica schist produced by Charmica Mines Limited from a deposit at Albreda, it is used locally in the manufacture of roofing material.

Production, Trade, and Consumption

	1952		1951	
	Pounds	$	Pounds	$
Production (primary sales)				
Trimmed	61,625	111,830	230,532	288,309
Splittings	6,900	10,849	6,302	5,421
Sold for mechanical splittings	105,795	19,756	108,831	17,350
Rough, mine-run, or rifted	14,350	850	274,980	48,646
Ground or powdered	988,051	41,545	2,062,854	75,140
Scrap	838,220	9,276	2,278,009	12,784
Total	2,014,941	194,106	4,961,508	447,650
Imports				
(including manufactures)				
From: United States	—	438,697	—	544,948
India	—	265,244	—	396,222
United Kingdom	—	20,342	—	32,487
Other countries	—	4,606	—	2,810
Total	—	728,889	—	976,467
Exports, unmanufactured				
Rough				
To: United States	178,700	31,291	234,900	45,630
Japan	100	28	11,800	3,430
Total	178,800	31,319	246,700	49,060
Trimmed				
To: Japan	28,900	23,905	77,900	44,563
United States	21,700	61,729	352,800	334,283
Total	50,600	85,634	430,700	378,846

Production, Trade, and Consumption—concluded

	1952		1951	
	Pounds	$	Pounds	$
Scrap				
To: United States	889,000	8,434	980,400	10,555
Ground				
To: United States	440,400	26,020	770,000	43,918
Panama	—	—	5,000	172
Total	440,400	26,020	775,000	44,090
Splittings				
To: Japan	3,100	4,689	—	—
United States	400	400	—	—
Total	3,500	5,089	—	—
Total unmanufactured	1,562,300	156,496	2,432,800	482,551
Exports, manufactures				
To: United States	—	277	—	655
Brazil	—	86	—	1,329
Hong Kong	—	—	—	233
Total manufactures	—	363	—	2,217

	1951	1950
Consumption		
Paints	1,594,733	1,680,720
Electrical apparatus	737,030	485,602
Rubber goods	313,147	349,792
Roofing	994,000	1,068,000
Wall paper	150,000	184,000
Mica products	119,719	118,108
Miscellaneous products	216,247	—
Total	4,124,876	3,886,222

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 radio, television, and sound-recording equipment; as the dielectric in capacitors; and as a glazing material for compass dials, boiler gauges, furnace observation holes, and lamps. Sheet mica is sold commercially according to variety, size, and quality.

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; such sheets may be made of any required size. Either muscovite or phlogopite may be employed according to end use. Splittings are used similarly in the manufacture of mica 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 is ground dry or wet, according to use. Dry-ground mica is usually made from lower-grade material of poor colour, mainly muscovite and phlogopite, but to some extent biotite, and is used principally by makers of asphalt-base roofing as a filler and dusting agent. It is also used for moulded high-frequency insulation, in which the mica is bonded with ceramic or plastic binders to form a material that may be pressed or moulded into any shape desired, 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. Grades	*Area of Maximum 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	1½
No. 5	3 to 6	1
No. 5½	2¼ to 3	⅞
No. 6	1 to 2¼	¾

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. Standard gradings are 1 by 1, 1 by 2, 2 by 3, 2 by 4, 3 by 5, 4 by 6, 5 by 8, and larger.

No formal quality grading applying 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 most characteristic 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 buyers in Canada include: Blackburn Bros., Ottawa; Walter C. Cross, Hull, Quebec, and Mica Company of Canada, Hull, Quebec.

Buyers in United States include: A. O. Schoonmaker Insulation Co., Inc., New York, N.Y.; F. D. Pitts Company Inc., Newton 67, Mass.; Electronics Mechanics Inc., Clifton, N.J.; and Mica Products Company, Dept. 4, Los Angeles, Calif.

Prices

Prices offered for trimmed sheet by Ottawa region dealers at the close of 1952 were approximately as follows:

Linear Dimensions	*Price per pound*
inches	$
1x1 and 1x2	0.30
1x3	0.75
2x3	1.25
2x4	1.60
3x5	2.10
4x6	2.60
5x8	3.25

Grinding scrap sold from about $15.00 to $22.00 per ton delivered at plant, depending on quality.

Tariffs

Canada

Mica, phlogopite and muscovite, unmanufactured, in blocks, sheets, splittings, films, waste, etc.

British preferential	10% ad valorem
Most favoured nation	10% ad valorem
General	25% ad valorem
Mica schist	free

United States

Mica, unmanufactured (not including waste or scrap), valued per pound.

Not over 15¢ per lb.	4¢ per lb.
Over 15¢ per lb.	2¢ per lb. and 15% ad valorem

Mica, cut or stamped to dimensions, form, or shape— 40 per cent ad valorem Mica films, and splittings, not cut or stamped to dimensions, and in thickness.

Not over 0·0012 in.	12½% ad valorem
Over 0·0012 in.	20% ad valorem

Mica plates and built-up mica, and all manufactures wholly or in chief value made of mica, by whatever name known— 25 per cent ad valorem. Untrimmed phlogopite from which no rectangular piece over 2 inches long or 1 inch wide may be cut—5 per cent ad valorem. Mica waste and scrap, valued per pound.

Not over 5¢ per lb.	
Phlogopite	12½% ad valorem
Other	15% ad valorem
Over 5¢ but not over 15¢	4¢ per lb.
Over 15¢	2¢ per lb. and 15% ad valorem

Mica, ground or pulverized, 12½% ad valorem.

NEPHELINE SYENITE

Shipments of nepheline syenite in Canada in 1952 rose slightly above the 1951 total to a record of 82,681 tons of which 69 per cent was glass grade and 24 per cent pottery grade. Sixty-eight per cent of total shipments was exported. Exports declined 6 per cent in volume below 1951 totals.

Production continued to be confined to American Nepheline Limited, Lakefield, Ontario, sole producer in the Western Hemisphere, operating extensive deposits on Blue Mountain, Peterborough County, Ontario.

Production and Trade

	1952	1951
	Short tons	Short tons
Production of crude		
(*ore transported to storage*)	79,968	194,814
Shipments		
Ground		
Glass grade	57,479	53,029
Pottery grade	19,507	23,641
Miscellaneous	4,256	3,618
Total, ground	81,242	80,288
Crude	1,439	820
Total, shipments	82,681	81,108
Exports of crude and processed materials		
To: United States	54,120	56,942
Puerto Rico	850	900
Netherlands	550	1,195
United Kingdom	338	442
Other countries	465	298
Total	56,323	59,777

Occurrences

Deposits of nepheline syenite are known to 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

Nepheline syenite is used almost exclusively for ceramic purposes, for which it is favoured principally because it effects a significant lowering of firing temperatures. It is valued in the glass batch because of its high alumina content (23 per cent in Lakefield nepheline syenite) to which are attributed low annealing temperature, reduced coefficient of expansion, increased tensile strength, hardness, and brilliancy.

Nepheline syenite is used in all types of pottery, enamels, floor and wall tile, as a bond in refractory cements, porcelain balls and liners, and in other ceramic products. About two-thirds of the annual Canadian production is consumed by the glass industry.

B-grade dust, a by-product, finds a limited market for use in cleansers, enamels, and certain clay products.

Prices and Tariffs

Prices of processed nepheline syenite remained the same as in 1951 as follows: f.o.b. Lakefield, Ontario, glass grade, 28-mesh, bulk carload lots, $14.00 per ton; pottery grade, 200-mesh, bulk carload lots, $18.00 per ton; grade B, 150-mesh, bagged, carload lots, $10.00 per ton.

Nepheline syenite, all classes, entered United States free of duty.

PHOSPHATE

Since about 1900, when phosphate rock (apatite) from large sedimentary deposits in the United States became available at low cost, phosphate mining in Canada has been conducted sporadically and on a small scale only. There was no Canadian production recorded in 1952.

Apatite occurs in a large number of deposits in the general Ottawa region of Ontario and Quebec. Production in the past reached a maximum of about 30,000 tons a year, almost 90 per cent of which came from the Lièvre River area in Quebec.

During the year Nemegos Uranium Corporation, Buffalo, N.Y., continued surface development of an iron deposit at Nemegos, Ontario, 155 miles west of Sudbury, which contains a high percentage (reported up to 30 per cent) of apatite.

Phosphate rock used for fertilizer and chemical manufacture in eastern Canada is obtained mainly from Florida. The Consolidated Mining and Smelting Company of Canada Limited, Trail, British Columbia, manufactures phosphate fertilizers from black phosphorite rock obtained from leased properties near Garrison, Montana.

Production, Trade, and Consumption

	1952		1951	
	Short tons	$	Short tons	$
Production	—	—	6	94
Imports				
Phosphate rock				
From: United States	457,518	2,891,087	487,312	3,028,071
Netherland Antilles	8,960	210,600	9,092	128,828
Other countries	4,435	28,619	3,307	22,000
Total	470,913	3,130,306	499,711	3,178,899
Superphosphate				
From: United States	206,390	3,868,987	187,537	3,354,901
Netherlands	6,600	228,990	375	32,371
Other countries	2,295	141,622	—	—
Total	215,285	4,239,599	187,912	3,387,272
Phosphoric acid				
All from United States	346	41,650	308	37,824

Production, Trade, and Consumption—concluded

	1951	1950 [1]
	Short Tons	Short Tons
Consumption		
Fertilizers	425,096	421,304
Chemicals	67,509	43,957
Stock and poultry	16,516	13,305
Pig iron	236	236
Refractories	286	252
Miscellaneous	9,500	9,183
Total	519,143	488,237

[1] Revised.

Uses

Phosphate rock is used chiefly in the manufacture of commercial fertilizers, mostly in the form of superphosphate made by treating the raw material with sulphuric acid. In the United States, fusion processes developed in recent years have given rise to the production of phosphate fertilizers of the slag type. Finely ground raw phosphate rock is also applied directly to the soil on a minor scale.

Phosphorus and many phosphorus compounds enter into the manufacture of a large variety of products such as detergents, flame retardants, water softeners, pigments, opacifiers, food preservatives, pharmaceutical preparations, livestock feed supplements, flotation reagents, glass, rodent poisons, fireworks, and many others. Ferrophosphorus is used in iron and steel castings to increase fluidity, and in rolled sheet to prevent sticking. Phosphorus is used as a hardening agent in non-ferrous alloys.

Specifications

To be acceptable for acid treatment, phosphate ore or concentrates should be virtually free from common impurities such as iron oxides, calcite, and ferromagnesian minerals. The grade should approach 80 per cent tri-calcium phosphate.

For furnace treatment, common impurities are tolerated within reasonable limits, but purchasers prefer rock containing a minimum of 70 per cent tricalcium phosphate. Size specifications call for a minimum of 80 per cent plus 10-mesh.

Apatite for furnace treatment is purchased by Electric-Reduction Co., Limited, Buckingham, Que.

Prices

Closing 1952 quotations for Florida pebble phosphate, f.o.b. mine, were as follows: 76—77 per cent B.P.L. (bone phosphate of lime), $7.00 per long ton; 66—68 per cent, $3.95. These quotations are unchanged from closing prices for 1951.

The price offered by eastern consumers for domestic phosphate was $16.00 per short ton for 80 per cent B.P.L., f.o.b. works, with a penalty or bonus of 20 cents per unit below or above that figure.

Phosphate rock is not dutiable under the Canadian tariff.

ROOFING GRANULES

The consumption of roofing granules in Canada declined from the all-time high of 124,640 short tons valued at $3,085,520 in 1951 to 108,815 tons valued at $2,781,192 in 1952. Domestic production has been about 30,000 tons annually for the past several years, with Building Products Limited of Montreal being by far the largest producer. Geo. W. Richmond and Company, Vancouver, has supplied natural granules to west coast manufacturers of asphalt roofing and siding for many years. Wendell Mineral Products Limited, Montreal, with quarry and colouring plant at Landrienne, Quebec, began shipments of natural and artificially coloured granules to consumers late in 1952.

Canadian manufacturers of roofing and siding imported 76,755 tons of granules valued at $2,041,547 in 1952, compared with 91,112 tons valued at $2,305,434 in 1951. As in previous years, all of these granules were imported from the United States, most of them being supplied by Minnesota Mining and Manufacturing Company, Central Commercial Company, and R. J. Funkhouser and Company. Minor amounts of roofing granules were supplied by Advance Industrial Supply Company and H. B. Reed Company.

The increasing preference by Canadian consumers for artificially coloured granules continues to show up in the returns to the Mines Branch: 86,219 tons were used in 1952, with 22,596 tons of natural granules. Comparative figures for 1951 were 92,997 tons of coloured granules and 31,643 tons of natural. Figures on natural granules include those used by some manufacturers as the under-coating for artificially coloured granules.

In 1952, granules made from rocks of sedimentary origin (slate) consumed by roofing manufacturers totalled 11,494 tons, compared with 31,660 tons in 1951. The remainder in both years consisted of granules made from rocks of igneous origin; of these, 13,080 tons were natural and 83,241 were artificially coloured in 1952.

Consumption and Trade[1]

	1952		1951	
	Short tons	$	Short tons	$
Consumption				
Natural	22,596	429,035	31,643	597,215
Artificially coloured	86,219	2,352,157	92,997	2,488,305
Total	108,815	2,781,192	124,640	3,085,520
Consumption by colour				
Black and grey-black	33,408	675,240	40,689	808,636
Green	33,909	894,002	37,978	980,654
Red	18,625	439,931	23,092	551,602
Blue	10,087	361,829	10,526	364,813
White and grey-white	9,671	321,223	8,197	268,560
Buff and brown	3,115	88,967	4,158	111,255
Total	108,815	2,781,192	124,640	3,085 520
Imports				
From United States	76,755	2,041,547	91,112	2,305,434

[1] Compiled from figures supplied to the Mines Branch by consumers.

Roofing Granule Plants in Canada

Quebec

Wendell Mineral Products Limited, Montreal, toward the end of the year started shipments of natural and artificially coloured roofing granules from its plant at Landrienne, Quebec, a short distance east of Amos. The company owns a large deposit of grey rhyolite about one mile north of its crushing and colouring plant situated close to Landrienne station. A complete line of coloured granules on the rhyolite base rock has been developed.

Ontario

Building Products Limited, Montreal, is by far the largest producer of roofing granules in Canada. The company operates a black amphibole rhyolite quarry 4 miles north and west of Madoc, a pink syenite quarry about 3 miles northwest of Madoc, and a grey basalt quarry near Havelock that was acquired from Ontario Rock Products Limited in 1950. Material from the first two quarries is trucked to the company's plant adjacent to the basalt quarry for crushing and sizing. The company supplies road metal for road surfacing from the Havelock quarry and, from the undersize material, produces roofing granules. The granules produced at Havelock are artificially coloured (ceramically) by the sodium silicate process in a plant adjoining the crushing and screening operation.

British Columbia

Geo. W. Richmond and Company quarries a dark grey slate at McNab Creek, Howe Sound, and a green siliceous rock at Bridal Falls near Chilliwack. The company continued to produce natural granules in its Vancouver plant for shipment to west coast roofing manufacturers.

Roofing and Siding Plants in Canada

Granule-coated roofings and sidings are manufactured by 9 companies at a total of 15 plants across Canada, as follows:

Company	*Location of Plant*
Bishop Asphalt Papers Limited	Portneuf Station, Quebec. London, Ontario.
The Brantford Roofing Company, Limited	Brantford, Ontario.
Canadian Gypsum Company, Limited (Formerly Toronto Asphalt Roofing Manufacturing Co., Limited)	Mount Dennis, Ontario.
The Philip Carey Company, Limited	Lennoxville, Quebec.
Building Products Limited	Montreal, Quebec. Hamilton, Ontario. Winnipeg, Manitoba. Edmonton, Alberta (new in 1951).
Sidney Roofing & Paper Company, Limited	Victoria, British Columbia. Lloydminster, Alberta (new in 1951).
Canada Roof Products Limited	Vancouver, British Columbia.
The Barrett Company, Limited	Montreal, Quebec. 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 are able to meet all requirements.

Rocks suitable for granules 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 as to withstand weathering effects from freezing and thawing and so that a minimum of pigment is required to 'cover' the granule. 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 calcium or magnesium carbonates will cause granules to weather badly. A rock suitable for making granules 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 haulage distance of roofing plants.

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, mainly because, on crushing, the material fractures with quite a glassy, smooth face.

There is no rule by which to determine the ability of a granule to take colour, but for a full range of colours a light-shade base granule is generally 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 ultraviolet light can penetrate the granules, the resultant deterioration of the asphalt underneath causes a loss of adhesion, and this results in ultimate loss of the granules from the roofing. Some manufacturers and consumers of granules claim that the infrared (heat) rays of the sun have a more direct effect on the durability of roofings than the ultraviolet.

Specifications for granules used in undercoating are as rigid as those for topcoat granules, with the exception of colouring characteristics, which are not important. Because undercoat granules can be made from dark rocks and left in their natural colour, they are cheaper than artificially coloured topcoat granules.

Processes for colouring granules are covered by many patents. The two most widely used 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.

After colouring, granules are usually treated with a paraffin-base oil. This improves the adhesiveness of the granules to the asphalt base, and also heightens the colour, although this latter effect soon wears off with exposure.

Many methods have been suggested for determining the quality of granules, either coloured or uncoloured, but actual exposure is considered the most satisfactory. Large producers of granules, and some consumers, maintain experiment stations where test panels are exposed to relatively warm, humid, weather conditions, which are considered to provide the severest test.

A good granule roofing should have a life expectancy of at least twenty years, and many such roofs are still in good condition after twenty-five years or more.

United States Production

The production of roofing granules in 1951, as reported to the United States Bureau of Mines, amounted to 1,614,779 short tons, valued at $24,284,137 which was a decrease of 10 per cent in both quantity and value compared with the all-time production record in 1950 (1,797,729 tons at $26,852,848). The average value per ton of all types of granules produced in the United States in 1951 was $15.04, an increase of $0.10 per ton over 1950. Of the total production in 1951, artificially coloured granules accounted for 1,184,544 tons and natural granules accounted for 430,235 tons. The average value for natural granules decreased from $8.80 per ton in 1950 to $8.08 per ton in 1951, while the average value for artificially coloured granules increased from $17.21 a ton in 1950 to $17.57 a ton in 1951, f.o.b. producers' plants.

Canadian Prices

Prices paid for roofing granules f.o.b. consumers plant depend upon the type of granule, distance from producing plant, and whether the colour is natural or artificial. Imported natural granules in 1952 averaged $18.64 per short ton, compared with $18.71 per short ton in 1951, f.o.b. Canadian roofing manufacturing plants. The average prices of artificially coloured granules per short ton in 1952, with comparative 1951 figures in brackets, were: reds $23.62 ($23.88); greens $26.36 ($25.82); blues $35.87 ($34.65); buff and brown $28.56 ($26.75); white and grey-white $33.21 ($32.76). The average value of all types of granules per short ton f.o.b. consumers' plants was $25.55 in 1952 compared with $24.75 in 1951.

SALT

The production of salt in 1952 reached an all-time high of 971,903 short tons, 7½ per cent more than in 1951. Imports of grain sizes and purities not produced in Canada amounted to 288,125 short tons, 11 per cent more than in 1951.

Practically 90 per cent of Canada's salt output comes from underground salt beds, the salt being pumped to the surface as brine. Such beds occur in all provinces, but production is limited to Ontario (78 per cent of the total), Nova Scotia (14 per cent), Saskatchewan, Alberta, and Manitoba. Malagash, Nova Scotia, is the site of the only rock salt mine operated in Canada. However, Canadian Salt Company, Limited, is preparing to mine an extensive bed of clean salt that has been found at a depth of 1,100 feet near Windsor, Ontario.

Salt deposits in Newfoundland and Nova Scotia were core-drilled during the summer to obtain data in connection with the possible establishment of industries using salt as a raw material.

Production, Imports, and Exports of Salt

	1952		1951	
	Short tons	$	Short tons	$
Production by types				
Fine vacuum salt	377,349	6,317,694	320,438	6,852,180
Coarse grainer salt	6,995	190,539	7,784	220,765
Mined rock salt	82,881	583,172	74,812	541,988
Salt, chemical[1]	504,678	683,410	561,491	1,586,332
Total	971,903	7,774,815	964,525	9,201,265
Production by Provinces				
Ontario	757,025	4,401,780	772,585	5,488,156
Nova Scotia	138,845	1,565,814	127,252	1,933,876
Saskatchewan	33,540	789,000	28,192	768,500
Alberta	24,380	614,522	19,718	562,062
Manitoba	18,113	403,699	16,778	448,671
Total	971,903	7,774,815	964,525	9,201,265
Imports				
From: United States	211,287	1,498,126	197,891	1,380,972
Spain	29,734	172,681	7,350	107,970
Bahamas	27,989	143,417	23,084	106,875
United Kingdom	6,867	157,049	6,996	165,510
Jamaica	5,154	21,852	16,529	127,274
Other countries	7,094	66,530	6,972	65,825
Total	288,125	2,059,655	258,822	1,954,426
Exports				
To: United States	2,680	37,142	3,762	37,642
Bermuda	136	6,386	152	7,100
Other countries	28	103	647	18,105
Total	2,844	44,631	4,561	62,847
Apparent Consumption	1,257,184	9,789,839	1,218,786	11,092,844

[1] Mainly from brine, and used by the producers in the manufacture of chemicals. The sharp decline in 1952 value results from the fact that one producer had for some years past been placing too high a value on the product. This was adjusted in 1952.

Production

Nova Scotia

In Nova Scotia, salt is mined at Malagash, Cumberland county, by Canadian Salt Company, Limited. The mined rock salt is crushed, screened, and sold for ice removal on highways and railways, and for dust control.

Fine salt from vacuum-pan evaporators is produced near Amherst by Dominion Salt Company, Limited, from brine obtained from massive salt beds, 860 feet below the surface.

Ontario

Ontario is by far the largest producer of salt in Canada accounting for 78 per cent of the total production in 1952. The salt is obtained from wells drilled into salt beds that lie from 800 to 1,500 feet below the surface at Goderich, Sarnia, Warwick, and Sandwich in southwestern Ontario and is used to supply the chemical industries of this province.

Purity Flour Mills, Limited, produces fine salt from vacuum-pan evaporators at its plant in Goderich.

The plants of Dominion Salt Company, Limited, at Goderich and Sarnia produce fine salt from vacuum-pan evaporators.

Dow Chemical of Canada Limited produces caustic soda and chlorine at its plant in Sarnia from brine obtained from nearby wells.

Warwick Pure Salt Company, Limited, produces a coarse salt by open-pan evaporation of brine from wells near the village of Warwick.

At Sandwich, Canadian Salt Company, Limited, produces both fine and coarse salt from vacuum evaporators and open-type grainers respectively. The brine comes from local wells.

Brunner Mond, Canada, Limited operates a large soda-ash plant at Amherstburg, the brine for which is obtained from wells a few miles to the north.

Prairie Provinces

Canadian Salt Company, Limited, with a plant at Neepawa, is the only producer in Manitoba. This plant produces all grades of evaporated salt by means of vacuum-pan evaporation of brine obtained from wells over 1,000 feet deep.

In Saskatchewan, Dominion Tar and Chemical Company, Limited, through its subsidiary Prairie Salt Company, Limited, obtains salt brine from beds of salt over 3,500 feet below the surface at Unity. This brine is evaporated at its vacuum-pan plant to produce a fine, pure salt.

At Lindbergh, Alberta, Canadian Salt Company, Limited, produces pure salt by the vacuum-pan process from brine obtained from salt beds 2,800 feet below the plant. Part of the output is marketed as fine salt and part is fused, crushed, and screened to give a coarse salt that is used for icing refrigerator cars, tanning hides, and other purposes. Natural gas, obtained from strata above the salt beds, provides fuel for the plant.

Undeveloped Deposits

Salt beds have been found on the west coast of Cape Breton Island; under Hillsborough Bay, Prince Edward Island; and at Weldon and Dorchester in New Brunswick.

In the Prairie Provinces, salt beds varying in thickness from a few feet to many hundreds stretch in a great crescent from the extreme north of Alberta through central Saskatchewan into the southern part of Manitoba.

Salt deposits are indicated in a number of places by brine springs. These occur in Antigonish, Pictou, and Cumberland counties in Nova Scotia, in western Newfoundland, and in various parts of British Columbia.

Uses

The finer grades of salt, produced by the vacuum-pan evaporation of brine, are used chiefly in the chemical industries. Such salt is used for household and food purposes also.

The coarser grades are used in the curing of fish, for ice and dust control on highways, for dairy uses, and in refrigeration. Coarse salt is obtained by the use of open-pan evaporators and by the mining, crushing, and screening of rock salt. Coarse salt produced by evaporation is very pure, but expensive, and hence is used only where purity is essential. The mined salt is impure and is used for such purposes as de-icing and dust control on highways. It is usually too impure to be used in the fish industry, and Canada has therefore to import large quantities of pure coarse salt to meet her needs in this respect. These imports are obtained from the West Indies and California, where salt is produced by solar evaporation.

Prices

According to Canadian Chemical Processing, there was no change in salt prices during 1952.

	November 1952	*December 1951*
Fine industrial salt, per ton bulk, carlots, f.o.b. plant	$ 8.80	$ 8.80
Coarse industrial salt, per ton bulk, carlots, f.o.b. plant	$17.80	$17.80

SAND AND GRAVEL

Since the end of the war, sand and gravel production in Canada rose from 29,750,703 tons in 1945 to 102,895,545 tons in 1952, an increase of 246 per cent.

Sand and gravel are produced commercially in all provinces except Prince Edward Island, with Ontario and Quebec accounting for 74 per cent of the total production. The materials are widely distributed, so that pits are found scattered throughout the country near areas of consumption.

Distribution of principal sand and gravel operators in 1951 by provinces was as follows:—

Province	*No. of principal producers**
Newfoundland	2
Nova Scotia	3
New Brunswick	3
Quebec	57
Ontario	210
Manitoba	15
Saskatchewan	45
Alberta	12
British Columbia	36

* Does not include intermittent production by railway companies for ballast, or by counties and townships in Ontario for road use.

Practically all large commercial sand and gravel plants are now equipped to wash and screen gravel. The product can successfully compete with most types of crushed stone, especially since both coarse and fine aggregate can be obtained from the same pit, whereas when crushed stone is used the fine aggregate has to be obtained from a separate source.

Production, Trade, and Consumption

	1952		1951	
	Short tons	$	Short tons	$
Production[1] by provinces				
Newfoundland	1,654,471	936,013	1,483,951	648,346
Nova Scotia	1,574,539	1,269,540	1,756,641	1,527,052
New Brunswick	3,670,289	1,815,576	2,966,210	2,229,258
Quebec	32,060,910	12,744,630	31,297,949	10,616,701
Ontario	43,423,737	23,240,203	39,218,058	19,905,293
Manitoba	3,763,418	1,253,642	2,832,110	929,989
Saskatchewan	3,544,602	1,657,919	2,951,813	1,874,071
Alberta	5,066,403	3,590,687	4,289,021	3,194,446
British Columbia	8,137,176	4,830,833	6,177,068	3,702,403
Total	102,895,545	51,339,043	92,972,821	44,627,559
Production[1] by type				
Sand				
Moulding sand	23,434	65,625	36,421	86,900
Building sand	8,069,333	5,743,760	7,972,740	5,116,901
Core sand	941	1,943	1,855	3,490
Other sand, etc	711,283	387,663	363,780	158,699
Total sand	8,804,991	6,198,991	8,374,796	5,365,990
Sand and gravel				
Railway ballast	7,122,550	2,403,865	6,991,189	2,291,532
Concrete, road building, etc	68,157,943	31,125,978	62,305,240	27,941,202
Mine filling	3,898,609	1,159,186	3,412,226	950,941
Crushed gravel	14,911,452	10,451,023	11,889,370	8,077,894
Total gravel and sand	94,090,554	45,140,052	84,598,025	39,261,569
Total production	102,895,545	51,339,043	92,972,821	44,627,559
Exports of sand and gravel				
To: United States	350,443	329,631	370,398	358,626
Imports of sand and gravel				
From: United States	181,729	169,644	261,141	213,628
United Kingdom	1,650	5,001	—	—
Total	183,379	174,645	261,141	213,628
Apparent consumption	102,728,481	51,184,057	92,863,564	44,482,561

[1] Does not include production of natural silica sand or of silica sand manufactured from quartz or silica rock.

Uses

The main uses for sand and gravel are in concrete work, building, and road construction. A total of 83,069,395 tons of sand and gravel valued at $41,577,001 was used for these purposes in 1952.

Gravel

Gravels vary widely in composition and in size of component particles and these factors determine suitability for various uses. About 16 per cent of output is washed and screened; the remainder is marketed as pit-run or bank gravel for use primarily in concrete work, road construction, building, and as railway ballast and mine fill.

Gravel is a good material for low-cost, all-weather road surface where the amount of traffic is not large enough to justify the expenditure for a more permanent type of surface. In Newfoundland, probably over 75 per cent of the gravel used goes into road building. Many stretches of road are built entirely of gravel from the bottom of the fill to the top of the wearing course.

Beach or stream gravels are not as desirable as bank gravels for road purposes, since they are deficient in binding material and contain a high proportion of hard, rounded, smooth pebbles.

Sand

The greater part of the sand output is used in concrete work, cement and lime mortar, and wall plaster. For these uses, sands have to be clean, but the specifications for such sand are otherwise fairly broad.

SILICA MINERALS

Although production of silica minerals showed a decline in tonnage of 6·4 per cent as compared with 1951, the value of the output increased by 9·2 per cent.

The requirements of the glass and chemical industries for silica sand are met by imports, chiefly from the United States. The Canadian output of quartz, quartzite, and silica sand is used as a fluxing material in the metallurgical industry, in the manufacture of silicon and ferrosilicon alloys and in the manufacture of abrasives. Silica for the manufacture of silica brick and moulding sands is also produced in Canada.

Interest has been shown in developing a deposit of silica sand in the Windsor, Ontario, area. Seventy feet of flat-lying beds of sandstone having a grain size suitable for the glass industry were encountered at a depth of about 500 feet by the Canadian Rock Salt Company when drilling to explore salt beds.

Other potential sources of glass sand in eastern Canada are also being investigated. One company has erected a mill at Lachine, Quebec, with the intention of producing glass sand from a silica deposit in the Laurentian Mountains north of Montreal, and two other companies are engaged in financing the development of sandstone deposits near Ottawa and Gananoque.

Production and Trade

	1952		1951	
	Short tons	$	Short tons	$
Production of Quartz and Silica Sand	1,783,267	2,467,267	1,904,885	2,258,468
	Thousands of brick		Thousands of brick	
Production of Silica Brick	3,544	606,394	3,510	465,229
	Short tons		Short tons	
Imports of Silica Sand				
From: United States	642,841	1,771,667	692,655	1,988,888
United Kingdom	39	510	282	2,145
Total	642,880	1,772,177	692,937	1,991,033
Exports of Quartzite				
To: United States	191,152	635,346	281,379	838,227
United Kingdom	2,803	7,005	—	—
Total	193,955	642,351	281,379	838,227

Canadian Production

Nova Scotia

Dominion Steel and Coal Corporation, Limited operates a quarry at Chegoggin Point, Yarmouth County. Quartzite is shipped to Sydney, where it is used in the manufacture of silica brick.

Investigations in this province have shown that there are a number of deposits of beach sands, sandstones, and quartzites that are potential sources of high-grade silica.

Quebec

Canadian Carborundum Company, Limited, quarries silica sand from the sandstone deposit at St. Canut in Two Mountains county. The sand is used in the production of abrasives at Shawinigan Falls.

St. Lawrence Alloys and Metals Limited produces ferrosilicon at Beauharnois, using a Nepean sandstone quarried at nearby Melocheville. Another ferrosilicon plant is being erected at Beauharnois by Electro-Reagents (Quebec) Limited, a subsidiary of Dominion Magnesium Limited.

Ontario

Kingston Silica Mines Limited works a deposit of Nepean sandstone near Joyceville, north of Kingston. The sand is used for sand-moulding by the steel industry, and in the manufacture of artificial abrasives.

Lorrain quartzite is quarried by Dominion Mines and Quarries, Limited at Killarney, Georgian Bay, and by Canadian Silica Corporation Limited at Sheguinda, Manitoulin Island. This quartzite is used in the manufacture of silicon and ferrosilicon; a large part of the production is exported to the United States.

Algoma Steel Corporation Limited quarries quartzite at Bellevue, north of Sault Ste. Marie, for the manufacture of silica brick for its own use.

Other Areas

Very little silica is produced in the Prairie Provinces or in British Columbia, although deposits that are potential sources of silica exist. Silica for metallurgical flux is quarried near Noranda, Quebec; Sudbury, Ontario; Flin Flon, Manitoba; and Trail, British Columbia.

Uses

Quartz and quartzite are used principally to supply siliceous metallurgical flux and for the production of silicon and ferrosilicon. If the quartz is of sufficiently high quality it may be ground to a fine powder and marketed as silica flour for various uses, mainly in the ceramic industry. Crushed quartzite is used in making silica brick, for sand-blasting sand, and occasionally as a silica sand for glass manufacture, etc.

Sandstone is broken down and cleaned to produce silica sand for use in glass making, as steel foundry sand, in making sodium silicate, and in the manufacture of artificial abrasives. Coarser grades are used in sand-blasting and the fines as fillers for asbestos-cement products, paints, and soaps. In value of products this is the most important silica raw material.

Quartz crystals, clear crystals of quartz without flaws, and possessing the necessary piezo-electric properties, are valuable in radio-frequency control apparatus. Very few suitable deposits have been found in Canada. Although Brazil continued to supply most Canadian requirements, there was a small production from an occurrence near Lyndhurst, Ontario.

Prices

According to Canadian Chemical Processing, November, 1952, prices of the several grades of silica were as follows:—

	Per ton
Silica Sand, various grades, car lots	$18 to $22
Silica, Quartz, 99%	
Car lots, 110-220 grade	$29
5-ton lots: 100 mesh	$24
140 "	$25
200 "	$28
325 "	$36

SODIUM SULPHATE

Production of natural sodium sulphate in Canada in 1952 amounted to 122,590 tons valued at $1,708,807 compared with the record output of 192,371 tons valued at $2,383,770 in the previous year. The entire output came from Saskatchewan. Imports remained about the same, but exports were 57 per cent lower than in 1951 as a consequence of decreased production.

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

	1952		1951	
	Short tons	$	Short tons	$
Production (shipments)	122,590	1,708,807	192,371	2,383,770
Imports				
From: United States	19,576	313,739	11,531	200,407
United Kingdom	—	—	7,902	140,333
Total	19,576	313,739	19,433	340,740
Exports[1]				
To: United States	27,144	382,274	63,179	735,902

[1] From United States import statistics.

Canadian Production

The producers of natural sodium sulphate in 1952 were: Natural Sodium Products, Limited, at Bishopric; 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, all in the province of Saskatchewan.

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 months 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 Glaubers 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.

The price of salt cake from the deposits in Saskatchewan in 1952 was quoted in Canadian Chemical Processing at $15.00 per ton, bulk, f.o.b. plant. The price at pulp mills, which are mostly distant from producing centres, was considerably higher.

SULPHUR AND PYRITE

Production of sulphur in Canada in 1952 was mainly in the form of sulphur dioxide derived either directly from the roasting of pyrite, or indirectly from smelter gas resulting from the processing of base metal ores. However, the year saw a small tonnage of elemental sulphur recovered from 'sour' natural gas. This was the first elemental sulphur produced in Canada since 1943, when the Consolidated Mining and Smelting Company of Canada Limited discontinued recovery from its smelter gas.

In November, Canadian Industries Limited began production of liquid sulphur dioxide at Copper Cliff, Ontario. The plant is the largest of its kind in the world.

Canada's production of sulphur in all forms amounted to 428,013 short tons in 1952, an 11 per cent increase over 1951.

Production, Trade, and Consumption

	1952	1951
	Short tons	Short tons
Production (sulphur content)		
By-product pyrites (shipments)	263,241	215,363
Recovered from smelter gases	160,547	156,427
Total	423,788	371,790
Elemental sulphur recovered from natural gas (shipments)	4,225	—
Total, all sulphur	428,013	371,790
Imports (crude, roll, and flour)		
From: United States	415,185	393,172
Mexico	—	2,756
Total	415,185	395,928
Exports (sulphur content of by-product pyrites)		
To: United States	154,698	114,542
Netherlands	29,100	—
Japan	7,766	30,411
United Kingdom	4,954	7,937
Other countries	1,379	25,149
Total	197,897	178,039
	1951	1950
Consumption		
Pulp and Paper	306,000	282,608
Heavy chemicals	245,427	230,693
Rubber goods	2,700	2,524
Insecticides	3,600	4,114
Explosives	2,100	1,900
Miscellaneous	1,320	1,193
Total	561,147	523,032

Elemental Sulphur Production in Canada

Canada has no known deposits of elemental sulphur. From 1935 to 1943, sulphur was produced from smelter gases by Consolidated Mining and Smelting at Trail by means of a coke reduction process. Since 1943, the sulphur dioxide in the stack gases has been used to make sulphuric acid, which is used to make fertilizer in the plant at Trail.

The recovery of sulphur from hydrogen sulphide (H_2S) in sour natural gas is a development of recent years. The amount of H_2S varies, but large volumes of proved reserves have been established in the Pincher Creek, Jumping Pound, Turner Valley, and other fields in Alberta; the H_2S content of the above-mentioned fields is estimated at 8, 4, and 2 per cent respectively.

Shell Oil Company of Canada began the production of elemental sulphur from natural gas from the Jumping Pound field early in 1952. With the 90 per cent recovery obtained, about 10,000 tons of sulphur annually will be extracted as a result of treating 25 million cubic feet of gas daily. Royalite Oil Company is producing about 10,000 tons of sulphur annually from the Turner Valley field in a plant similar to that of Shell.

One million cubic feet of H_2S contains about 44·6 tons of sulphur, of which 80/90 per cent is recoverable. With the completion of proposed natural gas lines to the Pacific northwest states, British Columbia, and eastern Canada, increased production of elemental sulphur from this source may be expected.

The core-drilling by Sunbeam Mines Limited to investigate the reported occurrence of elemental sulphur discovered while drilling for oil about 100 miles north of Edmonton was discontinued after two holes had been completed. No reports of the results have been published, but it would appear that commercial amounts were not located. Recovery of elemental sulphur from coke-oven, oil-refinery, and other industrial gases does not appear to be generally practicable in Canada at present. Several processes are used in plants in the United States for such recovery but over-all annual output there amounts to about 50,000 long tons only.

Pyrites in Canada

Canada's output of pyrite in recent years has been obtained as a by-product from the treatment of base metal ores and has been considered as a small-profit operation bringing from $2.00 to $3.00 per long ton f.o.b. the mine to the producers. Production in 1952 came from the Noranda, Waite Amulet, Quemont, East Sullivan, Normetal, and Weedon mines in Quebec, and from the Britannia mine in British Columbia. The output of the major producers is generally sold by negotiation between producer and consumer for future delivery over a period of time.

Consolidated Mining and Smelting uses pyrrhotite tailings to augment its output of sulphuric acid from stack gases at Trail, British Columbia.

Normetal Mining Corporation Limited, with mine in Desmeloizes township, western Quebec, began recovery of by-product pyrite in May, 1952, from the treatment of about 1,000 tons of copper-zinc ore daily. About 200 long tons of pyrite were recovered daily, but operations were discontinued in November owing to lack of markets. Barvue Mines Limited, in Barraute township in western Quebec, could recover about 200 tons of pyrite from its 4,000-ton-per-day zinc-mining operation; however, it is not at present planned to recover this pyrite. The company ships its zinc concentrates to Arvida, Quebec, where the Aluminum Company of Canada recovers the sulphur for acid manufacture and ships the calcine to the United States.

By-product pyrite is used in the manufacture of sulphuric acid at the plants of Nichols Chemical Company at Valleyfield, Quebec; at Sulphide, Ontario; and at Barnet, British Columbia. St. Lawrence Paper Mills Company Limited at Three Rivers, Quebec, and Columbia Cellulose Company, Prince Rupert, British Columbia, are the only pulp and paper companies burning pyrite as a regular source of sulphur in their plants. Some other pulp and paper companies have tested, or are testing, the burning of pyrite in Dorr Fluo-Solids roasters as the source of sulphur for their operations. However, it appears generally that as long as elemental sulphur is readily available, the pyrite burners will be used only as an alternative source of sulphur.

Large deposits of pyrite occur in several localities in Canada. Near the turn of the present century, before the native sulphur deposits of Texas and Louisiana were brought into operation, large shipments of high-grade pyrite were made from mines in Newfoundland and the Eastern Townships. Some of these former operations were re-examined during the recent critical shortage of sulphur. In 1951, Weedon Pyrite and Copper Corporation Limited de-watered the old Weedon Mine, about 40 miles northeast of Sherbrooke, and during 1952 made small shipments of hand-cobbed pyrite to Europe. A mill has been built on the property and production of copper and pyrite concentrates is planned. In former years, nearly massive pyrite bodies were mined in conjunction with chalcopyrite at Pilley's Island in Newfoundland and at the Eustis Mine (now Albert Metals Corporation Limited) near Sherbrooke, in the Eastern Townships. Ascot Metals Corporation Limited and Sheffield Metals Corporation Limited, with properties near Sherbrooke, have developed copper-lead-zinc orebodies carrying pyrite which could be recovered as a by-product. Noranda Mines Limited has blocked out about 100 million tons of pyrite reserves carrying low copper in the No. 5 orebody of its Horne mine at Noranda. During 1952, a new company was formed by Noranda and MacDonald Mines Limited, with Noranda having control, to develop the 50 acres of ground formerly leased to Noranda by MacDonald in Dufresnoy township, on which substantial reserves of pyrite have been indicated by diamond drilling. Gaspé Copper Mines Limited, a subsidiary of Noranda, has blocked out by diamond drilling large reserves of ore carrying over 1 per cent copper on its property in Gaspé, Quebec. Initial plans call for a 6,000-ton-per-day open-pit operation by 1955, and pyrite may be recovered as a by-product.

From 1908 to 1923, several mines in Ontario shipped pyrite grading above 40 per cent sulphur to acid manufacturers in Canada and the United States. Shipments were made from several properties in eastern Ontario—the Northland Pyrites mine about 12 miles north of Timagami, the Goudreau Lake deposits about 18 miles southwest of Missanabie, the Vermilion Pyrites mine about 7 miles west of Sioux Lookout, and other smaller operations. There are many known occurrences of pyrite in Ontario.

In British Columbia, large tonnages of pyrite associated with copper and zinc sulphides have been indicated by drilling in deposits on the Ecstall River near its junction with the Skeena River, about 35 miles above Port Essington. Britannia Mining and Smelting Company Limited recovers about 200 tons of pyrite (flotation concentrate) a day from its copper operations at Britannia Beach.

Anhydrite and Gypsum in Canada

The extensive deposits of anhydrite and gypsum in Canada, particularly in New Brunswick and Nova Scotia, constitute a huge potential source of sulphur and its compounds. While they do not at present constitute an economic source of supply, it may be noted that plants for the recovery of sulphur as sulphuric acid and production of Portland cement from anhydrite are in operation in England and on the Continent.

Recent Developments in Sulphur Production

During the year, several new projects for the recovery of sulphur from domestic sources were in the planning or development stage.

Canadian Industries Limited's plant for the production of liquid sulphur dioxide was put into operation during 1952. Capacity of the plant is about 90,000 short tons of liquid sulphur dioxide annually. The flash-smelting process developed by The International Nickel Company of Canada, Limited results in the delivery of a gas containing about 75 per cent or more sulphur dioxide to the new plant, and eliminates the costly concentration that would be involved in the use of a more dilute gas. The output of the plant will be distributed by railway tank cars to certain pulp and paper companies in Ontario and Quebec which will use liquid SO_2 in place of elemental sulphur. This is the largest single liquid sulphur dioxide unit in the world.

Nichols Chemical Company Limited is doubling, by a $2,500,000 expansion project, its sulphuric acid manufacturing capacity at its Valleyfield, Quebec, works. This plant obtains its sulphur from domestic by-product pyrite producers, and when the plant is operating at capacity output will be about 100,000 tons of sulphuric acid annually. This firm also operates sulphuric acid manufacturing plants utilizing by-product pyrite at Barnet, British Columbia, and Sulphide, Ontario.

Aluminum Company of Canada Limited was completing at the end of 1952 a new plant at Arvida, Quebec, to manufacture sulphuric acid from the gases resulting from roasting of zinc concentrates obtained from Barvue Mines Limited. The concentrates are flash-roasted at Arvida and the calcine is then exported to the United States for recovery of the contained zinc. An annual output of about 35,000 tons of sulphuric acid is expected, and will be used in the company's works to produce aluminum sulphate that will find markets in the pulp and paper industry and in municipal waterworks treatment plants.

The Consolidated Mining and Smelting Company of Canada Limited, as part of a $9 million program to increase fertilizer production, was building a new sulphuric acid plant at Kimberley, British Columbia, adjoining the concentrator. Plant capacity will be about 100,000 tons of sulphuric acid annually; the source of sulphur will be pyrrhotite obtained from the concentrator at a rate of about 300 tons daily. It is expected that this project will be in operation in 1953. Two other fertilizer plants are operated—one at Trail manufactures ammonium sulphate and the other at Calgary, Alberta, makes ammonium nitrate. Iron oxide sinter from the roasting of pyrrhotite will be stockpiled and may eventually become a source of iron.

Noranda Mines Limited announced plans for the building of a plant at Welland, Ontario, for the recovery of elemental sulphur and sulphur dioxide from pyrite. Initial plans call for the roasting of about 100,000 tons of pyrite annually; this will be obtained as a by-product of Noranda's operations at its Horne mine at Noranda, Quebec. The process, developed by Noranda, is essentially a method whereby most of the loosely held atom of sulphur is volatilized by roasting, and the residue from the roasting will be sintered. Elemental sulphur is recovered in the first step; sulphur dioxide gas driven off in the second step will be used in the adjoining North American Cyanamid plant in making fertilizer, while the residue can be 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 result annually from the treatment of about 300 tons of pyrite concentrate daily. This plant is not expected to be in operation until well on into 1954. Noranda, in addition to by-product pyrite recovery from the mining of copper ore, has estimated pyrite reserves in No. 5 orebody of the Horne mine of 100 million tons containing about 50 per cent pyrite and low copper values. Noranda also has a majority interest in a new company formed in 1952 on the portion of the MacDonald Mines property a short distance north of the Horne mine. Large reserves of material containing about 80 per cent pyrite and low zinc values have been outlined on this 50-acre property, which is held jointly by MacDonald and Noranda Mines. It is expected that feed for the new plant at Welland will eventually come in whole or in part from this operation.

Britannia Mining and Smelting Company Limited recovers pyrite as a by-product from its operations at Britannia Beach, British Columbia, where about 200 tons of pyrite is recovered daily as a flotation concentrate. This company supplies most of the requirements of the Columbia Cellulose Company, Prince Rupert, B.C., which operates a pulp mill where a Dorr Fluo-Solids roaster provides sulphur dioxide gas for the company's operations. Britannia also supplies pyrite for export.

The pulp and paper industry, during the critical shortage of sulphur in 1950 and 1951, took steps to obtain its requirements from sources other than elemental sulphur. St. Lawrence Paper Mills Company, Limited at Three Rivers, Quebec, had been the only firm using pyrite as a source of sulphur, but in 1952 several others installed Dorr Fluo-Solids roasters to cut down their imports of elemental sulphur. Of a total of seven installations, only that of the Columbia Cellulose Company has been in continuous operation. Some of the others have made test runs, but returned to burning elemental sulphur when supplies became easier. It appears that the great majority of pulp and paper companies prefer to obtain their sulphur dioxide by burning sulphur.

Sulphuric Acid in Canada

Production of sulphuric acid in Canada amounted to 803,703 tons (100 per cent acid) in 1952, compared with 813,210 tons in 1951. Exports in these years amounted to 33,135 tons and 57,000 tons respectively, with an apparent consumption of 770,653 tons in 1952 and 757,372 in 1951.

Sulphuric acid derived from smelter stack gases is produced in Canada by The Consolidated Mining and Smelting Company of Canada Limited at Trail, British Columbia, and Canadian Industries Limited, at Copper Cliff, Ontario. During 1952, the Aluminum Company of Canada Limited began the manufacture of sulphuric acid from the gas resulting from the roasting of zinc concentrates produced by Barvue Mines Limited at Barraute, Quebec. Nichols Chemical Company Limited manufactures acid at three plants in Canada from domestic by-product pyrite. These plants are located at Barnet, British Columbia; Sulphide, Ontario; and Valleyfield, Quebec; at the last named, current plant expansion will approximately double the previous plant capacity. North American Cyanamid Limited, Welland, Ontario, and Canadian Industries Limited, Hamilton, Ontario, manufacture acid from imported sulphur for use in their fertilizer plants. Dominion Steel and Coal Corporation Limited imports sulphur for acid manufacture at Sydney, Nova Scotia, for use in its own works. The aggregate rated annual capacity of the above plants is about 800,000 tons of 100 per cent acid.

Consumption of Sulphuric Acid by Industries

Industry	Short tons 100% acid	
	1951	1950
Fertilizers	510,090	503,865
Heavy Chemicals	84,278	59,745
Explosives	31,917	25,331
Non-ferrous metals, smelting and refining*	12,944	12,944
Textiles	23,926	23,593
Coke and gas	32,008	34,878
Petroleum refining	12,684	15,726
Leather tanning	1,747	1,891
Iron and steel	30,814	26,175
Electrical apparatus	5,286	5,713
Plastics	8,881	7,779
Soaps	7,657	6,418
Adhesives	718	687
Miscellaneous chemicals	2,286	2,265
Sugar refining	207	254
Pulp and paper	3,133	2,246
Vegetable oils	122	155
Total	768,698	729,665

* Estimated.

The sulphuric acid plant of Canadian Industries Limited at Copper Cliff expanded production facilities late in 1951 by 30,000 tons of acid annually, which represents about a 60 per cent increase. Columbia Cellulose Company Limited, Prince Rupert, B.C., began the manufacture of sulphuric acid for its new operations from by-product pyrite supplied by Britannia Mining and Smelting Company Limited. Consolidated Mining and Smelting increased facilities for production of sulphuric acid from pyrrhotite at Kimberley, B.C., for use in its fertilizer plant there.

The following table compiled by the Dominion Bureau of Statistics gives the production, trade, and consumption figures for sulphuric acid in recent years.

Production, Imports, Exports, and Apparent Consumption of Sulphuric Acid, 1948-1952

Year	Short Tons of 100% Acid			
	Production	Imports	Exports	Apparent consumption
1948	679,448	59	29,478	650,029
1949	707,717	24	17,336	690,405
1950	756,110	332	44,417	712,025
1951	813,210	1,162	57,000	757,372
1952	803,703	85	33,135	770,653

World Supply Situation

From the middle of 1950 to the end of 1951 a sulphur shortage existed in the free world, but there was a decided improvement in the supply situation during 1952. By the end of the year, United States' domestic restrictions on the distribution and use of sulphur had been lifted, and consumers throughout the world were able to obtain their full requirements. This was in marked contrast to the beginning of 1952, when the sulphur shortage was still critical and shipments to consumers were limited to 90 per cent of the 1950 rate of consumption, plus extra allowances for defence-essential industries.

This improvement in the supply situation was brought about by several factors. In the free world countries, nearly 100 new sulphur projects were expected to add an estimated 1,500,000 long tons to world production by the end of 1952, and a further 1,350,000 tons by the end of 1953. Salt-dome developments in Louisiana and Texas, where sulphur is mined by the Frasch process, will make the largest contribution to expanded production; four new mines and the expansion of an existing mine are expected to yield about 1,370,000 long tons of sulphur by the end of 1954. In Mexico, salt-dome deposits similar in structure and geology to those of the United States' Gulf Coast are being developed. The extent of these deposits is not yet known, but a $7 million sulphur mining plant is under construction and is expected to be producing at an annual rate of 300,000 tons by the end of 1954. Increased recovery of sulphur from native sulphur deposits, pyrites, 'sour' natural gases, refinery gases, smelter gases, and sulphate minerals such as anhydrite are all contributing to the improved supply situation.

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Uses

Sulphur in the elemental form is used in making a long list of commodities, including rubber and insecticides, and large tonnages are used in the manufacture of paper. Most of the sulphur from all sources, however, is converted into sulphuric acid, which is used chiefly in the manufacture of fertilizer, steel, and explosives, and in the petroleum refining, textile, chemical, and metallurgical industries. In Canada, the largest consumer, by far, of elemental sulphur is the pulp and paper industry, which uses about 75 per cent of the imports.

Prices

The price of sulphur, per long ton, f.o.b. Texas and Louisiana mines, remained at $22 throughout 1952. With transportation charges added, elemental sulphur costs from $30 to $40 per long ton at Canadian plants, according to location.

The price paid for Canadian by-product pyrite is subject to negotiation between buyer and seller, and consequently information on prices paid is not readily available. However, pyrite at the producer's plant is a relatively low-priced commodity and usually commands from $2.50 to $3.50 per long ton. Small shipments are sometimes made at prices ranging up to $7.00 per long ton. Contracts usually call for 48 per cent minimum sulphur content, with specifications calling for low moisture and metallic impurities content.

TALC AND SOAPSTONE

Primary production (sales) of talc and soapstone in Canada in 1952 totalled 25,032 tons, a slight increase over the total for 1951. Production is confined to the Eastern Townships of Quebec and the Madoc area in Ontario.

Exports, mainly to United States, dropped 8 per cent in volume and value below 1951 while imports, consisting mainly of special grades from United States for the ceramic, paint, and cosmetic trades, declined 6 per cent in volume and nearly 10 per cent in value.

Production, Trade and Consumption

	1952		1951	
	Short tons	$	Short tons	$
Production (sales)				
Ground	24,902	263,780	24,606	263,628
Sawn soapstone blocks and talc crayons	130	16,832	240	19,996
Total	25,032	280,612	24,846	283,624
Imports				
From: United States	7,891	238,790	8,549	271,206
Italy	838	36,742	667	32,269
France	20	964	11	434
Other countries	—	—	56	2,368
Total	8,749	276,496	9,283	306,277
Exports				
To: United States	3,331	42,200	3,519	45,670
Panama	40	681	20	356
Peru	28	370	—	—
Other countries	36	1,674	204	2,831
Total	3,435	44,925	3,743	48,857

Production, Trade and Consumption—concluded

	1951	1950
	Short tons	Short tons
Consumption		
Roofing	10,000[e]	9,739
Paints	6,921	9,023
Rubber	1,689	3,290
Pulp and paper	1,881	1,634
Toilet preparations	778	861
Clay Products		716
Other uses		7,515
Total		32,778

e—estimated.

Canadian Production

Quebec

Broughton Soapstone & Quarry Company Limited, Broughton Station, continued production of ground talc, sawn soapstone blocks, bricks, and crayons.

Baker Talc Limited (formerly Baker Mining and Milling Company Limited), Montreal, with mine and mill near Highwater, continued production of ground talc.

Eastern Townships talc, which in general is low in carbonates but slightly off colour, is used largely in construction materials, in insecticides, and to a smaller extent in the paint, rubber, and ceramic industries.

Ontario

Canada Talc Industries Limited (formerly Canada Talc Limited), Madoc, continued production of prime white talc for the ceramic, cosmetic, construction material, rubber, paint, and other industries. During the year the company continued rehabilitation of the Henderson mine, which has been inactive for some years, and which adjoins the Conley mine, hitherto the main producer.

British Columbia

Ground talc is produced from imported materials by Geo. W. Richmond and Company for the local roofing trade.

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 in 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, 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 a majority through 325-mesh is required.

Other uses include cleansers, plaster, polishes, plastics, foundry facings, linoleum and oilcloth, oil-absorbent preparations, and filler for textiles, pipeline enamel, and other products.

Steatite, the massive, compact, form of talc, is used in making ceramic insulators.

Pyrophyllite:—Pyrophyllite, a mineral similar to talc, but with alumina in place of magnesia, is adaptable for most of the uses of talc. A large deposit near Manuels, Conception Bay, Newfoundland has been worked intermittently, but there was no production in 1951 or 1952.

Markets

Purchasers of crude talc for grinding purposes include Industrial Fillers, Limited, Montreal, Quebec, and Geo. W. Richmond and Company, Vancouver, British Columbia.

Prices

Prices of talc quoted by United States journals at the close of 1952 were as follows:

Per short ton, f.o.b. works	
200-mesh	$10.50 to $15.00
325-mesh	$12.00 to $20.00

Canadian prices ranged from $10.00 to $15.50 for roofing and filler grades and from $17.50 to $50.00 for ceramic and cosmetic grades per short ton, carlots, bagged, f.o.b. Madoc, Ontario.

VERMICULITE

There has been no production of vermiculite in Canada up to the present. Imports, all from United States and Union of South Africa, showed an increase of 5 per cent in value over 1951.

Deposits of vermiculite, first reported in 1950, are known to occur in Ontario near Stanleyville, Verona, Lakefield, and Parham, and in British Columbia near Blue River.

Imports, and Consumption

	1952		1951	
		$		$
Imports, crude				
From: United States		274,638		269,867
Union of South Africa		45,700		35,472
Total		320,338		305,339
	1951		1950	
	Short tons	$	Short tons	$
Consumption				
Ore used in the miscellaneous non-metallic mineral products industry	16,720	430,526	18,540	485,546
Products:				
Loose insulation		859,799		798,542
Other		115,862		192,000
Total		975,661		990,542

World Sources

United States and South Africa are the principal suppliers of crude vermiculite. In United States the deposit at Libby, Montana, is outstanding. Other deposits occur in North and South Carolina, Wyoming, Texas, Colorado, Georgia, and other states. In Africa, the principal deposits are at Palabora, East Transvaal; others occur in Tanganyika, Kenya, Uganda, and other areas. Russia is known to be a producer, and occurrences have been reported in India, Australia, and Japan.

Description and Uses

Vermiculite, a hydrated magnesium-aluminum silicate, resembles mica closely but is softer and is inelastic. Its principal characteristic is its ability to expand many times on heating, and in its expanded form it possesses low bulk density, low thermal conductivity, high heat resistance, chemical inertness, and sound-proofing properties. Vermiculite is generally regarded as a product of alteration and is usually associated with metamorphosed ultra-basic rocks. Colour ranges from black through brown and dark green to almost colourless.

The principal uses for vermiculite are loose insulation in buildings; concrete and plaster aggregate; lightweight fire-resistant and acoustic tile and wallboard; rooting medium; and soil improvement. It is used also in dry chemicals (as a diluent), combination refractory and insulating brick, as a pigment and extender in paint, and as decorative filler in wallpaper. Vermiculite has been used as fireproof deck covering and partitions on ships, as loose insulation in fire and sound proof partitions in vehicles and aircraft, as filler for life jackets and, in finely powdered forms, as a dry lubricant.

Markets and Specifications

Purchasers of imported raw vermiculite include F. Hyde and Company, Limited, Montreal; Insulation Industries (Man.), Limited, Winnipeg; Vermiculite Insulating Limited, Montreal; and Suzorite Company of Ontario, Limited, Cornwall, Ontario.

Raw vermiculite is usually sold as concentrate screened to commercial sizes. Specifications vary according to the requirements of individual purchasers, but in general foreign impurities should not exceed 5 per cent and total unexpandable material 10 per cent.

Size classifications are approximately as follows:

Acoustic tile, $-\frac{1}{2}$ inch $+3$ mesh
Loose insulation, $-3+14$ mesh
Concrete and plaster aggregate, soil improvement, etc., -6 or $-8+65$ mesh.

Bulk densities of expanded vermiculite sold in Canada range from under 5 pounds per cubic foot for loose insulation to over 7 pounds for concrete and plaster aggregate.

Prices and Tariffs

According to E & M J Metal and Mineral Markets Bulletin, vermiculite prices during 1952 were as follows: crude, cleaned and screened f.o.b. Montana mines, \$12.00–\$14.00 per short ton; South African, f.o.b. Atlantic ports, \$30.00–\$32.00.

Crude vermiculite enters both Canada and United States free of duty.

WHITING AND WHITING SUBSTITUTE

True whiting is prepared by grinding chalk, whereas whiting substitute (generally referred to in Canada as domestic whiting or marble flour) consists of finely ground white limestone, calcite, marble, or marl; the substitute may also be prepared from calcium carbonate that has been precipitated in certain chemical processes.

Canada imports the raw material for making true whiting, as well as much of the finished product, mostly from the United States and the United Kingdom. Canadian production of whiting substitute is all from marble or limestone.

Production of substitute in 1952 amounted to 17, 527 tons valued at $188,044. This shows a slight decline from 1951, when tonnage was 18,380, and value $190,727. Quebec, Ontario, and British Columbia are the only producing provinces.

Uses

Both whiting and whiting substitute are widely used in industry in making such diversified materials as paint, rubber goods, linoleum and oilcloth, plastics, cleaning compounds, polishes, putty, and explosives, and as fillers in paper-making.

True whiting is essential for certain uses, particularly in the paint, pharmaceutical, and ceramic industries. In the last-named it is used for glazing and in the manufacture of whiteware.

If whiting substitute is of sufficient purity and whiteness, and has satisfactory oil absorption and particle shape, it may be used as an extender pigment in paint. The rubber industry demands substitute of correct particle size and adequate workability. Dispersion of particles and bonding power are also important, and the material must not have a deleterious effect on the finished product. Practically all users demand a very finely ground product, −200-mesh in most cases, and −325 in some instances.

Prices

Prices for limestone whiting have not changed since 1950: −325-mesh, bagged, in carload lots was $6–$10 f.o.b. United States points. Precipitated whiting was quoted in the U.S. at $18–$20 per ton, carload lots, f.o.b. works.

Production, Trade, and Consumption

	1952		1951	
	Short tons	$	Short tons	$
Production				
Stone processed for whiting substitute				
Marble	12,481	149,772	12,100	146,040
Limestone	5,046	38,272	6,280	44,687
Total	17,527	188,044	18,380	190,727
Imports				
Whiting, gilder's whiting, and paris white				
From: United States	6,234	211,317	13,972	377,325
United Kingdom	4,134	60,371	5,779	83,561
Other countries	1,618	19,195	814	8,112
Total	11,986	290,883	20,565	468,998

Production, Trade, and Consumption—concluded

	1952		1951	
	Short tons	$	Short tons	$
Chalk, prepared				
From: United States		2,443		4,447
United Kingdom		—		364
Total		2,443		4,811
Miscellaneous—chalk, china, Cornwall, or cliff stone (ground or unground), and mica schist				
From: United States		3,637		5,325
United Kingdom		106		194
Germany		—		13,863
Total		3,743		19,382

	1951	1950
Consumption		
Ground chalk and whiting substitute		
Paints	10,007	10,657
Rubber goods	6,575	6,444
Linoleum and oilcloth	6,308	6,386
Miscellaneous chemicals	789	983
Electrical apparatus	666	763
Explosives	301	255
Gypsum products	173	154
Tanneries	155	138
Medicinal and pharmaceuticals	124	102
Soaps	54	84
Enamelling	100	66
Non-ferrous smelters	50	49
Adhesives	18	13
Miscellaneous	546	16
Total	25,866	26,110

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FUELS

COAL

The Canadian coal industry continued to feel the effect of increasing competition from other fuels. Total production fell to 17,579,002 tons, a 5·4 per cent drop from 1951, and 8·2 per cent below the all-time peak of 19,139,112 tons in 1950. Alberta contributed about 41 per cent of the total, Nova Scotia 34, Saskatchewan 12, British Columbia 9, and New Brunswick 4.

Strip-mining was practised in all producing provinces, with the exception of Nova Scotia, 5,569,059 tons, or 31·7 per cent of the total output, being produced by this method. Although this is a slight decline from 1951, strip-mined coal continues to make up a substantial portion of the output of the various provinces. In Saskatchewan, 99 per cent of the output is strip-mined, in Alberta over 37, in New Brunswick 71, and in British Columbia about 17.

While the output per man-day in strip mining varies considerably from province to province, it is in all instances greater than in the case of underground mining. Taking the average for all provinces, output in short tons was about 11·3 tons per day for strip mining, as against 2·57 for underground.

Canadian consumption decreased about 6·8 per cent—from 44,637,857 tons in 1951 to 41,620,313 tons in 1952—but was still larger than that of 1949, the lowest post-war consumption year. Imports made up 58 per cent of the coal consumed; the corresponding figure for 1951 was 59 per cent. The decrease was reflected largely in domestic and building heating and in railway use, where fuel and diesel oil took the place of coal.

The industry continued its efforts to improve the quality of its products by the application of modern methods of beneficiation, such as cleaning, and by the briquetting of fines.

Beneficiation

One of the industry's major problems is the beneficiation of fines, both from the standpoint of turning out a reasonably low-ash product and the production of a lump fuel that will find greater acceptance in the domestic and industrial markets.

The problems involved were under constant study during 1952. The Mines Branch and other research organizations have taken an active part in conducting plant, pilot-plant, and laboratory investigations that have dealt with both wet and pneumatic methods of coal cleaning.

There was much activity in briquetting, especially towards the end of 1952, and it is expected that 1953 will see the establishing in western Canada of several large plants for the preparation from fines of agglomerated products suitable for use as locomotive fuel. Such fuel is already being turned out in the Nordegg, Mountain Park, Cascade, and, to a more limited extent, Crowsnest areas of Alberta; output is expected to be increased in the last-named area, and also in the East Kootenay area of British Columbia. Increased interest is being shown in the production of briquettes for domestic use, especially from sub-bituminous coals. As a result of experimental work carried on at various laboratories, and in the field by various operators, it seems likely that the briquetting of sub-bituminous coals will increase in the near future. Production of stoker-size briquettes from bituminous coal is also under study, and developments in this field may be looked for in 1953.

Competition

The displacement of coal by oil and natural gas is perhaps the most serious feature of the coal situation in Canada today. As the data presented below indicate, these fuels are replacing more and more coal each year.

Fuel Consumed by Railways, 1942–1952
(mainly as locomotive fuel)

Year	Coal	Fuel and diesel oil	Estimated heat equivalent in terms of coal*	Estimated heat equivalent of oil as a percentage of total coal and oil
	Thousands of tons	Millions of imperial gallons	Thousands of tons	
1942........	10,614	73·9	503·7	4·5
1943........	11,987	77·8	530·6	4·2
1944........	11,993	60·3	411·1	3·3
1945........	12,084	98·9	674·3	5·3
1946........	11,632	102·6	699·5	5·7
1947........	12,331	108·4	739·1	5·7
1948........	12,422	113·7	775·2	5·9
1949........	11,444	162·9	1,110·7	8·8
1950........	10,966	245·8	1,675·9	13·3
1951........	10,505	261·9	1,785·7	14·5
1952........	9,798	354·9	2,419·7	19·8

* 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.

The conversion of steam locomotives from coal to oil has continued. The Canadian National Railways alone has a five-year plan whereby about 200 coal-burning locomotives per year will by 1956 have been converted to oil or replaced by diesels. This will mean an additional drop of about 20 per cent from the 1952 coal consumption for this purpose. By the end of 1953, it is estimated that a grand total of between 976 and 1,026 diesel units will be in use. However, conversion of locomotives from coal to oil has displaced more coal than the adoption of diesel units. For example, the consumption of locomotive fuel in 1952 by the two major railways was distributed as follows; the oils being expressed as the heat equivalent of so many thousands of tons of coal:

	Thousand of tons
Coal..	9,241
Fuel oil..	1,495
Diesel oil..	344

Conversion of coal-burning locomotives to oil has occurred chiefly in western Canada, while replacement by diesels has taken place chiefly in the east.

The use of oil for domestic and building heating, at the expense of coal, continued to increase. From 1941 to 1945, fuel oil consumed for this purpose (exclusive of stove oil) averaged 122·66 millions of imperial gallons yearly. In 1946 the figure jumped to 323 millions, and has increased steadily year by year to 941·3 millions for 1952, an increase of 667·4 per cent over the 1941–45 average. Meanwhile, coal had declined from 12,163,000 tons in 1941 to 10,189,000 in 1952.

Both manufactured and natural gas have also been making inroads on the coal market. For the period 1942–1952, sales of manufactured gas have increased steadily, 1952 sales showing a 39·12 per cent increase over 1942. The natural gas figures are even more striking, the corresponding increase in this case being nearly 124 per cent. In the western provinces it is estimated that from 1946 to 1952 the increased consumption of natural gas for domestic use displaced about 423,000 tons of coal, while the industrial and commercial fields showed even greater increases, although not all of this can be said to have actually replaced coal. If the projected eastern gas pipe line program materialises a situation hitherto largely confined to western Canada will be extended to the east, with further serious effects on the demand for coal.

Production

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 from the Inverness area. Production in 1952 amounted to 5,905,265 tons. New Brunswick's output of high-volatile bituminous (742,823 tons in 1952) all came from the Minto area.

While the major portion of maritime production is used locally for both industrial and domestic purposes, a certain amount is shipped to central Canada—1,687,745 tons in 1952, as against 1,810,847 in 1951 and over 2,500,000 in 1950. Adoption of diesel engines by the railways should lend impetus to the development and extension of other outlets.

Saskatchewan

Only lignite is produced, chiefly from the Bienfait division of the Souris area, the other main producing fields being the Estevan and Roche Percée divisions of that area. Approximately 65 per cent of the output is shipped to Manitoba for both domestic and industrial use, and while the completion of the pipe line from Alberta has brought about more extended use of oil, the sales of lignite at present show no significant reduction.

Alberta

Alberta produces almost all types of coal, including a 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, 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 sub-bituminous, and that in the Tofield, Redcliff, and several other areas is on the border of sub-bituminous and lignite. These are all mainly domestic and commercial coals with a small proportion being used industrially for steam raising. The Cascade area was the only field that produced semi-anthracite in 1952. About 61 per cent of Alberta's output of coal in 1952 was bituminous and 39 per cent sub-bituminous and lignite, mainly the former. One large bituminous coal mine in the Mountain Park area closed down during the year, and as a result of consolidation of effort one mine tipple suspended operations in the Crowsnest area.

Production of Coal by Provinces[1]

(Short tons)

	1952				1951			
	Bituminous	Sub-bituminous	Lignitic	Total	Bituminous	Sub-bituminous	Lignitic	Total
Nova Scotia	5,905,265	—	—	5,905,265	6,307,629	—	—	6,307,629
New Brunswick	742,823	—	—	742,823	653,439	—	—	653,439
Saskatchewan	—	—	2,083,465	2,083,465	—	—	2,223,318	2,223,318
Alberta	4,378,622[2]	2,816,135	—	7,194,757	4,659,312	3,000,017	—	7,659,329
British Columbia	1,644,250	—	—	1,644,250	1,739,412	—	—	1,739,412
Yukon	8,442	—	—	8,442	3,696	—	—	3,696
Total	12,679,402	2,816,135	2,083,465	17,579,002	13,363,488	3,000,017	2,223,318	18,586,823
Dollar Value	$92,805,928	14,215,913	4,004,308	111,026,149	89,244,992	15,432,166	4,361,677	109,038,835

[1] Coals classed according to A.S.T.M. Classification of Coal by Rank—A.S.T.M. Designation D388-38.
[2] Includes a small quantity of semi-anthracite from the Cascade Area.

Consumption of Coal[1] in Canada for Fiscal Years Ending March 31, 1952 and March 31, 1953
(thousands of short tons)

Use	Bituminous[2]	Anthracite	Briquettes	Total
		1951–1952		
Domestic[3]	8,552	3,362	321	12,235
Industrial	13,848[4]	220[5]	—	14,068
Railroads	10,712	—	258	10,970
Coke and Gas	5,388	—	—	5,388
Water Transportation	528	—	—	528
Total	39,028	3,582	579	43,189
		1952–1953		
Domestic[3]	7,144	3,028	273	10,445
Industrial	13,681[4]	273[5]	—	13,954
Railroads	9,520	—	545	10,065
Coke and Gas	5,623	—	—	5,623
Water Transportation	460	—	—	460
Total	36,428	3,301	818	40,547

[1] Domestic and imported: compiled by Dominion Coal Board.
[2] Includes lignite.
[3] Government purchases included.
[4] Includes coal used by mines.
[5] Includes some uses other than industrial.

Imports of Coal for Domestic Consumption[1]
(short tons)

Country of origin	1952 Anthracite	1952 Bituminous	1952 Total	1951 Anthracite	1951 Bituminous	1951 Total
United States	3,550,120	20,854,281	24,404,401	3,561,775	22,841,694	26,403,469
United Kingdom	344,743	11,289	356,032	291,656	—	291,656
Others	—	—	—	—	54	54
Total	3,894,863	20,865,570	24,760,433	3,853,431	22,841,748	26,695,179
Value	$49,433,409	101,472,799	150,906,208	51,244,639	117,379,229	168,623,868

[1] From Trade of Canada: includes lignite and briquettes, but not coal imported and subsequently sold for use on board ship.

Export of Coal
(short tons)

Destination	1952	1951
United States	276,225	292,497
Japan	56,126	90,646
Brazil	44,738	32,718
United Kingdom	—	11,297
St. Pierre and Miquelon	11,850	7,809
Other countries	21	116
Total	388,960	435,083
Value	$3,203,522	$3,495,664

British Columbia

Bituminous coking coal, ranging from high to low volatile, is mined on Vancouver Island and in the Crowsnest, Telkwa, and Nicola areas. Small quantities of sub-bituminous coal have been produced, mainly in the Princeton field. In the Kootenay (Crowsnest) area, the largest producing field, medium-temperature oven (by-product) coke is manufactured, mainly for industrial consumption.

Consumption of Briquettes

Consumption of briquettes (domestic shipments plus "landed" imports) in Canada increased from 530,634 tons in 1951 to 814,499 tons in 1952. This was mainly due to the fact that one of the largest plants in Alberta, which was inoperative during 1951 because of destruction by fire, resumed operation. The consumption consisted of 49,231 tons made from carbonized Saskatchewan lignite; 660,970 tons made from low-volatile bituminous and semi-anthracite coals from the Nordegg and Cascade areas in Alberta, and from medium-volatile bituminous coal from the Crowsnest and Mountain Park areas of Alberta; and 104,553 tons imported from the United States and prepared from low-volatile bituminous coals and anthracite, alone and mixed. Of the total amount of briquettes produced in Canada, about 72 per cent was used by the railways, mainly as locomotive fuel, and it is anticipated that by the end of 1953 this will be substantially increased.

COKE

The 1952 production of coke from bituminous coal was 4,076,655 tons, as compared with 3,931,626 tons in 1951. Coal processed for the manufacture of coke amounted to 5,456,045 tons, of which 1,167,632 tons were of Canadian origin, and 4,288,413 imported from the United States. Petroleum coke produced at the refineries amounted to 203,388 tons, as against 164,689 tons in 1951.

Imports of coke totalled 825,259 tons, a decrease of 131,496 tons from 1951, while exports increased from 219,340 tons in 1951 to 359,456 tons in 1952.

Most of the coke produced for the Canadian market is obtained from standard by-product coke ovens which process coal in large tonnages for use in the production of steel and non-ferrous metals or for domestic use. The retort coke, a by-product of the gas industry, forms only a small part of the total coke production and is used to a large extent in the manufacture of carburetted water-gas for city use. The residual stocks of retort coke, about 20,000 tons a year, are sold as domestic coke prepared and sized in accordance with market requirements.

The increasing demand for metallurgical coke has caused the construction of new batteries of coke ovens in British Columbia, as well as the preparation of plans for expanding plants in other parts of Canada.

Several types of carbonization equipment are used for producing coke in Canada. These include seven by-product coke oven plants, one beehive plant, one Curran-Knowles installation, three continuous vertical retort plants, two installations of horizontal "D" retorts, and a coking stoker type of plant designed and operated by the Shawinigan Chemicals Company, Shawinigan Falls, Que. Many of the smaller gas retort plants have been replaced by carburetted water-gas plants or propane units.

Approximately 80 per cent of the coal used in the production of coke in Canada is processed by six companies at plants in eastern Canada, namely: Dominion Steel and Coal Corporation at Sydney, Nova Scotia, with an annual rated capacity of 1,001,900 tons of coal; Montreal Coke and Manufacturing Company at Ville La Salle in Quebec, with an annual rated 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 an annual rated capacity of 1,761,000 tons of coal; Hamilton By-Product Coke Ovens Limited at Hamilton, Ontario, with a rated capacity of 415,000 tons of coal a year; Dominion Steel Foundries Limited, Hamilton, Ontario with an annual capacity of 300,000 tons; and Steel Company of Canada Limited at Hamilton, Ontario with a rated capacity of 1,470,000 tons of coal a year.

The last of the beehive coke oven installations of western Canada has been replaced by the expansion of the batteries of Curran-Knowles ovens at Michel, British Columbia, which now have a rated capacity of 300,000 tons of coal a year.

Production and Trade

	1952		1951	
	Short tons	$	Short tons	$
Production from bituminous coal				
Ontario	2,706,544	36,935,991	2,466,842	37,251,442
Nova Scotia, New Brunswick, Quebec and Newfoundland	1,073,806	18,109,639	1,160,208	19,004,760
Manitoba, Saskatchewan, Alberta and British Columbia	296,305	3,655,480	304,576	3,592,630
Total	4,076,655	58,701,110	3,931,626	59,848,832
Production of pitch coke	14,180	315,421	13,673	263,132
Production of petroleum coke	203,388	2,157,262	164,689	1,674,174
Total production	4,294,223	61,173,793	4,109,988	61,786,138
Bituminous coal used to make coke				
Imported	4,288,413	44,545,466	3,963,571	41,821,089
Canadian	1,167,632	10,201,916	1,290,745	10,069,875
Total	5,456,045	54,747,382	5,254,316	51,890,964
Imports, all types				
From: United States	825,235	13,464,345	956,737	16,910,494
United Kingdom	24	588	1	44
Other countries	—	—	17	945
Total	825,259	13,464,933	956,755	16,911,483
Exports, all types				
To: United States	339,023	5,117,173	197,661	3,120,931
Other countries	20,433	820,176	21,679	841,336
Total	359,456	5,937,349	219,340	3,962,267

NATURAL GAS

The outstanding event in the natural gas industry in Canada in 1952 was the permission granted by the Alberta Government to Westcoast Transmission Company Limited to export gas from the Peace River area via a pipe line to be built to Vancouver and thence south into the Pacific northwest area of the United States. Approval for the building of this line in Canada was given by the Board of Transport Commissioners in Ottawa and the matter of extending the line into the United States is before the Federal Power Commission in Washington. The line will not be economic unless a considerable market becomes available in the United States, as the amount of gas that can be sold in Canada alone does not justify the expenditure involved in building a line 645 miles long from the Peace River to Vancouver through mountainous terrain.

Natural gas is produced in Ontario, Saskatchewan, New Brunswick, and the Northwest Territories, but 89 per cent of the total yield of 88,686,465 M cu. ft. in 1952 was from Alberta. This amount is an increase of 9,225,798 M cu. ft. above that of 1951.

The demand for natural gas in Alberta continued to increase, but the reserves increased at an appreciably higher rate than the consumption, so that there is now need for finding further markets. In the Edmonton area there has been a rapid growth in refining and in the establishment of a petrochemical industry. Also Sherritt Gordon Mines Ltd. is building a plant at Fort Saskatchewan near Edmonton which will use ammonia derived from natural gas in a chemical process for the extraction of nickel, copper and cobalt from concentrates shipped from Lynn Lake, Manitoba. Midwestern Industrial Gas Ltd. will supply 50 billion cubic feet of gas over a 20-year period to the Sherritt Gordon plant.

In 1952 Shell Oil Company of Canada began the extraction of sulphur from hydrogen sulphide in natural gas from the Jumping Pound field west of Calgary, and Royalite Oil Company Ltd. built a similar plant for the extraction of sulphur from gas produced in the Turner Valley field. Both of these fields supply natural gas to Calgary.

In 1952 there were a number of new and important gas discoveries. In the Peace River area, gas in large quantities was found in the vicinity of Fort St. John, British Columbia, and at Buick Creek, 40 miles to the northwest. In the Peace River area of Alberta, two fields, Gordondale and Rycroft, added new reserves to those previously proven.

In the more central part of Alberta, gas continued to be discovered in large quantities as wells were drilled for oil. One of the largest gas discoveries, with only limited amounts of oil present, was in the Nevis area, 12 miles west of Stettler. Several wells have been completed in this field, which may have a reserve of a half trillion cubic feet. The gas is in reef limestones of Devonian age. In its report of March, 1952, the Alberta Petroleum and Natural Gas Conservation Board stated that it was expected that "with a continued incentive for exploration for oil and gas resulting in the drilling of some 400 to 500 wildcat wells a year, the Province of Alberta can safely anticipate the development of further established reserves of natural gas at an average rate of at least 1 trillion cubic feet a year for at least the next 8 to 10 years"[1]. The Nevis discovery alone is likely to provide at least half of this amount for 1952 and this is but one of several important areas discovered during the year.

In the Pigeon Lake area of Alberta the Leduc-Wizard Lake-Bonnie Glen trend has been extended southwestward with the finding of more oil overlain by extensive gas caps. West of this, at Minnehik, a large gas discovery has been made in the Mississippian limestone, which is the productive horizon of foothills areas. In the area south of Calgary a large flow of gas has occurred in three Shell wells drilled near Okotoks. A feature of this gas is the abnormally large content of hydrogen sulphide.

[1] Report of the Alberta Petroleum and Natural Gas Conservation Board, March 1952, p. 6.

There is hardly an area in Alberta where drilling is being done that gas does not occur, but in many of these the gas is presently not considered important. Wells in many areas, however, have provided substantial flows, for example those in the Lac La Biche, Clive, Fort Saskatchewan, Big Lake, and Morinville areas north and east of Edmonton, and at Chancellor and along the Stettler-Big Valley reef trend farther south. In all, about 155 potential gas wells were drilled in Alberta during 1952 and it has been stated that the reserves have been increased by perhaps 3·5 trillion cubic feet.

In Saskatchewan there was an increase of 147,409 M cu. ft. in production in 1952 over 1951, bringing the yield up to 1,007,491 M cu. ft. The producing fields have been Lloydminster-Lone Rock and Unity, with a small volume being obtained from shallow wells at Kamsack. In 1951 the Brock field, 15 miles west of Kindersley, was discovered, and in 1952 there were extensions. It now appears that this field is the largest and most favourable gas reserve so far found in the province. It is proposed to pipe this gas to Saskatoon. Some small towns in the vicinity of the field have already been supplied.

There are two general areas in Saskatchewan in which success in finding oil has been achieved. The first is in the southwest part of the province, extending from the area around Kindersley to the area west and northwest of Swift Current, and reaching southwest through Gull Lake to Battle Creek and Eastend. In this area discoveries have been made in the Viking sand at D'Arcy, Dodsland, Elrose, and Eureka, in the Lower Cretaceous sands at St. Florence, and in the Jurassic at Battle Creek. In the Battle Creek well the flow of gas was 6,500 M cu. ft., possibly indicating an important discovery.

The other area of success in oil drilling is in southeastern Saskatchewan in the area east and south of Weyburn at Wapella, Forget, and Radville. This area, however, has as yet produced no gas discoveries of note.

In Manitoba, oil has been found at Virden, Tilston, and Waskada in the southwestern part of the province. These areas, however, like those in southeastern Saskatchewan, have yielded relatively little gas.

In Ontario, production of natural gas and crude petroleum is confined to the southwestern portion of the province. In all, 168 successful gas wells were completed in southwestern Ontario in 1952, of which 160 resulted from development drilling and 8 from exploratory tests. Of the successful development wells, 141 had an average initial production of 53 M cu. ft. of gas a day and the remainder an average initial yield of about 3,750 M cu. ft. a day. Six wells in Lambton county had an average initial open flow capacity of 11,100 M cu. ft. of gas a day.

The exploratory tests resulted in four gas discoveries, three of which are in Lambton county and the other in Elgin county.

An estimated 32 billion cubic feet of gas were added to the reserves as a result of exploratory drilling in 1952.

In New Brunswick, natural gas production totalled 202,042 M cu. ft. in 1952, a substantial decrease as compared with 1951. All the output comes from the Stony Creek field about 9 miles south of Moncton. No new gas wells were completed in 1952.

In Northwest Territories, the only production of natural gas is from the Norman Wells field, which yielded 24,847 M cu. ft. in 1952. The gas is used to meet local needs.

Production of Natural Gas

	1952		1951	
	M cu. ft.	$	M cu. ft.	$
Alberta				
Turner Valley	28,498,793	—	30,592,235	—
Viking-Kinsella	17,398,977	—	19,288,478	—
Pakowki Lake	8,308,127	—	—	—
Leduc-Woodbend	7,522,015	—	5,379,167	—
Jumping Pound	7,384,848	—	4,435,792	—
Medicine Hat	3,628,267	—	3,567,764	—
Redcliff	1,468,982	—	1,752,046	—
Other fields	4,939,886	—	4,861,349	—
Total	79,149,895	5,936,242[1]	69,876,831	3,493,842[2]
Ontario				
Kingsville, Tilbury	1,640,464	—	1,986,211	—
Dover, Electric, Declute, Chatham and Camden Gore	499,241	—	719,771	—
Zone	115,100	—	261,070	—
Dawn, Moore (Kimball-Payne), Beecher	2,696,883	—	2,434,635	—
Mosald, Bayham and Malahide	318,675	—	210,393	—
Haldimand	1,594,783	—	1,682,314	—
Norfolk	546,282	—	400,383	—
Welland	686,528	—	549,399	—
Other fields	204,234	—	198,666	—
Total	8,302,190	3,320,876[3]	8,442,842	3,377,137[3]
Saskatchewan	1,007,491	100,749	860,082	86,008
New Brunswick Stony Creek	202,042	150,073	261,579	194,312
Northwest Territories	24,847	9,698	19,333	7,621
Total Canada	88,686,465	9,517,638	79,460,667	7,158,920

[1] Well-head evaluation of 7·5 cents per M cu. ft.
[2] Well-head evaluation of 5 cents per cu. ft.
[3] Wholesale value of natural gas produced.

PEAT

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, as a packing material and as a means of introducing humus into the soil, and in stables and poultry runs as litter.

Peat is widely distributed in Canada, but commercial production is confined to British Columbia, Quebec, New Brunswick, Ontario, Manitoba, and Nova Scotia. Eighty-nine per cent of the 74,899 tons produced in 1952 came from the Rivière-du-Loup area of Quebec, and the delta of the Fraser River in British Columbia. Ninety-one per cent of the Canadian output is exported to the United States.

Peat is also used as a fuel. For this purpose the well-humified grass or sedge peat is required, rather than the unhumified sphagnum type used for making peat moss. In recent years a small amount of fuel peat has come from Gads Hill Station, near Stratford, Ontario, and in 1952 drainage work was started on a large bog near Shawinigan Falls, Quebec, in preparation for the production of peat fuel.

Production by Provinces and Exports

	1952			1951		
	Producers	Short tons	$	Producers	Short tons	$
Province						
British Columbia	13	46,939	1,685,406	13	46,947	1,700,030
Quebec	15	19,609	405,852	14	21,657	436,833
New Brunswick	2	2,400	96,000	3	4,587	161,934
Ontario	3	1,939	69,013	3	1,804	72,557
Manitoba and Nova Scotia	2	4,012	187,494	2	1,814	61,654
Total	35	74,899	2,443,765	35	76,809	2,433,008
Exports						
To: United States	—	68,265	3,127,017	—	71,840	3,070,795
Other countries	—	10	576	—	34	2,207
Total	—	68,275	3,127,593	—	71,874	3,073,002

Canadian Production

British Columbia

The peat operations in the Fraser River delta near New Westminster are the largest in Canada. From this small area, 13 companies in 1952 produced 47,000 tons, nearly two-thirds of the total Canadian production. The largest producers are Industrial Peat Limited, Atkins and Durbrow Limited, Lulu Island Peat Company Limited, and Northern Peat Moss Company.

Four bogs are being worked, namely: Pitt Meadows, Byrne Road, Lulu Island, and Delta (or Burns). These deposits are expected to last for 10 or 15 years at the present rate of production.

Manitoba

Western Peat Company Limited, the only producer in Manitoba, operates the Julius, or Shelley, bog about 50 miles east of Winnipeg.

Ontario

Three companies produced 2,000 tons of peat moss in 1952. Arctic Peat Moss Company, Limited, of Fort Frances, is the largest operator. In 1951, a property that had been worked by Atkins and Durbrow (Erie) Limited closed down. This property was taken over late in the summer of 1952 by Northern Peat Moss Company of British Columbia, with a view to the resumption of operations in 1953.

Quebec

The peat moss deposits now being worked are mainly in the lower St. Lawrence River region. Fifteen companies contributed to the output in 1952, 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 were engaged in peat moss production in 1952, namely: Fafard Peat Moss Company at Pokemouche; and Atlantic Peat Moss Company Limited, which now owns and operates the property of the Western Peat Company Limited at Shippigan, in addition to its own property on Shippigan Island.

Nova Scotia

Annapolis Peat Moss Company Limited, the only producer, operated the Caribou bog near Berwick, and produced a small tonnage of peat moss in 1952. On this bog, experiments in the rapid digging and drying of peat moss, involving use of a mechanical excavator, were started.

Price

The price of peat moss in 1952 varied from $21.00 to $44.00 a ton according to location.

CRUDE PETROLEUM

Canadian crude oil production in 1952 totalled 61,237,322 barrels, and increase of 28·6 per cent over the 1951 output of 47,615,534 barrels. Western Canada accounted for about 99 per cent of the total, with Alberta yielding 58,915,723 barrels, or 96 per cent of the total production. Alberta, Saskatchewan, Manitoba, and Northwest Territories all showed substantially increased production over 1951.

Ontario and New Brunswick, in that order, accounted for the remainder of the output.

Western Canada

Most of the drilling was again done in Alberta but discoveries in Saskatchewan and Manitoba resulted in a notable increase in drilling in these provinces over that done in 1951. About 2,223 wells were drilled in western Canada in 1952, an increase of 852 over the previous year. Of these, 1,643 are in Alberta, 496 in Saskatchewan, 70 in Manitoba, and 14 in British Columbia. The Alberta completions (totalling about 6,631,529 feet of drilling) resulted in 944 oil wells, 155 gas wells and potential gas wells, and 544 dry holes. More than 175 oil and gas discoveries and indicated discoveries were made in western Canada, of which at least 130 are in Alberta.

The number of active drilling rigs reached a record of 253 at the peak of the 1952 season. About 60 per cent of these were on field or extension locations and the remainder on exploratory wells. About 209 rigs were active in Alberta, 31 in Saskatchewan, 6 in Manitoba, and 7 in British Columbia. Geophysical activity was the highest on record during October, when about 179 crews were in the field at an estimated cost of $3,000,000 a month. Of these, 127 were in Alberta, 46 in Saskatchewan, 5 in Manitoba, and one in the Northwest Territories Seismic surveys constituted nearly 90 per cent of the geophysical activity.

Further expansion of transportation, refinery, and storage facilities has increased the outlets for western Canada crude oil. This in turn has permitted a corresponding increase in production, particularly in Alberta, where production potential is higher than that required to satisfy currently available markets.

Two major pipeline projects were undertaken in 1952. Interprovincial Pipe Line Company increased the capacity of its line into Superior, Wisconsin, from 61,000 to 100,000 barrels of oil a day by the installation of about 100 miles of 16-inch pipe to 'loop' a part of the central section of the main line between Regina, Saskatchewan, and Gretna, Manitoba. Construction of five 217,000-barrel storage tanks at the Superior terminus was completed. Work on the 711-mile Trans Mountain pipe line from Edmonton to Vancouver was begun: this 24-inch line will have an initial capacity of 120,000 barrels a day, and this can be increased to 200,000 barrels a day by building additional pumping stations. Cost of the line is estimated at approximately $86,000,000 and completion is expected late in 1953.

In addition to these major undertakings, several minor pipeline systems were built in 1952. Saskatoon Pipe Line Company completed 56 miles of 6-inch line extending from the Interprovincial pipeline at a point near Minden, Saskatchewan, to the Hi-Way Refineries at Saskatoon. Capacity of the line is from 10,000 to 12,000 barrels a day. Canadian Gulf Pipe Line Company completed construction of a 115-mile 12-inch line from the Stettler-Big Valley area to Edmonton. Capacity of this carrier is about 35,000 barrels a day and the initial operating throughput is between 10,000 and 11,000 barrels a day. The Edmonton Pipe Line Company built a 12-mile extension of its Edmonton-Joseph Lake line to reach the recently discovered Armena oil field. Interprovincial Pipe Line Company announced plans for extension of its pipeline system by building 635 miles of 30-inch line from Superior, Wisconsin, to Sarnia, Ontario, at an estimated cost of $70,000,000. Initial capacity of this extension will be 100,000 barrels a day with one pumping station at Superior, but capacity can be increased to 300,000 barrels a day by construction of additional pumping stations.

Refinery capacity for western Canada crude oil was increased appreciably during 1952. McColl-Frontenac Oil Company opened its new refinery in Edmonton with a capacity of 5,500 barrels of crude a day. British American Oil Company expanded and modernized its Moose Jaw refinery, bringing the processing capacity of this plant to about 15,000 barrels a day. This company also announced plans to build an $8,000,000 addition to its refinery at Clarkson, Ontario. Canadian Oil Companies Limited opened a new $23,000,000 refinery near Sarnia, Ontario, thus adding about 13,700 barrels a day to the refining capacity in that region. Storage for 2,000,000 barrels of crude oil and refined products was also constructed at this plant. Sun Oil Company Limited announced construction of a refinery at Sarnia, Ontario, with a crude oil capacity of 15,000 barrels a day and storage capacity for 1,070,000 barrels of crude oil. Work was started on construction of a 5,000 barrel-a-day crude oil topping plant at Coleville, Saskatchewan, for processing the heavy oil from the recently discovered Coleville field. This plant will include storage capacity for about 30,000 barrels of crude oil and refined products; completion is expected by the spring of 1953. In anticipation of completion of Trans Mountain pipeline, Imperial Oil Limited and Shell Oil Company are planning to increase the capacities of their respective refineries in the Vancouver area.

Important Alberta Oil Fields Discovered Prior to 1952

Name of field	Year of discovery	Producing formation	Lithology of producing formation	Depth to top of producing zone (feet)	No. of wells, end of 1952: Capable of production	No. of wells, end of 1952: On production	Total completions in 1952	A.P.I. gravity of oil
Redwater	1948	U. Devonian, D_3 zone	Limestone	3,100	926	906	43	34°–36°
Leduc–Woodbend	1948	L. Cretaceous	Sandstone	4,200	30	27		37.5–39
	1947	U. Devonian, D_2 zone	Dolomite	5,100	583	546	325	38–40
	1947	U. Devonian, D_3 zone	Dolomite	5,300	469	463		38–40
Turner Valley	1913	L. Cretaceous	Sandstone	3,100	4	4	0	43
	1924	U. Mississippian	Limestone and Dolomite	3,450–9,150	325	280		
Acheson–Stony Plain	1950	L. Cretaceous	Sandstone	3,941–4,250	7	4		36.5
	1950	U. Devonian, D_3 zone			81	81	51	37
		U. Devonian, D_2 zone	Dolomite	4,950	10	10		37–38
Lloydminster	1939	L. Cretaceous	Sandstone	1,920	317	216	115	9–16
Joseph Lake	1949	Viking (Cretaceous)	Sandstone	3,270	84	83	18	37
Excelsior	1949	U. Devonian, D_2 zone	Dolomite	3,820	35	34	7	36–37
Golden Spike	1949	U. Devonian, D_2 zone	Limestone	5,000	3	3	4	34–38
	1949	U. Devonian, D_3 zone	Limestone	5,365	8	8		
Stettler	1949	L. Cetaceous	Sandstone	4,250	2	2		
	1949	U. Devonian, D_2 zone	Dolomite	5,200	55	52	27	24–31
	1949	U. Devonian, D_3 zone	Dolomite	5,330	21	16		
Duhamel	1950	U. Devonian, D_2 zone	Dolomite	4,500	9	9	12	34–35
	1950	U. Devonian, D_3 zone	Dolomite	4,700	13	13		
Taber	1942	L. Cretaceous	Sandstone	3,200	21	10	0	18–23

Important Alberta Oil Fields Discovered Prior to 1952—(Continued)

Name of field	Year of discovery	Producing formation	Lithology of producing formation	Depth to top of producing zone (feet)	No. of wells, end of 1952 Capable of production	No. of wells, end of 1952 On production	Total completions in 1952	A.P.I. gravity of oil
Big Valley	1950	U. Devonian, D_2 zone	Dolomite	5,240	31	30	15	33.6–34.2
	1950	U. Devonian, D_3 zone	Dolomite	5,300	7	7		33–33.5
Conrad	1944	Ellis (Jurassic)	Sandstone	3,200	16	15	0	26
Campbell	1949	L. Cretaceous	Sandstone	3,700	15	12	3	31–35
Wizard Lake	1951	U. Devonian, D_3 zone	Limestone	5,975	32	32	26	38
Armena-Camrose	1951	Cretaceous	Sandstone	3,218	176	173	183	36–38
New Norway	1951	U. Devonian, D_2 zone	Limestone	4,580	10	10	11	32–39
	1951	U. Devonian, D_3 zone	Limestone	4,850	6	6		
Caprona (Fenn)	1951	U. Devonian, D_2 zone	Limestone	5,160	25	24	24	30–33
	1951	U. Devonian, D_3 zone	Limestone	5,335	1			
Bashaw	1951	U. Devonian, D_3 zone	Limestone	5,775	5	3	2	38–41
Armisie	1951	L. Cretaceous	Sandstone	4,040	10	9	7	38
Bonnyville	1951	Cretaceous	Sandstone	1,140	12	—	17	14

Alberta

During 1952, significant extensions were made to several established fields as a result of normal development and outpost drilling. Among these may be mentioned the Leduc, Acheson-Stony Plain, Joseph Lake, Stettler, Wizard Lake, Armena-Camrose, Fenn, Bashaw, and Lloydminster fields. Little or no drilling was done in the older fields such as Taber, Conrad, Princess, Del Bonita, Dina, and Vermilion, and production from these fields generally declined. Turner Valley, Canada's first major oil field, has been declining in production since 1942, the peak year, but yielded over 3,000,000 barrels of crude oil and natural gasoline from about 325 wells capable of production in 1952.

Although the discoveries made in 1952 extended from near the International Boundary to the Peace River area, a distance of about 550 miles, most are concentrated in the central plains region between Drumheller on the south and Athabasca to the north. Many of the discoveries and indicated discoveries cannot be evaluated yet, but it is clear that among them are several new oil fields, at least one of which can be reasonably expected to develop into a field of major significance.

The most spectacular discovery was made in the Bonnie Glen-Pigeon Lake district, about 25 miles west of the town of Wetaskiwin. The discovery well, Texaco-Bonnie Glen No. A-1, about $6\frac{1}{2}$ miles southwest of the Wizard Lake Devonian field, completed drilling at a depth of 7,120 feet with the top of the productive zone at a depth of 6,382 feet. About 688 feet of D_3 reef zone was penetrated, comprising 397 feet of wet gas and 291 feet of light-gravity oil, making it the thickest Devonian D_3 productive zone so far found in western Canada. Texaco-Pigeon Lake No. A-1 wildcat, about 3 miles southwest of the Bonnie Glen discovery, completed drilling at a depth of 7,240 feet; the Leduc formation (D_3) was reached at a depth of 6,674 feet. The productive zone is about 555 feet thick, comprising 254 feet of wet gas cap and 300 feet of light-gravity oil. The oil-water interface is at about the same level as at Bonnie Glen. About 22 wells were on production from the Bonnie Glen-Pigeon Lake area at the end of the year.

About $3\frac{1}{2}$ miles southwest of the New Norway field, Scurry Explorers New Norway No. 1 well found oil in both the Devonian D_2 and D_3 reef zones. The reef zones were reached at depths of 4,951 and 5,253 feet respectively and the discovery well was placed on production from the two zones. Development drilling followed rapidly and by the end of the year the field, known as the Malmo field, had 35 wells capable of production.

Other discoveries of commercial significance in the southern and central plains region of Alberta include: a new Devonian pool in the southeast part of the Leduc field; a new Devonian pool 2 miles south of the main Stettler field; a new pool or south extension of the Bashaw Devonian field; a Devonian oil strike about midway between the Big Valley and Fenn fields; a $\frac{1}{2}$ mile north extension of the Campbell (Cretaceous) oil field; an indicated 2-mile southeast extension of the Joseph Lake Viking sand (Cretaceous) oil field; and the first discovery of heavy oil in commercial quantity in Basal Colorado (Cretaceous) sands near Cessford.

Two important discoveries were made in the Peace River area of northern Alberta. Pacific Gas Exploration Rycroft No. 1 well, about 40 miles north of the town of Grande Prairie, found oil and gas in the Cadomin sand near the base of the Lower Cretaceous. The Cadomin sand was reached at a depth of 4,163 feet and drillstem tests of interval 4,199 to 4,220 feet gave a flow of 18° A.P.I. gravity oil at a rate of 4 to 5 barrels an hour; tests between depths of

4,181 and 4,210 feet gave gas at a rate of 6·95 MM cubic feet a day and 100 feet of oil. The well was capped as a potential gas well. Two additional wells, Pacific Gas Exploration Rycroft Nos. 2 and 3, located 3 miles northwest and 2½ miles northeast, respectively, of the discovery well, were completed by the end of the year. Number 2 well was capped as a potential gas well and No. 3 was abandoned.

The second important discovery was made in the Sturgeon Lake district about 50 miles east of Grande Prairie where Amerada Crown No. OF33–32 well obtained production from the Devonian reef. Drilling was carried to a depth of 9,015 feet and an 8-hour test of the Devonian strata at depth interval 8,918 to 8,976 feet gave 35° A.P.I. gravity oil at a rate of about 700 barrels a day. The well has been capped awaiting market outlets for the oil.

Saskatchewan

Saskatchewan witnessed the greatest exploratory activity in its history during 1952. About 496 wells were completed, of which 255 were wildcats or exploratory wells. About 19 oil discoveries and 7 gas discoveries were reported during the year.

The Fosterton district, about 30 miles northwest of Swift Current, witnessed the first discovery of medium oil in Saskatchewan. The discovery well, Socony-Western Prairie Fosterton No. 1, reached the Lower Cretaceous productive zone at a depth of about 3,065 feet, and on a 4-hour initial potential test the well flowed 24° A.P.I. gravity oil at a rate of 298 barrels a day. At the end of the year, 9 wells were capable of production in this pool; one well was actually on production and yielded 1,844 barrels of oil during December.

Three additional discoveries were made in this general area. About 8½ miles southeast of the Fosterton pool, Socony-Western Prairie Cantuar No. 2–14 well discovered two Lower Cretaceous productive zones separated by about 40 feet of strata. Tests of the upper zone between depths of 3,202 and 3,288 feet recovered 23° A.P.I. gravity oil; gravity of the oil from the lower zone is about 12° A.P.I. At the end of the year the Cantuar pool had 6 wells capable of production.

About 10 miles east of Fosterton, Socony-Western Prairie Success No. 3–6B made a strike of 22·6° A.P.I. gravity oil in Lower Cretaceous sands at a depth of about 3,100 feet. About 15 miles southwest of the Fosterton pool, Socony-Western Prairie Midway No. 1 well found two productive zones in rocks of Jurassic age. The first, reached at a depth of about 3,445 feet, yielded heavy oil of about 18° A.P.I. gravity; the second, at a depth of about 3,510 feet, gave a slightly lighter oil of about 21·5° A.P.I. gravity.

In the Williston Basin area near Ratcliffe, 5 miles north of the International Boundary and 100 miles southeast of Regina, Socony-Central Del Rio Ratcliffe No. 1 well found strong indication of light oil (about 31° A.P.I. gravity) in limestone of Mississippian age at a depth of about 6,400 feet. The well is reported to have yielded about 130 barrels of oil a day on swab test with about an equal amount of water.

In the Eastend district about 70 miles southwest of Swift Current, Tide Water-Eastend Crown No. 1 well made the first discovery of oil in substantial amount in Jurassic strata at a depth of about 4,740 feet. Maximum thickness of the productive zone is reported to be about 80 feet, and during a short test

20° A.P.I. gravity oil is reported to have flowed intermittently at a rate of 34 barrels an hour. Three wells were capable of production from the Eastend pool at the end of 1952, and one well on production yielded 1,480 barrels of oil during December.

In the Wapella district about 110 miles east-southeast of Regina, Tide Water Associated Oil Co. Wapella No. 9-33 well discovered 26° A.P.I. gravity oil in Lower Cretaceous sands at a depth of about 2,200 feet. The productive zone is about 20 feet thick and tests indicate an initial capacity of about 100 barrels a day. In the same district Imperial-Tide Water Wapella No. 4-3 well obtained 26° to 27° A.P.I. gravity oil in a 7-foot productive zone in Jurassic rocks at a depth of about 2,350 feet. Initial potential of this well is reported to be about 75 barrels a day.

At Buffalo Coulee, 5 miles northwest of the Coleville oil field, Canada Southern Oils Buffalo Coulee No. 1 wildcat well discovered heavy oil in the Banff sand of Mississippian age, the top of which was reached at a depth of 2,650 feet. Six wells capable of production had been completed in this pool at the end of 1952.

In addition to the foregoing, oil strikes were also made at Eagle Hills, Eatonia, Eureka, and Hossier in sands of Cretaceous age, and at Gull Lake in limestone of Jurassic age.

Manitoba

Seventy wells were completed in Manitoba during 1952. These resulted in 37 new oil wells, 32 dry holes, and one suspended well.

Perhaps the most promising results obtained during 1952 were in the vicinity of the Virden field discovered in 1951. In May, Canadian Superior Cruikshank No. 14-4 well indicated a 2½ mile west extension of the Virden field. This well found production in Mississippian limestone between depths of 2,515 and 2,530 feet and a daily potential of 52 barrels of 34° A.P.I. gravity oil was indicated by preliminary tests. The well had yielded 8,988 barrels of oil by the end of the year. Two additional productive wells were completed in this pool.

About 2½ miles southwest of the Virden field another extension or small pool was discovered by Souris Valley Coulter No. 1 well. This pool had four productive wells by the end of the year and had yielded about 5,616 barrels of oil. Still another successful completion was made in the northwest part of the Virden field where New Concord-Marwayne Jupiter-Powell No. 1 well penetrated a 61-foot productive zone in the Mississippian limestone, reached at a depth of about 2,503 feet.

A discovery was made in July by California Standard Tilson Province No. 5-32 well about 24 miles southwest of Virden. The oil is in Mississippian limestone at a depth of about 3,100 feet. First production was in August and by the end of the year the well had yielded 3,005 barrels of oil. Encouraging indications of oil were also obtained at three exploratory wells near Waskada and Coulter in the extreme southwestern part of the province, and in the Turtle Mountain area.

British Columbia

The finding of light oil in Peace River Allied Fort St. John No. 1 well, 6 miles southeast of Fort St. John, in November, 1951, gave further encouragement to exploration for oil and gas in the Peace River area of northeastern British

Columbia. More than 30,000,000 acres are now under permit in this area and applications for permits on an additional 2,000,000 acres have been filed with provincial authorities. Permits aggregating almost 2,000,000 acres in the Fernie, Quesnel, Fort George, Lillooet, and Fort Fraser districts are also held by interested companies.

Fourteen wells were completed during 1952, twelve of them being in the Fort St. John district. Ten of these latter wells found wet gas in commercial quantity, one was suspended but classed as an indicated oil well, and one was abandoned as a dry hole.

Two exploratory wells, Red Willow No. 1 in the Lone Mountain district, and Phillips Tenaka No. 1, located west 17,000 feet and south 2,000 feet of mile-post 247, Alaska Highway, were abandoned at depths of 2,970 and 9,217 feet respectively.

Drilling was commenced on two other exploratory wells during the year. One of these, Toad River Joint Project No. 1, located in unsurveyed territory near the confluence of the Toad and Liard Rivers, about 260 miles northwest of Fort St. John, was suspended for the winter months at a depth of 1,643 feet. It is expected that drilling will be resumed in May, 1953. Pacific-Atlantic Flathead No. 1 well, about 25 miles west of the Pincher Creek gas field, was drilling at a depth of 8,938 feet at last report and moderate flows of gas were reported at a depth of about 5,411 feet.

Northwest Territories

The presence of oil in commercial quantity in rocks of Devonian age in the Northwest Territories has been known since 1920, when the discovery well of the Norman Wells field on Mackenzie River near the Arctic Circle was drilled. This field was developed to its present stage during the second world war and operates for local requirements only. Production during 1952 was about 301,000 barrels of oil.

Drilling took place in two main districts in 1952, one at Deep Bay at the west end of Great Slave Lake and the other in the general vicinity of Fort Simpson on Mackenzie River about 135 miles to the north-northwest. On Deep Bay, Northwest Territories Petroleums Limited drilled 4 wells, N.W.T. Deep Bay Nos. 1, 2, 3, and 4. The first two were drilled to depths of 1,321 and 1,416 feet respectively and each is reported to have encountered oil staining in the Slave Point limestone of Devonian age. N.W.T. Deep Bay Nos. 3 and 4 wells reached depths of 1,140 and 1,054 feet respectively.

In the same general district, Punch Petroleums drilled three diamond-drill test holes from 456 to 1,327 feet in depth. Two of these are reported to have found good indications of oil in the Slave Point limestone. Four additional holes were completed by this company during the year.

In the Fort Simpson district, West Territories Oil Limited drilled three wells, designated Westeral Nos. 3A, 4A, and 7A. These wells were abandoned at depths of 2,422, 1,888, and 1,940 feet respectively.

Eastern Canada

Ontario

All productive oil and gas fields are in the southwestern part of the province. In all, 354 wells were drilled in this region in 1952, of which 86 were exploratory tests and 268 were development wells. The exploratory tests resulted in 3 shallow oil wells, 8 gas wells, and 75 dry holes. The development drilling resulted in 25 oil wells, 160 gas wells and 83 dry holes. Twenty-four of the oil wells were in Devonian strata and had an average initial production of 5 barrels a day; one oil well was in rocks of Silurian age and had an initial production of 10 barrels a day. Two shallow oil pools were discovered, one in Elgin county at a depth of 415 feet, and one in Lambton county at a depth of 310 feet.

The 1952 exploratory drilling added an estimated 70,000 barrels of oil to the existing reserves in Ontario.

About 500,000 acres were added to the area already under lease in the province, the total acreage under lease for oil and gas at the end of 1952 being about 1,750,000 acres.

Quebec

Drilling was continued on 5 exploratory wells in eastern Gaspé. The Quebec Government granted exploration licences on about 1,500,000 acres in the eastern and central Gaspé regions.

An exploration licence covering the whole of Anticosti Island, comprising approximately 1,950,000 acres, was granted by the Quebec Government. However, no geological exploration was carried out during the year.

Newfoundland

Exploratory drilling was commenced on the west coast of Newfoundland near St. Paul's Inlet and Parson's Pond. One well was drilled to a depth of nearly 2,000 feet, and three others were drilling at the end of the year.

Production [1] of Crude Petroleum
(In barrels of 35 Imp. gallons.)

	1952		1951	
	Bbls.	$	Bbls.	$
Alberta				
Redwater	23,975,842	—	23,177,607	—
Leduc-Woodbend	17,845,212	—	13,743,118	—
Turner Valley	2,655,007	—	2,952,387	—
Acheson	2,016,855	—	918,158	—
Wizard Lake	1,696,077	—	190,595	—
Armena-Camrose	1,307,526	—	63,078	—
Golden Spike	1,279,103	—	640,972	—
Lloydminster	1,057,354	—	900,469	—
Excelsior	933,644	—	723,005	—
Bonnie Glen	743,490	—	—	—
Big Valley	657,875	—	155,580	—
Stettler	607,078	—	606,068	—
Duhamel	347,140	—	184,582	—
Fenn	343,766	—	9,648	—
New Norway	287,988	—	20,664	—
Glen Park	282,719	—	22,443	—
Malmo	270,474	—	—	—
Drumheller	175,688	—	13,317	—
Conrad	135,037	—	142,497	—
Armisie	103,594	—	25,293	—
Bon Accord	83,526	—	14,717	—
Taber	81,464	—	182,449	—
North Big Valley	74,446	—	—	—
Princess	72,970	—	92,189	—
Jumping Pound	67,257	—	41,936	—
Bashaw	56,493	—	11,318	—
Campbell	45,650	—	60,436	—
Ellerslie	44,975	—	20,774	—
Mamao	41,333	—	4,972	—
Del Bonita	41,205	—	30,344	—
Other areas	1,584,935	—	966,848	—
Total	58,915,723	139,512,432	45,915,384	113,870,152
Saskatchewan (Lloydminster)	1,696,505	2,256,352	1,249,281	1,659,045
Northwest Territories	314,217	379,160	227,449	399,887
Ontario	191,814	641,037	197,171	677,905
Manitoba	104,826	229,299	10,698	26,478
New Brunswick	14,237	19,932	15,551	21,771
Total Canada	61,237,322	143,038,212	47,615,534	116,655,238

[1] Alberta production is the actual well-lease production of crude petroleum and does not include the production of natural gasoline. For the other provinces, shipments to refineries are taken as production.