CANADA
DEPARTMENT OF MINES AND TECHNICAL SURVEYS

MINES BRANCH

THE CANADIAN MINERAL INDUSTRY IN 1948

Reviews by the Staff of the Mines Branch

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PREFACE

A primary aim of these annual reports on the Canadian mineral industry is to provide the interested public with information that will enable them not only to keep abreast of operations and developments in the industry, but to gain an increasing appreciation of the present and potential importance of mining in the economy of the country. Changes, some of minor importance, others of the greatest significance, are taking place from year to year in the Canadian mineral landscape. Recent developments in the West that show promise of eventually making Canada self-sufficient in crude oil afford an outstanding illustration, as do those in the Quebec-Labrador region where large deposits of iron ore are being prepared for production, and in the Allard Lake area, Quebec, where work is proceeding toward bringing large deposits of titanium ore into production.

These and other developments are resulting in a heightening of public interest in mining, evidenced in part by the many inquiries being received by the Mines Branch for information on the industry, and in part by the prominence given to developments in mining by weekly periodicals in the daily press and other news media. The reviews contained in this report, combined with those in previous reports, provide a continuous source of information on activities relating to the metals and minerals produced in Canada. However, owing to the time interval between the preparation of the reviews and their publication in printed form, the Mines Branch each year issues mimeographed reviews on each metal and mineral and these are usually available to the public within 6 to 8 months of the commencement of the year concerned.

Much of the information appearing in the mimeographed separates and in the printed reports is contributed by operators of mines and quarries throughout Canada, and by officers of the Dominion Bureau of Statistics, to whom the Mines Branch is greatly indebted.

C. S. PARSONS,
Chief, Mines Branch.

Ottawa, December, 1949.

I. METALS

ALUMINIUM

Aluminium production in Canada during 1948 was 367,079 tons—the third greatest production on record, and would have been still greater had not an unprecedented shortage of water for power-generating purposes in the latter part of the year necessitated closing some of the pot lines.

Production in Canada is entirely by Aluminum Company of Canada, Limited, which has its alumina plant at Arvida and reduction plants at Arvida, Ile Maligne, Shawinigan Falls, LaTuque, and Beauharnois, all in the province of Quebec. These reduction plants have a total rated capacity of about 550,000 tons of aluminium a year, or over 20 per cent of the estimated productive capacity of the world. Operations in 1948 were concentrated at Arvida, Ile Maligne, and Shawinigan Falls.

Fabricating plants are located at Kingston, Toronto, and Etobicoke in Ontario, and at Shawinigan Falls in Quebec. Canadian consumption of aluminium products continues to grow, but the greater part of the aluminium production is exported in the forms of ingots, bars, blooms, rods, sheets, etc.

In addition to the above plants operated by the producing company there are other plants throughout the country engaged in the production of aluminium products.

During the year Aluminum Company of Canada, Limited investigated potential power and smelter sites in British Columbia, and also the possibilities of increasing available power in the Arvida area so as to be able to utilize reduction facilities now idle through lack of power.

The Canadian aluminium industry is exceeded in size only by that of the United States. The main factor favouring the establishment of the industry in Canada is the abundant and low-cost hydro-electric power at points where necessary raw materials can be cheaply and conveniently assembled. The principal imported raw materials used in the Canadian aluminium industry are bauxite from British Guiana, coal and coke from the United States, fluorspar from Newfoundland (which became a province of Canada in 1949), and cryolite from Greenland and the United States.

Although possessing no bauxite, Canada has in many areas low-grade potential ores of aluminium, such as clay, shale, nepheline syenite, and anorthosite containing from 20 to 30 per cent alumina. The utilization of these low-grade raw materials has been the object of much research in different parts of the world and various processes have been developed. The economic success of any of these processes will depend in large part upon local conditions, but it has yet to be proved that any of them can compete on an even basis with the Bayer process, the standard process for producing alumina and which utilizes bauxite containing less than 7 per cent silica and from 55 to 60 per cent alumina.

Uses and Price

Aluminium is finding an increasingly wide field of usefulness. It is available from fabricating plants in many forms such as sheets, castings, forgings, rolled and extruded shapes, tubes, rods, wire, foil, powder, and paste. In 1948 Canadian aluminium was sold for the following purposes: architectural and building uses, which took more than 35 per cent of the total; household applications, including cooking utensils, 20 per cent; transportation, 19 per cent; elec-

trical industry, 9 per cent; food and farming, 5 per cent; canning and packaging, 4 per cent; the chemical industry, 1 per cent, and miscellaneous uses, 5 per cent.

The domestic price of aluminium ingot 99·5 per cent pure, in carload lots, delivered Montreal or Toronto is 15½ cents per pound.

Production, Trade, and Consumption

	1947		1948	
	Short tons	$	Short tons	$
Production, Ingot	299,061	.....	367,079	.....
Imports: Bauxite				
From: British Guiana	1,191,890	5,391,625	1,820,237	7,070,960
United States	133,645	2,380,191	99,488	1,936,718
Neth. Guiana	61,589	517,837	87,947	872,605
Other countries	5,569	276,222	822	3,718
Total	1,392,693	8,565,875	2,008,494	9,884,001
Imports: Cryolite				
From: Denmark	6,393	961,786	6,008	901,105
United States	865	171,406	683	130,708
Total	7,258	1,133,192	6,691	1,031,813
Imports: Aluminium Products				
Semi-manufactured	.....	2,400,514	.....	1,400,182
Fully manufactured	.....	5,022,089	.....	5,235,715
Total	.....	7,422,603	.....	6,635,897
Exports: Bars, Ingots, Blooms				
To: United Kingdom	108,981	25,245,231	160,249	39,845,450
United States	16,261	3,909,266	77,775	19,067,488
Sweden	9,237	2,585,283	11,278	3,428,858
Netherlands	5,344	1,475,061	10,559	3,239,877
Germany	2,221	580,519	9,895	2,597,990
Czechoslovakia	6,175	1,894,434	8,848	2,655,109
Brazil	4,066	1,238,151	6,164	1,696,838
Other countries	61,431	15,682,796	42,340	11,660,102
Total	213,716	52,610,741	327,108	84,191,712
Exports: Rods, Sheets, Circles				
To: United States	35	29,480	3,020	1,542,578
India	755	347,459	1,036	604,275
Other countries	3,108	1,691,225	2,112	1,256,846
Total	3,898	2,068,164	6,168	3,403,699
Exports: Manufactures				
Wire and cable	.....	2,529,927	.....	5,521,471
Other manufactures	.....	4,812,061	.....	3,787,905
Total	.....	7,341,988	.....	9,309,376
Exports: Scrap				
To: United States	9,893	1,723,499	22,282	4,998,886
Other countries	909	211,182	558	142,755
Total	10,802	1,934,681	22,840	5,141,641
Domestic Consumption of Ingot	50,000	.....	66,000	.....

ANTIMONY

Although the demand for antimony continued firm in 1948, Canadian needs were obtained without difficulty. Production in China, principal world source of antimony prior to the war, remained at a greatly reduced level.

Production of refined antimony in Canada ceased in 1944 when The Consolidated Mining and Smelting Company of Canada, Limited dismantled its antimony refinery at Trail, British Columbia. Since then the company has been producing intermittently an antimony-lead alloy containing 25 per cent antimony, and in the latter part of 1948 it placed an antimonial lead containing 12 per cent antimony on the market. In 1948 it produced 123 tons of the former and 1,063 tons of the latter.

Restrictions on the export of lead scrap during 1948 provided a considerable supply of antimonial lead in the form of old battery plates, etc.

Canadian Occurrences

Antimony ore in the form of stibnite is found in various parts of Canada and a few of these occurrences were developed at one time or another. Prior to 1917 some antimony ore was produced intermittently in Yukon, British Columbia, Quebec, New Brunswick, and Nova Scotia, and a small amount of refined antimony was produced in New Brunswick. In recent years the only Canadian output has been derived from the residue resulting as a by-product in the refining of lead at Trail, British Columbia.

Following is a summary of the more important known occurrences.

From the West Gore deposit in Hants county, Nova Scotia, antimony in the form of a concentrate containing an appreciable amount of gold was produced for some years prior to 1917.

In New Brunswick, at the Lake George deposit, where mining operations were carried on intermittently between 1868 and 1931, stibnite occurs in several quartz veins. During several of these active periods smelting operations were carried on. The extensive ore dumps on the property are understood to contain considerable stibnite. Some exploratory work and drilling was done late in 1947 and early in 1948, but further attempts to develop the deposit were discontinued.

From a deposit in South Ham township, Wolfe county, Quebec, a small tonnage of ore was produced about 75 years ago.

In British Columbia, a few of the numerous occurrences have been worked in a limited way. Test shipments have been made from several deposits in the Bridge River area. In the Fort St. James area, the Stuart Lake mine was opened by a shaft about 1940 and a few tons of ore was shipped for test purposes. During 1948 Antimony Mines and Metals (Slocan), Limited began to develop a deposit 6 miles west of Slocan City.

Little development attention has been given to the several occurrences of antimony ore in Yukon and the Northwest Territories.

Production and Trade

The principal producer sources of antimony in 1948 were Bolivia, Mexico, United States, Union of South Africa, and China, in the order named. World production in 1948 as estimated by the United States Bureau of Mines was 41,300 metric tons. The United States is the chief consumer. Texas Mining and Smelting Company, Laredo, Texas, the principal producer of refined antimony

in the United States, operates almost entirely on ores and concentrates from Mexico and Bolivia. The construction of a new smelter by Bradley Mining Company at Stibnite, Idaho, is reported in the June 1948 issue of Engineering and Mining Journal. About 96 per cent of the United States domestic production of antimony is mined in Idaho, where the antimony is obtained as a by-product in the mining of tungsten and gold.

Chinese antimony continued under government control in 1948 and all export sales were made through the Foreign Trade Office of the Natural Resources Commission in Shanghai, or through the New York Branch of the Commission.

Production, Imports, Exports

	1947		1948	
	Short tons	$	Short tons	$
Production (Antimony content of antimonial lead alloy)	575	384,255	155	113,173
Imports				
From: China	893	513,868	.....	.....
United States	316	188,559	474	299,572
Belgium	11	7,392	73	52,370
Others	220	97,488	.....	.....
Total	1,440	807,307	547	351,942
Exports				
To: United States	.....	.....	325	Not available
Brazil	.....	.....	89	
Total	.....	.....	414	

Uses and Consumption

Antimony is used chiefly as an alloying element with lead, to which it imparts hardness and mechanical strength. Antimonial lead is used for battery plates; for cable covering; and for sheet, pipe, etc., in the chemical and pulp and paper industries. It is a component of most babbitt metals and is alloyed with lead and tin in solders, foil, collapsible tubes, and type metal. Its property of expanding on cooling makes it particularly useful in the manufacture of type-metal alloys.

Sulphides of antimony are used as pigments in paint manufacture and in the rubber industry, and the oxides are used in the production of porcelain enamel frits. There are numerous other uses of antimony in the chemical industry.

Canadian consumption of antimony in 1948 amounted to 812 tons compared with 1,216 tons in 1947. Consumption by specified industries in 1947 (not available for 1948) was:

	Tons
White metal foundries	948
Electrical apparatus	213
Silverware industry	39
Brass foundries	11
Miscellaneous	5
	1,216

Prices

The Canadian price of antimony rose from 35 cents at the beginning of 1948 to 41 cents at the end of the year.

The price of domestic antimony in the United States, according to Engineering and Mining Journal Metal and Mineral Markets, increased from 36·03 cents a pound at the beginning of 1948 to 41·67 cents at the year end.

ARSENIC

Production of arsenic in Canada amounted to 581 tons in 1948 valued at $82,909, compared with 394 tons valued at $49,348 in 1947 and with 3,927 tons valued at $580,893 in 1942, the peak year. It came from O'Brien Gold Mines, Limited, and Consolidated Beattie Mines, Limited in Cadillac and Duparquet townships, respectively, in Quebec.

O'Brien recovers crude arsenic as a by-product in the treatment of its gold ore, and ships the arsenic to Deloro Smelting and Refining Company, Limited, Deloro, Ontario, where it is refined into white arsenic of commerce.

Consolidated Beattie at Duparquet recovers crude arsenic by a Cottrell system in its roasting plant and ships to manufacturers in Canada and the United States.

From British Columbia, a gold-arsenic concentrate is shipped to the smelter at Tacoma, Washington, by Bralorne, Kelowna Exploration, Hedley Mascot, Polaris Taku, and other smaller gold mines, but no payment is made for the recoverable arsenic and hence this production is not included in the following figures.

Production and Trade

	1947		1948	
	Short tons	$	Short tons	$
Production				
Ontario	.....	.....	384	55,663
Quebec	394	49,348	197	27,246
Total	394	49,348	581	82,909
Exports[1]	82	8,487	85	6,582
Imports[2]	123	24,150	42	13,056

[1] Excluding those for which no payment is received.
[2] Include arsenic sulphide.

The world production of arsenic is practically all obtained as a by-product from the treatment of gold, silver, copper, lead, zinc, cobalt, tungsten, and tin ores, the leading producing countries being: Sweden, United States, Mexico, Australia, Italy, France, Japan, Germany, and Portugal.

Uses

Most of the world production of arsenic is used as insecticides, and as a weed killer, particularly on railroad rights-of-way. In Canada it is used chiefly as a clearing agent in the manufacture of glass.

D.D.T. (dichloro-diphenyl-trichlorethane) has replaced arsenic to an extent in the extermination of insects, and 2-4-D has commenced to replace the compound in the battle against weeds.

The use of arsenic in the medicinal trade has declined rapidly with the advent of penicillin in the treatment of venereal diseases.

A small amount of arsenic is used in lead cable sheathing to increase its resistance to soil corrosion. Other uses are: in the preservation of wood; in the manufacture of pigments for metal finishing; and in the manufacture of dyestuffs, cattle dip, and in bearing metals.

Consumers

The more important Canadian consumers are: Niagara Brand Spray Company, Limited, Burlington, Ont.; The Steel Company of Canada, Limited, Hamilton, Ont.; Canada Metal Company, Toronto, Ont.; Mount Royal Metal Company, The Sherwin-Williams Company of Canada, Limited, Dominion Glass Company, Limited, Brandram-Henderson, Limited, Montreal, Que.; Consumers Glass Company, Limited, Ville St. Pierre, Que.; and International Fibre Board, Limited, Gatineau, Que.

Consumption of Arsenious Oxide in Canada in 1946 and 1947

(1948 figures unavailable)

	1946	1947
	Pounds	Pounds
Glass industry	336,507	432,449
Insecticides	55,808	117,051
White metal alloys	27,501	37,454
Miscellaneous	8,000	9,000
Total	427,816	595,954

Prices

The price of refined arsenious oxide (white arsenic), minimum 99 per cent, in barrels, carload lots, delivered, remained at 6¼ cents per pound throughout 1948, according to Engineering and Mining Journal Metal and Mineral Markets.

BISMUTH

The Canadian output of metallic bismuth in 1948 was 16 per cent lower than in 1947. The production was from The Consolidated Mining and Smelting Company of Canada, Limited, Trail, British Columbia, which recovers the bismuth from the residues resulting from the electrolytic refining of lead bullion. A brief outline of the process was given in the 1947 review on bismuth.

Exports of bismuth were higher, but consumption in Canada was lower. Imports were all in the form of bismuth concentrate, about 83 tons of which was shipped to Canada in October for refining.

Occurrences in Canada

There are few known occurrences of bismuth in Canada, the most important being in Consolidated Smelter's Sullivan mine at Kimberley, British Columbia, where the bismuth in very small amounts is associated with the lead-zinc-silver ore.

Some years ago an occurrence of tetradynite (telluride of bismuth) was found in Glacier Gulch group, near Smithers, British Columbia.

Small amounts of bismuth are associated with the silver-cobalt ores of the Cobalt district, Ontario, and until a few years ago there was a small production from this area.

Bismuth is associated with molybdenite in the La Corne mine, La Corne township, Quebec. During 1946 and 1947 Molybdenite Corporation of Canada, Limited produced a small tonnage of bismuth concentrates and, later, metallic bismuth. The mine was closed late in 1947.

Canadian Production and Exports of Bismuth

	Production		Exports (lb.)		
	Pounds	Value	To United Kingdom	To other countries	Total
		$			
1947	284,372	560,213	72,000	50,000	122,000
1948	240,242*	480,484	150,000	8,300	158,300

*Comprised of 221,677 pounds of metallic bismuth; 13,203 pounds bismuth content of shipments from stock at La Corne mine; and 5,362 pounds bismuth content of silver-lead-bismuth bullion shipped by Deloro Smelting and Refining Company, Limited, Deloro, Ontario.

World production, in the neighbourhood of 1,200 metric tons a year, comes principally from the United States, Peru, Mexico, and Bolivia, minor sources of supply being Argentina, Chile, Brazil, and Canada. Most of the bismuth produced in the United States is from anode slimes obtained in the Betts electrolytic process for refining lead bullion, the principal producers being: American Smelting and Refining Company, Omaha, Nebraska; Anaconda Copper Mining Company, Perth Amboy, New Jersey; and United States Smelting, Refining, and Mining Company, East Chicago, Indiana.

Consumption and Uses

About half of the Canadian consumption of 50 tons of bismuth in 1948 was used in the manufacture of pharmaceuticals and the remainder in making special alloys. Consumption in 1947 amounted to 71 tons.

Bismuth is too brittle to be used alone but its low melting point and expansion on solidification make its alloys highly desirable for a number of applications. Bismuth is used with cadmium, tin, and lead in the manufacture of low melting alloys for sprinkler plugs and other fire-protection appliances, electrical fuses, low melting solders, dental amalgams, and tempering baths for small tools. Similar alloys are used for special airplane and automotive parts, to make moulds for electroforming, and in type metal. Bismuth is used also in the production of radar equipment and in the manufacture of optical glass.

Salts of bismuth are used extensively in medicinal compounds and pharmaceutical products. Because of their absorptive powers for X-rays, they are used in the X-ray examination of the digestive tract.

The principal consumers of bismuth in Canada are: Canada Metal Company, Limited, Toronto, Ont.; Mount Royal Metal Company, Limited, Montreal, Que.; Mallinckrodt Chemical Works, Limited, Ville La Salle, Que.; and Merck and Company, Limited, Montreal, Que.

Prices

The Canadian price in 1948 was $2 a pound delivered Montreal.

In ton lots the f.o.b. New York price was $2 a pound throughout 1948. This price was established in February 1947 and was the highest since 1928.

CADMIUM

Domestic refinery production of metallic cadmium was 7 per cent higher in 1948 than in 1947. Consumption was higher also, but exports were slightly lower. The Consolidated Mining and Smelting Company of Canada, Limited, Trail, British Columbia, produces about 80 per cent of the Canadian output and Hudson Bay Mining and Smelting Company, Limited, Flin Flon, Manitoba, the remainder. Most of the Trail production is derived from Consolidated Smelters' Sullivan lead-zinc-silver mine at Kimberley. The zinc concentrate produced in the Sullivan concentrator contains about 0·18 per cent cadmium. It is roasted and leached at Trail and the cadmium is recovered from the residues that result from the purification of the zinc electrolyte. The rated annual capacity output of the cadmium plant is 700 tons of cadmium metal of a purity of 99·99 per cent. The remainder of the Trail production is recovered from zinc concentrates containing cadmium sold to Consolidated Smelters by a number of mining companies in Canada and elsewhere. This is treated with the company's own concentrate. Among the more important producers of these concentrates in 1948 were Britannia Mining and Smelting Company, Limited, Zincton Mines, Limited, Western Exploration Company, Limited, and Base Metals Mining Corporation, Limited, all in British Columbia.

The copper-zinc ore of Hudson Bay Mining and Smelting Company's Flin Flon deposit on the Manitoba-Saskatchewan boundary contains minor amounts of cadmium which is recovered in the electrolytic zinc refining process in much the same way as that produced at Trail. The rated capacity of the Flin Flon cadmium plant is 180 tons a year.

The following table shows Canadian production, exports, and consumption of cadmium, and production by principal countries.

Canadian Statistics	1947		1948	
	Pounds	$	Pounds	$
Production	718,534	1,235,879	766,090	1,398,114
Exports				
To: United Kingdom	500,121	1,084,830	589,094	1,379,730
United States	6,884	14,054	6,032	13,570
France	114,092	268,207	.....	.....
Other countries	1,794	3,142	972	2,049
Total	622,891	1,370,233	596,098	1,395,349
Consumption				
Mainly in white metal alloys	150,000	.....	185,000	.....

Refinery production by principal countries[1]	1947	1948
	Pounds	Pounds
United States	8,000,000	7,500,000
Canada	718,534	766,090
Tasmania	421,792	493,696
Great Britain	218,000	249,088

[1] Source: American Bureau of Metal Statistics.

Uses

The demand for cadmium has increased rapidly since the pure metal became available as a result of the development of the electrolytic process for refining zinc. Its chief use is in electroplating, where it is applied as a thin protective coating to other metals, principally steel. Because of its relatively high cost compared to zinc this use is limited to such articles as bathroom, washing machine, and other household fittings, where a uniform attractive colour is desired, and to coffin fittings. Next in importance is its use in white metal alloys, especially where a hard, heat-resisting bearing alloy is required, as in high-speed internal combustion engines. The white metal alloy industry is the chief Canadian outlet. The addition of 0·7 to 1·0 per cent of cadmium strengthens copper without seriously reducing its electrical conductivity. Cadmium is used in the manufacture of low melting point solders and fusible alloys for sprinkler apparatus, fire detector systems, and valve seats for high-pressure gas containers.

Cadmium sulphide and cadmium sulphoselenide (red lithopone) are standard agents for producing bright yellow and red colours respectively in paints, ceramic materials, inks, rubber, and leather. Cadmium nitrate is used in white fluorescent lamp coatings, and the oxide, hydrate, and chloride of cadmium are used in electroplating solution. Cadmium bromide, chloride, and iodide are used in the preparation of special photographic film.

Prices

The average Canadian price in 1948, estimated by the Dominion Bureau of Statistics, was $1.82 a pound.

On August 2 the New York price of cadmium in the form of commercial sticks or bars increased from $1.75 to $1.90 a pound. It advanced to $2 a pound on November 15, where it remained for the rest of the year. Patented shapes and anodes cost an extra 5 cents a pound.

CHROMITE

There were no new developments of consequence in relation to chromite production in Canada in 1948. As in the three previous years the output came from Union Carbide Company's "Montreal" pit in the Black Lake area, Quebec. Shipments, all of which were to Electro Metallurgical Company of Canada, Limited, Welland, Ontario, for use in ferro-alloys, amounted to 1,715 short tons of lump ore valued at $33,568, compared with 2,162 tons of ore valued at $42,159 in 1947. Domestic consumption of about 73,000 tons of chromite was 6,000 tons higher than in 1947. The metallurgical industry used 64,000 tons mainly for ferro-alloys, the remainder being for refractory use. About 69,200 tons was imported, mostly from the Union of South Africa, and nearly half of the total imports was via the United States.

World demand for chromite eased slightly in 1948, and output from most of the principal producing countries was slightly higher than in 1947.

The "Montreal" pit was reopened by Union Carbide Company in 1941 and has been in continuous production since. It is operated for the company by Orel Paré.

Most of the deposits from which production was obtained in the past are between Quebec City and Sherbrooke in the Eastern Townships of Quebec. The main sources of supply during the war were the Sterrett mine in Cleveland township, and the Reed-Belanger property in the Black Lake district, both of which operations ceased in 1944.

Production, Consumption, and Trade

Chrome Ore	1947		1948	
	Short tons	$	Short tons	$
Production (Shipments)	2,162	42,159	1,715	33,568
Imports:				
From:				
United States[1]	67,973	2,540,154	31,133	1,206,837
Union of South Africa	20,269	318,348	27,140	394,818
Southern Rhodesia	3,358	99,542	4,733	184,111
Philippines	.....	.....	4,480	94,550
Turkey	.....	.....	1,232	46,429
Cuba	4,480	96,829	465	10,947
Other countries	2,242	83,356	.....	.....
Total	98,322	3,138,229	69,183	1,937,692
Domestic Consumption	66,400	.....	73,000	.....
Consumers' Stocks, Dec. 31st	37,000	.....	33,000	.....

[1] Imported via the United States.

Chromium Alloys	1947		1948	
	Short tons	$	Short tons	$
Production	22,000	.....	30,000	.....
Domestic Consumption	3,800	.....	6,500	.....
Exports of Ferro-Chrome:				
To:				
United States	14,849	2,037,245	11,552	1,759,112
United Kingdom	11,646	3,362,572	8,692	2,963,836
Other countries	1,239	376,824	2,271	832,138
	27,734	5,776,641	22,515	5,555,086

The large deposits of chromite in the Bird River area of southeastern Manitoba have a high iron content and are not of economic interest at present. However, research work on beneficiation is continuing.

World production figures for recent years are incomplete, the estimate for 1946 being about 1,500,000 metric tons. Russia, Union of South Africa, Cuba, Southern Rhodesia, and Turkey were the leading producers, with much smaller tonnages from Philippines, New Caledonia, and India. Output from South Africa in 1948 was about 414,000 metric tons, a 10 per cent increase over 1947. Grades of shipping ore range from 54 per cent concentrate to lump ore of 44 to 48 per cent Cr_2O_3. All types of ore are produced.

Southern Rhodesia's output increased in 1948 to about 260,000 short tons.

In Cuba the output in 1947 was about 180,000 short tons, nearly all of which was exported to the United States. About 94 per cent of the ore is refractory grade.

In Turkey the Guliman mine, the largest producer, is under government control and is now working at full capacity.

Philippines' production is now about 20,000 tons monthly. The principal producer is in Northern Mindanao. Most of the ore is refractory grade and is Canada's main source of supply for refractory purposes.

The chromite reserves in New Caledonia are estimated at over a million tons, most of it metallurgical grade of 45 per cent Cr_2O_3 and over.

In the United States, production of metallurgical chrome in 1948 was about 3,500 tons.

Uses and Specifications

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

Chromium is one of the principal alloying elements in a great variety of steels, chief of which in the amount of chromium used are the stainless and the corrosion-resistant steels, and the heat-resisting alloy steels. Chromium is used in high-speed tool steels, and as a hard, toughening element in vehicle axles and frames and in aeroplane parts. Chromium in high-temperature alloys is being used for gas turbines, jet propulsion units, and gas engine superchargers. The metal is used in nickel-chrome resistance wire.

For standard metallurgical uses chromite should contain a minimum of 48 per cent Cr_2O_3 with a chrome-iron ratio of 3 to 1 or higher, and the ore should be hard and lumpy. For special products, however, made by a Canadian company, friable ores as low as 42 per cent Cr_2O_3 and a ratio of 1·5 to 1 can be successfully used.

Chrome ore is used for making refractory bricks or materials used in basic open-hearth furnaces, in arches of furnaces, and in parts of combustion chambers of high-pressure steam boilers, etc. It is used with magnesia to make chrome-magnesia refractories, an important use in Canada being in the manufacture of brucite magnesia bricks that contain up to 30 per cent Cr_2O_3.

Refractory chromite should be fairly high in Cr_2O_3 and alumina and as low as possible in silica and iron. The ore should be hard and lumpy and not under 10-mesh, and the chromite should be present in an evenly and finely distributed form, not as coarse grains mixed with blobs of silicate. The Cr_2O_3 content is usually over 40 per cent.

In the chemical industry chromite is used mainly in fundamental salts such as sodium and potassium bichromates. A large use of the former is for the chrome tanning of leather. Other uses of the salts are: as a mordant in dyeing, electroplating, pigments, and camouflage paints; as a catalyst in petroleum refining; in glassmaking, photography, bleaching, safety matches, synthetic rubber manufacture, processing of textiles, antiseptics, etc. Finely powdered chrome oxide is used as a buffing compound for polishing stainless steels.

Chemical grade ore should contain a relatively high percentage of Cr_2O_3 and be low in silica.

Prices

The principal Canadian buyers of chromite for metallurgical use are: Chromium Mining and Smelting Corporation, Limited, Sault Ste. Marie, Ontario, and Electro Metallurgical Company of Canada, Limited, Welland, Ontario. The only important purchaser of refractory ore is Canadian Refractories, Limited, Canada Cement Building, Montreal.

Canadian prices of 47 to 48 per cent Cr_2O_3 concentrates are $25 to $40, and crude ore $15 to $20 a long ton, f.o.b. mines, depending upon the chrome-iron ratio and upon the percentages of certain impurities.

At the end of 1948 the United States price of domestic and imported ores of 48 per cent Cr_2O_3, 3 to 1 ratio, was $38 to $39 a long ton, dry basis, at seaboard. Ores of lower grade and ratio vary down to a minimum of $21 a long ton for ore of 44 per cent Cr_2O_3 and no ratio.

COBALT

The cobalt content of Canadian ores, concentrates, oxides, metal, and salts of the metal shipped in 1948 amounted to 772 tons, compared with 286 tons in 1947. Most of the tonnage shipped in 1948 was from stocks of crude or partly processed material produced in previous years. The shipments comprised: 3,000 tons of concentrate, containing 323 tons of cobalt, stockpiled at Deloro, Ontario, which was produced in the Cobalt area and purchased during the war by the United States Government; 508 tons of concentrate containing 58 tons of cobalt which Silanco Mining and Refining Company, Limited shipped, partly from stock, to Shepherd Chemical Company, Cincinnati, Ohio; cobalt oxide from the plant of The International Nickel Company of Canada, Limited at Port Colborne, Ontario, which in 1948 was producing about 15 tons of metal in oxide monthly; and metal, oxides, and salts produced at Deloro by Deloro Smelting and Refining Company, Limited, mainly from accumulated speiss obtained from the treatment of ores received from the Cobalt area in past years.

Production (Shipments) from Canadian Ores

	1947		1948	
	Short tons	$	Short tons	$
Production (from Canadian ores[1])				
In concentrates exported	44		381[2]	
In oxides and salts produced	229		357	
Metal	13		34	
Total production	286	875,644	772	2,029,178
Exports				
In concentrates:				
All to United States	44		381[2]	
Metal:—				
To: United Kingdom	9	33,514	16	61,824
Austria	11	38,581	.....	.....
Total	20	72,095	16	61,824
Oxides and Salts (Gross weight)				
To: United Kingdom	398	784,901	435	1,024,870
Other countries	21	50,240	3	7,840
Total	419	835,141	438	1,032,710
Alloys (Gross weight)				
To: United Kingdom	28	289,373	40	416,950
Other countries	2	27,476	4	49,528
Total	30	316,849	44	466,478

[1] Not necessarily mined in years specified.
[2] 323 tons of which represents the United States stockpile accumulated during the war.

Canadian consumption of cobalt in all forms in 1948 was close to 100 tons.

Silanco Mining and Refining Company, which has produced much the greater part of the output from the Cobalt area in recent years, treated in its Colonial mill at North Cobalt almost 10,000 tons of ore obtained from old stopes

in the Agaunico mine. The concentrate contained about 40 tons of cobalt. Several hundred tons of cobalt concentrate are stockpiled at the mill, which was closed in November 1948. The company continued work on the construction of its speiss plant at Gillies, 5 miles south of Cobalt.

Zones of good grade cobalt ore were encountered in the adjoining Lumsden and Rochester mines operated by Silver Miller Mines, Limited and the company plans to erect a mill to treat this ore and the cobalt-bearing silver ore, spectacular discoveries of which were made in 1948.

Small shipments of cobalt ore and concentrates were made by a number of other operators in 1948, including the following: Cross Lake lease, operating the O'Brien property near the north end of Cross Lake; Silver Arrow Mines, Limited, near the southwest end of Paterson Lake; Kerr Lake lease (C. Price) from the old workings at the bottom of Kerr Lake; Silco Mines (now Nu Silco), on the west side of Giroux Lake; and La Rose Mines from La Rose, University, and Lawson mines. Ausic Mining and Reduction Company salvaged over 3,000 tons of cobalt-silver ore from the dumps of the Savage mine north of the Silver Arrow mine and treated some of it.

International Nickel Company's plant to recover cobalt in the form of oxide was brought into operation in June 1947, the source of the oxide being the company's nickel-copper deposits in the Sudbury area, Ontario. The oxide is shipped to the company's plant at Clydach, Wales, and a large part of the metal produced in this plant is sold in the form of cobalt salts.

Deloro Smelting and Refining Company treats foreign as well as Canadian ores for the recovery of cobalt and its compounds, but in 1947 and 1948 these were recovered mainly from ores of Canadian origin. Shipments of domestic origin to the company in 1948 for treatment comprised 110 tons of cobalt ore and concentrates, containing 12 tons of cobalt, and 100 tons of silver ore containing 5 tons of cobalt, all from the Cobalt area.

World production of cobalt in 1948 is estimated at about 5,000 tons, the principal sources of supply being Belgian Congo and Northern Rhodesia, and the largest producer being Union Minière du Haut Katanga in Belgian Congo.

Uses

More than 75 per cent of the world production of cobalt is used in the metallurgical industry and most of the remainder in the ceramic industry. Its principal metallurgical use is in stellite alloys that are used mainly for cutting metals at high speed, for making magnets, and in the manufacture of valves for aeroplane engines. Cobalt is a major constituent in some types of high-temperature alloys used for the rotor blades of turbines in jet aircraft engines and turbosuperchargers. Cobalt is used in electroplating; as a catalyst; and with other chemicals in nickel-plating solutions as an undercoating for chromium plating.

Cobalt oxide has fine colouring properties and is used chiefly in the ceramic industry. It is one of the best known frits for porcelain enamels and its use for this purpose has shown a steady increase. Cobalt sulphate is used in the paint industry.

Prices and Tariffs

The price per pound of contained cobalt in concentrate f.o.b. Cobalt, Ontario, was 75 to 85 cents for 10 to 12 per cent cobalt shipped to the United States in 1948. Deloro Smelting and Refining Company buys cobalt ore or concentrate at a base price, with bonuses for cobalt in excess of 10 per cent and for the silver in excess of 150 ounces a ton. In silver ores only 5 per cent or over of cobalt is paid for at 5 cents a unit per pound.

The New York price of cobalt metal at the end of 1948 was $1.65 a pound for 97 to 99 per cent cobalt in 500-pound lots, and $1.72 for less than 100-pound lots. Cobalt oxide, 72 per cent metallurgical grade, was $1.65 a pound at Niagara Falls, New York, and $1.27 to $1.30 a pound for 70 to 71 per cent ceramic grade.

United States tariffs are as follows:

Cobalt and cobalt in ore	Free
Cobalt oxide	10 cents per lb.
Cobalt sulphate	5 cents per lb.

Under the British preferential tariff cobalt in all forms enters the United Kingdom duty free.

COPPER

Canada's output of copper (exclusive of Newfoundland) in 1948 was 240,732 tons valued at $107,159,756. This tonnage is not far below the normal capacity of the present mines, though it is considerably below the wartime maximum output. New mines in Quebec will augment the output of that province in 1949. Of the 1948 output, 50 per cent came from the mines of Ontario, 21 per cent from Manitoba and Saskatchewan, 20 per cent from Quebec, and 9 per cent from British Columbia.

Ninety-two per cent of the copper produced from the mines in 1948 was converted to refined copper in Canadian plants. Concentrate exported from the two copper mines of British Columbia and nickel-copper matte sent from the Sudbury area to Great Britain, Norway, and the United States accounted for the remaining 8 per cent.

Consumption of copper in Canada was 107,353 tons, which is equivalent to 45 per cent of the production.

Mines, Smelters, and Refineries

Quebec

Noranda. The smelter of Noranda Mines, Limited, at Noranda, Quebec, treated ore and concentrate from the company's Horne mine, concentrate from its subsidiary, Waite Amulet, and custom concentrate from Normetal. The blister copper thus obtained was shipped to Noranda's subsidiary, Canadian Copper Refiners, Limited, in Montreal East, where blister copper from the Flin Flon smelter was also refined. Preparations were made to receive custom concentrate from East Sullivan early in 1949 and from Quemont later in the year. The refinery is being enlarged to handle the increased amount of copper expected in 1949 from the new mines.

The Noranda smelter treated 836,450 tons of concentrate and other material, of which 327,049 tons was for other companies on a toll basis. The output of anodes was 51,354 tons. The refinery in Montreal East treated these anodes and those from the Flin Flon smelter to give 95,410 tons of refined copper. The Horne mine produced 977,403 tons of ore, 90 per cent more than in 1947. Of this, 398,584 tons was direct smelting ore, 574,103 tons concentrating ore, and 4,716 tons siliceous fluxing ore. The ore reserve at the end of 1948 was 19,366,000 tons. The concentrator yielded 107,735 tons of copper-gold concentrate and 86,932 tons of pyrite concentrate. The latter was sold for use in the production of sulphuric acid. In addition to copper-gold ore from the Horne mine, the concentrator

treated 30,828 tons of gold ore from the New Rouyn Merger mine. Siliceous fluxing ore produced from the Powell-Rouyn and Elder mines went directly to the smelter.

Waite Amulet Mines, Limited and its subsidiary *Amulet Dufault Mines, Limited* had an output of 422,785 tons of ore which yielded concentrate that produced 22,256 tons of copper and 50,218 tons of pyrite concentrate. Zinc concentrate was also produced. The ore reserve at the end of the year was 1,444,400 tons. A new orebody discovered in the north end of the property at a depth of 1,500 feet was being drilled.

Normetal Mining Corporation, Limited had an output of 236,844 tons of ore which yielded 26,397 tons of copper-gold concentrate containing 5,901 tons of copper. Zinc concentrate was also produced. The ore reserve is 1,625,900 tons averaging 3·51 per cent copper and 7·67 per cent zinc.

East Sullivan Mines, Limited commenced operation of its mills, rated at 2,000 tons daily, at the beginning of 1949. Its ore reserve is 4,372,000 tons averaging 2·12 per cent copper and 1·36 per cent zinc.

Quemont Mining Corporation, Limited expects to commence operation of its 2,000-ton mill about the middle of 1949. It will produce concentrates of copper, zinc, and pyrite. During 1948 the mine was prepared for production. The ore reserve remains at 9,431,000 tons averaging 1·49 per cent copper, 2·69 per cent zinc, 0·174 ounce gold, and 0·943 ounce silver.

Gaspé Copper Mines, Limited, subsidiary of Noranda Mines, Limited, did further drilling which indicated 6,000,000 tons averaging 1·8 per cent copper. This brings the total indicated by drilling to 40,000,000 tons averaging 1 per cent.

The copper deposits at Opemiska and Chibougamau were not developed further.

Ontario

Ontario's copper output comes entirely from the nickel-copper mines of the Sudbury district. All the ore is smelted and most of the copper is refined there.

International Nickel. The International Nickel Company of Canada, Limited has five mines, a concentrator, two smelters, and a copper refinery in the Sudbury area. The smaller smelter at Coniston makes matte principally for the production of Monel metal, the natural alloy of nickel and copper. Most of the ore is treated in the concentrator at Copper Cliff to make two concentrates, one containing most of the copper and the other high in nickel, which are smelted separately. The blister copper is refined in the copper refinery at Copper Cliff, where blister from the Sherritt Gordon mine in Manitoba is also refined.

The company's five mines, namely Frood, Creighton, Levack, Murray, and Garson, produced 10,866,862 tons of ore. Underground development totalled 84,152 feet. Ore of progressively lower grade has been mined during recent years and this is to continue. To the present, improved methods of mining and treating ore have served to offset the lower grade mined and there is evidence that additional economies will be attained. The ore reserve at the end of 1948 was 246,177,000 tons, an increase of 24,000,000 tons during the year. The average grade is 3·5 per cent copper and nickel combined.

Sales of refined copper in 1948 were 109,565 tons, about the same as in 1947. Of this, 57,500 tons was sold for use in Canada. Sales of Monel metal, of which somewhat less than one-half is copper, were 18,468 tons.

Falconbridge. Falconbridge Nickel Mines, Limited carried on an active program of expansion at its properties in the Sudbury area and at its refinery at Kristiansand in Norway. The Falconbridge mine produced 821,259 tons of ore, part of which went direct to the blast furnace, the remainder being concentrated and sintered. The resulting matte was shipped to the refinery, which is being modernized and expanded.

The company's ore reserve is as follows:

	Tons	Nickel, per cent	Copper, per cent
Falconbridge mine	8,098,500	1·63	0·88
Outside holdings	5,909,000	1·88	1·02
	14,007,500	1·74	0·93

In the Falconbridge mine, the ore reserve is calculated down to the 2,800-foot level. The mine is partly developed below this to the 3,150-foot level, where new orebodies of substantial size and better than average mine grade have been found in the south wall. At the McKim mine, 12 miles to the west, the shaft has been completed to 1,421 feet and four levels are under development. The company's ore deposit in Levack township remains undeveloped. Falconbridge has commenced exploration of the Rexora property at Werner Lake, 32 miles north of Minaki in northwestern Ontario, where drill intersections have indicated material carrying about 1 per cent copper and 0·5 per cent nickel.

Manitoba and Saskatchewan

Hudson Bay. Hudson Bay Mining and Smelting Company, Limited has the Flin Flon mine astride the Manitoba-Saskatchewan boundary, the Cuprus mine 13 miles to the southeast in Manitoba, and the Schist Lake mine 3½ miles southeast of Flin Flon. These mines, the Flin Flon smelter, and other mining properties in the district are supplied with electrical power from the company's plant at Island Falls on Churchill River, which has an installed capacity of 110,000 horsepower.

The Flin Flon mine in 1948 furnished 1,865,835 tons of ore to the concentrator, averaging 2·30 per cent copper, 5·0 per cent zinc, 0·084 ounce gold, and 1·32 ounces silver. The Cuprus mine commenced operation in October and treated 13,039 tons of ore in its 300-ton concentrator, the grade being similar to that of Flin Flon mine. The Schist Lake mine is still being developed. The copper smelter produced from the company's own ores 39,799 tons of blister copper which was shipped to Montreal East for refining. By-products of the refining were 138,597 pounds of selenium, 127,007 ounces of gold, and 1,889,718 ounces of silver. The company produces refined zinc and cadmium as well.

Sherritt Gordon. Sherritt Gordon Mines, Limited produced from its West mine 458,325 tons of ore from which copper and zinc concentrates were obtained. The copper concentrate was smelted at Flin Flon and the blister copper was refined at Copper Cliff, yielding 9,986 tons of refined copper, 5,352 ounces of gold, and 171,856 ounces of silver. During 1948 a copper-zinc ore deposit nearby, beneath Bob Lake, was examined by drilling, but was too low in grade to repay mining under present circumstances. The mining equipment from the East mine,

now worked out, has been transferred to the company's new mine at Lynn Lake, and that of the West mine will be transferred in due course, along with much of the milling equipment.

At Lynn Lake, 150 miles north of Sherridon, a shaft to develop four of the five orebodies had reached a depth of 617 feet by the end of 1948. It is intended to continue the shaft to 1,000 feet, to develop the ore at that level, and to drill down to 2,000 feet for additional ore. The ore reserve remained unchanged at 8,300,000 tons averaging 1·514 per cent nickel and 0·687 per cent copper.

British Columbia

Granby. The Copper Mountain mine of Granby Consolidated Mining, Smelting and Power Company, Limited operated at capacity to produce 1,705,780 tons of ore, containing 0·976 per cent copper. This was milled in the company's concentrator at Allenby, 6 miles north of the mine, and the concentrate was shipped to the smelter at Tacoma, Washington. The smelter returns showed a production of 13,297 tons of copper, 8,362 ounces of gold, and 191,462 ounces of silver.

The ore reserve at the end of 1948 was 7,606,000 tons averaging between 1·10 and 1·20 per cent copper. During 1948 ore of lower grade that formerly had been written off the ore reserve was mined and milled, and this may be done again in 1949. A program of underground exploration has been authorized for 1949 and 1950 to extend the present orebodies or to find new deposits.

Britannia. Britannia Mining and Smelting Company, Limited treated 799,502 tons of ore of an average grade of 1·08 per cent copper, 0·80 per cent zinc, 0·022 ounce gold, and 0·18 ounce silver. Shipments to the copper smelter at Tacoma were 26,827 tons of copper concentrate and 752 tons of copper precipitate obtained from the mine water, which yielded 7,978 tons of copper, 10,441 ounces of gold, and 56,647 ounces of silver; 6,191 tons of zinc concentrate shipped to the zinc smelter at Tadanac, B.C., yielded 3,306 tons of zinc, 1,257 ounces of gold, 5,631 ounces of silver, and 17 tons of cadmium. Pyrite concentrate amounting to 38,865 tons and containing about 50 per cent sulphur was sold during the year.

Vananda. Vananda Mines (1948), Limited took over the Little Billy property on Texada Island from the predecessor company which had partly developed a substantial tonnage of copper-gold ore on three levels. A 125-ton mill was installed, but the mine was unable to furnish enough concentrating ore to run it to capacity. Hand-picked ore running 2 per cent copper or better is shipped direct to the smelter at Tacoma, as well as the concentrate.

Whitehorse. Noranda Mines, Limited made a further surface examination of a part of the Whitehorse copper belt in Yukon and did some drilling. The company reports that the material thus found was too low in copper to be considered ore under present conditions.

Newfoundland

Though Newfoundland did not join Canada until March 31, 1949, it may be noted that the Buchans mine treated 319,000 tons of ore in 1948 which yielded 17,400 tons of copper concentrate as well as lead and zinc concentrates.

	1947		1948	
	Short tons	$	Short tons	$
Production, all forms [a]				
Ontario	113,934	46,018,544	120,384	53,384,560
Quebec	42,561	17,356,259	48,813	21,819,473
Saskatchewan	33,151	13,518,963	31,074	13,890,237
British Columbia	20,900	8,402,305	21,501	9,590,326
Manitoba	15,316	6,245,817	18,960	8,475,160
Total	225,862	91,541,888	240,732	107,159,756
Production, refined [b]	202,427		221,275	
Exports of ingots, bars, slabs, etc.				
To: United Kingdom	55,742	21,039,342	63,494	27,872,171
United States	1,055	441,734	18,086	8,042,218
France	12,152	4,770,014	14,097	5,964,180
Czechoslovakia	3,579	1,433,317	6,411	2,760,716
Switzerland	1,902	682,019	4,119	1,774,242
Other countries	13,048	5,119,384	9,962	4,269,123
Total	87,478	33,485,810	116,169	50,682,650
Exports of rods, strips, sheets, tubing				
To: United Kingdom	11,181	4,609,431	14,002	6,614,582
Switzerland	2,313	963,879	3,656	1,705,439
Netherlands	4,030	1,739,426	2,821	1,327,489
Denmark	373	152,834	2,015	943,588
Other countries	2,587	1,385,637	6,145	3,417,111
Total	20,484	8,851,207	28,639	14,008,209
Exports in ore, matte, regulus				
To: United States	23,092	7,389,392	22,624	7,239,840
Norway	5,500	1,759,856	5,346	1,710,576
United Kingdom	502	160,752	586	187,424
Total	29,094	9,310,000	28,556	9,137,840
Consumption, refined	109,200		107,353	

(a) Blister copper made from Canadian ore plus recoverable copper in concentrates, matte, etc., exported.
(b) Including any made from imported ore.

An estimated 107,353 tons of ingot copper was processed in Canada during 1948. Most of this was rolled into wire rods, a part of which was exported as noted above and the remainder re-rolled into a great variety of wire products. Much of this wire was exported also. The remainder of the Canadian consumption was used to make brass and bronze and for numerous miscellaneous purposes.

The American Bureau of Metal Statistics has issued the following estimate of 1948 copper production in most of the countries where it is produced or refined. The figures cover blister copper or refined copper only, copper exported in the form of concentrate being credited to the country where it is smelted.

Copper Output of Smelters and Refineries, 1948

(Tons of 2,000 pounds)

United States	1,055,728	Rhodesia	234,647
Canada	221,275	Belgian Congo	171,387
Chile	468,349	Union of South Africa	31,776
Peru	14,119	Australia	12,651
Mexico	57,272	Japan	59,893
Germany (Bizone)	68,612		

Uses and Price

Electrical manufactures such as generators, motors, switch-boards, and light bulbs provide the largest single market for copper. Next in importance comes copper wire installed in buildings, railway cars, ships, tramways, and similar uses. The automotive industry is another important outlet. A substantial part of the total is used as brass and bronze in many industrial and household forms.

The year 1948 opened with the price of copper at 21½ cents a pound. In August it advanced to 23½ cents where it remained till the end of the year.

GOLD

Resulting largely from further improvement in the supply of labour and from the cost-aid assistance provided under the Emergency Gold Mining Assistance Act, production of gold in Canada in 1948 showed a 14 per cent increase over that of 1947. Although the output in 1948 was 35 per cent lower than in 1941, the peak year, the uptrend in production appeared to be gaining momentum.

Canadian Gold Production (Fine Ounces)

	1948	1947	1941
Ontario:			
Lode gold mines			
Porcupine	998,838	937,415	
Kirkland Lake	447,888	438,936	
Larder Lake	204,144	188,158	
Matachewan	48,994	52,175	
Sudbury	23,974	4,778	
Algoma	165	24	
Thunder Bay	112,351	117,613	
Patricia	219,204	161,994	
Other mines	39,819	43,726	
Total	2,095,377	1,944,819	3,194,308
Quebec:			
Lode gold mines	604,260	488,547	
Base metal mines	166,365	109,580	
Total	770,625	598,127	1,089,339
British Columbia:			
Lode gold mines	253,870	223,804	
Placer mines	18,133	5,732	
Other mines	34,995	19,475	
Total	306,998	249,011	608,203
Northwest Territories: Lode gold mines	101,625	62,517	74,417
Manitoba:			
Lode gold mines	63,074	42,325	
Other mines	43,102	30,581	
Total	106,176	72,906	150,553
Saskatchewan:			
Placer gold	4	4	
Other mines	87,923	93,743	
Total	87,927	93,747	138,015
Yukon: Chiefly placer	60,614	47,745	70,959
Nova Scotia: Lode gold mines	188	1,271	19,170
Alberta: Placer mines	78	78	215
Canada: Total	3,529,608	3,070,221	5,345,179
Value	$123,536,280	$107,457,735	$205,789,392

The Emergency Gold Mining Assistance Act, which came into force June 15, 1948, provides for cost-aid assistance to gold mine operators in respect of gold produced in the years 1948, 1949, and 1950, termed under the Act the 'designated' years.

It is estimated that assistance payments under the Act for the calendar year 1948 will amount to approximately $10,000,000.

Operations and Developments

British Columbia

Uninterrupted operation of the large lode mines and an increasing recovery from dredging operations resulted in the 24 per cent increase in production shown in the above table. Two base metal companies contributed to the output, namely, Britannia Mining and Smelting Company, Limited at Britannia Beach, and Granby Consolidated Mining, Smelting and Power Company, Limited at Copper Mountain.

Bralorne Mines, Limited in the Bridge River area, Kelowna Exploration Company, Limited in the Osoyoos area, and Polaris-Taku Mining Company, Limited in the Atlin area, were in that order the leading producers of gold in the province in 1948. The remainder of the lode gold production came from the Pioneer mine in the Bridge River area, Cariboo Gold Quartz and Island Mountain mines in the Cariboo area, Hedley Mascot mine in the Osoyoos area, Silbak Premier mine in the Portland Canal area, Privateer mine in the Zeballos area, Vancouver Island, Sheep Creek, Kenville, and Alpine mines in the Nelson area, and I.X.L. and Kootenay Central mines in the Rossland area.

The famous Premier mine, the largest producer in the history of British Columbia and operated by Silbak Premier Mines, Limited was forced to suspend operations at mid-year.

The Privateer mine suspended operations in November because of labour conditions.

The more than threefold increase in placer gold production shown above resulted from the increase in the number of dragline dredges in the Cariboo, Princeton, Manson Creek, and McDame Creek areas.

Saskatchewan

The gold output came from that part of the copper-zinc-gold mine of Hudson Bay Mining and Smelting Company, Limited at Flin Flon that lies within Saskatchewan.

Manitoba

San Antonio Gold Mines, Limited in the Rice Lake area was the largest gold producer, its output being 38 per cent of the total for the province. Jeep Gold Mine, Limited (subsidiary of San Antonio Gold Mines, Limited) in the Rice Lake area, and Ogama-Rockland Gold Mines, Limited in the same area entered production in 1948.

The remainder of the production came from three base metal mines, namely, Hudson Bay Mining and Smelting Company, Limited at Flin Flon, Cuprus Mines, Limited (subsidiary of Hudson Bay Mining and Smelting Company), 8½ miles southeast of Flin Flon, and Sherritt Gordon Mines, Limited at Sherridon.

The 2,000-ton flotation-cyanidation mill of Nor-Acme Gold Mines, Limited (subsidiary of Howe Sound Exploration Company, Limited) at Snow Lake in the Herb Lake area was nearing production. Diamond drilling and surface trenching have indicated close to 5,000,000 tons of ore averaging 0·1363 ounce of gold per ton.

Ontario

The lode gold mines of the Porcupine, Kirkland Lake, and Larder Lake areas supplied most of the output, other important contributors being the lode gold mines of the Patricia, Thunder Bay, and Matachewan areas, and the nickel-copper mines of the Sudbury area. The power shortage hampered production from the Kirkland Lake, Larder Lake, and Porcupine areas.

In the Porcupine area, the producers of gold in order of output were Hollinger, McIntyre, Dome, Aunor, Preston East Dome, Hallnor, Pamour, Paymaster, Coniaurum, Delnite, Buffalo Ankerite, Ross, Broulan, Porcupine Reef, Hoyle, Bonetal, Naybob, and Hugh-Pam.

In the Kirkland Lake-Larder Lake area the producing mines in order of output were Kerr-Addison, Lake Shore, Wright-Hargreaves, Sylvanite, Macassa, Kirkland Lake, Chesterville, Upper Canada, Teck-Hughes, Toburn, and Bidgood. Kerr-Addison increased its mill capacity to 4,100 tons a day, thereby making it the largest gold producer in Canada.

In the Patricia area the producing mines in order of output were Pickle Crow, Central Patricia, Madsen Red Lake, Cochenour Willans, Hasaga, McKenzie Red Lake, Berens River, Starratt Olsen, and McMarmac Red Lake. Starratt Olsen and Dickenson Red Lake entered production in 1948. Campbell Red Lake Mines, Limited in Balmer township was nearing production. McMarmac Red Lake mine was closed at the end of September.

In the Thunder Bay area the chief producers were McLeod-Cockshutt, Leitch, and Little Long Lac; the others being Hard Rock, Magnet, and Talmora.

Other mines that produced gold in Ontario were Matachewan Consolidated and Young-Davidson in the Matachewan area, and Renabie in the Missanabie area.

Quebec

The Rouyn-Harricanaw belt of northwestern Quebec was the source of Quebec's gold, except for a small quantity recovered by New Calumet Mines, Limited in its zinc and lead concentrates which were shipped to the United States and elsewhere for treatment. The New Calumet mine is on Calumet Island in the Ottawa River. The lode gold mines that accounted for the production, roughly in the order of their output, were: Lamaque, Sigma, Malartic Gold Fields, Consolidated Beattie, Belleterre, East Malartic, Canadian Malartic, Sullivan, O'Brien, Stadacona, Perron, Senator-Rouyn, Louvicourt, Siscoe, Sladen Malartic, Consolidated Central Cadillac, Powell-Rouyn, Elder, New Marlon, New Rouyn Merger, Hosco, and Donalda. The remainder came from four base metal mines, namely, in order of quantity: Noranda, the largest gold producer in the province, Waite Amulet, Golden Manitou, and Normetal.

East Sullivan Mines, Limited brought its copper-zinc-gold mine into production early in January 1949, and Quemont Mining Corporation, Limited was completing its milling plant. Both these base metal mines are to ship concentrates to the Noranda smelter.

Barnat Mines, Limited was formed to operate the Sladen-Malartic and National Malartic mines as a unit. Donalda Mines, Limited started to ship its ore in October to the Powell Rouyn mill, which commenced to operate in July. Anglo-Rouyn Mines, Limited expected to start shipping ore to the same mill early in 1949. Hosco Gold Mines, Limited also commenced to produce in 1948.

Present indications are that the 154-mile road being constructed by the Quebec Department of Mines from Lake St. John to the Chibougamau area will be ready for traffic over the whole length in the autumn of 1949.

Nova Scotia

The production was the lowest in the history of the province.

Northwest Territories

The Northwest Territories was the only territory or province in Canada to record a higher output of gold in 1948 than in 1941. Reasons for the increase were the entry into production of the Giant Yellowknife mine and the increase in the milling rate of the Negus mine. The gold production came from Con, Negus, Rycon, Thompson-Lundmark, Giant Yellowknife, and West Bay Yellowknife mines, all in the Yellowknife area on the north shore of Great Slave Lake, and in that order of output.

The Con and Rycon mines of The Consolidated Mining and Smelting Company of Canada, Limited resumed treatment of stockpiled concentrates.

The Dominion Government's 8,000 horse-power hydro-electric plant on Snare River was officially opened on October 4 and will supply power to mining companies and residents in the Yellowknife area.

Other mines that did major development work were: Akaitcho Yellowknife Gold Mines, Limited, on its property that adjoins Giant Yellowknife on the north; Discovery Yellowknife Mines, Limited in the Quyta-Giaque Lake area; Crestaurum Mines, Limited in the Yellowknife area; and Diversified Mining Interests (Canada), Limited in the Indin Lake area.

Yukon

The production came from the Dawson, Mayo, and Whitehorse areas.

The Yukon Consolidated Gold Corporation, Limited, the principal producer of gold in Yukon, produced 47,500 ounces of the 53,660 recorded ounces. It had eight dredges in operation on Hunker, Bonanza, Dominion, and Sulphur Creeks.

IRON ORE

Although production of iron ore in Canada was lower than in 1947, developments in the past year provided assurance of an increased production in the near future. All of the output in 1948 continued to come from the Steep Rock and Helen mines in Ontario, which were preparing for a considerable increase in production. Most of the ore produced by the two mines is for export to the United States, as it is found to be economical to use lower grade ores from the United States mixed with a proportion of the Canadian ores in the blast furnaces of Ontario. The Labrador-New Quebec project advanced to the stage where construction of a railway and port facilities are warranted. Further progress was made in the treatment of iron sulphide concentrate at the Noranda copper-gold mine in Quebec, which gives high-grade iron oxide sinter as a by-product.

Developments at Properties

Algoma Ore Properties, Limited. This company is a wholly owned subsidiary of Algoma Steel Corporation, Limited. It holds a number of mineral properties in the Michipicoten area northeast of Lake Superior, including the Helen mine and the Goulais magnetite deposits north of Sault Ste. Marie.

During 1948 the siderite ore for the company's sinter plant at the Helen mine was derived mainly from the Victoria open pit and partly from development of the underground mine beneath the Helen open pit adjoining the Victoria pit on the west. The larger part of the siderite from the Victoria pit was treated in the sink-float plant to remove quartz, siliceous ore, and dyke rock. A part of the open pit ore and all the ore from the present underground development are sent direct to the sinter plant. The Victoria pit, and an extension of the ore eastward that was found and opened during 1948, will continue to furnish ore until the underground mine is capable of supplying the full requirement of the sinter plant, now being enlarged to an annual capacity of 1,000,000 long tons of sinter.

The underground mine is being developed through a shaft 921 feet deep which will be used ultimately only for servicing the mine. Two levels are being developed, at 300 feet and 600 feet below the floor of the open pit above. These will serve to extract a block of ore 200 to 300 feet wide and 600 feet deep, comprising about 10 million tons. Each level of this block is expected to feed the enlarged sinter plant for 5 years. The ore is to be stoped by block-caving, fed by gravity to a primary crusher, and elevated to the surface on a series of belt conveyers. The larger part of the mine development was done by the end of 1948, and it is expected the mine will be in full operation late in 1949.

No work was done on the Britannia (formerly Bartlett) siderite deposit, nor on the Goulais magnetite property. Drilling on the eastern part of the Helen iron range gave encouraging results. The Josephine mine remained flooded. Jones and Laughlin completed drilling of the Ruth siderite deposit, near the Josephine, with results reported to be favourable.

Steep Rock Iron Mines, Limited. The output of hematite continued to come from the "B" pit. This output, however, was well below the million tons anticipated early in 1948. During the summer some of the working-faces ran into high sulphur ore, and the orebody in general had not been stripped sufficiently to permit the shovels to move to areas of better grade ore. It is expected that stripping will be advanced sufficiently to permit an output of a million tons or more from "B" pit during the 1949 season.

There were only two shipping grades for 1948, Seine River for blast-furnace feed, and Steep Rock open-hearth lump. The Steep Rock grade was divided into lump ore, minus 10 plus 4 inches, and charge ore, minus 4 plus $1\frac{1}{2}$ inches.

Drilling during 1948 extended the known length of "B" orebody to 3,750 feet, with both ends open. Of this only the central 3,200 feet can be mined conveniently by open pit. The pit at present is 1,550 feet in length, and the deepest part is at 200 feet, which is half its projected depth of 400 feet. It is estimated that the ore recoverable from "B" open pit will last 10 or 12 years at the rate of a million tons a year. A preliminary investigation of the conditions for underground mining was commenced.

Late in 1948 negotiations were completed to finance the opening up "A" orebody, $1\frac{1}{2}$ miles north of "B". Silt from the lake bottom will be removed by a large suction dredge and it is expected that production from "A" pit will be commenced in 1951. As "A" orebody is considerably wider than "B", it is estimated that it will maintain an output of 2 million tons a year for 12 to 15 years from an open pit.

Initial drilling between "B" and "A" orebodies indicates a substantial tonnage of ore.

Only a small part of the Steep Rock ore is used by Canadian furnaces, and the rest is exported to the United States. The Cleveland-Cliffs Iron Company is sales agent.

Labrador and New Quebec

The hematite deposits in the interior of the Labrador Peninsula form part of an iron range 350 miles or more in length and 10 to 60 miles in width. All the orebodies discovered so far are on two concessions held by subsidiaries of Hollinger Consolidated Gold Mines, Limited. The M. A. Hanna Company of Cleveland, Ohio, prominent iron ore operator of the Lake Superior region, has a minority interest in both subsidiaries. The concession of Labrador Mining & Exploration Company, Limited covers 20,000 square miles in Labrador, and that of Hollinger North Shore Exploration Company, Limited in Quebec contains 3,900 square miles. In both cases, a smaller area must be selected for retention within a few years.

All the orebodies so far drilled were discovered by the company's geologists and prospectors as surface outcrops, with the exception of one deposit found by accident while testing a drill. No attempt has been made as yet to investigate the intervening ground where it is covered by a thin layer of drift rock. By the end of 1948, twenty-eight separate orebodies were drilled and proved. All are of high grade and economic size, the largest containing 45 million tons. These orebodies stretch for 90 miles on the two concessions, but most of them lie in a fairly small area in the central part. The company's first objective of 300 million tons of proven ore was reached at the end of 1948.

The substantial tonnage of manganiferous ore now proved is particularly interesting. Outcrops of material high enough in manganese to be classed as manganese ore have been found in a number of places, but no body of manganese ore has been proved as yet.

The location for a railway line 350 miles in length has been surveyed from the port of Seven Islands on the St. Lawrence to the main ore zone, with a maximum grade of 0·2 per cent southbound. The port has been surveyed and a suitable site for ore docks and stock piles selected. Navigation is assured for 9 or 10 months in the year, and probably the year round with the aid of an ice-breaker. A convenient site for hydro-electric power has been found 25 miles from one of the large orebodies.

The ore is strikingly similar to the high-grade ore of the Mesabi range. The conditions of mining will also be similar, except that in Labrador there is little overburden and much of the ore is in ridges above valley level. To test its physical nature underground, two adits have been driven which penetrate 100 feet beneath the surface, and some shallow shafts have been sunk. The ore has the same physical characteristics underground as at surface. Because of late and early frosts, the operating season is expected to be limited to 6 months.

To the present the camp has been served entirely by air. In 1947 the Knob Lake airport was established 10 miles by road from the base camp at Burnt Creek. By the end of 1948 the company had constructed 90 miles of roads.

The company has announced that 10 million tons annual production is required for operation on a profitable basis. The total investment required is estimated at 200 million dollars. A comparatively small market is expected on the Atlantic Coast, including Sydney, Nova Scotia, and it is possible that the

financial difficulties of selling ore in Great Britain and Belgium will be overcome. The bulk of the ore, however, will have to be sold in the markets now served by Lake Superior ores.

Production and Trade

As noted in the following table, most of the iron ore produced in Canada is exported to the United States, where it is much in demand because of its high grade and its good furnace qualities.

Canadian Iron Ore Production, Imports, and Exports

(Long tons)

Year	Canadian Ore		Imports			Total ore available for use in Canada
	Available for use in Canada	Exported to United States	From United States	From Newfound-land	From other countries	
1945.....	324,954	688,835	2,668,289	657,737	13,141	3,664,121
1946.....	360,953	1,022,550	1,505,568	463,005	68,633	2,398,164
1947.....	151,241	1,562,479	2,791,345	674,654	55,921	3,673,161
1948.....	238,364	955,604	3,028,627	732,761	78,043	4,077,795

In addition to the iron ore noted above, there is a small unrecorded tonnage of pyrite residue used in Canadian furnaces after sintering in admixture with flue dust and other such materials. A small tonnage of pyrite residue is used in some of the cement plants to provide the necessary iron in the cement.

As such a large part of the ore supply for Canadian furnaces is obtained from the Lake Superior district of the United States, it is of interest to note that the rate of decline in grade has been reduced markedly during recent years by the installation of washing plants to remove siliceous and argillaceous gangue from the raw ore.

Dominion Steel and Coal Corporation's plant at Sydney, Nova Scotia, draws its ore supply principally from its own mines at Wabana, Newfoundland. As the Wabana ore is rather high in silica, high-grade lump ore is brought from overseas for use in the open-hearth furnaces. No doubt the low-silica ore of Labrador will be used to advantage in admixture with the Wabana ore in the blast-furnaces when it becomes available.

The Wabana mines are capable of producing a larger annual tonnage than at present, and the cost of mining and transportation is low. The ore is rather high in silica, however, and the high phosphorus content restricts its more general use on this continent.

Wabana Iron Ore Shipments, 1948

(Long tons)

To Sydney, Nova Scotia	750,000
To Great Britain	875,000
To Germany	97,000

Some details of imports from overseas (excluding Newfoundland) are shown in the following table. This ore is used at Sydney, Nova Scotia, almost entirely as open-hearth lump ore.

(Long tons)

	Sweden	*Brazil*	*Others*
1945	13,126	....	....
1946	38,339	30,300	....
1947	....	55,900	....
1948	....	74,030	4,013 (Morocco)

Swedish ore is again being shipped in appreciable quantity to overseas markets, the United States having imported a substantial tonnage in 1948. The bulk of the Swedish ore is magnetite from the Kiruna deposits in Lapland.

Very large deposits of high-grade hematite occur in the province of Minas Geraes, Brazil. The principal orebody now furnishing shipments for export is at Itabira, 350 miles by narrow-gauge railway westward from the port of Victoria. Ore is also being exported from mines some distance to the south.

Canadian Plants Using Iron Ores

The four companies listed below use almost all of the Canadian consumption of iron ore.

Blast Furnace and Open-Hearth Plants in Canada

	Blast Furnaces		Open-hearths	
	Number	Annual capacity	Number	Annual capacity
Dominion Steel & Coal Corp., Ltd., Sydney, Nova Scotia	4	730,000	15	745,000
Algoma Steel Corporation, Ltd., Sault Ste. Marie, Ontario	5	1,035,000	12	610,000
Canadian Furnace, Ltd., Port Colborne, Ont.	2	221,760	.....	.....
The Steel Company of Canada, Ltd., Hamilton, Ontario	3	757,000	13	1,145,000
Totals	14	2,743,760	40	2,500,000

A small tonnage of lump ore is required by several other steel companies making steel from scrap in small open-hearth furnaces and electric furnaces.

LEAD

Canada's production (exclusive of Newfoundland) of 167,251 tons of lead, 96 per cent of it refined lead, was slightly greater than in 1947 and the value reached a peak of $60,344,146. The price of lead in Canada increased from 14·25 cents a pound to 20·5 cents during the year. The Consolidated Mining and Smelting Company of Canada, Limited, at Trail, B.C., produced all of the refined output, much the greater part of it from the company's Sullivan lead-zinc silver mine at Kimberley, B.C. A number of small mines were reopened and widespread

exploration resulted from the stimulus of higher metal prices. Several noteworthy discoveries of lead-bearing ore were reported. Domestic consumption was slightly less than in 1947 when 61,364 tons of lead was used, but was over twice the average amount consumed before the war. There was some loss in production due to power shortages, but the supply of mine labour was greatly improved over 1947 and 1946.

Production, Trade, and Consumption

(Exclusive of Newfoundland)

	1947		1948	
	Short tons	$	Short tons	$
Production, all forms	161,668	44,200,124	167,251	60,344,146
Production, refined	161,394	.....	160,025	.....
Exports, in ore				
To: United States	3,240	745,860	3,393	888,862
Belgium	3,486	855,723	2,214	674,630
Total	6,726	1,601,583	5,607	1,563,492
Exports, refined				
To: United States	58,369	12,663,262	53,036	17,241,784
United Kingdom	43,914	10,606,679	47,367	14,535,514
France	12,096	2,986,399	1,473	402,046
Netherlands	2,718	789,003	521	156,624
Other countries	7,868	2,053,384	1,365	422,546
Total	124,965	29,098,727	103,762	32,758,514
Exports, lead manufactures				
To: Portugal	.....	.....	.....	67,069
Venezuela	.....	37,595	.....	55,139
Iran	.....	6,722	.....	48,060
United States	.....	7,188	.....	26,863
Other countries	.....	193,015	.....	164,614
Total	.....	244,520	.....	361,745
Imports of tetraethyl lead compounds				
All from United States	7,103	4,348,920	7,286	5,131,472
Domestic consumption of refined lead				
Solders and alloys[1]	25,806	.....	25,642	.....
Wire coating and cable covering	12,624	.....	12,247	.....
Paints and pigments	10,269	.....	9,376	.....
Storage batteries	8,489	.....	8,482	.....
Hot dipping and annealing	1,921	.....	1,774	.....
Foil and collapsible tubes	911	.....	400	.....
Ammunition	349	.....	342	.....
Miscellaneous	995	.....	1,269	.....
Total	61,364	.....	59,532	.....

[1] Partly used in the manufacture of storage batteries.

Production Operations

British Columbia

The Sullivan ore is milled, near the mine, in the Sullivan concentrator of 8,600 tons daily capacity and the lead and zinc concentrates produced are shipped by rail to the company's smelter and refineries at Trail, where the metals are recovered. The company milled 2,283,625 tons, compared with 2,252,729 tons in 1947, and produced 160,107 tons of refined lead. The lead production includes about 5,000 tons of the metal derived from ores and concentrates shipped to Trail by a number of small operations, mostly in British Columbia.

Completion of the new sink-float plant was held up by delay in the delivery of equipment, but this project and the related underground crusher and haulage-way development on the 3,700-foot level, which was commenced in 1947, is expected to be in operation by mid-1949. An 11½- by 12-foot rod mill, the largest operating mill in the world, was installed in the concentrator to simplify coarse grinding. At Trail the construction of a slag-fuming furnace, commenced in 1947, was not completed owing to delay of delivery of equipment. Plans were made for other renovations in the lead smelter.

Among the more important producers of lead ores and concentrates that shipped to Trail were: Western Exploration Company, Limited, which operated the Standard and Enterprise mines, and Zincton Mines, Limited, which operated the Lucky Jim mine, all in the Slocan district; Ainsmore Consolidated Mines, Limited, at Ainsworth, and Base Metals Mining Corporation, Limited, which operated the Monarch and Kicking Horse mines near Field. Altogether there were over sixty individual shippers of lead ore to Trail. In some cases the chief value of the shipments was in the silver content.

Silver Standard Mines, Limited, near New Hazelton, constructed a 70-ton mill and commenced production of zinc and lead concentrates in September.

ViolaMac Mines, Limited acquired the Victor-Lone Bachelor property near Sandon and resumed production of silver-lead ore on a much larger scale. A new discovery on this property was made in September.

Yukon

United Keno Hill Mines, Limited made good progress in the development of its rich silver-lead deposits in the Mayo district. Concentrates and sorted crude ore produced during the year and shipped to a United States smelter contained 1,908,267 ounces of silver and 2,544 tons of lead.

Ontario

Berens River Mines, Limited, in Patricia district, the only producer of lead in Ontario in recent years, was closed in August after all known ore was exhausted.

Quebec

New Calumet Mines, Limited and Golden Manitou Mines, Limited, the two established producers of lead, expanded their operations; the Candego mine in Gaspe was brought into production; and the Tetreault mine was reopened.

New Calumet Mines, Limited, on Calumet Island, Ottawa River, produced concentrate containing about 3,500 tons of lead. The company did considerable underground development, including the sinking of an internal shaft 900 feet to the 1,500-foot horizon, and its ore reserves were slightly increased. During the first half of the year the company shipped its lead concentrate to Belgium, and after July 1 to Trail, B.C.

Golden Manitou Mines, Limited, near Val d'Or, Abitibi county, produced about 1,800 tons of lead concentrate containing 900 tons of lead as a by-product from its zinc operation. This concentrate was exported to the United States. Its 1,000-ton concentrator was operated at capacity most of the year. Development on the lower levels established the downward continuation of the ore, and reserves were increased.

Candego Mines, Limited, from open pit operations commenced production of lead and zinc concentrates in its 50-ton mill in February 1948. Plans were laid by the company for the underground development of surface exposures of zinc-lead ore at its property.

The Tetreault mine, 50 miles west of Quebec City, was reopened by Anacon Lead Mines, Limited and production of lead and zinc concentrates in the 400-ton mill was commenced in November. The grade of Tetreault ore is 0·87 per cent lead and 4·9 per cent zinc.

Newfoundland

Buchans Mining Company, Limited, a subsidiary of American Smelting and Refining Company, operated the only base metal mine in production in 1948. The company milled 319,000 tons of ore from which were produced 32,500 tons of lead concentrate, 17,400 tons of copper concentrate, and 70,900 tons of zinc concentrate. All of the production was shipped via the Port of Botwood to smelters in England, Europe, and United States. Development work carried out during the year indicated substantial additions to the known reserves of ore.

The world production of new refined lead in 1948 is estimated to have been about 1,300,000 tons, the principal producing countries in order of importance being United States, Australia, Mexico, and Canada. The United States imported about 246,000 tons of refined lead, approximately 21 per cent of it from Canada.

New Developments and Exploration

British Columbia

Reeves MacDonald Mines, Limited completed construction of a 1,000-ton concentrator on Pend d'Oreille River, and made preparations to commence production in the spring of 1949. Close to 3,000,000 tons of zinc-lead ore have been outlined.

Canadian Exploration, Limited prepared to mine ore from the Jersey lead-zinc deposit on its Emerald property near Salmo. The ore will be milled in the 300-ton concentrator which had been used to produce tungsten concentrate since 1947.

Consolidated Smelters did exploration and development at several lead-zinc properties, including Tulsequah Chief and Big Bull in the Taku River area, Bluebell on the east side of Kootenay Lake, and H. B. property near Salmo.

Northwest Territories

Consolidated Smelters, jointly with Ventures, Limited, commenced large-scale exploration of a 500-square mile concession near Pine Point, Great Slave Lake. Drilling in 1930 had indicated 500,000 tons of ore averaging 7 per cent lead and 9 per cent zinc.

A deposit of zinc-lead-silver ore was discovered near Indian Mountain Lake, about 10 miles north of McLeod Bay at the east end of Great Slave Lake. Drill-

ing has indicated a zone 250 feet long and 18 feet wide with a grade of 3 per cent lead, 20 per cent zinc, and 8 ounces of silver a ton. The property is being developed by Hollinger interests.

Ontario

McWilliams-Beardmore Mines, Limited reopened the Silver Mountain zinc-lead-fluorspar mine near Port Arthur and commenced the construction of a 100-ton concentrator.

Mattarrow Lead Mines, Limited drilled two lead-zinc veins on its property in the Matachewan district, as a result of which 60,000 tons averaging 5·3 per cent lead and 2·4 per cent zinc was indicated.

Preparations were made to reopen the old Kingdon mine near Arnprior.

Quebec

Results of drilling by Dome Exploration, Limited of its silver-zinc-lead deposit near Bachelor Lake are reported as encouraging and exploration is to be continued.

Gulf Lead Mines, Limited did extensive exploration on its 250-square mile concession on the east coast of Hudson Bay and encouraging results from drilling were reported.

New Norzone Mines, Limited developed about 60,000 tons of zinc-lead ore at its mine in Montbeillard township, near Noranda.

Uses and Prices

Lead has a wide variety of industrial uses and it forms an essential component of a number of important chemical compounds and products. The principal uses vary in different countries but the overall peacetime uses in order of importance are: for storage battery manufacture, cable covering, bearing metal and solders, red lead and litharge, tetraethyl lead compound, and white lead. Other uses include sheeting, ammunition, plumbing, caulking, foil for packaging, type metal, and chemical products. The development of atomic energy may create important increased demand for lead as large amounts will probably be required for shielding of personnel against radiation.

From the viewpoint of world supply the large quantities of lead recovered as secondary metal from battery plates, cable sheathing, plumbing and caulking lead, etc., are of increasing importance.

In Canada the price of pig lead at Toronto and Montreal rose from 14·25 to 20·57 cents. The average Canadian price including the value of lead exported in concentrates was estimated to be 18 cents a pound. The quoted New York price for common lead advanced from 15 cents to a peak of 21·5 cents during 1948.

MAGNESIUM

The only production of magnesium in Canada during 1948 was by Aluminum Company of Canada, Limited, which operated its electrolytic magnesium plant at Arvida, Quebec, during part of the year. The raw material used was magnesia obtained from brucitic limestone at its plant at Wakefield, Quebec. Dominion Magnesium, Limited, Haley, Ontario, shipped some magnesium from stock and also made and shipped some magnesium alloys but produced no metal during 1948.

Magnesium foundries operating during 1948 were: Robert Mitchell Company, Limited, Montreal; Light Alloys, Limited, Renfrew, Ontario; Aluminum Company of Canada, Limited, Etobicoke, Ontario; Canadian Magnesium Products, Limited, Preston, Ontario; and Western Magnesium, Limited, Vancouver, British Columbia.

Developments in alloying, in fabrication, and in protecting the metal from corrosion are improving the prospects for a greater use of magnesium in the near future. Among the new alloys is a zirconium-zinc-magnesium alloy developed in England and that has higher compressive and tensile strength and is easier to fabricate than other alloys made to date. Lithium-magnesium alloys and cerium-magnesium alloys are also being developed, and Dow Chemical Company has evolved a process of plating magnesium with chrome to prevent corrosion.

Principal Canadian Sources of Supply

Sources, actual and potential, of magnesium in Canada are brucite, dolomite, magnesite, serpentine, and sea-water.

Brucite, the hydroxide of magnesium, containing 41·6 per cent magnesium, is available in the form of granules 1 to 4 mm. in diameter thickly disseminated throughout certain deposits of crystalline limestone in Quebec, Ontario, and British Columbia. The Canadian deposits of this mineral are the largest known. The brucite is being recovered in the form of magnesia at a plant operated by Aluminum Company of Canada, Limited, at Wakefield, Quebec, and is being used for the production of magnesium and for the manufacture of basic refractories, and for fertilizer.

Dolomite, the double carbonate of calcium and magnesium, containing 13 per cent magnesium, is available in all provinces of Canada except Prince Edward Island. It formed the basis of wartime production of magnesium in Canada.

Magnesite, the carbonate of magnesium, containing 28·7 per cent magnesium, and hydromagnesite, containing 26·5 per cent magnesium, are available in British Columbia. Deposits of magnesitic dolomite consisting of an intimate mixture of magnesite and dolomite occur in Argenteuil county, Quebec, where they are being worked for the production of basic refractories. The magnesite deposits in British Columbia are undeveloped, but magnesium has been made from them on an experimental scale. Magnesitic dolomite possesses no advantages over dolomite or magnesite as a source of magnesium.

Serpentine, the silicate of magnesium, contains 25·8 per cent of magnesium, and occurs in many deposits throughout Canada. It is also available in huge waste dumps, aggregating probably 100,000,000 tons, in the asbestos-producing region of Quebec. The average magnesium content of these dumps is about 23 per cent. A process has been worked out for the recovery of magnesium from serpentine.

Sea-water, although it contains only 0·13 per cent magnesium, is a source of the metal in England and the United States. Dolomitic lime is used to precipitate the magnesia from the sea-water in the form of hydroxide, and the magnesia from both is recovered in the process.

Underground brines containing magnesium chloride ($MgCl_2$), and residual brines from salt-making operations, containing $MgCl_2$, are used in the United States as sources of magnesia, but brines containing sufficient $MgCl_2$ to render them of value are not available in Canada.

Processes for the production of the metal from the various raw materials may be divided into two groups, namely, electrolytic and thermal. At present all production is obtained by the electrolytic process.

Production, Trade, and Uses

Data on production, exports, and imports are not available for publication.

The field of usefulness for magnesium is steadily expanding. It was formerly used almost exclusively in pyrotechnics, but it is now an important structural material, being used alloyed with various proportions of other metals in the form of castings, extruded shapes, forgings, and sheets. Other uses have been developed such as for the cathodic protection of underground pipelines and also of domestic hot-water tanks from corrosion. It is used as a minor constituent of many aluminium-base alloys, and recently it has been discovered that a small percentage of magnesium alloyed with grey cast iron will greatly improve the properties of the latter.

The price of 99·8 per cent magnesium in ingot form in carload lots f.o.b. Freeport, Texas, is 20½ cents per pound, United States currency, and in lots of 100 pounds or more l.c.l., 22½ cents per pound.

MANGANESE

Except for a small output of bog maganese from New Brunswick in 1947, and a test lot shipment of 3 tons by a Quebec producer in 1948, no Canadian manganese properties have operated since 1943 and all Canadian requirements are imported. These imports in 1948 amounted to 230,298 short tons, the principal countries of origin being Gold Coast and Transvaal, India, and Russia. Nearly 75 per cent of the imports entered Canada via the United States. Canadian consumption in 1948 was about 228,000 tons, an increase of 6 per cent over that of 1947. About 223,000 short tons was used in the metallurgical industries and the remainder in the manufacture of dry batteries.

The known Canadian deposits are usually either very small or low grade.

In Quebec, all operations of Quebec Manganese Mines, Limited on its deposit on Grindstone Island in the Magdalen Islands were discontinued when a survey showed that the ore is much lower in grade and tonnage than was originally estimated.

Though Canada produces no manganese ore, its production of manganese ferro-alloys has averaged about 80,000 tons annually in the past 3 years, the largest output in this period being in 1948. Over 85 per cent of the output in 1948 was in the form of ferromanganese, mainly high carbon, and most of the remainder as silicomanganese.

Canadian Imports of Manganese Ore

Country from which Shipped	1947		1948	
	Short tons	$	Short tons	$
United States[1]	100,889	2,909,528	169,746	4,882,357
Gold Coast	109,903	2,894,957	60,516	1,564,898
United Kingdom	.....	.....	36	2,564
India	12,711	341,083	.....	.....
Total Imports	223,503	6,145,568	230,298	6,449,819

[1] None of which was of United States origin.

Canadian Exports of Ferromanganese

Country of Destination	1947		1948	
	Short tons	$	Short tons	$
United States	69,125	8,670,642	72,462	9,923,496
Mexico	1,166	151,198	847	124,195
United Kingdom	1,688	396,916	502	80,590
Others	1,442	259,311	688	139,584
Total Exports	73,421	9,478,067	74,499	10,267,865

World Sources

Figures for world production of manganese ore for recent years are incomplete. Russia's output is estimated to be more than half the world total. In 1948 the United States obtained 26 per cent (348,500 metric tons) of its imports of manganese ore from Russia.

The Nsuta manganese mine in the Gold Coast, Africa, one of the largest in the world, is the main source of battery ore for Canada and United States. British India produced 450,000 short tons in 1947 and the output is increasing. The output from Union of South Africa in 1948 was 304,673 short tons.

Increased shipments are expected from Brazil in the near future, but transportation costs are high. Cuba's production is mainly metallurgical grade ore. Its output has declined due to exhaustion of its important deposits.

In the United States, output in 1948 is estimated at about 140,000 short tons, and consumption at 1,400,000 short tons, of which over 90 per cent was metallurgical grade.

Uses

About 90 per cent of the manganese consumed is used in all steels, an average of about 12 pounds per ton of steel. Manganese deoxidizes the steel; removes or makes harmless the sulphur and other impurities; and imparts hardness. It is mainly employed as ferromanganese containing about 80 per cent manganese, but other alloys such as spiegeleisen, silicomanganese, etc., containing 15 to 20 per cent manganese are also used. High-grade manganese dioxide (pyrolusite) is used in the manufacture of dry batteries. In Canada 4,000 to 5,000 tons are so used, and in the United States about 50,000 tons annually. In chemical compounds manganese is used in the glass, enamel, paint, pigment, and rubber industries; in medicinal preparations; and in certain types of fertilizers.

Prices and Tariffs

The average Canadian price (based on exports) of ferromanganese in 1948 was $154 a long ton.

United States prices of 48 to 50 per cent manganese ore at the end of December 1948 were 70·6 to 72·6 cents a long ton unit (22·4 pounds of manganese) duty paid, f.o.b. cars at American ports. The United States import tariff was reduced from ½ cent per pound of contained Mn to ¼ cent effective January 1, 1948. Manganese ore is admitted into Canada free of duty.

MERCURY

World production of mercury in 1948 was again in excess of consumption, causing a further decline in price. In December 1948, however, the Spanish-Italian (Mercureo Europeo) group formed the International Quicksilver Corporation to represent it in the United States and raised the price to $70 a flask (76 pounds) at European ports. This is equivalent to $90 a flask in United States, compared with $76.50 prior to the change. The British Metal Corporation, Montreal, was appointed sole sub-agent in Canada for the British Empire representative (Elder, Smith & Co., London) of the Mercureo Europeo.

No mercury has been produced in Canada since September 1944, as world prices for the metal have been too low to enable profitable operation. All of the production in the past came from the Pinchi mine of The Consolidated Mining and Smelting Company of Canada, Limited, and from the Takla mine of Bralorne Mines, Limited, both mines being in the Omineca mining division, British Columbia.

Canadian imports of mercury in 1948 were almost double those of 1947, apparently as a result mainly of the installation of two more plants using mercury cells for the production of caustic soda and chlorine, one at Beauharnois, Quebec, and the other at Sarnia, Ontario. The other plant, erected in 1947, is at Arvida, Quebec.

Trade and Consumption

(Flasks of 76 pounds)

—	1947	1948
Imports		
From: Spain	.....	7,110
United States	5,080	3,242
Other countries	350	225
Total	5,430	10,577
Value	$400,156	$600,223
Exports (all from stock)	1947	1948
To: Czechoslovakia	191	.....
Jugoslavia	33	.....
Colombia	.....	.....
Newfoundland	.....	1
Other countries	1	1
Total	225	2
Value	$22,205	$251
Consumption[1] (for specified uses)		
Heavy chemicals	938	Not yet available
Pharmaceuticals and fine chemicals	797	
Gold mining	85	
Electrical apparatus	72	

[1] In addition about 2,300 flasks were used in the installation of the above plant at Arvida in 1947, and about 754 flasks for miscellaneous uses.

Italy and Spain are the chief producers of mercury, the two other major producers being United States and Mexico. Varying smaller amounts are produced in China, Jugoslavia, Japan, Russia, Czechoslovakia, Chile, Algeria, and New Zealand.

MOLYBDENUM

Production of molybdenite in Canada ceased in December 1947, with the closing of the La Corne mine of Molybdenite Corporation of Canada, Limited, in La Corne township, Quebec. The 163 tons of concentrate averaging 94·4 per cent molybdenum sulphite (MoS_2) that remained in stock at the end of 1947 was shipped in 1948. All of this was exported to Europe with the exception of a small trial shipment to Atlas Steels, Limited in Welland, Ontario. The La Corne mine has been developed to a depth of 550 feet on four levels and the ore contains some bismuth that was recovered in addition to the molybdenite. Nearly 7 tons of this bismuth, the remainder of the stock, was also shipped to Europe in 1948. Ore reserves at the mine at the time it was closed were estimated by the company at about 130,000 tons, with a grade of about 0·5 per cent MoS_2.

Canadian Imports and Consumption

Canada imports all the molybdenum addition agents it uses from the United States through Climax Molybdenum Company, and direct through Molybdenum Corporation of America, New York. Imports of molybdenum addition agents in 1948 amounted to 167 tons of contained molybdenum valued at $341,824, of which about 57 per cent was in the form of molybdenum trioxide, 39 per cent as ferromolybdenum, and the remainder as calcium molybdate and sodium molybdate.

Receipts (consumption not available) of these products by Canadian steel companies in 1948 had a molybdenum content of 190 tons. Consumption in Canadian steel furnaces in 1947 amounted to 139 tons of contained molybdenum. These compounds are used by about ten Canadian iron and steel manufacturers, but most of the tonnage is consumed by Atlas Steels, Limited and Steel Company of Canada, Limited.

World Production

Data on world production of molybdenum are incomplete, but much the greater part of the output is from the United States, which, according to such statistics as are available, is followed in order by Chile and Mexico.

Uses and Specifications

Molybdenite concentrate is converted into an addition agent that is introduced into steel as molybdenum trioxide, ferromolybdenum, or to a small extent as calcium molybdate. The oxide is usually moulded into briquettes.

About 70 per cent of the molybdenum consumed is used as an alloying agent in steel manufacture, and almost 20 per cent in grey iron and malleable castings. Molybdenum intensifies the effect of other alloying metals in the steel, such as nickel, chromium, and vanadium. These steels contain from 0·15 to 0·5 per cent molybdenum and many high-temperature alloys have been developed, the molybdenum content ranging from 0·5 up to 25 per cent. The market for these alloys is expanding, particularly for jet air engines, turbosuperchargers, and gas turbines. Molybdenum increases the resistance of stainless steels to chemical action. High-speed tool steels contain about 9 per cent molybdenum. For steels under 1·0 per cent the usual addition agents are molybdic oxide or calcium molybdate; but for higher proportions, ferromolybdenum is used.

Molybdenum wire and sheet are used in the incandescent lamp and in the radio industries; and new alloys suitable for electrical resistance and contacts, and for heating elements, contain molybdenum. An appreciable amount of

molybdenum is used in the glass industry, in which heavy sheets of the metal act as electrodes to conduct the current through the molten glass in the electric furnaces.

Molybdenum salts are used in pigments, in vitreous enamels for coating steels and sheet iron, in welding rod coatings, in lithographing and printing inks, and for analytical work.

United States specifications for concentrate dried at 212°F. are: MoS_2, minimum 85 per cent; copper, maximum 0·6 per cent; iron, maximum 3·0 per cent; combined phosphorus, antimony, and tin, maximum 0·2 per cent.

Prices

There is no Canadian market for concentrate as there are no conversion plants, and since July 1945 the only shipments have been to Europe. The price of these shipments in 1948 was 41½ cents per pound of MoS_2 in high-grade concentrate.

The price per pound of contained molybdenum, f.o.b. Toronto, in Canadian funds, for the following imported compounds was approximately: calcium molybdate (42 per cent Mo), 90 cents; ferromolybdenum (60 per cent Mo), $1.13; and molybdic oxide (52 per cent Mo), 90 cents. Calcium molybdate is sold in bags of about 12½ pounds containing exactly 5 pounds of molybdenum.

On January 1, 1949, Climax Molybdenum Company increased the price of its molybdenum concentrate and products to the following, f.o.b. Langeloth, Pa., or Climax, Colo.: concentrate, 90 cents; ferromolybdenum, $1.10; molybdic oxide briquettes, 95 cents; calcium molybdate, 96 cents.

Tariff

Canadian ore and concentrate when shipped to the United States are subject to a duty of 17½ cents a pound of contained molybdenum.

NICKEL

The mines and smelters of the Sudbury area, Ontario, produced 131,740 tons of nickel in all forms in 1948, of which 71,247 tons was refined in Canada and exported, and 50,801 tons was exported as matte for treatment in the United States, Great Britain, and Norway. All the Canadian output comes from the five mines of The International Nickel Company of Canada, Limited and the single mine of Falconbridge Nickel Mines, Limited.

Canadian consumption of refined nickel in 1948 was 1,887 tons.

The nickel-copper mines of the Sudbury district are the world's major source of nickel. The annual peacetime demand for nickel is now close to the economic capacity of the Sudbury area to produce it, and an active search is under way for additional sources of supply. The substantial orebodies at Lynn Lake, Manitoba, are being examined by mine workings, and some smaller deposits elsewhere are being drilled. Abroad, the Petsamo mine in Russia near the border of Finland, and the New Caledonia deposits of the East Indies are the only known commercial sources of nickel. Deposits in Venezuela examined by International Nickel showed a large tonnage of low- to medium-grade material.

Canadian Nickel Producing Mines

International Nickel. During recent years International Nickel has brought its Frood, Garson, Murray, Creighton, and Levack mines close to their capacity, having due regard to orderly and economical production and to the

many years they are expected to continue their present supply. For some years past, ore of progressively lower average grade has been treated and this is to continue. Marked improvements in mining, milling, and smelting have served to keep down the cost of the resulting metals, and additional economies are being adopted periodically.

A small part of the lump ore is treated in the company's smelter at Coniston, mainly for the production of Monel metal, the natural alloy of nickel and copper in which the two metals are left in the same proportion as they occur in the ore. As there is no opportunity in this process to recover the platinum metals, ore is chosen in which there is a minimum amount of these metals.

The larger part of the ore is treated in the concentrator at Copper Cliff where two concentrates are made, one containing principally copper, and the other mainly nickel. These concentrates are treated separately in the smelter to give crude nickel and crude copper, which are sent to the respective refineries. The refinery at Port Colborne, Ontario, produces pure nickel by the electrolytic method. The platinum metals as well as gold and silver are accumulated in a residue that is shipped to Great Britain for refining.

An improved method of separating nickel and copper that gives a clean separation and good recoveries was adopted at Copper Cliff during 1948. From the nickel portion is produced the new commercial form of nickel, namely nickel oxide sinter, which is expected in due course to be used largely in place of refined nickel for certain important uses. Part of the sinter is treated in the refinery at Port Colborne to give electrolytic nickel.

A part of the nickel-copper matte made at the smelters is sent to the refining plant at Clydach, Wales, to be treated by the Mond process. Nickel-copper matte is sent also for treatment to the company's plant at Huntington, Virginia.

A radically new method of treating the concentrate was demonstrated during 1948 at Copper Cliff on a pilot-plant scale, and is expected in due course to supersede the older method. The concentrate is flash-roasted in oxygen to give molten matte and concentrated sulphur dioxide gas. The gas is compressed to the liquid state and in this form can be shipped economically for long distances to existing markets. It seems possible that the abundance of by-product sulphur that will thus be made available will induce the establishment of new industries in and about the Sudbury region.

The company's five operating mines produced 10,866,862 tons of ore in 1948, which is almost double their output of 5,785,294 tons in 1938. The ore reserve of 246,177,000 tons is 10 per cent above that of 1947. It contains an average of 3·5 per cent combined nickel and copper.

Falconbridge. The Falconbridge mine of Falconbridge Nickel Mines, Limited produced 821,000 tons of ore in 1948, of which one-third was smelted in lump form and two-thirds was milled to give a concentrate that was smelted after roasting and sintering. The larger part of the resulting nickel-copper matte was shipped to the company's refinery at Kristiansand in Norway for the production of electrolytic nickel and copper, the platinum metals, and gold and silver. A part of the matte was sold in the United States. The company's McKim mine is expected to commence production in 1949.

The company's ore reserve remains at 14 million tons averaging 1·74 per cent nickel and 0·93 per cent copper. New ore deposits have been found in the footwall of the Falconbridge mine in new levels below 2,800 feet, of a grade above the average, and this is not yet included in the ore reserve.

The refinery in Norway is being modernized and its capacity increased.

Work on Nickel Prospects

Lynn Lake (Sherritt Gordon). Sherritt Gordon Mines, Limited continued development of its Lynn Lake nickel-copper deposits, 120 miles north of the railhead at Sherridon, Manitoba. Exploration by geophysical surveys and drilling disclosed twenty-two new deposits of sulphides, all of which were barren or had very low values in base metals. Thus the ore reserve remains at 8,300,000 tons averaging 1·514 per cent nickel and 0·687 per cent copper.

A shaft to develop the larger orebodies was sunk to 617 feet. Ore from development will be used to feed the pilot mill now under construction at the mine. A new chemical process that uses oxygen and ammonia to treat the ore has been devised at the University of British Columbia, and a pilot plant will be erected in Ottawa to try it out, using concentrate from the pilot mill at Lynn Lake.

Although the tonnage of proven ore at Lynn Lake is insufficient to warrant the expense of a railway from Sherridon, there is a reasonable expectation that the vigorous prospecting campaign still under way will disclose additional ore.

Other Prospects. The Rexora property in northwestern Ontario, on Werner Lake 30 miles north of Minaki, has been taken under option by Falconbridge Nickel. Drilling so far has given low values in nickel and copper over substantial widths.

The nickel deposits at Shebandowan Lake, 75 miles west of Port Arthur, Ontario, at Rankin Inlet on the west coast of Hudson Bay, and near Hope, British Columbia, have remained inactive in recent years.

Production and Trade

The output of nickel in 1948, which was 11 per cent above that of 1947 and not far below the wartime peak, was readily marketed, mainly in the United States.

Production and Exports of Nickel

	Production		Exports	
	Tons	Value	Tons	Value
1944	137,299	$69,204,152	132,599	$68,400,634
1945	122,565	61,982,133	108,221	54,778,226
1946	96,062	45,385,155	111,939	55,204,632
1947	118,626	70,500,000	117,057	60,442,762
1948	131,740	86,904,235	131,840	73,801,871

Exports of Nickel in Various Forms

	In matte or speiss		In oxide		Refined nickel	
	Tons	Value	Tons	Value	Tons	Value
1944	33,848	$12,185,370	1,242	$ 574,857	97,509	$55,640,407
1945	28,295	10,186,290	1,758	808,715	78,168	43,783,221
1946	30,625	11,026,910	517	228,562	80,797	43,949,160
1947	39,768	18,292,728	6,535	3,075,068	70,756	39,074,966
1948	50,801	24,320,922	9,792	5,020,167	71,247	44,460,782

Nickel Exports

Destinations	1947		1948	
	Tons	Value	Tons	Value
Great Britain	26,844	$12,954,143	25,555	$12,626,831
Norway	10,402	4,784,874	8,968	4,239,082
United States	74,062	38,808,145	96,433	56,318,271
Australia	249	147,657	26	16,385
Argentina	104	71,743	61	40,401
Belgium	266	182,839	245	168,983
Brazil	41	27,021	40	29,027
Chile	65	42,716	121	82,746
Czechoslovakia	392	266,561	1	1,030
France	2,802	1,904,507	2	2,604
Netherlands	160	111,402	3	2,380
Sweden	1,237	842,340	336	239,264
Others	433	298,814	49	34,867
Total exports	117,057	$60,442,762	131,840	$73,801,871

Uses and Prices

No data are available on the various uses of nickel in Canada and the amount for each use. As noted elsewhere, the Canadian consumption is relatively small.

The United States used 177 million pounds of nickel in 1948. The newly discovered method of making cast iron malleable with the addition of nickel and magnesium, or nickel and zirconium, is likely to consume a rapidly increasing amount of nickel.

The price of electrolytic nickel in Canada in lots of 20,000 pounds and over, f.o.b. warehouse, Toronto, rose in the middle of 1948 from 33·5 cents a pound to 39·75 a pound, where it remained to the end of the year. At the same time the United States price, for carlots, f.o.b. refinery, Port Colborne, U.S. import duty of $1\frac{1}{4}$ cents a pound included, rose from $33\frac{3}{4}$ cents a pound to 40 cents.

PLATINUM GROUP METALS

Production of platinum group metals in Canada in 1948 was 269,747 fine ounces valued at $16,917,982, a gain of 32 per cent in output and 62 per cent in value over 1947. With the exception of 242 ounces from the gold placers of Yukon and British Columbia it came as a by-product from the nickel-copper mines of the Sudbury district in Ontario.

Though no statistical information is available from Russia, it seems that Canada is still the principal producer of platinum group metals. The substantial shipments of these metals, except platinum, from Russia to the United States suggest that Russia remains in second place. The United States is by far the largest consumer of the platinum metals.

Canadian Mines and Prospects

In the Sudbury area there are six nickel-copper mines from which the platinum group metals are derived as a by-product. Five of the mines belong to The International Nickel Company of Canada, Limited, which has smelters

at Copper Cliff and Coniston in the Sudbury field, a copper refinery at Copper Cliff, and nickel refineries at Port Colborne, Ontario, and at Clydach in Wales. The platinum group metals, along with gold and silver, are collected in the refinery residues that are shipped to Acton near London, England, for treatment. The refined platinum metals from Acton are sold in world markets, but are mainly sent back to this continent for use in the United States.

The single mine of Falconbridge Nickel Mines, Limited supplies a smelter at the mine. Matte from this smelter is shipped to the company's refinery at Kristiansand in Norway, where the platinum group metals are recovered as anode residues and refined.

From the records of ore treated in the smelters, and of platinum group metals produced for some years past, it can be deduced that the average recovery from a ton of ore is 0·033 ounce—an amount that can be extracted profitably because it is concentrated automatically and without extra cost in the refinery sludges.

The platinum placers of the Tulameen River in British Columbia, the nickel-copper-platinum deposits near Hope, B.C., and the nickel-copper-palladium-platinum deposits at Shebandowan Lake, Ontario, remain inactive.

Production and Trade

The annual Canadian output of platinum group metals, as recorded by the Dominion Bureau of Statistics, does not correspond with the annual amount of 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 in Acton, England, at similarly irregular intervals. The only practicable way to record the output is to estimate the precious metals content of the shipments to Acton. The record for 1947 and 1948 and the trade statistics follow:

	1947		1948	
	Fine ounces	$	Fine ounces	$
Production				
Platinum	94,570	5,582,467	121,404	10,622,850
Palladium, rhodium, ruthenium, iridium and osmium	110,332	4,387,740	148,343	6,295,132
Total	204,902	9,970,207	269,747	16,917,982
Exports of platinum group metals in concentrates and other forms except scrap:				
To:				
United Kingdom	.....	7,228,737	.....	11,155,831
United States	.....	4,368,501	.....	5,620,889
Other countries	.....	61,586	.....	13
Total	.....	11,658,824	.....	16,776,733
Imports of platinum group metals, all forms:				
From:				
United Kingdom	.....	7,406,337	.....	10,672,941
United States	.....	157,712	.....	121,480
Jamaica	.....	1,793	.....	.....
Total	.....	7,565,842	.....	10,794,421

As an indication of the respective proportions of the platinum group metals supplied to world trade by the British Empire (mainly Canada) and other countries, the following data from the quarterly reports of the United States Bureau of Mines may be significant. Canadian metals from Norway are included in the British Empire figures:

Imports of Refined Metals into the United States in 1948

(Fine ounces)

	British Empire	*Russia*	*All Imports*
Platinum	72,344	....	100,838
Palladium	46,001	63,304	115,449
Iridium	2,284	3,118	5,472
Osmium	55	1,283	1,338
Rhodium	5,864	....	5,864
Ruthenium	2,740	....	2,740
Total	129,288	67,705	231,701

Besides the refined metals noted above, 34,661 ounces of unrefined metals were imported during the year, including 25,602 ounces from Colombia and 1,070 ounces from South Africa.

Uses

The six platinum metals fall naturally into two categories. Platinum, osmium, and iridium have atomic weights around 190, and specific gravities of 21 to 22. Palladium, rhodium, and ruthenium have atomic weights of about 100 and specific gravities of 11 to 12. The particular qualities that make them useful may be stated as follows:

High Melting Point. Ranges from 1,554° C. for palladium to 2,700° C. for osmium.

Corrosion Resistance. The resistance of platinum to common reagents except chlorine is well known. The metals and their alloys are mostly resistant to tarnishing. Silver is electroplated with an extremely thin coating of rhodium to make it non-tarnishing. A reflector of rhodium in optical instruments can be used at high temperatures.

Ductility. Used mainly in wrought forms. Platinum and palladium are extremely ductile. Rhodium and iridium are worked with difficulty, ruthenium with still more difficulty, and osmium is almost completely non-ductile.

Alloys. The metals are used mainly as alloys. Rhodium, iridium, ruthenium, palladium, copper, gold, and nickel are the elements most commonly added to platinum, seldom over 25 per cent and often 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.

Catalysts. Platinum in particular is a useful catalyst. Eighty-mesh gauze of 10 per cent platinum-rhodium alloy is used commonly for nitrogen fixation. A unit containing 90 troy ounces of gauze, operating at about 1,000° C., can give 40 tons of nitric acid in 24 hours with a conversion efficiency of 96 per cent.

Prices

There were rather marked fluctuations during 1948 in the prices of platinum, ruthenium, and iridium. Those of palladium, osmium, and rhodium remained unchanged at $24, $100, and $125 respectively per fine ounce.

Platinum and ruthenium commenced the year at $69, rose to $101 (the highest point since 1927), fell rapidly to $78, and ended the year at $96. The price of iridium, which started the year at $80 to $85, advanced to $110 to $115 at the end of 1948.

SELENIUM AND TELLURIUM

Production of selenium and tellurium in Canada, though small, is greater than that of any other country except the United States. Much the greater part of the Canadian output of the two metals is exported. Both metals are recovered as by-products from tank slimes of electrolytic copper refineries, the two Canadian producers being Ontario Refining Company, Limited (subsidiary of The International Nickel Company of Canada, Limited) at Copper Cliff, Ontario, and Canadian Copper Refiners, Limited (subsidiary of Noranda Mines, Limited) at Montreal East, Quebec.

At Copper Cliff the metals originate in the ore of International Nickel's copper-nickel deposits at Sudbury. The plant has a demonstrated capacity of 270,000 pounds of selenium a year and is probably capable of a larger production. At Montreal East selenium and tellurium are recovered from the refining of copper anodes made at Noranda, Quebec, from copper ores of that area and from blister copper produced by Hudson Bay Mining and Smelting Company, Limited, from its copper-zinc deposit at Flin Flon on the Manitoba-Saskatchewan boundary. The Montreal East refinery, with an annual rated capacity of 450,000 pounds, is the largest selenium plant in the world.

Production and Trade

	1947		1948	
	Pounds	$	Pounds	$
Production [1]				
Selenium	501,090	937,038	327,500	655,000
Tellurium	9,194	16,090	32,100	56,175
Exports of Selenium and Salts				
United States	521,403	848,837	264,197	469,058
United Kingdom	131,945	244,169	156,110	304,058
Brazil	3,105	7,302	9,958	20,184
Other countries	17,135	30,705	17,620	34,581
Total	673,588	1,131,013	447,885	827,881

[1]Exports of tellurium are not reported separately, but most of Canada's production is exported to the United States.

Canada and United States are the principal producers of both metals. Small quantities of selenium are also produced in Russia, Rhodesia, Mexico, and Sweden.

Uses

Selenium is used chiefly in the glass, rubber, and paint industries. In glass manufacture selenium is used to neutralize the green colour caused by iron impurities, and when sufficient selenium is added the glass turns a ruby colour highly suitable for signal lenses. The addition of selenium to rubber in con-

centrations of from 0·1 to 2·0 per cent promotes resistance to heat, oxidation, and abrasion. It is also used as an accelerator in the vulcanization of synthetic rubber.

A unique characteristic of selenium is that its conductivity of electricity increases on exposure to light. This property is used in selenium photo-electric cells which can be arranged to operate automatically various devices and controls for lighting lamps and buoys, ringing alarms, in wireless photography and telephony, and in television and sound film. The total amount of selenium so used, however, is small.

Selenium is used to improve the machineability of metals without impairing their resistance to corrosion; as an antioxidant in lubricating oil; for fat hardening; as a catalyst in the petroleum industry; in the hydrogenation of coal; in some types of printing inks; in therapeutic preparations for treating skin diseases; in flotation reagents; and in moth repellants. Among the more important of the new uses for selenium that were developed as a result of research during the war is in electrical dry plate rectifiers for radar equipment and aircraft generators.

Selenium dioxide is used in medicine and as a rubber accelerator; ferroselenium as a master alloy for addition to steel; selenium oxychloride as a solvent; sodium selenate in the preparation of an insecticide; sodium selenite in glass manufacture; and sodium sulphoselenate to produce brown tones in photographic toning baths. Cadmium sulphoselenite pigments are used where a durable outdoor paint is required with a colour ranging from orange to maroon.

Tellurium is used in the rubber industry; to increase the hardness of metals; in zinc refining; and in the ceramic and glass industries where it imparts blue to brownish effects in the products.

Prices

The price of black powdered selenium, 99·5 per cent pure, at New York was $2 a pound, and tellurium sold for $1.75 a pound. These prices remained unchanged throughout 1948.

SILVER

Canada's silver production of 16,109,982 ounces in 1948 was 29 per cent greater than in 1947. Most of the output was derived as a by-product from the treatment of base metal and gold ores, but several mines produced substantial amounts of silver in ore and concentrates as their principal output. The price of silver was fairly steady, exports were lower, and owing largely to increased coinage requirements, domestic consumption was greater. The Sullivan lead-zinc-silver mine of The Consolidated Mining and Smelting Company of Canada, Limited, at Kimberley, British Columbia, is Canada's chief source of silver, the next largest producer in 1948 being United Keno Hill Mines, Limited, in the Mayo area, Yukon.

Production Operations

British Columbia

The Sullivan ore, which contains about 2 ounces of silver per ton, is concentrated near the mine and lead and zinc concentrates are shipped to the company's smelter and refineries at Trail, British Columbia, where the metals are recovered. Consolidated Smelters also treated ores and concentrates containing silver, lead, and zinc from a number of smaller mines, mostly in British Columbia. About three-quarters of the 6,344,701 ounces of silver bullion produced at Trail

came from the Sullivan mine. The second largest producer was Highland Bell, Limited, at Beaverdell, which shipped 5,466 tons of ore to Trail containing over 740,000 ounces of silver.

Among the other more important silver-lead-zinc operators in 1948 were: Western Exploration Company, Limited, Santiago Mines, Limited, and Zincton Mines, Limited, all in the Slocan area; and Base Metal Mining Corporation, Limited, near Field. Other silver production came from the copper-gold ores of Britannia Mining and Smelting Company, Limited, on Howe Sound, and Granby Consolidated Mining, Smelting and Power Company, Limited, near Princeton, and from the various lode and placer gold mines.

Torbrit Silver Mines, Limited (subsidiary of The Mining Corporation of Canada, Limited) constructed a 300-ton mill on its property near Alice Arm and commenced production in February 1949. Ore reserves were estimated at 645,000 tons averaging 19·3 ounces silver per ton.

Silver Standard Mines, Limited, near New Hazelton, commenced production in a new 70-ton mill in October. The indicated ore averages 30 ounces of silver per ton with moderate values in zinc, lead, and gold.

Reeves MacDonald Mines, Limited, on Pend d'Oreille River, near Salmo, partly completed the construction of a 1,000-ton concentrator and it was expected that production of zinc and lead concentrates would commence early in 1949. Reserves of 3,000,000 tons have been outlined containing 6·0 per cent zinc, 1·0 per cent lead, and 0·5 ounce silver per ton.

Silbak Premier Mines, Limited, in the Portland Canal district, suspended operations in July because of labour difficulties. The company has been an important producer of concentrates containing gold, silver, and lead for many years.

Yukon

United Keno Hill Mines, Limited made good progress in the development of its rich silver-lead properties in the Mayo area. Production, largely from the Hector mine section, amounted to 1,908,267 ounces of silver and 2,544 tons of lead contained in crude ore and concentrates. Substantial shipments were made to a smelter in the United States. Construction was commenced of a new road from Minto on the Lewes River to Mayo, a distance of about 80 miles. This road will help service the Mayo district which has been largely dependent upon river navigation. Some potentially important silver-lead discoveries were made in the Mayo area.

Manitoba-Saskatchewan

Hudson Bay Mining and Smelting Company, Limited produced 1,889,718 ounces of silver from its copper-zinc deposit at Flin Flon on the Manitoba-Saskatchewan boundary. Sherritt Gordon Mines, Limited, 50 miles northeast of Flin Flon, produced concentrates containing 171,856 ounces of silver which were treated at the Flin Flon smelter.

Ontario

The International Nickel Company of Canada, Limited is the largest producer of silver in the province. It recovered 1,320,754 ounces from its copper-nickel deposits in the Sudbury area.

Shipments from the Cobalt-Gowganda district, formerly one of the world's principal silver-producing areas, contained 481,165 ounces of silver. The principal producer was Silver Miller Mines, Limited, which developed a high-grade silver vein under Brady Lake, a few miles southeast of Cobalt. Other operators that made shipments were: Cross Lake Leasers; Ausic Mining and Reduction

Company, Limited; Silanco Mining and Refining Company, Limited; and Siscoe Metals, Limited. The last-named company operated the former Miller Lake-O'Brien mine near Gowganda, most of its mill feed consisted of old tailings. The Hydro Electric Power Commission's transmission line to Gowganda was re-established, making electric power available to Siscoe Metals and the neighbouring Castle-Tretheway silver mine. The latter mine is expected to be reopened in 1949, after being idle since 1931.

Ontario's forty-three gold mines in operation in 1948 produced 409,642 ounces of silver, the chief contributor being McIntyre Porcupine Mines, Limited, with a silver production of 58,067 ounces.

Concentrates containing 394,985 ounces of silver were shipped by Berens River Mines, Limited, in the Patricia district. This silver-lead mine was closed in September 1948, when all the known ore was exhausted. It had been in operation since 1939.

Quebec

Noranda Mines, Limited produced 437,493 ounces of silver from its own ore, and 816,872 ounces mostly from copper concentrates produced by Waite-Amulet Mines, Limited, near Noranda, and Normetal Mining Corporation, Limited, in Desmeloizes township.

Golden Manitou Mines, Limited, near Val d'Or, shipped lead concentrate and gold precipitates containing 562,294 ounces of silver to the United States.

New Calumet Mines, Limited, on Calumet Island on the Ottawa River, shipped lead concentrate containing about 550,000 ounces of silver.

Silver production from the gold mines of northwestern Quebec amounted to about 120,000 ounces.

East Sullivan Mines, Limited commenced production at its copper-zinc deposit, near Val d'Or, late in December. Limited amounts of silver and gold will be recovered from its copper concentrate.

Quemont Mining Corporation, Limited, near Noranda, is expected to be in production by mid-1949. Ore reserves are in excess of 9,000,000 tons averaging 0·94 ounce of silver per ton, 0·17 ounce gold, 1·49 per cent copper, and 2·69 per cent zinc.

Dome Exploration (Quebec), Limited reported encouraging results from drilling done on its base metal prospect near Bachelor Lake. A zone 650 feet long and 150 feet wide was indicated and drill intersections over a width of 11 feet showed an average grade of 10 ounces silver per ton, 10 per cent zinc, and 0·78 per cent lead.

Production, Trade, and Consumption

Production by provinces	1947		1948	
	Fine ounces	$	Fine ounces	$
British Columbia	5,903,367	4,250,424	6,717,908	5,038,431
Ontario	2,342,032	1,686,263	3,210,107	2,407,580
Quebec	2,134,189	1,536,616	2,376,754	1,782,566
Yukon	372,051	267,877	1,718,618	1,288,964
Saskatchewan	1,282,546	923,433	1,323,900	992,925
Manitoba	424,365	305,543	737,298	552,974
Other provinces	45,468	32,737	25,397	19,047
Total	12,504,018	9,002,893	16,109,982	12,082,487

Production by sources	1947	1948
From:	Ounces	Ounces
Base metal ores	11,411,080	14,113,904
Gold ores	751,824	1,002,525
Silver, cobalt and other ores	330,623	979,108
Placer gold operations	10,491	14,445
Total	12,504,018	16,109,982

Exports of Silver Bullion

	1947		1948	
	Ounces	$	Ounces	$
To:				
United States	4,345,965	2,969,385	5,434,299	4,026,118
United Kingdom	1,804,809	1,278,054	.....	.....
France	1,332,114	1,153,486	.....	.....
Other countries	31,485	28,410	65	56
Total	7,514,373	5,429,335	5,434,364	4,026,174

Exports of Silver in Ore and Concentrates

	1947		1948	
	Ounces	$	Ounces	$
To:				
United States	2,186,121	1,590,275	2,945,149	2,178,323
Belgium	536,140	408,189	349,542	255,630
Total	2,722,261	1,998,464	3,294,691	2,433,953

Exports of Silver Manufactures

	1947	1948
To:	$	$
United States	531,796	608,545
Other countries	115,424	37,491
Total	647,220	646,036

Imports of Unmanufactured Silver

	1947		1948	
	Ounces	$	Ounces	$
From:				
United States	67,246	53,125	637,597	468,410
United Kingdom	4,253	3,879	80,220	60,050
Total	71,499	57,004	717,817	528,460

Imports of Silver Manufactures

	1947	1948
	$	$
From:		
United States	114,334	72,869
United Kingdom	542,672	411,210
Other countries	47,746	51,663
Total	704,752	535,742

Consumption by Uses

	1947	1948
	Ounces	Ounces
Coinage	499,335	2,185,067
Sterling	1,285,906	1,730,735
Anodes	1,155,920	1,365,093
Silver nitrate	874,465	956,062
Brazing alloys	32,601	41,069
Wire and shot	65,124	28,800
Lead-silver alloys	36,715	4,641
Miscellaneous	252,605	247,561
Total	4,202,671	6,559,028

The peak year in Canada's silver production was 1910, when 32,869,264 ounces were produced. Between 1905 and 1920 most of the production came from mines in the Cobalt area of Ontario.

The world production of silver comes chiefly from countries in the Western Hemisphere, Australia and Belgian Congo being the only other sources of importance. According to Handy and Harman silver production in North and South America in 1947 and 1948 was:

	1947	1948
	Ounces	Ounces
Canada (including Newfoundland)	13,500,000	16,000,000
United States	36,100,000	37,000,000
Mexico	49,200,000	46,000,000
Peru	10,200,000	8,500,000
Bolivia	6,200,000	6,000,000
Others	6,600,000	7,500,000
Total	121,800,000	121,000,000

The United States is the largest consumer of silver, its industrial requirements amounting to more than 100 million ounces in 1948. As the United States Treasury pays 90½ cents for all newly mined domestic silver and the Government selling price is 91 cents, very little of the United States production goes into industry, so that its industrial demand is filled largely by imports.

Uses

Silver has been widely used for coinage since ancient times and although the trend in some countries in recent years has been to substitute other metals for this purpose, a large amount of the world's silver is still so used. Other long-established outlets are for ornaments, jewellery, and tableware. The electro-plating industry is a leading consumer.

Silver, either pure or alloyed, is used in electrical contacts where a very low resistance conductor is required. Metals with which silver is alloyed for this purpose include copper, nickel, cadmium, and magnesium. Silver alloys are also used in certain types of bearings, brazing solders, and in dentistry.

A high percentage of silver consumption goes into the manufacture of silver nitrate, used chiefly in the preparation of light sensitive photographic emulsions for use on photographic film.

Prices

The average Canadian price of refined bar silver was 74·7 cents an ounce, compared with 72 cents in 1947 and 83½ cents in 1946. Prices quoted by Handy and Harman in New York ranged from a high of 77½ cents an ounce in October to a low of 70 cents at the end of 1948.

TIN

The supply of tin improved progressively in 1948. World production of tin in concentrates was the highest since 1941 and was close to that of 1938. World production of tin metal for 1948 is estimated at 156,500 long tons, an increase of 32,000 long tons over 1947.

The Canadian output, which is only about 8 per cent of the domestic requirements, amounted to 309 long tons valued at $688,565, compared with 319 long tons valued at $517,650 in 1947. Canada's allocation by the Combined Tin Committee for 1948 was 4,470 long tons. Regulations governing the domestic sale and restricted use of tin were removed on May 11, 1948, but the metal still remains under nominal import and export control.

The rehabilitation of the industry in Malaya made good progress in spite of the disorders that swept the country for the greater part of the year. At the end of September 1948, 67 dredges were operating, an increase of 10 since the first of the year. The total number of mines in operation rose from 494 to 607 during the same period. Production from Indonesia was almost double that of the preceding year and exceeded pre-war production. Bolivia's production was slightly higher than in 1947. Belgian Congo and Nigeria maintained production at approximately the 1947 level. These five countries, along with China and Siam, are the leading sources of tin production.

The source of the Canadian output is the very small percentage of cassiterite in the lead-zinc-silver ore of the Sullivan mine, Kimberley, British Columbia. Since 1941 The Consolidated Mining and Smelting Company of Canada, Limited has been recovering a part of the tin as a by-product from the concentration of its Sullivan mine ore. The tin content is largely in the tailings and these are re-treated, first by flotation to remove the iron sulphides, and then by tabling to yield a cassiterite concentrate. This is smelted in an electric furnace to give metallic tin. In 1948, 1,787,497 short tons of tailings was treated to produce

the aforementioned 309 long tons of tin. From the inception of tin production at Kimberley to the end of 1948, a total of 2,528 long tons of refined tin was produced.

Canadian Occurrences

Minor occurrences, principally of cassiterite (SnO_2), the most important tin mineral, are found in a number of localities across Canada, but no deposits of economic importance have been found. These occurrences are in the New Ross area, Lunenburg county, Nova Scotia; in the Sudbury and Thunder Bay districts of Ontario; in the Lac du Bonnet district of southeastern Manitoba; in southern British Columbia; in the Mayo district, Yukon; and in the Yellowknife district, Northwest Territories. Most of the occurrences are in pegmatite dykes, exceptions being those of Yukon, where crystalline cassiterite is found in placer gravels along numerous creeks and in one small lode deposit; and in British Columbia, where cassiterite and also stannite (SnS_2) are associated with base metal ores. The last mentioned type of occurrence is the only one that has been exploited, and is the sole source of Canadian production.

The deposit in the Thunder Bay district of Ontario is at the east end of Linklater Lake. The Ontario Department of Mines reports that stripping and sampling disclosed cassiterite mineralization in narrow, discontinuous felsite dykes occurring in a zone 1,500 feet long by 50 feet wide. The work done to date has not revealed a deposit of economic importance.

Uses, Trade

Tin is used chiefly in the manufacture of tin plate and terne plate; in the production of solder, babbitt metal, and bronze; in tinning; as foil and collapsible tubes; in chemicals and as an addition agent to the molten bath in hot zinc galvanizing. The largest consumption is in the manufacture of tin plate. The tin plating industry was established in Canada in 1940 and in 1949 will have a capacity of some 300,000 tons of tin plate a year.

So far, production of tin plate in Canada has been confined to the manufacture of standard hot-dip plate by two companies, namely, Steel Company of Canada, Limited, Hamilton, and Dominion Foundries and Steel, Limited, Hamilton. In 1948 work was started by these companies on the construction of two electrolytic tin plate plants.

Steel Company of Canada brought into production a new five-stand tandem cold reducing mill for cold reduced and black plate, the annual capacity of which is 300,000 tons. Black plate is the type required for tin plating. Dominion Foundries and Steel's black plate requirements are met by its own cold rolling mill. With the operation of Steel Company's new unit the tin-plating operations of both companies are assured of a domestic source of cold rolled plate.

The anticipated increase in consumption as envisaged by the improved supply position of tin and the removal of restrictions on its use was offset somewhat by the increase in price. This is particularly apparent in the use of tin for foil and collapsible tubes. In both these products, aluminium has replaced tin to an appreciable extent. The manufacture of electrolytic tin plate may also lead to a reduced consumption of tin. Thinner coatings of tin are possible by this process than by the standard hot-dip method. The latter is now made as low as 1·25 pounds an average 100-pound base box, whereas the normal range for electrolytic

plate is from 0·25 to 0·75 pound. The amount of reduced consumption will depend largely upon the extent to which electrolytic tin displaces hot-dip plate in the can and container field.

Consumption and Imports

Consumption of tin in Canada by industrial uses for 1947 and 1948 was as follows:

	1947	1948
	(Long tons)	
Tin plate and tinning	2,096	2,181
Solder	949	1,241
Babbitt metal	211	220
Brass and bronze	274	281
Tin foil and collapsible tubes	53	45
Miscellaneous	45	78
Total	3,628	4,046

Imports of Tin and Allied Products

	1947		1948	
	Long tons	$	Long tons	$
Tin in blocks, pigs, or bars				
From:				
United Kingdom	.....	.....	10	22,200
British Malaya	2,580	4,143,243	2,559	5,519,472
Hong Kong	.....	.....	35	79,213
Belgium	1,175	2,215,992	650	1,473,889
Netherlands	.....	.....	233	591,748
United States	206*	318,201	111*	211,813
Total	3,961	6,677,436	3,598	7,898,335
Tin plate				
From:				
United Kingdom	327	106,876	613	215,495
United States	62,267	7,894,751	42,991	6,303,906
Total	62,594	8,001,627	43,604	6,519,401
——	Pounds	$	Pounds	$
Tin foil				
From:				
United Kingdom	2,510	3,249	.....	.....
United States	7,264	4,633	2,681	1,919
Total	9,774	7,882	2,681	1,919
Babbitt metal				
From:				
United Kingdom	.....	.....	15,700	13,158
United States	74,400	32,882	30,700	12,331
Total	74,400	32,882	46,400	25,489

*Secondary tin reclaimed from scrap tin plate shipped to United States detinning plants and returned to Canada.

Prices

The Canadian price of tin f.o.b. Montreal or Toronto was controlled at 80·000 cents per pound until May 11, 1948, when price control and restrictions on use were removed. After this date the price increased and at the end of 1948 was 105·000 cents per pound.

The price of tin in New York increased from 94·000 cents per pound at the beginning of 1948 to 103·000 cents at the end of the year.

TITANIUM

Plans were made during 1948 for the establishment of a substantial titanium industry in Canada, based upon development of the large deposit of ilmenite at Allard Lake, Quebec. Discovered in 1946 by the prospectors of Kennco Explorations, a subsidiary of Kennecott Copper Corporation, this deposit has been tested by drilling and is known to contain upwards of 150 million tons of ore averaging 35 per cent TiO_2 and 40 per cent iron. The deposit is 22 miles north of Havre St. Pierre, a port on the north shore of the Gulf of St. Lawrence, 570 miles below Montreal. A railway 27 miles in length is under construction from Havre St. Pierre to the orebody.

Kennecott Copper Corporation, in collaboration with New Jersey Zinc Company, has worked out a process for treating ilmenite in the electric furnace whereby most of the iron in the ore is reduced to the metallic state and separated as pig iron, and the titanium is concentrated in the slag which carries 70 per cent TiO_2. Present plans of the company envisage an electric furnace plant to treat 1,500 tons of ilmenite a day to be built at Sorel, on the St. Lawrence River, 30 miles below Montreal. A contract has been made with Shawinigan Water and Power Company for 150,000 horsepower of electrical power, to be made available in 1951. The proposed daily output of the plant is 500 tons of iron and 700 tons of titanium dioxide concentrate. Two subsidiary companies have been formed: Allard Lake (Quebec) Mines, Limited, to mine the ore, and Quebec Iron and Titanium Corporation to operate the smelter.

The present plans for mining ilmenite at Allard Lake and treating it at Sorel are related only to the production of titanium dioxide pigment. When a suitable process for the economic production of titanium metal has been worked out there is no doubt that the output of ilmenite from the mine and of its products from the smelter will be increased. Provision has been made in the plans for a considerably increased output.

Ilmenite, which contains 30 to 40 per cent TiO_2, is one of the two classes of titanium-bearing ores occurring in Canada; the other being titaniferous magnetite, which is composed of ilmenite and magnetite mixed intimately in varying proportions, with a content of 5 per cent or more of TiO_2.

Ilmenite occurs in two other localities in Quebec, namely, St. Urbain, and Ivry. At St. Urbain, on the St. Lawrence, 60 miles below Quebec City, a part of the ore contains free TiO_2 as rutile mixed with the ilmenite, and its content of TiO_2 reaches 50 per cent and more.

During recent years the only production has been from the St. Urbain deposits, which are scattered through a small area about 9 miles north of Baie St. Paul. They are worked intermittently to supply the present annual demand for export. During the war, when the interruption of supplies of titanium ore from India put the pigment plants in the United States in short supply, and concentrate from the McIntyre deposits in the Adirondacks was not yet available, there was a substantial production from St. Urbain.

Small shipments of ilmenite were made in the past from the Ivry deposits, 65 miles north of Montreal.

Titaniferous magnetite ore occurs more widely in Canada than does ilmenite, but is not used in this country at present as a source of titanium. Large deposits occur at Mine Centre in northwestern Ontario, and smaller deposits in the southern part of Hastings county north of Belleville, Ontario; at Desgrosbois, 65 miles north of Montreal, and on the Saguenay River near Arvida, Quebec.

Deposits of magnetic beach sands containing titanium occur at a number of places on the north shore of the Gulf of St. Lawrence. A bed of such sand that has been consolidated into solid material occurs at Burmis, Alberta, just east of Crowsnest Pass.

No rutile, the natural oxide of titanium, is produced in Canada.

Production and Trade

Shipments of ilmenite from the St. Urbain deposits in Quebec to the United States were continued in 1948.

Production of Ilmenite in Canada

	Short tons	Value
1945	14,147	$ 67,575
1946	1,406	7,735
1947	7,104	36,036
1948	4,441	21,091

All titanium products used in Canada are imported, mainly from the United States during recent years.

Imports of Titanium Dioxide and of Pigments Containing not less than 14 per cent Titanium[1]

	Tons	Value
		$
1945	10,680	2,045,889
1946	11,965	2,193,685
1947	13,656	2,965,826
1948	19,646	4,610,340

[1] Includes a comparatively small amount of antimony pigments.

Titanium dioxide remains in short supply in the United States in spite of an increase in plant capacity during 1948. Additional production facilities are expected to become available during 1949.

Uses and Specifications

Titanium is used at present mainly as titanium dioxide in pigments. A smaller amount is used in the iron and steel industry as ferrotitanium and ferrocarbontitanium. Production of metallic titanium has now been established experimentally.

Titanium White used in Canadian Paint Industry

(1948 not available)

	Tons
1945	3,153
1946	3,416
1947	4,050

The paint industry uses, in addition to titanium white, a considerably larger amount of mixed pigments containing titanium, also imported from the United States.

Titanium white has many other uses, such as: to make paper opaque; to make rubber white; in ceramic glazes; for printing inks; in linoleum; in cosmetics; and to de-lustre artificial silk. Thus the total annual imports are much larger than recorded in the table above.

Titanium is used in many other forms. Ferrotitanium and ferrocarbon-titanium are used under special circumstances to purify steel. They are imported from the United States.

Ferrotitanium used in Canadian Steel Industry

(1948 not available)

	Tons
1939	132
1945	656
1946	416
1947	500

Titanium-bearing steel has come into use recently as a base for white glazes. Titanium carbide is used as the hard ingredient of the "carbide" high-speed cutting-tools, usually mixed with tungsten carbide. Titanium dioxide, made artificially or in the natural form of rutile, is used commonly as a coating for welding rods. Titanium tetrachloride was used extensively during the war for smoke screens. A small amount is used for purifying alloys of aluminium.

Increasing amounts of titanium dioxide are being used to produce metallic titanium, using the process established by the United States Bureau of Mines in a pilot plant at Boulder City, Nevada. The metal is made by changing the titanium dioxide into titanium tetrachloride and then reducing it to the metal by the use of metallic magnesium. A Canadian company, Dominion Magnesium Limited, has evolved a method of making the metal from the oxide by its own process. Production of the metal is not yet on a commercial scale, most of it still being used for experimental purposes.

Titanium metal melts at about 1800° C., can be rolled, drawn, and forged, and has a specific gravity of 4·5 (iron is 7·8). It has excellent corrosion resistance, except for certain acids, and shows no tarnish after 30 days' exposure to salt spray. 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 pounds per square inch. These properties suggest important uses for the metal when the cost of producing it has been reduced sufficiently.

Prices

Prices (nominal) f.o.b. Atlantic ports at the end of 1948 were:
Ilmenite, 56 to 69 per cent TiO_2, $18 to $20 per long ton.
Rutile, 94 per cent TiO_2, minimum, 8 to 10 cents per pound.

TUNGSTEN

The Emerald mine of Canadian Explorations, Limited, near Salmo in southern British Columbia, Canada's only producer of tungsten ore in recent years, was closed for an indefinite period in December 1948, following the decision of the company to mine a lead-zinc deposit on the same property and to change the mill flow-sheet to make lead and zinc concentrates. Since January 1947, when it

acquired the property, the company maintained a steady production of high-grade scheelite concentrate, most of it for use by Atlas Steels, Limited, Welland, Ontario. The main deposit in the Emerald mine is estimated to contain about 200,000 tons of 1·0 per cent WO_3 ore.

The expected production by Philmore Yellowknife Gold Mines, Limited, Great Slave Lake, and by Reno Gold Mines, Limited, Canadian Creek, Yukon, did not materialize. Towards the end of 1948, the Woolsey (Regal Silver) mine near Albert Canyon, British Columbia, was reopened by Selkirk Tungs-Tin Mines, Limited, with a view to future production.

World output of tungsten increased slightly in 1948 as did the demand in major consuming countries. Prices declined, however, due in part to a reduction of 24 per cent in the United States import duty on tungsten.

Shipments, Trade, and Consumption

	1947		1948	
	Short tons	$	Short tons	$
Shipments of Scheelite				
WO_3 content	248	680,792	523[1]	1,004,124
Imports of Ferrotungsten				
From:				
United Kingdom	155	427,046	122	400,611
United States	159	348,164	71	206,311
Sweden	28	97,442	.....	.....
Total	342	872,652	193	606,922
Imports of Scheelite				
From:				
Spain	29	51,839	83	126,519
United States	13	16,877	.....	.....
Bolivia	7	7,095	.....	.....
Total	49	75,811	83[2]	126,519
Consumption				
Metal in ferrotungsten and scheelite consumed in steel furnaces	330	.....	250	.....

[1] From 71,000 tons of ore treated at the Emerald property.
[2] Containing 49 tons of tungsten.

No ferrotungsten is made in Canada. Tungsten steels are made in two plants. Atlas Steels, Welland, Ontario, the principal producer, uses ferrotungsten and high-grade scheelite concentrate (74 per cent WO_3), which in 1948 came mainly from the Emerald mine. Scheelite is added directly to the steel bath because of the comparative ease with which calcium forms as slag. Quality Steels (Canada), Limited, London, Ontario, used some scheelite and ferrotungsten in the production of high-speed tool steel, but the plant was closed temporarily in November 1948.

World Sources of Production

World production figures for recent years are incomplete and only limited information is available on developments in 1948 in several of the producing countries. China was long the world chief source of supply, but information on

the present status of the industry in that country is indefinite. The deposits in China are among the most extensive in the world and occur mainly in the Nanling belt in Kiangsi, Kwantung, and Hunan provinces, the largest being in South Kiangsi. Only a few of the better known deposits have been thoroughly explored. Wolframite is the principal tungsten mineral in all the deposits.

The other principal producers of tungsten are: Burma, Korea, United States, Portugal, Bolivia, Brazil, Argentina, Peru, Belgian Congo, Uganda, Union of South Africa, Southern Rhodesia, and Australia. Output in the United States in 1948 was about 4,000 short tons of 60 per cent WO_3 concentrate, nearly 26 per cent greater than in 1947. The chief producers in 1948 were: Nevada-Massachusetts Company, and U.S. Vanadium Corporation (Riley mine) in Nevada; and Tungsten Mining Corporation from the Hamme mine in Vance county, North Carolina. Climax Molybdenum Company started to recover wolfram from its molybdenite mill tailings, which average 0·04 per cent WO_3, the output being at the rate of about 300 tons a year of 70 per cent WO_3 concentrate. The United States imported 8,395 tons of tungsten ore in 1948, of which 3,700 tons came from China and the remainder mainly from Korea, Brazil, Bolivia, Spain, Siam, Peru, and Canada (316 tons). Consumption in the United States in 1948 was about 7,500 short tons (60 per cent WO_3).

Tungsten is used as an alloying metal in steel (usually as ferrotungsten, but sometimes as calcium tungstate or scheelite concentrate) essentially to impart hardness and toughness, which are maintained even when the steel is heated to a high temperature. Most of the consumption of tungsten in the United States is used for the production of high-speed steels for cutting-tools, in which the tungsten content is 15 to 20 per cent. Minor amounts are used in steels for dies, valves, and valve seats for internal combustion engines, and for permanent magnets. Stellite, the best known non-ferrous alloy, contains 10 to 15 per cent tungsten with higher percentages of chromium and cobalt. Tungsten carbide is widely used as an extra hard cutting-tool and as inserts into detachable bits for rock drilling. Pure tungsten is used in lamp filaments, in radio tubes, contact points, etc. Tungsten salts (tungstates) are used for X-ray screens, fireproofing and waterproofing fabrics, etc.

Prices

The price of the concentrate from the Emerald property is an arbitrary arrangement between the Canadian producer and the buyers. In 1948 it ranged between $19 and $21 a short ton of WO_3 on cars at the mine. United States prices of imported ores dropped from $29 per unit (duty paid) at New York in January 1948, to $24.50 in December. In May 1948, the United States import duty on ores and concentrates was reduced from $7.93 to $6.03 per unit of WO_3.

ZINC

Production of refined zinc and of zinc contained in concentrates consigned for export was higher than in 1947 and a record output value was set for the second successive year. Electrolytic zinc made by The Consolidated Mining and Smelting Company of Canada, Limited, at Trail, British Columbia, and by Hudson Bay Mining and Smelting Company, Limited, at Flin Flon, Manitoba, comprised about 80 per cent of the total output. The remainder was contained in

concentrates produced in Quebec and exported to the United States. The price of high-grade zinc in Canada increased from 11 cents to 18 cents a pound during the year.

Production, Trade, and Consumption

(Exclusive of Newfoundland)

	1947		1948	
	Short tons	$	Short tons	$
Production, all forms (a)				
British Columbia	126,503	28,412,593	135,155	37,654,210
Manitoba and Saskatchewan	46,628	10,472,731	51,130	14,244,651
Quebec	34,732	7,800,686	47,879	13,339,095
Total	207,863	46,686,010	234,164	65,237,956
Production, refined metal (*b*)	178,264	.....	196,575	.....
Exports of refined metal				
To: United States	55,152	11,160,922	75,408	20,173,019
United Kingdom	56,175	10,313,866	55,433	12,623,151
France	23,180	4,599,192	8,709	2,455,059
India	448	88,177	1,724	483,275
Other countries	2,273	499,203	3,613	951,446
Total	137,228	26,661,360	144,887	36,685,950
Exports, in ore				
All to United States	40,575	2,916,649	54,227	4,752,238
Exports of scrap, dross, and ashes				
To: United States	4,417	396,054	6,848	826,239
India	27	4,231	303	56,230
Other countries	276	41,883	68	16,592
Total	4,720	442,168	7,219	899,061
Exports of zinc manufactures	.....	172,465	.....	159,232
Imports of zinc and zinc products				
From: United States	.....	3,893,756	.....	4,923,683
United Kingdom	.....	330,861	.....	458,681
Other countries	.....	306,806	.....	109,323
Total	.....	4,531,423	.....	5,491,687
Consumption of refined zinc				
Galvanizing	21,506	.....	22,888	.....
Zinc oxides and dust	15,338	.....	7,580	.....
Brass and copper products	4,653	.....	4,664	.....
Diecasting alloys	3,653	.....	3,395	.....
Dry batteries	1,564	.....	1,794	.....
Secondary smelters	4,116	.....	6,054	.....
Miscellaneous	242	.....	524	.....
Total	51,072	.....	46,899	.....

(*a*) Includes zinc estimated recoverable from concentrate exported.

(*b*) Includes zinc recovered from imported concentrates.

Lithopone, the chief zinc product imported came mostly from the United States.

World production of slab zinc as compiled from statistics published by the Zinc Development Association for 1947 and 1948 was as follows:

	1947	1948
	Short tons	Short tons
United States	848,400	849,600
Canada	177,800	195,600
United Kingdom	76,800	80,400
Australia	72,000	92,400
Rhodesia	24,000	25,200
France	49,200	61,200
Belgium	145,200	169,200
Spain	21,600	22,800
Mexico	52,800	55,200
Norway	38,400	46,800
Italy	26,400	29,900
Germany	(*b*)24,000	(*a*)50,000
Netherlands	10,800	14,400
Poland	79,200	94,800
Japan	14,400	22,800
Total	1,661,000	1,810,300

(*a*) Bizonal area. (*b*) British zone.

The above totals for Germany and Poland for 1948 are estimates based on average monthly production in the first nine months. Totals for Italy are based on first eleven months.

Production by Russia and some other countries is not available.

Production Operations; Developments

British Columbia

Consolidated Smelter's zinc plant at Trail produced 145,446 tons of refined zinc, compared with 126,589 tons in 1947. The increase was the result of additional receipts of custom ore, largely in the form of zinc concentrate. Delayed delivery of equipment prevented completion of the company's new slag-fuming furnace being constructed to provide for reclamation of zinc plant residues.

By far the greater part of the Trail zinc output comes from the company's Sullivan lead-zinc-silver mine at Kimberley, where 2,283,625 tons of ore was mined, compared with 2,252,729 tons in 1947. The large-scale development project that was commenced in 1947, comprising a new underground crushing plant, 4-mile haulageway (2 miles of which were driven underground on the 3,700-foot level), and a sink-float plant at the concentrator, was not completed owing to delay in delivery of equipment. A new rod mill, reported by the company to be the largest in operation anywhere, was installed in the Sullivan concentrator to facilitate coarse grinding.

The revival of base metal mining, especially in the southern areas, continued. The number of individual shippers of custom ores and concentrates to Trail increased by about 50 per cent and the quantity of zinc contained in the shipments was more than double that of 1947. Information on the more important shippers follows:

In the Slocan-Ainsworth area regular shipments of concentrates were made by: Western Exploration Company, Limited, at Silverton; Zincton Mines, Limited, at Zincton; and Ainsmore Consolidated Mines, Limited, at Ainsworth.

Kootenay Belle Gold Mines, Limited treated ore from the Van Roi, Doherty, Utica, and Bosun properties and material from Whitewater mine dumps and old mill tailings in the Whitewater mill near Retallack.

At Field, Base Metals Mining Corporation, Limited operated its concentrator at a rate of about 100 tons a day and produced about 5,000 tons of zinc concentrates averaging 60 per cent zinc. Britannia Mining and Smelting Company, Limited, which operates the Britannia copper-zinc mine on Howe Sound, shipped 5,500 tons of zinc concentrates containing about 53 per cent zinc.

Silver Standard Mines, Limited, near New Hazelton, started to produce zinc and lead concentrates in its new 70-ton mill in September.

Reeves MacDonald Mines, Limited, on Pend d'Oreille River, south of Salmo, continued construction of a 1,000-ton concentrator. Production from its Reeves orebody is expected by mid-1949. Ore reserves are estimated to be over 2,500,000 tons averaging 6 per cent zinc and 1 per cent lead.

Sheep Creek Gold Mines, Limited reopened the Paradise lead-zinc mine near Inverness and commenced foundations for a 50-ton mill at Jacknife, 7 miles from the property.

Canadian Exploration, Limited prepared to mine ore from the Jersey lead-zinc deposit on its Emerald property near Salmo and made adjustments to the 300-ton Emerald tungsten concentrator for the production of zinc and lead concentrates.

Northwest Territories

A 500-square mile concession surrounding the lead-zinc deposit at Pine Point on the south shore of Great Slave Lake was granted to Northern Lead Zinc, Limited, in association with The Consolidated Mining and Smelting Company, and Ventures, Limited. Extensive drilling exploration under direction of Consolidated Smelters was commenced in an attempt to disclose new orebodies. Drilling done by Northern Lead Zinc in 1930 indicated 500,000 tons averaging 9 per cent zinc and 7 per cent lead.

Preliminary drilling of a zinc-lead-silver deposit discovered by prospectors near Indian Mountain Lake, 10 miles north of McLeod Bay at the east end of Great Slave Lake, indicated a zone 250 feet long and 18 feet wide, averaging 20 per cent zinc, 3 per cent lead, and 8 ounces of silver per ton. The property was acquired jointly by Hollinger Consolidated Gold Mines, Limited, Noranda Mines, Limited, and The Mining Corporation of Canada, Limited. Operations are under the direction of Hollinger.

Several other zinc-lead discoveries in the Great Slave Lake area were reported.

Saskatchewan and Manitoba

Hudson Bay Mining and Smelting Company, Limited, at Flin Flon on the Manitoba-Saskatchewan boundary, operated its zinc plant at close to capacity and produced 51,129 tons of slab zinc, of which the tonnage of "special high grade" (four nines plus) zinc was the highest on record. Included in the production was zinc derived from concentrates produced by Sherritt Gordon Mines, Limited, and Cuprus Mines, Limited, both nearby in Manitoba. Hudson Bay commenced construction of a slag-fuming plant adjacent to its copper smelter, and an addition to its zinc plant. Completion of these projects, expected in 1950, will enable much of the zinc in stocked zinc plant residues (now over 770,000 tons) and zinc in the reverberatory slag to be recovered. The enlarged zinc plant will provide for increased zinc production that will result from the electrolytic treatment of zinc oxide from the fuming plant.

The company mined 1,865,137 tons of copper-zinc ore, compared with 1,855,035 tons in 1947, the average grade being 5 per cent zinc, 2·31 per cent

copper, 1·32 ounces silver, and 0·08 ounce gold per ton. At the company's Schist Lake mine, 3½ miles southeast of Flin Flon, a shaft was sunk 625 feet and preparations were made to construct an aerial tramway to transport copper-zinc ore to Flin Flon.

Cuprus Mines, Limited (subsidiary of Hudson Bay Mining and Smelting Company), 13 miles southeast of Flin Flon, commenced production of copper and zinc concentrates in its 300-ton concentrator in October. The concentrates were transported to Flin Flon by truck.

Sherritt Gordon Mines, Limited milled 458,325 tons of copper-zinc ore at its property at Sherridon. It shipped its copper and zinc concentrates to Flin Flon for treatment. The orebody is nearing exhaustion.

Ontario

McWilliams-Beardmore Mines, Limited reopened the Silver Mountain zinc-lead-fluorspar mine, 30 miles west of Fort William, and plans to build a 200-ton concentrator in 1949.

Quebec

Zinc concentrates for export were produced at the copper-zinc mines of Waite Amulet Mines, Limited, and Normetal Mining Corporation, Limited, and at the zinc-lead mines of Golden Manitou Mines, Limited, New Calumet Mines, Limited, Anacon Lead Mines, Limited, and Candego Mines, Limited.

Waite Amulet, near Noranda, milled 422,785 tons of ore from which concentrates containing 14,521 tons of zinc, 22,256 tons of copper, and 418,826 ounces of silver were produced. About 80 per cent of the ore came from the "A" orebodies of the Amulet Dufault section. The Waite section was worked out in January 1948. Production from "C" orebody was resumed in January 1948, and from "F" orebody in November. Both of these orebodies are nearing depletion. Exploratory surface drilling disclosed an orebody at a depth of about 1,500 feet, 3,000 feet east of the Waite mine and it is planned to sink a shaft to further explore this deposit. Drilling from the 1,000-foot level outlined a new copper-zinc deposit about 250 feet southwest of "Lower A" orebody.

Normetal, in Desmeloizes township, milled 236,844 tons of ore and produced concentrates containing 15,791 tons of zinc, 5,902 tons of copper, and 341,070 ounces of silver. A winze was commenced from the 2,900-foot level to explore the ore zone to the 4,000-foot horizon. The power-line from Noranda to the property was completed and delivery of power by the Quebec Hydro Commission was commenced in April 1949.

Golden Manitou, 9 miles east of Val d'Or, milled 344,200 tons of ore and shipped zinc concentrates containing about 14,000 tons of zinc. Lead concentrates and gold precipitates were also produced and exported. The mill operated at its capacity of 1,000 tons for most of the year. Preparations were made to deepen the shaft from 1,600 to 2,500 feet in 1949.

New Calumet, on the Ottawa River, Pontiac county, milled 193,647 tons of ore in the fiscal year ended September 30. The zinc concentrates contained 11,612 tons of zinc. The mill operated in excess of its rated capacity of 500 tons. An internal production shaft was sunk from the 600-foot to the 1,500-foot level and six new levels were established, from which the Longstreet orebody will be developed.

Anacon Lead Mines, Limited, formed in 1948 to acquire and reopen the Tetreault zinc-lead mine, Portneuf county, 50 miles west of Quebec City, commenced to produce zinc and lead concentrates in its 400-ton concentrator in December. The ore grades 5 per cent zinc and 0·8 per cent lead.

Candego Mines, Limited, centrally situated in Gaspe Peninsula, commenced production of zinc and lead concentrates in a 50-ton mill in February 1948 and made a small shipment to Europe in December. The ore came from open-pit operations on surface exposures. Plans were laid for an underground development program in 1949.

East Sullivan Mines, Limited, near Val d'Or, brought its 2,000-ton concentrator into production in January 1949. Preproduction development work above the 600-foot level outlined 4,372,000 tons of ore averaging 1·36 per cent zinc, 2·12 per cent copper, and low values in gold and silver.

Quemont Mining Corporation, Limited, near Noranda, partly completed construction of a mining plant and of a concentration plant designed to treat 2,000 tons a day. Production of copper, zinc, and pyrite concentrates is expected to start by mid-1949. The estimated reserves remained at 9,431,000 tons averaging 2·69 per cent zinc, 1·49 per cent copper, 0·174 ounce gold per ton, and 0·943 ounce silver per ton, as reported at the end of 1947. No. 2 shaft was being deepened to 2,600 feet.

Eldona Gold Mines, Limited disclosed a zinc deposit below the 800-foot level at its mine 3 miles east of Noranda.

New Norzone Mines, Limited, 10 miles southwest of Noranda, outlined 87,000 tons of ore averaging 8·4 per cent zinc, with values in silver and lead. It was planned to deepen the shaft to 1,000 feet.

Dome Exploration (Quebec), Limited did extensive exploratory drilling on its zinc-silver-lead deposit at Bachelor Lake. A mineralized zone 650 feet long and 150 feet wide containing sections of mineable ore is indicated. Drill intersections showed an average grade of 10 per cent zinc, 0·78 per cent lead, and 10 ounces of silver per ton over a width of 11 feet. Exploration was to continue in 1949.

New Brunswick

Coulee Lead-Zinc Mines, Limited made preparations to sink a 275-foot exploration shaft at the Elmtree lead-zinc deposit near Bathurst.

Newfoundland

Buchans Mining Company, Limited (subsidiary of American Smelting and Refining Company), produced 70,900 tons of zinc concentrate, 32,500 tons of lead concentrate, and 17,400 tons of copper concentrate from its Buchans mine near Red Indian Lake in central Newfoundland. It is the only producing base metal mine on the island. The output was shipped to the United Kingdom, Continental Europe, and United States. Exploration during 1948 indicated substantial additions to the known orebodies.

Uses

For Canadian uses by industries see table on page 56.

Zinc has a wide range of industrial uses. In the United States about 45 per cent of the consumption of 806,000 short tons in 1948 was in galvanizing; 29 per cent in zinc base alloys; 13 per cent for brass products; and 9 per cent in rolled zinc fabrications. In the United Kingdom, consumption of new zinc was 310,500 long tons, brass manufacturers being the largest consumers.

The metal is marketed to industry in grades, varying according to their respective content of lead, iron, cadmium, and other impurities. In North America, the principal grades produced are "Special High Grade", used chiefly for diecasting; "Regular High Grade", used for brass manufacture and rolled zinc fabrications; and "Prime Western", used for galvanizing. In Canada, zinc

is refined only by the electrolytic process, by which "Special" and most "Regular High Grade" zinc is produced. To fill orders for "Prime Western", Canadian producers debase their product to meet specifications.

In galvanizing, zinc is applied to iron or steel as a thin coating to prevent rusting. Zinc has an affinity for iron and the coating is usually applied by hot-dipping. However, for some purposes, such as wire screening, the coating is applied by electroplating. Zinc base alloys prepared from high-grade electrolytic zinc to which is added 3 to 4 per cent aluminium, up to 3·5 per cent copper, and 0·02 to 0·1 per cent magnesium, are used extensively for diecasting complex shapes especially for automobile accessories. 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 for fabrications exposed to corrosion such as weather stripping, fruit jar sealer rings, battery cups, boiler and hull plates, and brake linings. Zinc dust is used to make zinc salts and compounds; for purifying fats; manufacture of dyes; and to precipitate gold and silver from cyanide solution. Zinc oxide is used in compounding rubber and in the manufacture of paint, ceramic materials, inks, matches, and many other commodities. Among the more important of the zinc compounds and products are lithopone, zinc carbonates, zinc chloride, zinc stearate, zinc sulphate, and zinc sulphide.

Prices

The price of high-grade zinc in Canada increased from 11 cents to 18 cents a pound during the year, the average price being about 14 cents. The average net value of zinc contained in concentrates exported to the United States is estimated to have been about 7 cents a pound after deduction of freight and treatment charges.

II. INDUSTRIAL MINERALS

ABRASIVES (NATURAL)

As the Canadian production of natural abrasives has been small for many years, brief reviews only are given below of garnet, pulpstones, grindstones, scythestones, and volcanic dust. Corundum is reviewed separately.

Garnet

No garnet was mined or milled in 1948. From 1943 to 1947 Niagara Garnet Company produced garnet ore from a deposit near River Valley in Dana township, Ontario, and shipped it to the company's mill at Sturgeon Falls where the ore was concentrated to about 95 per cent garnet content and then pulverized into flour grade for use in the grinding of lenses in the optical trade. The company was the only Canadian producer during that period.

Over 85 per cent of the world output of garnet comes from North Creek, New York, and the product is regarded as the world standard garnet. Production in the United States in 1948 was about 8,039 tons, compared with 8,722 tons in 1947.

Garnet, crushed and suitably graded as to size, is used for making abrasive-coated papers and cloth, which in turn are used mainly in the wood-working (hard woods), and to a lesser extent in the shoe-leather industries. The specifications for this use are somewhat exacting. Garnet is used to a minor extent for sandblasting and for surfacing plate glass. Garnet superfine (flour) grades are used as a partial substitute for corundum flour, which is used for polishing optical lenses.

Canadian consumption of garnet grain suitable for the manufacture of sandpaper is about 500 tons a year, the two Canadian manufacturers of sandpapers being Canadian Durex Abrasives, Limited, Brantford, and Canada Sandpapers, Limited, Preston, both in Ontario. Competition from silicon carbide, and from oxide of alumina, is a serious factor in the marketing of garnet. Little, if any, garnet is used for other purposes in Canada.

Prices, f.o.b. mines in United States, of ungraded concentrate suitable for sandpaper are about $88 a ton, and flours from 6 cents a pound for 275 mesh to 65 cents a pound for 5 and 10 micron. Garnet for surfacing plate glass is $100 a ton, and for sandblasting, $90 a ton.

Grindstones, Pulpstones, and Scythestones

Material suitable for these stones occurs in certain sandstone beds in Nova Scotia, New Brunswick, and on the coast of British Columbia. Many years ago the output was considerable, but most of the known beds have been depleted and the demand for natural stones has decreased.

Read Stone Company, Sackville, New Brunswick, and Bay of Chaleur Company, the two operators, shipped a total of 249 tons of grindstones valued at $15,735 in 1948, all for domestic use. This compares with shipments of 335 tons of grindstones valued at $21,475 in 1947. Read Stone Company, by far the larger operator, obtains its material in New Brunswick and ships from Stonehaven in that province. Bay of Chaleur Company obtains its material from along the Bay of Chaleur at low tide near Grande Anse, New Brunswick.

Good pulpstones are in demand, particularly for use in the large magazine grinders, but known Canadian deposits containing thick beds of sandstone of the proper quality appear to be almost worked out. Pulpstones were last produced in Canada in 1937 from a deposit on Gabriola Island opposite Nanaimo on Vancouver Island, British Columbia. There is increasing competition from Canadian-made artificial segmental pulpstones, mainly of silicon carbide grit, and about one thousand of these stones were in use and about two hundred in stock at the end of 1948 in Canadian pulp mills. Most of these are made by Norton Company of Canada, Hamilton, Ontario, but those supplied by Carborundum Company are made in its plant in the United States.

The imported natural pulpstones come mainly from West Virginia.

Volcanic Dust

Deposits of volcanic dust occur in Saskatchewan, Alberta, and British Columbia, but there has been no production in recent years.

The main use in Canada for the powder is for scouring and cleaning.

Light-weight hollow building blocks and chimney blocks composed of a pumice cement mixture are made by several companies in British Columbia. The pumice aggregates are imported from Oregon and Washington states at a delivered price of $6 to $9 a ton. About 3,500 tons of pumice was used for the above purpose in 1948. A thin layer of pumice covers the surface of a large area in the Bridge River district of British Columbia, but operating and transportation costs prevent material from this area being used in competition with the imported pumice.

Output of pumice and volcanic dust in the United States in 1948 was 607,746 tons, a 37 per cent increase over 1947.

Imports are grouped with a number of similar products (pumice, pumice stone, lava, and calcareous tufa), the value of which totalled $108,684 in 1948, about 90 per cent of which came from United States and the remainder from Italy. Most of the pumice dust was used in scouring powders.

ASBESTOS

Asbestos production in Canada set a new record in 1948 when 716,769 tons valued at $42,231,475 was produced. Despite the greatly increased production, which reflects the large expenditures made in recent years on plant expansion and improvements, the demand for fibre of all grades continues strong. The large new plant of Turner & Newall (Canada), Limited, at Montreal, in which is manufactured a wide range of asbestos products, came into production. Canadian Johns-Manville Company, Limited began production of asbestos-cement pipe in its large new plant at Port Union near Toronto. Additions were made to other asbestos manufacturing plants in various parts of the country. These new plants and additions to existing plants make Canada an important source of finished asbestos products as well as of raw fibre.

At the end of 1948 it was reported that a large deposit of chrysotile asbestos had been found near Matheson, Ontario, about 45 miles east of Timmins. Exploration work on the new deposit is proceeding. Search for new deposits was also active in the Thetford Mines area, Quebec. In this area a new orebody was found at the Vimy Ridge property of Asbestos Corporation, Limited.

Production and Trade

	1947		1948	
	Short tons	$	Short tons	$
Production (Shipments)				
Crude	958	503,137	977	594,594
Milled fibres	222,196	20,221,444	241,953	25,943,710
Shorts and refuse	438,667	12,281,167	473,839	15,693,171
Total production	661,821	33,005,748	716,769	42,231,475
Exports of Crude				
To: United States	647	298,113	644	363,924
Other countries	306	147,037	228	193,203
Total	953	445,150	872	557,127
Exports of Milled Fibres				
To: United States	161,188	13,956,375	168,211	17,089,931
United Kingdom	20,260	1,895,169	24,365	2,716,452
France	10,165	1,184,131	10,623	1,493,736
Australia	5,698	509,749	6,726	711,091
Belgium	5,654	565,031	6,048	782,086
South America	10,968	1,145,596	10,129	1,415,576
Other countries	9,760	1,019,482	10,975	1,343,382
Total	223,693	20,275,533	237,077	25,552,254
Exports of Shorts and Refuse				
To: United States	395,825	11,079,672	430,894	14,529,902
United Kingdom	11,399	326,640	13,799	478,540
Other countries	5,026	164,294	7,800	281,233
Total	412,250	11,570,606	452,493	15,289,675
Exports of Manufactures (Brake linings, clutch facings, roofing, packing, etc.)				
To: United States	.....	73,191	.....	110,091
French Africa	.....	53,343	.....	116,962
Argentina	.....	99,215	.....	57,597
Netherlands	.....	22,822	.....	26,960
Other countries	.....	429,403	.....	268,549
Total	.....	677,974	.....	580,159
Imports				
Packing	124	137,295	89	108,092
Brake linings for motor vehicles	.....	584,530	.....	649,896
Clutch facings for motor vehicles	.....	244,205	.....	218,202
Brake linings and clutch facings, other	.....	93,929	.....	83,724
Miscellaneous manufactures	.....	2,620,342	.....	2,692,065
Total[1]	124	3,680,301	89	3,751,979

[1] 79 per cent from the United States in 1948.

All asbestos produced in Canada during 1948 was of the chrysotile variety and came from the Eastern Townships of Quebec, where the producing centres are Asbestos, Thetford Mines, Black Lake, East Broughton, Vimy Ridge, and St. Remi de Tingwick. The Canadian deposits are the largest known and the great open pit at Asbestos is the largest asbestos quarry in operation.

Small deposits of chrysotile asbestos are known in other parts of Quebec, in Ontario, and in British Columbia, and several have been worked from time to time. The fibre from some of these deposits has a very low iron content and is free from magnetite, and is thus particularly suitable for making insulation for electrical machinery.

No amosite or crocidolite has been found in Canada, but there are numerous deposits of fibrous tremolite, actinolite, and anthophyllite. These varieties are commercially termed amphibole asbestos. The fibres are harsher, longer, and weaker than those of chrysotile and cannot be spun, but they have a higher resistance to acids than has chrysotile fibre, and are usually used in preference to the latter for filtering acid solutions. Fibre from certain of the tremolite deposits in Ontario and Quebec has proved suitable for this use and small-scale development work is proceeding on a deposit of fibrous tremolite near Calabogie, Ontario, and near St. Luc de Matane, Quebec.

In 1948 there were seven producing companies. Asbestos Corporation, Limited worked two properties at Thetford Mines, and one each at Black Lake and Vimy Ridge; Johnson's Company operated at Thetford Mines and at Black Lake; Bell Asbestos Mines, Limited operated at Thetford Mines; Quebec Asbestos Corporation, Limited, at East Broughton; Canadian Johns-Manville Company, Limited, at Asbestos; Nicolet Asbestos Mines, Limited at St. Remi de Tingwick; and Flinkote Mines, Limited, 2½ miles east of Thetford Mines. Seven other companies did exploration or development work searching for new deposits in the Eastern Townships of Quebec.

The asbestos-bearing rock is mined both in open pits and underground. However, the block-caving method of underground mining is coming into general use by all companies and within relatively few years all production will be by that method.

Production in the Thetford area has been continuous since 1878 and reserves of asbestos-bearing rock are huge. Core drilling to depths of from 1,200 to 1,700 feet has revealed the presence of fibre comparable in quantity and quality with that in the present workings. Most of the output consists of vein fibre obtained from veins less than ½ inch in width, though in rare instances veins exceeding 5 inches in width are found. The fibres run crosswise of the vein and thus the width of the vein determines the length of the fibre. Slip fibre, occurring in fault veins, is obtained largely in the East Broughton area.

Canada continues to be the principal asbestos producer, probably accounting for about 70 per cent of the world's output. Other countries producing relatively large quantities are Russia, Rhodesia, Union of South Africa, Swaziland, the United States, and Cyprus. Small shipments are made from Australia, Bolivia, China, India, and Venezuela. The world's largest market for asbestos is in the United States, and Canada's proximity to this market is of great advantage to the Canadian Industry.

Uses; Prices

Asbestos is used for a great variety of purposes, the principal products being; cloth, brake linings, clutch facings, packings, insulation, mill-board, siding, shingles, roofing, tile, and pipes. Short fibre is also finding important new applications in the plastics industry.

Prices of fibres advanced during 1948. According to the Engineering and Mining Journal Metal and Mineral Markets, at the close of the year, quotations

in United States funds for fibre per ton, f.o.b. Quebec mines, bags included, were: crude No. 1, $896 to $960; crude No. 2 and sundry crudes, $350 to $545; spinning fibres, $204.50 to $378; magnesia insulation and compressed sheet fibres, $204.50 to $221; shingle stock, $84.50 to $128; paper stock, $51.50 to $78; cement stock, $26 to $43.50; floats, $27; shorts, $24.50 to $46.

BARITE

Mine shipments of barite, both crude and ground, in Canada in 1948, decreased to 95,747 tons, nearly 26 per cent below the 1947 output. Exports declined from 137,000 tons in 1947 to 95,787 tons in 1948; and imports dropped 27 per cent, to 1,263 tons. Nova Scotia supplied 98·5 per cent of the output and British Columbia, the remainder.

Production, Trade, and Consumption

	1947		1948	
	Short tons	$	Short tons	$
Production (Mine shipments)				
Crude	70,053	.....	44,726	.....
Ground	58,622	.....	51,021	.....
Total	128,675	1,380,753	95,747	1,073,380
Imports (ground)				
All from United States	1,737	51,060	1,263	39,613
*Exports**				
Crude	76,000	.....	38,596	.....
Ground	61,000	.....	57,191	.....
Total	137,000	1,525,204	95,787	1,219,017
Consumption				
Paints	1,658	.....		
Rubber goods	556	.....		
Glass	237	.....	Not yet available	
Miscellaneous	313	.....		
Total	2,764	.....		

[1] In 1948, 92 per cent of the crude was consigned to the United States, and the remainder to European markets. Almost all of the ground barite was shipped to the West Indies, South America, and Arabia.

In Nova Scotia, Canadian Industrial Minerals, Limited, with mine and mill at Walton, Hants county, is now firmly established as one of the world's major producers of barite. Although the barite is off-colour and thus not suitable for the general pigment and filler trades, the ore is high in barium sulphate and meets drilling-mud and chemicals specifications without need for concentration. Laboratory tests have shown it to be amenable to bleaching at 325-mesh grind, yielding a product of good white colour. Further stripping of overburden was done in 1948, and underground development work was continued on the 270-foot and 350-foot levels.

Maritime-Barytes, Limited incorporated early in 1948 to develop barite occurences in the Brookfield area, Colchester county, Nova Scotia, commenced

a program of drilling on its Middle Stewiacke and Upper Brookfield deposits. Calcining of the Upper Brookfield ore, which carries considerable intergrown brown siderite, effects conversion of the siderite to magnetite, with the production of a composite magnetite-barite having a higher specific gravity than straight barite. It may thus have superior properties for oil-drilling use.

In British Columbia, Mountain Minerals, Limited shipped 1,472 tons of crude barite from its properties at Parson and Brisco, southeast of Golden. Of this total, 1,167 tons was consigned to Industrial Fillers, Limited (formerly Pulverized Products, Limited), Montreal, for grinding, and the remainder to the plant of Summit Lime Works, Crowsnest, Alberta, where it was ground for use in drilling-mud and glass manufacture.

In Ontario, no mining was done by Woodhall Mines, Limited, at the old Premier Langmuir mine on Nighthawk Lake in Langmuir township, Porcupine area, but the ground product from a trial shipment of 47 tons of crude ore from the stockpile to the grinding plant of Industrial Fillers, Montreal, proved of good white colour and assayed 98·32 per cent barium sulphate. During the year the company reported various preparations for production. The intention is to ship crude ore to Whitby, Ontario, where a grinding plant of 75 tons a day capacity was nearing completion at the end of 1948.

Uses

Crude lump barite is used in the manufacture of lithopone, an important white pigment and filler material, and in a wide range of barium chemicals. These products are not manufactured in Canada.

For most other industrial purposes, barite is used in finely ground form, 325-mesh being the general specification. It is used chiefly as a heavy weighting medium in oil-well drilling muds, to overcome gas pressures. Other uses for ground barite are as a heavy, inert filler or loader in rubber, asbestos products, paper, linoleum and oilcloth, textiles, and leather and plastics. It is an important pigment and extender in paints. Considerable barite is used in the glass industry as a batch fluxing ingredient for moulded flint glass.

Prices and Tariffs

The average unit price of domestic crude barite of white pigment grade sold in 1948 was $8.10 per short ton f.o.b. mine. Ground, off-colour barite exported for oil-well drilling use had an average declared unit value of $15.25 per ton f.o.b. Atlantic ports, and off-colour crude, $9.10 per ton. Ground white for the pigment, filler, and glass trades averaged $39.50 per ton f.o.b. mill.

Canadian imports are free of duty under the British preferential tariff and there is no duty on barite used in drilling mud, or in the manufacture thereof. Otherwise, imports from countries other than the United Kingdom are subject to a duty of 25 per cent.

The United States duty of $4 per long ton on crude barite was reduced to $3.50 effective January 1, 1948, except for material from Cuba, which continued to pay $3.20 per ton. The duty of $7.50 per ton on ground or otherwise manufactured material remained unchanged.

Witherite

Witherite (natural barium carbonate) is the only other barium mineral of commerce. Commercial deposits are rare, and most of the world supply is obtained from mines in the north of England.

BENTONITE

Canadian mine shipments of crude bentonite increased to 16,440 short tons during 1948, but Canada continued to import a substantial supply of both activated (treated with sulphuric acid) clay and natural ground bentonite from the United States to meet domestic requirements. Manitoba and Alberta remained the sole supply sources of Canadian production, with Manitoba reporting a 29 per cent increase in tonnage, and Alberta, 7 per cent, over 1947 totals.

In Manitoba, production in recent years has been confined to operations by Pembina Mountain Clays, Limited, of Winnipeg, in the Morden-Thornhill area in the southern part of the province. This company ships the dried ground clay to its plant at Winnipeg for activation. Manitoba clay is of the non-swelling type. It possesses bleaching properties in the crude state, but these are enhanced by activation.

In Alberta, production is derived from several sources in the Drumheller area, Red Deer Valley, north of Calgary. In 1948, the following reported shipments of crude bentonite; Gordon L. Kidd, and Aetna Coal Company, Drumheller, and Western Gem and Jewel Collieries, Limited, Cambria. Alberta bentonite is of the highly colloidal, swelling type, suitable for controlling the viscosity of oil-drilling muds and for foundry use.

Bentonite beds up to 9 feet thick occur south of Princeton, British Columbia, and there also are deposits near Merritt, south of Kamloops in that province. In 1948, there were reports of further exploration of occurrences in the Princeton area. There are a number of scattered occurrences in southern Saskatchewan.

Production and Trade	1947		1948	
	Short tons	$	Short tons	$
Mine Shipments of Crude				
Manitoba	11,000	.....	14,140	.....
Alberta	2,060	.....	2,300	.....
Total	13,060	.....	16,440	.....
Manitoba Sales of Activated Bentonite	4,500	.....	5,200	.....
Production of Processed Bentonite[1]	6,000	306,882	7,897	415,408
Imports of Activated Clay[2]				
All from United States	.....	242,483	.....	272,586

[1] Comprising ground natural clay and activated material.
[2] Considerable, unrecorded amounts of ground, natural bentonite are imported from the United States, mainly for foundry use.

Uses

Bentonite is used chiefly as a bonding ingredient in foundry sands; for the bleaching (decolorizing) and filtering of mineral and vegetable oils and of packing-house products; and to control the viscosity of oil-well drilling muds. Activated bentonite is used mainly in bleaching petroleum products and animal and vegetable oils and fats. It is similarly used by firms engaged in reclaiming crankcase oil. The colloidal or swelling type of bentonite produced in Alberta is used mainly in oil-well drilling in the province. It has also been used in diamond drilling through heavy overburden in Ontario and Quebec, providing

a casing for deep holes where the use of piping proved impractical. A small tonnage has been used in drilling water wells; in exploratory drilling in the Athabasca tar sand area; and for foundry purposes.

Consumption in 1947 (1948 not yet available)

	Short Tons
Petroleum refining	8,252
Steel foundries	3,095
Iron foundries	1,800
Oil-well drilling	2,000
Soaps	794
Pulp and Paper	220
Miscellaneous	197
Total	16,358

Prices and Tariffs

The price of bentonite varies within wide limits depending upon the nature of the material and the degree of processing it has been given. Alberta crude clay sold in 1948 for $5 to $5.75 per short ton f.o.b. mines. Material processed for oil-drilling use was priced at $35 per ton, bagged f.o.b. plant. The cost of activated bentonite for bleaching use in bulk carload lots, delivered eastern Canadian points, rose from about $62 per ton at the beginning of the year to nearly $72 in the July-December period.

The average consumer price for Wyoming and South Dakota standard 200-mesh bentonite in 1948 was $11 per ton, bagged, in carload lots, f.o.b. plant, with an advance to $11.50 in October. Special premium grades in powdered, pellet, and dust form were quoted at $13 to as high as $80 in the last quarter. Dried, crushed, ¼-inch to 20-mesh material sold at $9 per ton, bulk, in carload lots. Mississippi bentonite, natural, ground, 200-mesh material, was priced at $13.50 bagged, in carload lots, f.o.b. plant.

The duty on unmanufactured bentonite entering the United States is 75 cents per long ton, and on manufactured, $1·625 per ton. Bentonite, not further manufactured than ground, enters Canada duty free. Activated bentonite for oil-refining use imported into Canada pays 10 per cent ad valorem.

CEMENT

Though production of cement in Canada in 1948 reached a peak of 14,127,123 barrels, with a peak value of $28,264,987, it was necessary to import 1,120,671 barrels to meet the rising construction and engineering demands. Expansions to plants underway in 1948 or planned will increase present annual capacity by approximately 2,000,000 barrels a year.

Four companies comprise the Canadian cement industry:

Canada Cement Company, Limited operates cement producing plants at Exshaw, Alberta, Fort Whyte, Manitoba, Port Colborne and Belleville, Ontario, and Hull and Montreal East, Quebec; and bagging plants at Chatham, New Brunswick, and Halifax, Nova Scotia, to which bulk cement is shipped from Montreal East where it is bagged and shipped as required.

St. Mary's Cement Company, Limited operates a plant at St. Mary's, Ontario.

Medusa Products Company of Canada, Limited operates a grinding plant at Paris, Ontario, for the production of white cement and other cement products from imported clinker.

British Columbia Cement Company, Limited makes cement at Bamberton, British Columbia.

The above plants have a total daily capacity of approximately 42,000 barrels. Canada Cement Company brought an additional kiln of 700,000 barrels annual capacity into service at its Exshaw plant in May 1948, and was installing a new kiln with a capacity of 1,200,000 barrels a year at its Belleville plant. St. Mary's Cement Company was also installing an additional kiln with a capacity of 900,000 barrels a year in its plant at St. Mary's.

Clay and limestone, the chief raw materials used in making cement, are widely distributed in Canada.

Production and Trade

	1947		1948	
	Quantity (Barrels of 350 lb.)	Value $	Quantity (Barrels of 350 lb.)	Value $
Production	11,936,245	21,968,909	14,127,123	28,264,987
Exports:				
Newfoundland	18,951	44,706	29,687	77,627
Venezuela	.....	.....	23,625	64,784
Other countries	69,079	153,648	19,687	58,164
Total	88,030	198,354	72,999	200,575
Imports:				
United States	1,178,710	3,625,642	981,620	3,547,860
Belgium	27,247	70,708	119,792	349,815
United Kingdom	41,990	143,639	18,201	91,748
Other countries	678	3,663	1,058	5,750
Total	1,248,625	3,843,652	1,120,671	3,995,173

In addition to imports shown above, 5,950 tons of white Portland cement clinker valued at $92,195 was imported from the United States for further processing in Canada. This compares with 4,881 tons valued at $64,054 in 1947.

Uses and Prices

The principal uses of cement are well known. In recent years the requirements for cement of the cement products industry have increased considerably. The products made include concrete pipe, hollow building blocks, cinder blocks, artificial stone, concrete bricks, laundry tubs, garden furniture, burial vaults, etc.

The selling price of cement per barrel fo.b. plant in the producing provinces has remained relatively steady during the past decade.

Average prices in 1947 and 1948 for Portland cement, f.o.b. cars at cities named, as compiled by the Dominion Bureau of Statistics were, per barrel of 350 pounds:

	1947	*1948*
Montreal	$1.85	$2.11
Toronto	2.33	2.58
Winnipeg	2.36	2.47
Regina	3.21	3.46
Vancouver	2.82	3.10

CLAY AND CLAY PRODUCTS

The post-war demand for clay products was reflected in the output records set by this industry in 1948. As a result of this demand expansion in production capacity and modernization in production method in the interest of efficiency have been general. However, the demand for high-tension insulators in particular was still far ahead of supply.

The demand for refractories, brick, tile, and other heavy clay products continued at a high level. In some cases expansion programs have been carried out, even to the extent of installing tunnel kilns for firing building brick.

Many new small plants have been established since the war, particularly in Eastern Canada, and others are being established. The products made or to be made by these plants include hotel and restaurant ware, low-tension electrical insulators, glazed wall tile, and art or novelty ware. A number of these plants have installed small cross-section tunnel kilns. Some are electrically heated, with globar elements, and others use fuel oil or gas.

Because of the narrowing market for Canadian-made art or novelty ware, a number of the art potteries have turned to the production of such utility ware as mugs, bowls, lamp bases, and electrical switch-boxes.

Production and Trade

	1947	1948
	$	$
Production		
From: Canadian clays[1]	14,486,189	17,629,048
Imported clays[2]	9,604,476	12,350,000
Imports		
Clays		
From: United States	1,593,082	1,887,400
United Kingdom	433,859	475,443
Total	2,026,941	2,362,843
Clay Products		
From: United States	11,912,208	14,913,340
United Kingdom	9,509,621	12,716,811
Other countries	510,897	695,952
Total	21,932,726	28,326,103
Exports		
Clays		
To: United States	13,482	15,518
Other countries	3,572	3,138
Total	17,054	18,656
Clay Products		
To: United States	267,310	324,137
Sweden	196,474	378,579
Other countries	702,062	786,760
Total	1,165,846	1,489,476

[1] Products comprise building brick, structural tile, drain tile, roofing tile, sewer pipe, stoneware, pottery and refractories.
[2] Products comprise electrical porcelain, sanitary ware, sewer pipe, tableware, pottery, ceramic floor and wall tile, thermal insulating materials, and various kinds of refractories.

Common Clays

Common clays suitable for the production of building brick and tile occur in all the provinces of Canada, but clays or shales suitable for the manufacture of high-quality brick and other clay products are not plentiful. This has presented difficulties in attempts to establish new plants in various parts of the Dominion. However, good brick clays or shales occur near Toronto, Hamilton, Montreal, and in the eastern and western coastal areas, and production of good-quality brick and structural tile is on a large scale. Good-quality structural clay products are also produced in certain areas of the Prairie Provinces.

There has been a great demand for light-weight concrete aggregate. "Haydite" (shale bloated by heat treatment) is produced regularly in a large plant near Toronto, but the demand far exceeds the amount of available material suitable for making light-weight structural units.

Stoneware Clays

The largest production in Canada 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, owing to the availability of cheap natural gas, it is used extensively to make a wide variety of stoneware articles, sewer pipe, pottery, etc. Tableware of the semi-porcelain type is also being made in Medicine Hat, but for the production of such whiteware it is necessary to import china clay from southern United States. Efforts are being made by the operating companies to develop a suitable semi-porcelain body using Saskatchewan ball clays in conjunction with nepheline syenite and certain other ingredients.

Modernization of plants has been underway for some time in the Medicine Hat area. Tunnel kilns and drying systems have been installed, forming practices have been improved, and efforts have been made to improve efficiency and control of production generally.

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 the manufacture of sewer pipe, flue liners, and certain 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 also occur near Williams Lake and Chimney Creek Bridge in British Columbia, and near Swan River, Manitoba, but they are difficult of access and have not been developed.

Throughout Ontario and Quebec stoneware clays where needed must be imported.

The value of stoneware articles (sewer pipe, pottery, etc.) produced in Canada from domestic clays was $2,684,704 in 1948, compared with $2,381,018 in 1947. The value of such products made from imported clays is not given.

Fireclays

Two large plants and a few small plants manufacture fireclay refractories from domestic clay. At one plant, about 50 miles south of Vancouver, firebrick and other refractory materials are manufactured on a large scale 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 recent years in this area for the manufacture of refractories or allied products from material obtained from the Sumas Mountain deposits. Some of this material is also exported to the northwestern states of the United States for use in making refractories. Another 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.

A small amount of the most refractory clays in the deposits near Shubenacadie has been used by the steel plant at Sydney, Nova Scotia, for refractory purposes, and some of the Musquodoboit clay has been used for the production of stove linings. Other production of fireclay refractories (firebrick, high-temperature cements, plastic refractories, etc.) in Canada, particularly in Eastern Canada, is from imported clays.

Rather extensive deposits of plastic fireclays occur in the Mattagami, Missinaibi, and Abitibi Rivers in northern Ontario, but their remoteness and certain difficulties attending efforts to extract uniform high-quality material have seriously handicapped their development.

Fireclays may be imported by rail or water transportation from the United States duty free, if not further processed than ground, and this has a decisive bearing on the question of the development of deposits of Canadian raw materials relatively remote from the consuming centres. Furthermore, suitable deposits of such alumina or alumina-silica minerals as bauxite, sillimanite, kyanite, and andalusite, valuable raw materials for the production of super-duty refractories, have either not been found in commercial quantities in Eastern Canada or suitable methods of mining and recovering them have not been applied.

The value of refractories produced in Canada from domestic clays in 1948 was approximately $689,644, compared with $559,358 in 1947. The value of refractories made from imported clays is not available. The value in 1947 was $1,327,412.

China Clay and Ball Clay

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

Several other smaller deposits of kaolin have been discovered in Quebec, one near Point Comfort, Thirty-one Mile Lake, Hull county, others near Brebeuf, Lake Labelle, and Chateau Richer; but none of these has been developed.

The clay deposits in northern Ontario, mentioned under fireclays, contain material that may be classified as crude china clay; and in British Columbia, extensive clay deposits occur along the Fraser River, about 25 miles above Prince George, some of which yield high-grade kaolin. However, their remoteness from industrial centres has prevented their exploitation.

High-grade ball clays are associated with the extensive clay deposits of southern Saskatchewan, and are being used by the potteries in the Medicine Hat area. There has also been a limited demand for these highly plastic ball clays in the United States.

China clay imported from England or the United States is used to make electrical and other porcelains, sanitary ware, tableware, ceramic floor and wall tile, etc. Because of the limited number of plants in Canada engaged in the manufacture of these products production figures are not given. Large quantities of china clay are also imported for use in the paper and rubber industries. The

total value of china clay imported into Canada in 1948 was $1,415,322, of which imports valued at $958,921 came from the United States, and at $456,401 from the United Kingdom.

CORUNDUM

No corundum has been produced in Canada since October 1946, when treatment of the old tailings at the Craigmont property, Renfrew county, Ontario, was completed. This was undertaken at the request of the United States Government and during the 2 years of operation, 2,600 tons of concentrate was shipped to American Abrasive Company, Westfield, Massachusetts, the only handler of corundum on the continent.

Shipments of corundum from the Transvaal to the United States have not been sufficient to meet the demand, and since the summer of 1947 an American Abrasive Company engineer in co-operation with the Mines Branch, Ottawa, has been investigating the possibility of supplying the deficiency from Canadian deposits. Two types of corundum are required by the company, a coarse product (8 to 20 mesh) for snagging grinding wheels and a fine (minus 100 mesh) product mainly for grinding into powders for the optical trade. It was found that in the aggregate, there is a large tonnage of corundum in the numerous deposits that occur within a belt 100 miles long and 6 miles wide in Haliburton, Hastings, and Renfrew counties in Ontario. Although much of the material is suitable for the production of wheel-grade (coarse) corundum, the deposits are scattered and the narrow corundum-bearing zones are erratic in nature. Thus it was considered that production at the present price of corundum would not be economic.

A deposit containing about 4 per cent fine-grained white corundum occurs in the east bank of York River in Monteagle township, 9 air miles northeast of Bancroft, Ontario. The corundum appears to be fairly evenly distributed throughout the exposed part of the nepheline syenite-feldspar-mica belt, this part of the belt being about 600 feet long and 150 feet wide. Tests by the Mines Branch on a 5-ton sample showed that a good recovery of concentrate containing well over 90 per cent fine-grained corundum can be made, and also that by a magnetic treatment of the tailings a product suitable for the glass trade can be obtained. Samples of this product submitted to glass companies in Canada and United States have been favourably received.

Production and Trade

Canada imports about 50 tons annually of coarse-grained corundum for use in the manufacture of snagging grinding wheels, and also a small quantity of flour corundum. The coarse-grained corundum imported is prepared for marketing in the United States from Transvaal ore.

Most of the world production of corundum during the past 30 years has come from the Transvaal, from which production in 1948 was 2,797 tons. Prior to 1946 most of the output was crystal, but the tonnage of concentrate, first produced in 1944, is now over five times that of crystal. The entire output is exported to the United States. The ores of the Transvaal vary from 20 to 50 per cent corundum.

Uses and Prices

The United States is by far the largest consumer of corundum and uses from 4,000 to 5,000 tons annually, over half of it as a flour for the polishing of lenses, and the remainder as coarse grain for snagging wheels, for which purposes it is more suitable than artificial abrasives.

United States prices of South African crystal and concentrate are $100 and $110 per ton. Prices of prepared grain and flour corundum vary considerably according to mesh size, and are 8¾ cents per pound for 6 to 60 mesh and 9¾ cents for 70 to 275 mesh. Flours range from 30 cents for 850 mesh to 70 cents for 2600 mesh.

DIATOMITE

Canadian output of diatomite in 1948 amounted to only 68 tons and sales to 46 tons. Though Canada has some large deposits of the mineral, production in the peak year 1933 amounted to only 1,800 tons, the peak since 1939 being 365 tons in 1942. Since 1941 the output has come from two deposits, one at Digby Neck in Nova Scotia and the other on lot 1122 on the west bank of the Fraser River, about 3 miles north of Quesnel in the Cariboo area, British Columbia.

Thus, Canada imports practically all of its requirements of diatomite, the sources of these imports in recent years being the states of California, Oregon, and Washington. Canadian consumption in 1948 was approximately 15,000 tons, of which 7,670 tons was used as a fertilizer dusting agent, 5,000 tons for filtration, and the remainder mainly as a filler in the paint, chemical, paper, rubber, soap, and textile industries, and also for insulation. Small amounts are used in silver polish bases, and as an admixture in concrete.

The ammonium nitrate fertilizers in which diatomite is used as a dusting agent are made in Canada by The Consolidated Mining and Smelting Company of Canada, Limited in its plants in Trail, British Columbia, and in Calgary, Alberta; and by North American Cyanamid, Limited in its plant near Welland, Ontario. The diatomite thus used is highly porous and when added to the nitrate it absorbs moisture and coats the small grains or nitraprills, which prevents caking and ensures even spreading. Specifications call for uncalcined material of 325 mesh and less than 5 per cent moisture.

The Tertiary fresh-water (swamp) deposits in the Cariboo area are by far the largest known diatomite deposits in Canada. They extend for many miles along the Fraser River, are compact, and are up to 40 feet thick. The deposit on lot 1122 is operated by A. Knickerboker for L. T. Fairey of Vancouver. The deposits on the farm of P. G. Lepetich, about 20 miles south of Quesnel, were drilled and sampled in 1948 by the British Columbia Department of Mines in co-operation with the Mines Branch, Ottawa, and several large areas of diatomite within a few feet of the surface were blocked out. Tests by the producers indicated that the diatomite is suitable for use as a fertilizer dusting agent.

At Digby Neck, Nova Scotia, are the largest known Recent fresh-water deposits in Canada and from which there has been a small output for many years.

No further work was done on Murray Campbell's diatomite deposits near Saint John, New Brunswick, which were examined by the Resources Development Board, Fredericton, in 1946.

Production and Trade

The United States, with an estimated output in excess of 200,000 short tons in 1948, is the leading producer of diatomite. Most of the output is by two companies, namely, Johns-Manville Corporation (Celite Division) from deposits at Lompoc, California; and Dicalite Company from deposits at Walteria, California,

	1947		1948	
	Short tons	$	Short tons	$
Production (Shipments)	103	2,677	46	1,487
Imports				
From:				
United States	15,073	431,012	17,197	511,679
United Kingdom	1	113	4	436
Total	15,074	431,125	17,201	512,115

Terrebonne, Oregon, Basalt, Nevada, and Kittitas and Quincy, Washington. A little over half the diatomite exported to Canada came from the various Dicalite deposits and the remainder from Lompoc.

Prices

The price of diatomite used in Canada for fertilizer grades varies from $36 to $42 a ton; for filtration from $40 to $75 a ton; and for insulation from $23 to $40 a ton. For material suitable for polishes the price for small lots ranged up to $200 a ton in 1948. Imported insulation bricks vary in price from $85 to $140 per 1,000 according to grade and density.

FELDSPAR

Production of crude feldspar in Canada during 1948 reached a record of 54,851 tons, a 52 per cent increase over 1947 and a 22 per cent increase over 1924, the previous peak year. Quebec furnished 78 per cent of the output and Ontario, 22 per cent. About 44 per cent of the tonnage was consigned to Canadian mills grinding for the domestic market and the remainder was exported to grinding mills in the United States.

Production, Trade, Consumption

In Quebec, Canadian Flint and Spar Company with mines in Derry, Buckingham, West Portland, and Templeton townships, Papineau county, accounted largely for the 1948 output. Bon Ami, Limited, and a few other smaller operators also made shipments from properties in the same general area. The old Coté mine near Cantley in Gatineau county was reopened, and minor tonnages were produced at other mines in the Lièvre River section.

In Ontario, the leading producers in order of tonnage were: Bathurst Feldspar Mines, Limited, in Bathurst township, Lanark county; Canadian Flint and Spar Company, Limited, in Bedford township, Frontenac county; and Opeongo Mining Company, with properties in the Madawaska area, Nipissing district. There was also a small production by other operators in Parry Sound district, and in Hastings and Lanark counties.

Consumption of feldspar in Canada in 1947 (figures for 1948 not available) totalled 16,013 short tons. Ontario used about 49 per cent, Quebec, 45 per cent, and Alberta, 6 per cent.

	1947		1948	
	Short tons	$	Short tons	$
Production				
Quebec	29,146	320,964	42,800	464,926
Ontario	6,958	60,396	12,051	99,511
Total	36,104	381,360	54,851	564,437
Imports				
All from United States	321	7,947	207	4,640
Exports				
To: United States	18,137	117,504	31,459	223,345
Other countries	174	3,494	8	600
Total	18,311	120,998	31,467	223,945
Consumption, by Uses				
Clay products	6,975	.....	Not yet available	
Cleansers	4,058	.....		
Glass	3,267	.....		
Enamelling	1,690	.....		
Abrasives	23	.....		
Total	16,013	.....		

All feldspar used in industry is ground, either in mills run in conjunction with mining operation or in merchant mills. Some manufacturers of ceramic products mine or buy crude spar and grind it for their own use. Feldspar for domestic use is ground by Canadian Flint and Spar Company, Limited, at Buckingham, and by Bon Ami, Limited, at Montreal, Quebec. The former company produces ground spar for ceramic and cleanser use, and Bon Ami uses its product in making cleanser compounds.

Prices and Tariffs

The average price quoted by Canadian producers for standard grades of crude ceramic and cleanser feldspar during 1948 remained at $7 to $8.50 a short ton, f.o.b. rail, for export or shipment to domestic mills. Special, high-quality ceramic crude sold up to $13. The average declared unit value of all crude ceramic-grade feldspar exported to the United States in 1948 was $7.10 a short ton. The average declared value of selected dental spar exports was $75 a ton. Domestic ground feldspar was quoted at $13 a short ton for granular glass grade, and $20 for 200-mesh pottery grades, all in carload lots, f.o.b. mill. The import duty on crude feldspar entering the United States remained unchanged at 25 cents per long ton, and on ground feldspar it was 15 per cent ad valorem.

FLUORSPAR

Fluorspar production in 1948 rose to 11,340 tons, an increase of 58 per cent over 1947. Due to lack of important fluorspar reserves, however, Canada continued to depend largely upon imports to meet domestic requirements. Imports in 1948 comprised 82 per cent of the year's indicated consumption.

With the entry of Newfoundland into the Dominion, production in Canada will be greatly increased and the lack of reserves overcome. During 1948

Newfoundland furnished 85 per cent of the total fluorspar imported into Canada. The total production of 25,743 tons in 1947 in Newfoundland was mined at St. Lawrence by the St. Lawrence Corporation of Newfoundland and by Newfoundland Fluorspar. Reserves are estimated at several million tons.

Production, Trade, and Consumption

	1947		1948	
	Short tons	$	Short tons	$
Production (Sales)	7,186	209,886	11,340	344,834
Imports				
From: Newfoundland	27,088	598,893	41,405	927,566
Mexico	3,923	69,986	6,044	130,472
United States	990	33,540	1,475	47,152
Total	32,001	702,419	48,924	1,105,190
Consumption, by Uses				
Steel	18,768	.....	Not available	
Non-ferrous smelters	18,037	.....		
Heavy chemicals	3,534	.....		
Glass, enamelling, etc.	1,040	.....		
Total	41,379	.....		

The Madoc area in Hastings county, Ontario, has supplied about 66 per cent of the total Canadian fluorspar production. Shipments in 1948 represented a record for the area. Production came from the Rogers mine operated by Reliance Fluorspar Mining Syndicate, Limited, and the Bailey mine operated by Millwood Fluorspar Mines, Limited.

The exploratory work of tunnelling, drifting, and drilling done by Cardiff Fluorite Mines, Limited, in the Wilberforce-Harcourt district, Cardiff township, Haliburton county, about 50 miles north of Madoc, during the past few years, was continued. The company reported it was considering plans for a mill to treat its anticipated production. The Wilberforce property of Fission Mines, Limited, and Dominion Magnesium's property near Cobden, in Ross township, Renfrew county, were inactive.

Fluorspar deposits occur also 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

Fluorspar is used chiefly as a powerful fluxing agent in open-hearth steel furnaces and in smaller amounts in numerous other metallurgical industries. The next largest market is for the manufacture of hydrofluoric acid for use in the aluminium industry. Most of the fluorspar imported into Canada from Newfoundland is used for this purpose at Arvida, Quebec. The ceramic industry ranks third, using fluorspar as a fluxing and opacifying ingredient in glass and enamels. Uranium hexafluoride is used for the gaseous diffusion separation of the uranium isotopes U_{235} and U_{238} in the development of atomic energy.

At present fluorspar is the only commercial source of fluorine, but a potentially important and as yet untapped source of the element exists in the huge quantities of phosphate rock used in the fertilizer industry for the production of superphosphate. On a minor scale, recovery of the average 3 per cent fluorine content of such rock, which is driven off in the form of gaseous compounds during the acidulation process, is being made at the fertilizer plant of The Consolidated Mining and Smelting Company of Canada, Limited, Trail, British Columbia.

Prices and Tariffs

Canadian trade journal quotations for metallurgical gravel 85 per cent grade fluorspar in 1948 remained at $40 a ton, bulk, f.o.b. Toronto, and for ground, 97 per cent grade, bagged, $66 to $69. Madoc fluorspar, under individual contract, sold for $25.50 a ton for 70 per cent grade, with a premium of 50 cents a ton for each unit of CaF_2 above 70 per cent. Average unit value of Madoc shipments was $30.75 a ton. Average declared unit value of fluorspar imports from Newfoundland was $22.40 a ton, from Mexico, $21.59, and from the United States, $31.97.

Ceramic and acid grades of fluorspar are produced in Canada by beneficiation of imported Newfoundland crude by Aluminum Company of Canada, Limited, at Arvida, Quebec. Quotations by this company for open sale of metallurgical grade spar in 1948 were $24 a short ton, in bulk cargo lots, f.o.b. St. Lawrence, Newfoundland. Ceramic grade was quoted at $42.50 a short ton, bagged, in carload lots, f.o.b. Arvida.

The price of acid grade was not openly quoted and was subject to individual contract. Fluorspar enters Canada duty free.

GRANITE

Improvement continued in the granite industry in 1948, the result mainly of increased construction of public and semi-public buildings, coupled with maintenance of the import quotas on foreign granites. The demand for monumental stone continued at a high level.

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. Probably 30 per cent of the area of Canada is underlain by igneous rocks. In only a small percentage of this area, however, are the rocks economically suitable for the production of granite, considering such factors as qualities of the stone, nearness to transportation, and markets.

Production and Trade

The export possibilities of monumental stock are worthy of careful study by Canadian producers especially for the black and red varieties. Many Canadian granites are suitable for all purposes for which granite is used.

All granite imported in 1948 was on a quota basis.

In Quebec grey granite is the principal rock quarried and comes from many districts, including Rivière-à Pierre, St. Samuel, St. Sébastien, Stanhope, Scotstown, and Stanstead. Black granite is produced at St. Joseph d'Alma in the Lake St. John district and in the Noranda area. Dark bluish grey granite is produced from Mount Johnson about 40 miles east of Montreal. Red granites are produced in the Grenville, Guenette, and Lake St. John districts.

	1947		1948	
	Short tons	$	Short tons	$
Production of Monumental and Building Granite				
Dressed	15,326	1,698,612	17,273	1,921,481
Rough	19,112	270,945	17,619	282,557
Total	34,438	1,969,557	34,892	2,204,038
Production of rubble and riprap, roofing granules, concrete aggregate, road metal, etc.	517,089	1,205,807	1,008,036	1,575,398
Total Granite	551,527	3,175,364	1,042,928	3,779,436
Exports of Granite and Marble, Unwrought				
To:				
United States	4,500	65,447	5,123	99,242
Jamaica	.....	.....	1	192
Total	4,500	65,447	5,124	99,434
Imports of Granite				
From:				
Sweden (mostly rough)	.....	101,241	.....	94,138
United States (about one-half rough)	.....	114,232	.....	99,362
Finland (all rough)	.....	15,327	.....	24,674
Other countries	.....	3,856	.....	2,121
Total	.....	234,656	.....	220,295

Nova Scotia is a small producer of granite. Grey granite is produced in the Nictaux and Shelburne areas and black granite from the Shelburne area.

New Brunswick has deposits of red, black, and grey granites of good quality. However, little development took place in 1948. Red granite is produced in the St. George and Bathurst districts; black granite in the Bocabec district; and grey and bluish grey granite in the Hampstead area.

Ontario produces little granite. There was some development work on the black granite at River Valley and some interest was shown in the black and red granite of northwestern Ontario.

Manitoba produced a small amount of red, grey, and black granite from quarries 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.

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 for breakwaters and causeways where there is heavy wash or currents to withstand, and some of the smaller pieces are crushed for concrete aggregate, or are used as poultry grit, paving blocks, or curbstones. However, these uses for granite waste are extremely limited compared with the amount of granite produced. Granite as a building stone is used chiefly as an ornamental stone, forming the outside facing of the lower part of many buildings.

GRAPHITE

Canadian production of graphite in 1948 totalled 14,330 tons of milling ore, a 6 per cent increase over the amount produced in 1947. Black Donald Graphite Company, Limited, subsidiary of Frobisher, Limited, which operates the Black Donald mine near Calabogie in Renfrew county, Ontario, continued to be the sole Canadian producer of natural graphite.

Artificial graphite made in the electric furnace is produced in Canada by Electro-Metallurgical Company of Canada, Welland, Ontario.

Production and Trade

	1947		1948	
	Short tons	$	Short tons	$
Shipments, by Types				
Amorphous foundry grades	2,070	143,794	2,035	165,059
Dust grades	93	18,427	124	15,722
High-grade lubricating and pencil flake	235	45,143	380	59,150
Total	2,398	207,364	2,539	239,931
Shipments, by Destination				
Export market, mainly United States	1,930	170,138	1,983	184,302
Domestic market	468	37,226	556	55,629
Total	2,398	207,364	2,539	239,931
Imports, Unmanufactured				
From: Mexico	.....	54,467	.....	45,063
United States[1]	.....	21,313	.....	25,714
Ceylon	.....	.....	.....	11,122
Total	.....	75,780	.....	81,899
Imports, Ground and Manufactured[2]				
From: United States	.....	363,271	.....	321,958
United Kingdom	.....	16,075	.....	4,552
Mexico	.....	.....	.....	7,169
France	.....	79	.....	.....
Total	.....	379,425	.....	333,679
Imports of Crucibles				
From: United Kingdom	.....	73,325	.....	59,265
United States	.....	62,569	.....	57,517
France	.....	.....	.....	217
Total	.....	135,894	.....	116,999

[1] Mainly re-exported foreign graphite.
[2] Excluding crucibles.

Occurrences and Development

Flake graphite is found in many parts of the eastern Canadian Shield. Both Canada and the United States possess important graphite reserves but are deficient in the types of graphite required for the most exacting uses, notably for crucible manufacture. Most of the deposits are comparatively low grade and production costs are high.

Mill feed at the Black Donald mine was wholly newly mined ore. Underground development comprised 408 feet of crosscuts, 156 feet of drifts, and 248 feet of raises, together with 1,088 feet of diamond drilling. This work was done on orebodies located by earlier exploration.

A total of 14,273 tons of ore of the year's production was milled. Average carbon content of the mill heads was 21 per cent, and carbon recovery, 86·6 per cent.

Uses

In Canada graphite is used chiefly in the foundry, dry battery, packings, lubricants, and paint trades. Foundry needs are met in part by domestic production and in part by imported plumbago from Ceylon. The battery trade uses mainly Mexican amorphous, and paint requirements are filled largely by low-grade amorphous and flake. American imports of Canadian graphite are used chiefly in foundry facings, lubricants, and pencils.

Mexican amorphous graphite in the form of 4-pound briquettes recently appeared on the market for use by grey iron and steel foundries during periods of pig-iron shortages.

Considerable quantities of specially refined artificial graphite are used in the construction of "atomic piles" for the production of atomic energy.

Prices and Tariffs

Type	*Price (United States, 1948)*
Flake graphite-standard grade	10 to 15 cents per pound
Crude Ceylon lump, chip and dust	5 to 14 cents per pound
Madagascar crucible flake	10 to 15 cents per pound (nominal)
special high-carbon grades....	to 35 cents per pound
Mexican crude amorphous	$16 to $35 per ton, c.i.f. New York, (according to grade)

Effective October 1, 1948, new official minimum prices set for graphite exports from Madagascar represented increases over previous levels of $18 to $20 per metric ton for flake, and $16 to $19 for fines. These increases have resulted in raising the official minimum prices for flake from $132 to $165 per metric ton (according to carbon content) to $150 to $185, and for fines from $66 to $125 to $82 to $143, all f.o.b. mines.

The average price received by Canadian exporters of graphite in 1948 was $4\frac{3}{4}$ cents per pound f.o.b. shipping point.

The Canadian tariff is as follows; graphite, not ground or otherwise manufactured, British, free; intermediate (including the United States), $7\frac{1}{2}$ per cent ad valorem; general, 10 per cent; on ground and manufactures of, including foundry facings, but not crucibles, British, 15 per cent; intermediate, $22\frac{1}{2}$ per cent; general, 25 per cent. Graphite crucibles enter Canada free under the British preferential tariff; under other tariffs the duty is 15 per cent ad valorem.

GYPSUM AND ANHYDRITE

Canadian output of gypsum for the first time exceeded 3 million tons in 1948 and the value of output for the first time passed the 5 million dollar mark. Output was 29 per cent higher than in 1947, the previous record year, and the value of output was 17 per cent higher. Much the greater part of the Canadian output is exported in the crude state mainly to the United States.

Canada has practically unlimited supplies of gypsum and anhydrite. Good-quality deposits occur in seven of the ten provinces, but production is limited to five of them.

Production and Trade

	1947		1948	
	Short tons	$	Short tons	$
Production				
Nova Scotia	2,137,704	2,303,275	2,795,848	3,028,646
New Brunswick	65,939	711,535	61,534	338,405
Ontario	155,249	671,548	182,303	770,004
Manitoba	79,356	525,197	94,698	836,483
British Columbia	58,736	523,298	82,426	574,707
Total	2,496,984	4,734,853	3,216,809	5,548,245
Exports of crude and ground gypsum and plaster of Paris and wall plaster				
To: United States	1,833,792	1,929,508	2,589,602	2,677,672
Newfoundland	82,105	90,314	31,581	38,674
Puerto Rico	6,262	10,958	7,382	12,918
Other countries	16,254	41,639	242	9,199
Total	1,938,413	2,072,419	2,628,807	2,738,463
Imports of gypsum, plaster of Paris and wall plaster				
From: United States	10,729	187,411	10,831	217,415
Mexico	8,080	56,858	.....	.....
United Kingdom	137	5,349	153	5,968
Total	18,946	249,618	10,984	223,383

Nova Scotia produces about 87 per cent of the Canadian total. Most of this production is exported to the United States in the raw state and only minor quantities are processed in Nova Scotia and Quebec. The deposits are widespread over much of the province, but mining activity is limited to two counties, Hants on the mainland and Victoria in Cape Breton Island.

Canadian Gypsum Company, Limited, a Canadian subsidiary of U.S. Gypsum Company, operated large quarries at Wentworth, Hants county. The gypsum and anhydrite is shipped by rail to large storage sheds at Hantsport and Digby from which the gypsum is transported by the company's own boats to the plants of the parent company in Atlantic coastal cities of the United States. Some anhydrite obtained from this operation is shipped to the southern United States where it is used on the peanut crop.

National Gypsum (Canada), Limited, a Canadian subsidiary of National Gypsum Company of United States, ships gypsum from its large quarry at Dingwall, Victoria county, to its own plants in eastern United States and to cement and gypsum plants in the province of Quebec. The company also obtains gypsum on contract from the quarries at Walton, Hants county.

Victoria Gypsum Company, Limited, at Little Narrows, Victoria county, made shipments of high-grade gypsum to cement plants in the United States, West Indies, and South America.

Windsor Plaster Company, Limited quarried gypsum about 12 miles east of Windsor and calcined it in a small mill at Windsor to produce hardwall and finishing plasters.

Connecticut Adamant Gypsum Company mined a small quantity of gypsum from Cheverie, Hants county, and shipped it to the company's finishing plant in New Haven, Conn.

In New Brunswick, Canadian Gypsum Company, Limited at Hillsborough produced all grades of plaster and wallboard for the markets of Eastern Canada. This plant produces high-grade plasters that are used extensively throughout Canada.

Gypsum, Lime and Alabastine, Canada, Limited enlarged the storage facilities and completely modernized the plaster mill at its Montreal East plant. Gypsum rock for this plant is obtained from Dingwall, N.S.

In Ontario, the two producers of gypsum products, namely, Gypsum, Lime and Alabastine, Canada, Limited, at Caledonia, and Canadian Gypsum Company, Limited, at Hagersville, obtain their gypsum by underground mining and produce the usual range of plaster and wallboard products.

In Western Canada, Gypsum, Lime and Alabastine, Canada, Limited has plants in Winnipeg, Calgary, and New Westminster, gypsum for which is supplied by the company's own quarries at Gypsumville, Manitoba, and Falkland, British Columbia.

Western Gypsum Products, Limited mines gypsum at Amaranth, Manitoba, which is used in the company's plants at Winnipeg and Calgary.

In 1948, a new company, Columbia Gypsum Products, Incorporated, started to mine gypsum at Windermere, British Columbia, which is to be exported by rail to the company's gypsum plant in Spokane, Washington.

Uses

Gypsum

As gypsum is the principal part of plasters and wallboards its markets depend chiefly upon the construction industry. Gypsum when heated at a low temperature gives off three-quarters of the water of crystallization. The product known as plaster of Paris will quickly set to a hard, porous mass when water is added. Plaster of Paris as such has only limited uses; for example, in moulding work where quick setting is required, or in ceramic work where its porous properties are essential. To make plasters and wallboards, the chief uses of gypsum, certain materials are added to the plaster of Paris as retarders and fillers. This gives the final products a longer period of set and greater strength than the original plaster of Paris. Special products are also made from calcined gypsum such as acoustic boards, partition tile, fire-resisting walls, insulating tile, etc. Gypsum is also added in small quantities to Portland cement, where it acts as a retarder in the time of set of the cement.

Gypsum in the ground form was formerly used in large quantities as a fertilizer on many types of soil. This use, however, now appears to be limited mainly to black alkali soils.

Anhydrite

Anhydrite has few uses compared with gypsum. Production is usually from gypsum quarried where the removal of anhydrite beds is essential to the further operation of the quarry as a gypsum producer. The material is used on peanut crops in the United States where the anhydrite acts as a soil conditioner. Development work is still proceeding on a plant in Hillsborough, New Brunswick, to use Canadian anhydrite for the manufacture of sulphuric acid and cement. Such plants are operated successfully in France and England. Another potential use for anhydrite is as a filler in making some papers.

Prices

The nominal price of crude gypsum as quoted by Canadian Chemical and Process Industries was $3 to $3.50 per ton f.o.b. quarry or mine. However, large contracts with seaboard quarries were at prices much below these figures.

For export, contracts are generally made with the producer for the year's requirements of the purchaser and are usually made early each year.

IRON OXIDES (OCHRES)

Ochreous iron oxide, which is sold uncalcined and is used chiefly in the purification of illuminating gas, comprises the bulk of the minerals produced under this category. The Canadian output has ranged from a peak of 19,128 tons in 1920 to a low, since then, of 4,357 tons in 1933, the output in 1948 being 13,181 tons. The province of Quebec has been the chief source of production since records were started in 1886. Its output is mainly from deposits near Trois Rivières, and provides the domestic requirements and a small export market. A small production of crude iron oxide from deposits in British Columbia has been recorded each year since 1921.

Sherwin-Williams Company of Canada, Limited, the only Canadian producer of calcinated iron oxides, operated its deposits and plant at Red Mill, Champlain county, Quebec, a few miles east of Trois Rivières, throughout 1948. The mill output consisted of calcined, milled, and air-floated products, used for mineral pigments and polishing rouge. Crude ochres were mined from deposits at Pointe-du-Lac, Les Vieilles Forges, and Marchand, St. Maurice county; at Almaville, Saint Louis de France, and St. Adelphe, Champlain county; and at St. Raymond, Portneuf county. A new operation was started at Fief St. Maurice, 1 mile south of Les Vieilles Forges, and a small output of air-dried ochre was shipped to the United States.

The small production of iron oxide from the Morning Star mine of B.C. Electric Company at Alta Lake, New Westminster district, British Columbia, is used chiefly for the purification of illuminating gas. Elsewhere in Canada, the several known deposits of ochre have received little active attention. The principal deposit in Saskatchewan of possible economic interest is at Loon Lake, 32 miles from St. Walburg on the Canadian National Railway, and 77 miles northwest of North Battleford. In northern Manitoba, large deposits occur near Grand Rapids and Cedar Lake, but they have not been developed because of lack of markets.

Production and Trade

	1947		1948	
	Short tons	$	Short tons	$
Production (Sales)				
Quebec	13,360	257,621	12,095	193,619
British Columbia	58	701	1,086	9,772
Total	13,418	258,322	13,181	203,391
Imports—Ochres, siennas, umbers				
From: United States	1,197	65,130	1,423	67,905
United Kingdom	39	3,296	39	3,367
Total	1,236	68,426	1,462	71,272
Exports—Iron oxides				
To: United States	4,439	174,966	4,466	182,321
Belgium	282	40,831	135	21,767
Brazil	31	5,039	95	15,683
Other countries	635	92,181	554	92,814
Total	5,387	313,017	5,250	312,585

Uses and Prices

The ochreous iron oxide used in the manufacture of paints is largely in the calcined form. However, a small quantity of natural iron oxides associated with clay-like materials in the form of umbers and siennas is also used as pigments in paints, in the raw and calcined states.

The Canadian consumption of iron oxide by the illuminating gas industry in 1947 (figures for 1948 not available) was 10,105 tons. The paint industry consumed 2,865 tons of calcined iron oxide valued at $339,151 and 404 tons of ochres, siennas, and umbers valued at $57,876.

Iron oxide pigments are used also as colouring agents and fillers in the manufacture of imitation leather, shade cloth, shingle stain, paper, and cardboard. Siennas and umbers are used in wood stains and wood fillers. The natural ochre is used as a pigment for linoleum and oilcloth; as a pigment in wood stains and wood fillers; and in colouring cement, stuccos, and mortar.

The Canadian price of red iron oxide, f.o.b. Toronto or Montreal, as given by Canadian Chemistry and Process Industries, varied from 2 to 9 cents a pound throughout 1948, and yellow, brown, and black iron oxides remained between 5 and 12 cents a pound.

LIME

Canadian production of lime reached a record total of 1,053,584 tons valued at $10,655,062 in 1948, reflecting the exceptionally strong demand for the product in the chemical, metallurgical, and construction industries. Ontario contributed 48 per cent of the tonnage output, and Quebec, 37 per cent. The remainder came from British Columbia, Manitoba, Alberta, and New Brunswick, in that order.

Production, Trade, and Consumption

Limestone suitable for the production of lime occurs in all provinces except Prince Edward Island. The concentration of industry in Ontario and Quebec, however, resulted in the establishment of the important centres of lime production in these two provinces. This concentration of demand has encouraged development of large kilns and efficient plants with relatively low production costs.

British Columbia, Alberta, and Quebec are sources of high-calcium lime; and Ontario, Manitoba, and New Brunswick produce both dolomites and high-calcium lime.

There are many prospective lime-producing localities in Canada as limestone is abundant throughout the country; but in the more highly industrialized areas, particularly in Quebec and Ontario, unworked, easily accessible deposits of pure high-calcium limestone that will yield a white lime suitable for chemical requirements are becoming scarce.

Quicklime is marketed in the lump, pebble, crushed, and pulverized forms. The lump and pebble lime is sold either in bulk or packed in air-tight multi-wall paper bags.

Hydrated lime, a specially prepared dry slaked lime in the form of a powder of such fineness that usually over 95 per cent will pass a 325-mesh sieve, is marketed in 50-pound multi-wall paper bags.

	1947		1948	
	Short tons	$	Short tons	$
Production				
Quicklime	801,886	7,021,199	850,043	8,709,834
Hydrated lime	175,527	1,521,308	203,541	1,945,228
Total production	977,413	8,542,507	1,053,584	10,655,062
Imports (Quicklime)				
All from United States	13,044	115,199	23,878	219,485
Exports				
To: United States	27,910	286,098	31,741	460,352
Newfoundland	689	11,094	596	10,254
Other countries	16	386	17	503
Total exports	28,615	297,578	32,354	471,109
Production, showing Purpose for which Used[1] *or Sold*				
Pulp and paper mills	212,985	2,032,302	230,317	2,577,266
Metallurgical	129,572	796,814	143,709	964,308
Building trades	126,705	1,537,193	141,388	1,916,400
Glass works	25,314	140,135	14,451	138,023
Sugar refineries	18,467	137,125	19,317	144,977
Sand-lime brick	10,390	79,088	9,634	85,296
Agriculture	6,664	60,864	12,249	124,136
Other industrial uses	437,247	3,631,052	464,410	4,474,234
Miscellaneous non-industrial uses	10,069	127,934	18,109	230,422
Total	977,413	8,542,507	1,053,584	10,655,062

[1] Approximately 45 per cent of the total is consumed by the producers themselves.

Uses and Prices

Lime is one of the great basic raw materials of the modern chemical and metallurgical industries. Large quantities are also used in the construction industry. Hydrated lime is used in agriculture as the principal ingredient of certain spray mixtures and dusting powders and for sweetening acid farmland.

Prices of the various lime products vary over a wide range, depending upon the geographical position of the plants and upon differences in the quality of the lime. The average price in 1948 of quicklime f.o.b. plants, but exclusive of containers, was $10.11 per ton.

LIMESTONE (GENERAL)

Production of limestone in Canada for 1948, exclusive of stone quarried for the cement and lime industries, reached a new peak of 10,003,142 tons valued at $12,523,275, compared with 9,497,754 tons valued at $11,966,520 in 1947. The over-all production in 1948 amounted to 15,245,789 tons.

Limestone is widely distributed in Canada and is available in all provinces, with the exception of Prince Edward Island. Its uses have become so important

and varied that it is quarried widely and present production, including that required by the cement and lime-burning industries, amounts to nine-tenths of the country's total stone production.

In Canada limestone occurs mostly in extensive bedded formations, and also in highly metamorphosed non-bedded deposits. It is from the former that most of the Canadian output is obtained. In composition the limestones range from high-calcium through magnesian limestones to dolomite, with occurrences of both the argillaceous and siliceous varieties. There are also large deposits of brucitic limestone and magnesitic dolomite.

It is now evident, however, that in spite of the abundance of domestic limestone high-calcium varieties suitable for chemical and metallurgical use, and near industrial areas, are becoming scarce. Future supply may, therefore, have to be obtained by underground mining or beneficiation of deposits of lower grade. At several Portland cement plants located in various parts of the world impure stone is beneficiated by flotation.

There is little trade in limestone between Canada and other countries as the material is a low-cost commodity widely distributed. In certain consuming centres it is imported for use as blast furnace flux, road metal, and for pulp manufacture. A small quantity is exported to the United States for use in sugar refineries and agriculture. Trade in limestone is not recorded separately.

Uses

To meet the various industrial requirements limestone is marketed in many forms, ranging from dimensional blocks for constructional use to finely pulverized material used as a mineral filler. For most uses, such as railway ballast, road metal, concrete aggregate, and as a flux in metallurgical plants, limestone is processed by crushing and screening, but for certain uses such as in the pulp industry the stone is used as quarried. Considerable stone is used in the manufacture of Portland cement, lime, and in the chemical industry. The chemical and metallurgical industries use high-calcium stone chiefly.

Argillaceous dolomite is used in the manufacture of rock wool. Production of the eleven rock wool plants in 1948 amounted to $6,016,441, compared with $4,946,388 in 1947. Imports of rock wool, all from the United States, decreased to $8,795 from $417,450 in 1947. Imports of glass wool, all from the United States also, increased from $520,786 in 1947 to $1,303,099 in 1948.

Magnesia and magnesium carbonate are prepared from calcined dolomite by the Pattinson process. During the latter part of the recent war dolomite became an important source of raw material in Canada and elsewhere for the production of magnesium metal.

Dead-burned dolomite for use by the steel industry as a refractory in basic open-hearth furnaces is produced at Dundas, Ontario, in a plant that commenced operations in 1945.

At Kilmar, Quebec, a magnesitic dolomite is mined and processed into magnesite brick and other basic refractories. At Wakefield, Quebec, brucitic limestone is processed for the production of magnesia, fertilizer material, and hydrated lime. The magnesia so produced is used in part in the manufacture of magnesium metal and of basic refractories.

In agriculture the necessity of adding limestone or lime to the soil to neutralize acidity and overcome deficiencies of lime and magnesia, to preserve or increase the fertility of farm lands has long been emphasized. However, consumption of limestone for this purpose in Canada remains relatively small. In 1947, 6,664 tons of quick- and hydrated lime were used for this purpose and 450,553 tons of limestone were used as direct addition to soil or by fertilizer plants.

LIMESTONE (STRUCTURAL)

The large demand for dimension stone for building construction experienced by the industry in 1947 continued on a slightly reduced scale during 1948. Production of 54,340 tons valued at $1,334,680 was down slightly in value and moderately in tonnage from 1947. Most of the decrease occurred in the province of Quebec, where dressed stone of higher unit value than in the previous year was reported with a lower production of rough and cheaper types of dressed stone. The intensive building program in Canada resulted in activity in a number of small quarries producing small amounts of hand-dressed stone to supply local demand.

Production of dimension limestone is confined to Quebec, Ontario, and Manitoba. Most of the requirements are for sawn slabs and blocks, accurately dimensioned for use in the larger types of buildings. Stone suitable for this purpose is of the heavily bedded variety, free from cracks and other defects and easily worked. Such stone of the desired texture is not plentiful in Canada and a considerable quantity is imported from the United States.

Production and Trade

	1947		1948	
	Short tons	$	Short tons	$
Production [1] of Limestone for Building Purposes				
Quebec	36,131	957,806	23,279	949,362
Ontario	23,342	207,096	29,261	285,318
Manitoba	6,076	216,699	1,800	100,000
Total	65,549	1,381,601	54,340	1,334,680
Imports of Building Stone (Except Marble and Granite)				
From: United States	19,015	189,697	34,388	370,085
United Kingdom	.....	.....	662	11,498
Other countries	136	4,047	240	5,696
Total	19,151	193,744	35,290	387,279
Exports of Building Stone Unwrought (Except Marble and Granite)				
To: United States	65	959	49	1,078
Newfoundland	.....	.....	1	90
Total	65	959	50	1,168

[1] The value of production refers only to stone marketed as mill blocks or in finished condition by the quarry and does not include the value of the work done on the stone by cut-stone contractors.

Producing quarries in Quebec are located in Portneuf county at St. Marc des Carrieres, and in the vicinity of Montreal. Both areas supply a grey stone.

In Ontario, heavily bedded deposits of silver grey limestone are quarried at Queenston in the Niagara district and from these deposits variegated buff and grey stone are also obtained. At Longford Mills, near Orillia, buff, silver grey, and brown limestone suitable for building stone is available but the quarries are now inactive.

A number of small quarries in Quebec and Ontario intermittently quarry hand-stone for local demand.

Limestone suitable for building exteriors and as an interior decorative stone, often polished, is quarried at Tyndall, Manitoba, the types marketed being a characteristic grey, a mottled buff, and a variegated stone.

Prices

Prices of mill blocks vary with the quarry location, size of block, and grade of stone, and range up to $1.10 a cubic foot, f.o.b. quarry.

MAGNESITE AND BRUCITE

The value of refractory products made from magnesitic dolomite and brucitic limestone in 1948 amounted to $1,724,489, a new record.

Magnesitic dolomite, a rock composed of an intimate mixture of magnesite and dolomite, is mined at Kilmar, Argenteuil county, Quebec, by Canadian Refractories, Limited and converted into refractory products. During 1948 the company put a new 245-foot rotary kiln into operation and completed the installation of a heavy-media separation plant that will permit mining lower grade ore. The new rotary kiln replaced four small kilns.

Brucitic limestone, a rock composed of granules of brucite (magnesium hydroxide) thickly distributed throughout a matrix of calcite, is quarried from large deposits near Wakefield, Quebec, by Aluminum Company of Canada, Limited and processed for the recovery of magnesia and lime. Most of the output of magnesia is sold for use in making basic refractories and as fertilizers. Some is used for making magnesium metal and for general chemical purposes. Hydrated lime produced during the process of recovering the magnesia is marketed for use chiefly in the building trades, in non-ferrous smelters, in pulp and paper mills, and for agricultural purposes.

Brucitic limestone deposits occur also at Bryson, Quebec, at Rutherglen, Ontario, and on West Redonda Island in British Columbia. In addition there are small deposits at a number of other places in Ontario and Quebec.

Magnesite occurs in British Columbia and in Yukon. The most important of these deposits, at Marysville, British Columbia, near Cranbrook, is owned by The Consolidated Mining and Smelting Company of Canada, Limited, but there is no production. The magnesite contains considerable silica but the company has devised a flotation process to remove the greater part of these impurities. Other known deposits of magnesite in British Columbia and Yukon are either of such limited extent or so far from transportation that they are not of economic interest at present. Some deposits of earthy hydromagnesite near Atlin and Clinton in British Columbia have been worked on a small scale at various times but there has been no production in recent years.

Uses

Magnesitic dolomite is used entirely for the production of basic refractories. These include dead-burned grain materials; bricks and shapes; and finely ground refractory cements.

Brucitic limestone yields magnesia for making basic refractory bricks and shapes both burned and chemically bonded, for use in fertilizers, for magnesium oxysulphate products, for magnesium metal, and for a number of minor uses. The magnesia has been used satisfactorily for making magnesium bisulphite liquor needed in making special grades of paper, and, on an experimental scale, for magnesium oxychloride cement.

	1947		1948	
	Short tons	$	Short tons	$
Production: Magnesite—Brucite*	.....	1,238,948	.....	1,724,489
Imports:				
Dead-burned and caustic-calcined magnesite:				
From: United States	8,764	609,985	7,018	485,215
United Kingdom	49	9,753	518	67,316
Other countries	526	43,012	177	19,543
Total	9,339	662,750	7,713	572,074
Magnesite fire-brick:				
From: United States	.....	464,048	.....	430,768
Other countries	.....	993	.....	653
Total	.....	465,041	.....	431,421
Magnesia Alba and Levis:				
From: United States	337	45,189	433	92,574
United Kingdom	87	30,634	60	29,488
Total	424	75,823	493	122,062
Magnesia pipe covering:				
From: United States	.....	58,643	.....	128,081
United Kingdom	.....	142,748	.....	257,271
Total	.....	201,391	.....	385,352
Magnesium carbonate:				
From: United States	161	21,644	163	22,251
United Kingdom	385	50,157	532	69,038
Total	546	71,801	695	91,289
Magnesium sulphate:				
From: United States	2,897	107,961	2,742	114,501
United Kingdom	10	879	55	4,291
Total	2,907	108,840	2,797	118,792
Exports:				
Basic refractories, dead-burned:				
To: United States	1,000	1,665	2,383	95,616
Brazil	2,272	32,222	1,480	84,993
Argentina	76	3,594	220	8,028
Other countries	1,519	44,205	274	15,034
Total	4,867	81,686	4,357	203,671

* Includes magnesium metal.

MARBLE

Few new developments of consequence occurred in the marble industry in 1948. Production amounted to 68,347 tons valued at $528,529, compared with 45,574 tons valued at $326,605 in 1947. Ontario produced about 73 per cent of the Canadian output of marble, Quebec 26 per cent, and British Columbia the remainder. However, Quebec's output in 1948 was of approximately the same value as that of Ontario. Although mill blocks for sawing into ornamental slabs were quarried, Canadian production in 1948 consisted chiefly of terrazzo chips, poultry grit, whiting substitute, stucco dash, marble flour, and of aggregate for the manufacture of artificial stone.

The value of imports of the various types of marble was lower than in 1947, the breakdown for 1948 being as follows:

Imports of Marble, 1948

(By countries of origin)

Type of marble	United States	Belgium	Italy	France	United Kingdom	Total
	$	$	$	$	$	$
Rough	38,053	6,069	37,687	.....	.....	81,809
Sawn	59,785	1,032	34,614	.....	.....	95,431
Tombstones	63,888	.....	241	.....	.....	64,129
Manufactured	6,322	105	3,864	.....	.....	10,291
Ornamental for churches	241	.....	19,951	5,041	.....	25,233
Totals	168,289	7,206	96,357	5,041	.....	276,893
Mosaic flooring[1] materials	116,081	11,228	11,735	6,122	50,162	195,328

[1] Consist largely of marble.

Imports in 1947, excluding mosaic flooring materials, were valued at $319,232. Including these materials, they were valued at $487,881.

Imports of marble are mainly in the form of mill stock which is processed in Canadian marble dressing mills to meet customers' requirements.

Operations

Quebec

Missisquoi Stone and Marble Company, Limited operates the largest marble quarry in Canada at Philipsburg near the foot of Lake Champlain, and produces clouded grey marble.

Orford Marble Company, Limited produces terrazzo chips from a deposit of red, green, and grey marbles of the serpentine variety in Shefford county, near North Stukely. Provided the marble has the required physical properties, the company plans to produce mill blocks.

Canadian Dolomite Company, Limited quarries a white dolomite at Portage du Fort, Pontiac county, which is crushed to produce terrazzo chips, stucco dash, aggregate in artificial stone, and various other products.

The building stone quarries at St. Marc des Carrieres, Portneuf county, produce a brown marble from the Trenton limestone to supply an intermittent demand. The marble is dressed for store counters and wainscoting.

Ontario

Silvertone Black Marble Quarries, Limited quarries black marble at St. Albert, 30 miles southeast of Ottawa.

Karl Stocklosar produces buff, red, white, green, and black marbles, and terrazzo chips from a deposit near Madoc.

Verona Rock Products, Limited, Verona, about 20 miles northwest of Kingston, produces poultry grit and stucco dash from white limestone.

Bolender's, Limited produces white terrazzo and poultry grit at Marmora, 10 miles west of Madoc.

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, about 100 miles north of Winnipeg.

British Columbia

Production is confined to a small tonnage of white marble by Marble and Associated Products from a quarry near Victoria.

There are several undeveloped deposits in the province.

Price

The price of marble varies widely according to quality and to variety of colour.

MICA

Canadian sales of sheet mica of all classes declined 23 per cent during 1948 below the 1947 output of 562,606 pounds. Production of newly mined sheet mica has shown a progressive decline since the war. Although the quantity of scrap sold increased slightly, the output of flake mica mined for the production of ground mica decreased 24 per cent to 6,692 tons, and ground mica sales, 10 per cent, to 1,874 short tons.

Sheet mica comprises material sold in the rough, mine-run, rifted, or untrimmed state, trimmed block or sheet, and splittings. With the exception of a few tons of low-grade muscovite, the 1948 production of sheet mica comprised phlogopite and lepidomelane. The great bulk of the rough, untrimmed mica sold consisted of formerly discarded small sizes salvaged from old waste dumps.

Quebec furnished nearly 84 per cent of the sheet sold, and Ontario, the remainder. Ontario supplied 87 per cent of the scrap sales, and Quebec, 13 per cent. Of the flake mica rock mined directly for the production of ground mica, 94 per cent was produced in Quebec and 6 per cent in British Columbia. Of ground mica sales, 83 per cent was produced in Quebec and the remainder in British Columbia.

Production and Trade

Main source of phlogopite production is the general Ottawa region in both Ontario and Quebec. Most of the output of sheet phlogopite is handled and prepared for market by producers and dealers having trimming establishments in or near Ottawa.

In Quebec, the large mine of Blackburn Bros. (Blackburn Building, Ottawa), near Cantley in Hull township, was closed all year and only a small amount of mica was taken from old surface pits. J. J. Egan (Sydenham Mining Company)

	1947		1948	
	Quantity	Value	Quantity	Value
	Pounds	$	Pounds	$
Production (Sales)				
Primary sheet, including rough, trimmed, and splittings	271,057	49,169	114,456	33,931
Small untrimmed, sold for mechanical splittings	291,549	54,357	317,005	67,635
	Short tons		Short tons	
Scrap	1,789	30,781	1,861	34,158
Ground	2,089	66,596	1,874	84,224
Total sales	.....	200,903	.....	219,948
	Short tons		Short tons	
Rock mined for recovery of grinding flake	8,822	.....	6,692	.....
Imports (Mica and Manufactures thereof)				
From: United States	.....	249,480	.....	241,850
India	.....	307,196	.....	148,230
Other countries	.....	14,962	.....	17,122
Total imports	.....	571,638	.....	407,202
	Pounds		Pounds	
Exports				
Rough—All to United States	430,200	71,002	354,300	75,205
Splittings—All to United States	3,400	2,186	11,300	8,272
Trimmed block or sheet:				
To: United States	3,900	3,915	8,400	3,745
Japan	40,000	18,500	.....	.....
Other countries	2,200	3,077	100	90
	Short tons		Short tons	
Scrap—All to United States	1,280	21,724	999	16,002
Ground—All to United States	90	6,940	1,061	45,185
Manufactures:				
To: Brazil	.....	2,010	.....	1,461
Other countries	.....	185	.....	401
Total Exports	.....	129,539	.....	150,361

produced some high-quality mica from an old property adjoining the Blackburn mine. J. B. Gauthier of Buckingham continued small shipments from a deposit in Denholm township. The remainder of the Quebec output came mainly from a number of small scattered deposits in the general Gatineau-Lièvre Rivers section.

The grinding plant of Suzorite Company, Limited, a subsidiary of Siscoe Metals, Limited, installed at Shawinigan Falls, Quebec, in 1947, was closed in April 1948 and the equipment was moved to a new site at Cornwall, Ontario. The new mill came into operation early in 1949. The company recovers flake mica from a large deposit in Suzor township, Laviolette county, Quebec.

In Ontario, old waste dumps at the Lacey mine of Loughborough Mining Company (General Electric Company), near Sydenham, in Frontenac county, continued to be the principal source of scrap mica sold. Bancroft Mica and Stone Products Mining Syndicate, Limited, with mine in Faraday township,

Hastings county, and shop at Bancroft, accounted for most of the sheet mica output in the province and also made shipments of shop and mine scrap. F. Lemieux of Godfrey made small shipments of rough sheet and scrap from the old Orser mine at Thirtyisland Lake in Bedford township, Frontenac county.

In British Columbia, ground muscovite mica made from schist rock mined in the Albreda region by George Campbell continued to be produced by Fairey and Company and George W. Richmond and Company, both of Vancouver, for sale to the local roofing trade.

*Consumption in 1946**	Short tons
Electrical apparatus	178
Rubber	132
Roofing	1,064
Wallpaper	199
Mica manufacturing	70

* No later figures available as yet.

Uses

Mica is outstanding as an insulating material in all forms of electrical equipment and appliances, and almost all the production of sheet muscovite and phlogopite is used in the electrical industry. Some clear mica, mostly muscovite, is used as stove windows and in lighting equipment. There is a limited demand for special large-sized, flawless sheet for use in marine compass dials, boiler gauges, and in the iconoscopes of television transmitters.

Large quantities of muscovite are used in the form of thin sheets for radio and magneto capacitor films. Heavily spotted and stained muscovite ("electric" mica) is used chiefly in domestic heater appliances. Fine flake or powdered mica is used mainly in the roofing and paint trades. It is also used in rubber manufacture, wallpaper, plastics, moulded electrical insulation, lubricating greases, foundry core and mould washes, fire-resistant wallboard, pipeline enamel, Christmas tree "snow", and for oil-well drilling and annealing.

Prices and Tariffs

Dealers' selling quotations for the smaller sizes of Canadian sheet phlogopite in 1948 remained unchanged, but advanced from 15 to 30 per cent in the range 2 by 3 inches and up. Prices vary according to quality, as based on colour, softness, and splitting properties.

Ground phlogopite was quoted as follows, according to fineness: 20 mesh, $60; 60 mesh, $80; 150 mesh, $90; 250 mesh, $140; all prices f.o.b. Ottawa, in ton lots, bags extra. Scrap phlogopite for grinding was sold for $16 to $20 per short ton, according to quality.

Under the Multilateral Trade Agreement, effective January 1, 1948, downward revision was made in the United States tariff on the following classes of mica: on unmanufactured mica valued at over 15 cents per pound, the duty was reduced from 4 cents per pound plus 25 per cent to 2 cents per pound plus 15 per cent; the former duty of 10 per cent on small sizes of untrimmed phlogopite was lowered to 5 per cent; mica films and splittings not cut or stamped to dimensions and not over 1·2 mils in thickness become dutiable at 12½ per cent (from 25 per cent), and over 1·2 mils in thickness at 20 per cent (from 40 per cent); the duty on films and splittings cut or stamped to dimensions was reduced from 45 per cent to 22½ per cent, and on micanite and other manufactures of mica, from 40 per cent to 25 per cent; the duty on phlogopite waste or scrap valued at not over 5 cents per pound remained unchanged at 15 per cent, and on scrap of other types of mica was lowered from 25 per cent to 15 per cent. Ground mica continues dutiable at 15 per cent, unchanged.

NEPHELINE SYENITE

Production of crude nepheline syenite in Canada in 1948 increased 31 per cent over the 1947 output, to a total of 94,200 short tons, of which 53,000 tons was exported as crushed crude to the United States. American Nepheline Corporation, with operation at Blue Mountain in Methuen township, Peterborough county, Ontario, continued to be the sole Canadian producer. The exported material was shipped to the company's Rochester, N.Y., mill.

Production, Trade, and Consumption

	1947		1948	
	Short tons	$	Short tons	$
Production of crude	72,000	.....	94,200	.....
Shipments of crushed crude	53,000	173,968	53,173	212,975
Sales of processed material made in Canada				
Granular, glass grade	12,720	148,007	16,587	219,532
Ground, pottery grade	1,229	19,065	4,546	73,155
Dust, B-grade	46	595	80	800
Total sales	13,995	167,667	21,213	293,487
Exports of crushed crude and processed material				
To: United States	52,176	187,848	60,537	314,826
United Kingdom	22	504	286	5,701
Czechoslovakia	.....	.....	222	5,256
Other countries	.....	.....	62	1,735
Total	52,198	188,352	61,107	327,518
Consumption, by uses				
Glass	9,122	.....	Not available	
Pottery	115	.....		
Total	9,237	.....		

Known resources in Ontario are near Bancroft in Hastings county, near Gooderham in Haliburton county; in the French River area, Georgian Bay district; and at Port Coldwell, Thunder Bay district, on the north shore of Lake Superior. In Quebec nepheline is a constituent of syenites in the Montreal, Labelle-Annonciation, and other areas. In British Columbia there are extensive bodies in the Ice River district near Field.

Canada and Russia are the only important producers of nepheline syenite, Canada being the sole source of high-grade ceramic material. Nepheline syenite is relatively high in alumina (23 per cent in the Blue Mountain rock) compared with straight feldspar (17 to 20 per cent), and for this reason it has found favour as a feldspar substitute in a number of ceramic industries, more especially in the glass trade.

In the combined surface and underground workings at Blue Mountain about 32 per cent of the rock produced in 1948 was taken from surface and 68 per cent from underground. A new open-pit operation on the site known as the "Cabin Ridge" section was started. This site furnishes rock entirely free of corundum and muscovite mica, often present in the western part of the deposit, and which was difficult to remove by processing. Indicated reserves

in this section total at least one million tons. It is proposed to draw all future production from this new quarry, and to use the underground stopes for storage of broken rock to supply the mill during the winter.

The crude rock of the Blue Mountain deposit contains a small and fairly uniform amount of iron-bearing impurities, chiefly magnetite and biotite mica. These are of relatively coarse size and can be removed readily at a 28-mesh grind by magnetic means.

The cleaning mill put into operation in 1947 carries processing of crude to the stage of removal of iron-bearing impurities at 28-mesh size, delivering a clean, granular product for the glass trade and for the production of ground pottery-grade material. Crushing capacity for ¾-inch rock is 300 tons per day, and output capacity of cleaned glass-grade product, 100 tons per day. Loss in cleaning runs about 30 per cent of the mill-feed. With the addition of a second Hardinge mill at the company's grinding plant at Lakefield the former capacity of one ton per hour was doubled. This plant produces 200-mesh pottery-grade material for the Canadian and export markets.

Uses

The use of syenite has been expanding rapidly in other branches of ceramics, besides its former chief use in the manufacture of container glass, for which it was marketed in the form of a 28-mesh product. Ground to 200-mesh it is now used in low-temperature vitreous bodies, dinnerware, electrical porcelain, sanitary ware, enamels, etc. Nepheline syenite is claimed to be superior to feldspar in the manufacture of artificial teeth. The by-product, low-grade dust, made in the cleaning process finds a limited market for cleansers, enamels, and certain other clay products.

Prices and Tariffs

Granular glass-grade nepheline syenite produced in Canada in 1948 was quoted at $14 per ton in carload lots f.o.b. rail. That made in Rochester, N.Y., sold for $14.25. Ground 200-mesh pottery grade was priced at $18 f.o.b. Lakefield mill, and $18.25 f.o.b. Rochester. B-grade dust sold at $10 l.c.l., f.o.b. both points. Average declared value of crude exported to the United States was $4 a ton. Both crude nepheline syenite and the finished product, granular glass grade, enter the United States free of duty.

PHOSPHATE

There was no production of phosphate in Canada in 1948 nor in 1947. Practically all of the Canadian phosphate requirements are imported from the United States. Production in the past has consisted almost wholly of the mineral apatite, of which Quebec supplied about 90 per cent, and Ontario 10 per cent.

A program of exploration by drilling was commenced on a group of old apatite mines in the Lièvre River district in Quebec, under option of Quebec Smelting and Refining, Limited, of Montreal. The company will also study possible methods of beneficiating low-grade rock.

Sedimentary rock phosphate that occurs along the Rocky Mountain Divide, notably in the vicinity of Crowsnest, is too low grade to be of present economic interest.

Trade and Consumption

	1947		1948	
	Short tons	$	Short tons	$
Imports				
From: United States	474,957	2,726,961	476,968	2,842,200
Netherlands W. Indies	10,434	130,561	5,040	68,968
Total	485,391	2,857,522	482,008	2,911,168
Consumption				
Fertilizers	398,685	.....	Not available	
Phosphorus and compounds	22,000	.....		
Steel furnaces	1,300	.....		
Miscellaneous	12,986	.....		
Total	434,971	.....		

Uses

Phosphate is used chiefly for the manufacture of fertilizer and for the production of elemental phosphorus and phosphorus base chemicals. All material for fertilizer is imported from Florida and Montana and is used in plants of Canadian Industries, Limited, and of The Consolidated Mining and Smelting Company of Canada, Limited.

Prices

Trade journal quotations for Florida pebble phosphate at the end of 1948 ranged from $7.31 to $4.61 per long ton for grades between 76 and 66 per cent B.P.L. (bone phosphate of lime), an advance of $1 to $1.25 per ton over quotations at the beginning of the year. Laid-down cost of Florida rock, 72 to 73 per cent grade, at Buckingham, Quebec, ranged from $15 to $15.75 per long ton.

PYRITES AND SULPHUR

All pyrites produced in Canada is obtained as a by-product from the concentration of base metal sulphide ores, and none is mined as a primary material. The sulphur content of these pyrites concentrates ranges from 47 to 50 per cent. Pyrites in this form is sold for making sulphuric acid at plants in British Columbia, Ontario, and Quebec, and is exported to the United States and Mexico for the same purpose.

Companies marketing pyrites concentrates in 1948 were: Noranda Mines, Limited, Noranda, Quebec; Waite Amulet Mines, Limited, Noranda, Quebec; and Britannia Mining and Smelting Company, Limited, Britannia Beach, British Columbia.

In addition to these sources of pyrites there are large deposits at a number of places, notably in British Columbia on Ecstall River near its junction with Skeena River 45 miles from Port Essington; in Ontario 7 miles west of Sioux Lookout; and in the Algoma district.

The sulphur content of gases from the smelter of The Consolidated Mining and Smelting Company of Canada, Limited at Trail, British Columbia, and from the smelter of The International Nickel Company of Canada, Limited

at Copper Cliff, Ontario, is utilized for the manufacture of sulphuric acid, and at Copper Cliff, liquefied sulphur dioxide is also produced from the gases. Smelter gases now constitute the principal source of sulphuric acid in Canada.

Native sulphur is not known to occur in commercial quantities in Canada but it has been produced from smelter gases at Trail, British Columbia, by Consolidated Smelters. It is not being produced at present because all the sulphur in the gases is required for making sulphuric acid for use in the manufacture of fertilizers.

Noranda Mines, Limited has large-scale experimental work underway on the production of sulphur and iron from pyrites. If a commercial process is evolved there is sufficient pyrites available in the Noranda district to produce 200,000 tons of sulphur annually for many years.

The deposits of anhydrite and gypsum in the Maritime Provinces and elsewhere in Canada constitute a huge potential source of sulphur and its compounds. A process producing sulphuric acid and Portland cement from anhydrite and gypsum is in successful operation in Germany, England, and France. Atlantic Chemicals, Limited, a newly formed company, proposes to employ this process at Hillsborough, New Brunswick, but plant construction is not yet under way.

Production and Trade

	1947		1948	
	Short tons	$	Short tons	$
Production of Sulphur				
In pyrites shipped	82,637	431,427	87,126	412,988
Sulphur equivalent recovered from smelter gases	139,144	1,391,440	142,337	1,423,370
Total	221,781	1,822,867	229,463	1,836,358
Imports, crude, roll, and flour sulphur:				
All from United States	361,424	5,466,201	354,622	5,528,740
Exports, in pyrites:				
To: United States	53,345	267,411	47,051	180,357
Mexico	2,991	14,469	3,192	15,353
Total	56,336	281,880	50,243	195,710

Uses

Sulphur in the elemental form or as sulphuric acid has many important uses in industry. The chief uses made of sulphur and its compounds in Canada are given in the following table.

Consumption of Sulphur by Industries, 1947

	Short Tons
Pulp and paper	253,423
Heavy chemicals	228,710
Rubber goods	2,165
Insecticides	1,545
Explosives	1,496
Miscellaneous	924
Total	488,263

Prices

The price of sulphur for the domestic market in the United States at the close of 1948 was $18 per long ton f.o.b. Texas mines.

The price of Spanish pyrites at United States east coast ports was 14 to 16 cents per long ton unit of sulphur, c.i.f., guaranteed 48 per cent sulphur.

ROOFING GRANULES

Much the greater part of the roofing granules output in Canada comes from three deposits in Ontario. The remainder comes from one deposit in Quebec and four in British Columbia. However, about 64 per cent of the tonnage used is imported, practically all from the United States. Prior to January 1948, the tariff on granules imported from the United States was 20 per cent, but in June granules were transferred to the free list, resulting in a slight drop in prices to Canadian consumers.

Consumption and imports were slightly lower than in 1947. Users continued to show increasing preference for artificially coloured granules over the natural material. The search for rocks suitable for making the best type of granules was continued by some of the leading manufacturers of granule roofings and by individuals. Tests by the Mines Branch on slates and rocks from various Canadian deposits gave satisfactory results in several cases.

Consumption and Trade

	1947		1948	
	Short tons	$	Short tons	$
Consumption				
Natural	51,488	912,768	40,366	722,868
Artificially coloured	72,050	1,820,171	72,719	1,748,291
Total	123,538	2,732,939	113,085	2,471,159
Consumption by colours				
Grey and black	41,430	722,775	35,177	627,057
Red	34,561	787,921	27,383	608,812
Green	34,955	840,293	32,433	721,701
Blue	4,741	167,566	6,856	225,993
Buff and brown	3,897	98,608	6,017	149,649
White and grey-white	3,954	115,776	5,219	137,938
Total	123,538	2,732,939	113,085	2,471,150
Imports				
From:				
United States	81,095	1,856,377	72,219	1,612,639
United Kingdom	.....	.....	3	318
Total	81,095	1,856,377	72,222	1,612,957

About 29 per cent of the material used was slate (16 per cent natural and 13 per cent artificially coloured), which was 9 per cent less than in 1947.

In Ontario the deposits at present producing granules are in the vicinity of Madoc, Hastings county. They consist of a grey rhyolite deposit 5 miles north-

east of Madoc; a black amphibole rhyolite, 4 miles northwest of Madoc; and a greenish grey basalt, 20 miles west of Madoc, near Havelock. Building Products, Limited, the leading Canadian manufacturer of roofing granules, crushes and screens the rock from the first two quarries at a mill near Madoc, and from the other at a plant in Havelock. At the latter plant the granules from the three quarries are artificially coloured. It is the only granule-colouring plant in Canada.

In Quebec, granules were made by Suzorite Company, Limited, from a deposit near McCarthy in Suzor township, 160 miles east of Senneterre. The suzorite rock contains pyroxenite, feldspar, apatite, and mica and is treated at the company's new plant at Cornwall, Ontario, where the mica is removed and the remaining material, crushed to granule size, is shipped to Canadian consumers. Large deposits of dark grey and small deposits of red and green slates occur near Granby and Richmond in the Eastern Townships.

In British Columbia, G. W. Richmond quarried a dark grey slate at McNab Creek, Howe Sound, and a greenish siliceous rock at Bridal Falls, near Chilliwack. At Kapoor on southern Vancouver Island, O. M. Brown mined a grey-black slate, and from an adjacent deposit, hard greenish rock. These two operators have crushing and screening plants in Vancouver and Victoria, respectively, where natural granules are produced and sold to roofing companies in the two cities. The capacity of the Richmond crushing and screening plant was increased in 1948.

Granule-coated roofings and sidings were manufactured by ten companies which have a total of fourteen plants located at Asbestos, Montreal, and Lennoxville, in Quebec; Toronto, Hamilton, Brantford, and London, in Ontario; Winnipeg in Manitoba; and Vancouver and Victoria in British Columbia. The capacities of the British Columbia plants were almost doubled in 1948 and their combined output was 45 per cent greater than in 1947. A further increase in these western plants is expected in 1949.

The United States output of granules in 1948 amounted to 1,485,690 short tons valued at $20,971,831, a decrease of about 12 per cent in tonnage below that of 1947. About 67 per cent was artificially coloured.

Specifications

The pertinent information on specifications is given in the review on roofing granules for 1947 by the Mines Branch.

Processes for colouring granules are covered by many patents. A few of the methods employed consist of: heating, which darkens the colour; adding oxides of iron and chromium and then burning; addition of sodium silicate, clay, and the required pigment; addition of zinc oxide, clay, and liquid phosphoric acid, heating and then adding the pigment. Many combinations are employed and generally the formulæ used by individual companies are closely guarded secrets.

Prices

Prices vary considerably depending upon the type of granule and upon whether the colour is natural or artificial. Imported granules in 1948 averaged $17.91 a ton, f.o.b. eastern Canadian plants for natural rocks and slates; $22.21 for artificially coloured reds; $22.93 for greens; $24.90 for browns; and $32.96 for blues. In the United States the 1948 average was $14.12, of which natural averaged $8.54 and artificially coloured averaged $16.52.

SALT (SODIUM CHLORIDE)

The Canadian salt industry provided further tangible evidence of expansion in 1948. The new salt plant of Alberta Salt Company, Limited, Lindbergh, Alberta, was brought into production early in the year; construction in Sarnia, Ontario, of the caustic soda-chlorine plant of Dow Chemical Company of Canada, Limited was nearing completion; and construction was commenced in Beauharnois, Quebec, of a similar plant by Dominion Alkali and Chemical Company, Limited (subsidiary of Dominion Tar and Chemical Company, Limited). The output of 741,261 short tons of salt in 1948 was slightly higher than in 1947, the previous peak year. Ontario produced 84 per cent of the total output.

The salt produced in Canada is chiefly in the form of fine grades from brine and vacuum pan operations.

Production, Trade, and Consumption

	1947		1948	
	Short tons	$	Short tons	$
Production (Sales):				
Fine vacuum salt	285,481	3,316,689	282,711	3,464,190
Coarse grainer salt	14,224	202,202	19,419	376,277
Mined rock salt	23,920	195,188	25,908	266,285
Salt produced for chemical purposes[1]	404,920	722,851	413,223	729,276
Total	728,545	4,436,930	741,261	4,836,028
Production by Provinces				
Ontario	633,766	3,132,165	619,598	3,265,654
Nova Scotia	40,107	416,332	61,799	700,164
Alberta	29,698	438,825	34,613	449,780
Manitoba	24,974	449,608	25,251	420,430
Imports				
From:				
United States	160,530	847,500	155,142	833,935
Bahamas	44,756	282,620	22,227	139,462
United Kingdom	3,498	63,602	4,576	83,604
Jamaica	8,441	32,954	3,476	14,329
Other countries	2,654	19,875	650	7,500
Total	219,879	1,246,551	186,071	1,078,830
Exports				
To:				
Newfoundland	1,944	51,694	2,562	50,314
United States	521	7,404	1,463	18,636
New Zealand	7,322	155,745	905	30,314
Other countries	1,425	28,820	700	27,840
Total	11,212	243,663	5,630	127,104
Apparent consumption	937,212	5,439,818	921,702	5,787,754

[1] Mainly in brine and used by the producers in making chemicals.

Canada's imports of salt are chiefly of grain sizes and of purities not obtainable in the Dominion. The salt obtained from direct mining of rock salt beds usually contains many of the impurities of the original beds, and although all

grain sizes required can be obtained by this method, the purity may not be sufficiently high to satisfy all uses. The salt from vacuum pan evaporation is of high purity, but only fine grain sizes are produced. Geographical location of deposits in relation to markets also has a bearing on imports. British Columbia, for instance, will need to continue to import salt from California as the long rail haul from the nearest domestic sources of supply would prohibit competition under present circumstances with ocean transportation.

Nova Scotia

In Nova Scotia, salt is produced by two companies. Malagash Salt Company, Limited operates a salt mine at Malagash, Cumberland county. The mined rock salt is crushed, screened, and sold as fishery, refrigerator, hay, and dairy salt, for ice removal on highways and railways, and for dust laying. Maritime Industries, Limited (subsidiary of Standard Chemical Company, Limited) at Nappan, near Amherst, Cumberland county, obtains its salt from the vacuum pan evaporation of salt brine from wells drilled into massive beds of salt that come within 860 feet of the surface at this point.

Quebec

No salt is produced in Quebec. Salt used by chlorine caustic soda plants in Quebec is obtained from Ontario and United States.

Ontario

Ontario's large production of salt is used mainly to supply its expanding chemical industries. The salt is all obtained from wells at Goderich, Sarnia, Warwick, and Sandwich in southwestern Ontario, drilled into salt beds that lie from 800 to 1,500 feet below the surface.

Goderich Salt Company, Limited (subsidiary of Standard Chemical Company, Limited) and Purity Flour Mills, Limited are the two producers in Goderich. The latter company's plant was enlarged and modernized in 1948.

Dominion Salt Company, Limited operates the plant at Sarnia. Salt from this plant will be used in the caustic soda-chlorine plant at Beauharnois. Salt for the Dow Chemical caustic soda-chlorine plant in Sarnia is obtained from brine wells on the company's property. The chemicals from the plant will be used chiefly in the company's plants in Sarnia.

At Sandwich, Canadian Industries, Limited produces salt from vacuum evaporators and from open-type grainers. The brine from these salt wells is also used in the company's caustic soda-chlorine plant at Sandwich, and salt from this plant is also shipped to other chlorine-caustic soda plants of Canadian Industries, Limited, at Cornwall, Ontario, and Shawinigan Falls, Quebec.

Several miles south of Sandwich, Brunner-Mond Canada, Limited has brine-producing wells from which the brine is pumped to the plant at Amherstburg where it is one of the basic raw materials in the manufacture of soda ash.

Warwick Pure Salt Company, Limited produces coarse salt from open-pan evaporation of brine obtained from wells on its property near the village of Warwick.

Prairie Provinces

Canadian Industries, Limited, with plant at Neepawa, is the only producer of salt in Manitoba. Erected in 1941, the plant utilizes vacuum pan evaporation to produce all grades of evaporated salt. The brine, obtained from wells over 1,000 feet deep, is a nearly saturated natural brine occurring in porous sedimentary rocks. There are no proved bedded deposits of rock salt in this area.

In Saskatchewan, Dominion Tar and Chemical Company, Limited, through its subsidiary Prairie Salt Company, Limited, continued construction of its salt plant at Unity. This plant will obtain salt brine from beds of salts over 3,500 feet below the surface.

In Alberta, Industrial Minerals, Limited, Waterways, obtains brine from a bed of pure rock salt 200 feet thick about 700 feet below the surface. The company produces all grades of evaporated salt for household and dairy uses. Alberta Salt Company's plant at Lindbergh obtains brine from salt beds lying over 2,800 feet below the surface. Natural gas obtained from strata above the salt beds is used for fuel in the evaporation of the brines.

The reserves of salt underlying Alberta and Saskatchewan were further increased in 1948 by drilling for oil and gas which gave additional information on the already extensive occurrence of salt beds. These beds have been traced from southern Saskatchewan to northeastern Alberta with total thickness in any one section ranging from a few feet to over 1,000 feet.

Uses and Prices

The uses of salt are mostly well known. The demand for salt for use in the production of caustic soda and chlorine has been increasing rapidly as a result of expansion of the paper and rayon industries. The bleaching of sulphate papers is another field that may eventually require quantities of these chemicals derived from salt.

According to Canadian Chemistry and Process Industries the prices of salt remained constant throughout 1948 and were as follows:

	Prices
Specially purified salt per 100 lb. 99·9 per cent f.o.b. plant	$ 1.10
Fine industrial salt per ton bulk, carlots, f.o.b. plant	6.00–$ 7.80
Coarse industrial salt per ton bulk, carlots, f.o.b. plant	13.00– 14.80

SAND AND GRAVEL

In 1948, for the third successive year, a record was set in the production of sand and gravel in Canada. Output amounted to 68,670,863 tons valued at $30,629,596, compared with 56,789,569 tons valued at $23,114,431 in 1947. In 1946, delayed road projects started during that year were the main factors in establishing the record; and in 1947 and 1948 development of power sites and greater activity in the building industry contributed largely to the production records.

Production

	1947		1948	
	Quantity, tons	Value, $	Quantity, tons	Value, $
Nova Scotia	2,966,680	1,363,363	1,636,808	1,706,838
New Brunswick	3,464,347	1,278,376	3,347,817	1,231,256
Quebec	16,537,303	4,877,339	28,102,377	9,535,944
Ontario	20,230,499	9,034,131	20,588,496	10,468,216
Manitoba	1,765,976	549,640	2,498,277	754,196
Saskatchewan	2,131,705	1,137,609	1,846,336	917,243
Alberta	2,058,142	1,170,883	3,592,275	2,219,497
British Columbia	7,634,917	3,703,090	7,058,477	3,796,406
Total	56,789,569	23,114,431	68,670,863	30,629,596

Uses

Concrete, road making, and building construction absorb by far the greater part of the gravel and sand used. Gravel has proved a good material for low cost, all-weather road surfaces and also for pavement bases on rural highways, as a result of improved methods used in compacting and stabilizing base courses for pavements.

Most of the gravel used for road work comes from pits worked exclusively for that purpose. The pits are operated to supply the immediate need and to build up a reserve of processed gravel, in the form of stockpiles large enough for one or two years' requirements, after which the processing equipment is moved somewhere else. Thus road pits may remain idle for two or more years.

Part of the gravel used is crushed, screened, and in some cases even washed, and the proportion thus processed is increasing steadily. Some provinces use crushed instead of pit-run gravel for surfacing their main highways because the angular aggregate produced by crushing can be more densely compacted and imparts greater stability to the road surface under traffic.

On main railway lines gravel ballast is being gradually replaced by crushed stone ballast. This practice was started years ago but the steady increase in weight and speed of rail traffic has intensified the work of replacement. Intermittent operation also applies to railway pits.

A large tonnage of sand and gravel is also used for refilling the worked out parts of mines.

Most of the large commercial plants are equipped for producing crushed and screened gravel, a product that can compete with crushed stone.

The amount of sand consumed follows roughly the trend of building activity, as the larger part of the sand excavated is used in the building industry, such as concrete work, cement and lime mortar, and wall plaster. For these purposes the sand must be free from dust, loam, organic matter, or clay.

Other important uses of sand are for moulding in foundries, filtering of water supply, and glass-making, all of which require special grades of sand.

Prices

Prices for carlots, f.o.b. cars, at the end of 1948, as reported by the "Engineering and Contract Record", were as follows:

(In dollars per short ton)

—	Montreal	Toronto	Winnipeg	Vancouver[1]
Sand	2·05	2·90	3·35*	2·00
Gravel, ¾ inch	1·75	3·35	3·50*	2·00
Crushed stone, ¾ inch	1·10	3·35	3·50*	2·00

[1] Prices subject to 3 per cent Provincial Government tax.
* Per cubic yard.

SILICA MINERALS

Although production was higher than in 1947, silica continued to be imported into Canada in record quantities in 1948, the imported material being chiefly high-quality silica sands for use in the glass, sodium silicate, and abrasives industries. This increase in imports was partly due to the closing of the plant of Canada China Clay and Silica, Limited, near St. Remi d'Amherst, Quebec,

about the middle of 1948, as it was the only plant in Canada that produced glass sand. The increased consumption of silica is arousing interest in Canadian sandstone and quartzite deposits as possible sources of high-quality silica sands.

Production and Trade

The following table shows Canadian production, exports, and imports of silica in 1947 and 1948.

	1947		1948	
	Short tons	$	Short tons	$
Production of quartz and silica sand..	1,836,428	1,796,612	2,017,262	2,082,573
Production of silica brick (thousands of bricks).....	3,094	193,998	3,234	367,742
Imports of silica sand				
From:				
United Kingdom.....	180	1,020	270	1,352
Norway.....	.....	.....	600	540
United States.....	533,276	1,147,377	583,149	1,444,732
Total.....	533,456	1,148,397	584,019	1,446,624
Exports of quartzite:				
All to United States.....	223,240	489,129	228,100	494,284

Nova Scotia

Quartzite is quarried at Chegoggin Point, Yarmouth county, for Dominion Steel and Coal Corporation, Limited, which uses it to manufacture silica brick at Sydney. Some experimental work was continued on the silica sand from beaches at Port Mouton and Barrington Passage, but it is doubtful if a commercial silica sand can be prepared economically under present conditions.

Quebec

Canadian Carborundum Company, Limited produces silica at St. Canut, Two Mountains county, from a quarry in a large outcrop of Potsdam sandstone for use in the company's abrasive plant at Shawinigan Falls.

St. Lawrence Alloys and Metals, Limited, Beauharnois, produces silica in a large number of screen sizes in its plant at Melocheville from an outcropping Potsdam sandstone. Most of this output is used in the company's plant at Beauharnois for the production of silicon and ferrosilicon.

Ontario

Kingston Silica Mines, Limited produces silica sand from an outcrop of sandstone near Joyceville, 11 miles north of Kingston, for sale chiefly as steel foundry sand and in the artificial abrasives industry.

Dominion Mines and Quarries, Limited, Killarney, shipped crushed quartzite from its quarry at Killarney to producers of ferro-alloys in Welland, Ontario, and in several American centres.

Canadian Silica Corporation, Limited produces quartzite for export to the United States from its quarry at Sheguindah, Manitoulin Island.

Wright Brothers shipped quartzite to Algoma Steel Corporation, Limited, Sault Ste. Marie, Ontario, from a quarry 20 miles north of Sault Ste. Marie on the Algoma Central Railway, to be used in making silica brick.

Prairie Provinces

No high-grade silica sand is produced but several deposits of silica have been investigated in Manitoba and Saskatchewan. Most of these are distant from transportation and the markets for silica sand have not been extensive enough to justify development. Among the deposits on which preliminary work has given interesting results are those on Black and Punk Islands in Lake Winnipeg, and on Red Deer River, northeast of Hudson Bay Junction, Saskatchewan.

Silica as Flux

One of the largest items in the silicon production of Canada is the production of quartz and quartzite for use as a flux in the large base metal smelters at Trail, British Columbia, Flin Flon, Manitoba, Sudbury, Ontario, and Noranda, Quebec. Most of these companies maintain their own quarries near their smelters or buy special siliceous ores from companies in the vicinity.

Uses and Specifications

Silica sand is generally prepared from a friable sandstone or quartzite by crushing, washing, drying, and screening to recover different grades of material according to the use for which it is required. Natural silica sands are usually too impure to warrant removal of the impurities, although in certain cases this might prove satisfactory, depending upon the ease of separation of the various minerals in the sand and the size of the silica sand grains. In the manufacture of container glass, for instance, the sand used should range between 28 and 150 mesh and the iron (Fe_2O_3) content should be less than 0·04 per cent.

Silica sand for use in the artificial abrasives or sodium silicate industries varies slightly in screen size but in general has to be as pure as glass sands.

Silica sand for steel foundry use generally contains a greater percentage of impurities than do glass sands and varies greatly in screen size depending upon type of castings and the foundry practice of the firm using the sand. These sands usually contain no material coarser than 20 mesh nor finer than 200 mesh, but percentage of fines to coarse must be varied greatly to produce all types of foundry sand required by Canadian manufacturers.

Sand-blast sand is usually the coarsest grains produced from a sand plant and might vary from 8 mesh to 48 mesh in closely sized ranges. The physical properties of these sands are of great importance, including shape of grains, friability, and hardness.

Sandstone in run-of-mine size is used by the cement manufacturers to increase the silica ratio of their original mixes.

Silica ground to 150 mesh or finer is known as "potter's flint" in the ceramic industry. This material must be prepared from very pure quartz or high-grade silica sand. Fine ground silica is also required in the paint, soap, building products, and general chemical industries.

Quartz, quartzite, or sandstone in sizes from 6 inches to ½ inch is used in the manufacture of ferrosilicon and metallic silicon.

Quartzite of high purity and crushed to about 8 mesh is used to manufacture silica brick.

In producing silica for the above uses, regularity of shipments and meeting of rigid specifications are important factors.

Quartz in crystal form, without flaws, transparent, and possessing the necessary piezo-electric properties, is valuable in radio frequency control apparatus. Crystals may also be cut and ground for lenses and prisms, or fused to make clear fused quartz equipment No quartz with the necessary properties for these uses has been found in Canada, the only present world sources of supply being Brazil and Madagascar.

Prices

The price per ton of the several grades of silica varies greatly, depending upon its purity and the purpose for which it is to be used. Silica generally is a low-priced commodity, and therefore the location of a deposit with respect to markets is of great importance. The largest markets for silica are in Quebec and Ontario, and new deposits, to be of interest to these markets, should be within economic reach of the southwestern Ontario, Toronto, or Montreal areas. In Western Canada the main markets are in Alberta and Manitoba. West of Winnipeg the silica needs are almost entirely imported.

The prices, according to Canadian Chemistry and Process Industries, increased slightly during 1948, chiefly in the coarser grades.

Silica Sand

—	Various grades		Silica, quartz	99% Silica soft
	Toronto, carload lots	Toronto, l.c.l.	110-220 grade	Decomposed, 325 mesh
	Ton	Ton	Carlots, per ton	Carlots, per ton
Dec. 1947	$10.00—$10.50	$14.50	$14.00—$20.00	$30.00—$35.00
Dec. 1948	$10.50—$11.00	$16.00	$14.00—$20.00	$30.00—$35.00

SODIUM SULPHATE (NATURAL)

Canadian production of 153,698 tons of natural sodium sulphate in 1948 was 6 per cent lower than in 1947, accounted for by labour troubles at some plants and by a gradual falling-off in the market for 'salt cake' in the paper industry during the latter part of the year. However, plant productive capacity was greatly increased. Exports were 37 per cent lower than in 1947. All the output comes from Saskatchewan, in which province and elsewhere in Western Canada large reserves of sodium sulphate occur in beds and in the form of highly concentrated brines in many lakes and deposits.

The sodium sulphate recovered from the lakes is in the hydrous form (55·9 per cent water of crystallization) and is known as "Glauber's Salt". Usually the water of crystallization is removed in rotary kilns before the material is shipped to markets as anhydrous sodium sulphate, known to the trade as 'salt cake'. A small quantity is marketed in the hydrous form.

A small output of anhydrous sodium sulphate is also obtained as a by-product from the chemical industry.

Production and Trade

The principal producers of natural sodium sulphate in Saskatchewan in 1948 were: Natural Sodium Products, Limited, with plants at Bishopric and Alsask; Horseshoe Lake Mining Company, Limited, Ormiston; Midwest Chemi-

cals, Limited, Palo; Sybouts Sodium Sulphate Company, Gladmar; and Saskatchewan Minerals, Sodium Sulphate Division, with plant at Chaplin Lake. The plant at Chaplin Lake is owned and operated by the Saskatchewan Government and was brought into production about the middle of 1948, its present capacity being 100,000 tons of salt cake a year. There was considerable activity throughout the year at a number of other deposits in Saskatchewan.

	1947		1948	
	Short tons	$	Short tons	$
Production (Shipments)	163,290	1,793,043	153,698	2,136,276
Imports				
From:				
United States	8,972	177,398	13,866	292,440
United Kingdom	2,240	36,258	.....	.....
Total	11,212	213,656	13,866	292,440
Exports to United States	47,025	532,148	29,612	468,561

Uses and Prices

Sodium sulphate is used chiefly in the sulphate process for the manufacture of kraft pulp. It is used in the glass, dye, chemical, and textile industries, and to a smaller extent for medicinal purposes and for tanning.

The price of natural sodium sulphate from the deposits in Saskatchewan in 1948 was quoted by Canadian Chemistry and Process Industries at $15.50 per short ton in carload lots f.o.b. plant. The price at pulp mills, which are mostly distant from producing centres, is considerably higher.

TALC AND SOAPSTONE

Total talc and soapstone sales in Canada during 1948 amounted to 28,780 short tons, an increase of 8 per cent over the 1947 output. Production is confined mainly to Quebec and Ontario, in about equal tonnages, and comprises powdered material made from both talc and soapstone, sawn soapstone furnace blocks and bricks, and talc crayons. The ground talc produced in Quebec consists of grey, slightly off-colour material, classed for statistical purposes as soapstone; that from Ontario is of prime white grade.

Eighteen per cent of the 1948 production was exported. Canada produces its entire requirements of sawn dimension soapstone and talc crayons, but imports, mainly from the United States and Italy, certain special qualities of ground talc demanded by the ceramic, paint, and cosmetic trades.

In Quebec, Broughton Soapstone and Quarry Company with mine, mill, and sawing plant near Leeds station, in Broughton township, is the principal operator and produces ground talc, sawn soapstone blocks and bricks, and talc crayons. In June 1948, this company took over the operation owned by Charles Fortin, of Robertsonville, Thetford township, which produces soapstone blocks. Ground talc, sawn soapstone blocks and bricks, and talc crayons are also made by L. C. Pharo Company of Thetford Mines, at Kinnear's Mills in Leeds township. Baker Mining and Milling Company operates a mine and grinding plant near Highwater, Brome county.

In Ontario, Canada Talc, Limited produces prime white foliated talc from the Madoc area. The company's grinding mill has a capacity of about 5 tons an hour of finished products. Coarse rejects are screened and de-dusted for the production of granular roofing grades. The Madoc talc varies from coarsely foliated to massive, compact material. Exploration by drilling was done during the year on a deposit of grey talc in Grimsthorpe township, Hastings county, by the Active Exploration Prospecting Syndicate of Ottawa, and by W. J. Symon of Madoc.

In British Columbia, some ground soapstone for local roofing and building use is produced in Vancouver by George W. Richmond and Company from waste imported from the state of Washington.

Production, Trade, and Consumption

	1947		1948	
	Short tons	$	Short tons	$
Production (Sales)				
Ground	26,219	246,008	28,445[1]	292,288
Sawn soapstone blocks and talc crayons	490	20,369	325[2]	17,535
Total	26,709	266,377	28,770	309,823
Imports				
From: United States	7,887	174,937	7,051	183,489
Italy	585	21,760	742	29,749
Hong Kong	.....	.....	5	200
Total	8,472	196,697	7,798	213,438
Exports				
To: United States	5,454	60,730	5,032	62,533
Australia	25	1,120	19	905
Other countries	328	6,544	1	36
Total	5,807	68,394	5,052	63,474
Consumption				
Roofing	8,618	.....		
Paints	7,352	.....		
Rubber	3,075	.....		
Insecticides	2,388	.....	Not yet available	
Pulp and Paper	1,899	.....		
Toilet preparations	1,350	.....		
Clay products	1,214	.....		
Other uses	1,219	.....		
Total	27,115	.....		

[1] Ontario—14,301 tons, Quebec—14,144 tons.
[2] All from Quebec.

Uses

Ground talc, including soapstone and pyrophyllite, is used chiefly in the paint, roofing, paper, rubber, insecticide, and ceramic industries. In addition, it is used in foundry facings, in bleaching fillers for textiles, in cosmetics and pharmaceuticals, in soaps and cleansers, in plaster, polishes, and plastics, and for rice polishing.

Soapstone is used in the form of sawn blocks and bricks for lining the alkali recovery furnaces and kilns of kraft pulp and paper mills; as brick and slab liners for fireboxes, stoves, and ovens; and for switchboard panels, laboratory benches, etc. Compact massive talc, sawn into square pencils and slices, is an important material for steelmakers' crayons. Recent shortages of suitable raw material have led to the introduction of extruded crayons compounded of ground talc with a suitable binder.

Prices

The market value of ground talc varies widely and is dependent upon purity, particle shape, and fineness of grinding. Roofing and foundry talcs are the cheapest grades, the users being satisfied with coarser, grey or off-colour material, often soapstone powder or sawing dust, which sells at about $8 a ton f.o.b. rail. Domestic grey talc suitable for roofing, rubber, and paper use, sold in 1948 for $7.50 to $10 a short ton, according to fineness. White talc from Madoc, Ontario, continued to be quoted at $8.50 for the coarser roofing grade, $9.50 to $28 for finer mesh sizes, and $44 for minus 400-mesh material. Imported superfine Italian and French cosmetic talcs may cost as high as $80 per ton delivered.

Average unit value of the ground talc produced in Ontario in 1948 was $11.50 per ton, and of the ground material (comprising both talc and soapstone) supplied by Quebec, $8.80 per ton. Average value of sawn soapstone furnace blocks was $35 per ton or $3 per cubic foot, and of talc crayons about $255 per ton, or $1.10 per gross. Average declared unit value of exports of ground talc was $12.40 per ton.

Tariffs

Under the Multilateral Trade Agreement, effective January 1, 1948, the duty of ground talc imported into the United States from Canada was reduced from 17½ per cent to 10 per cent ad valorem on material valued at not over $12.50 a ton. On material valued at over $12.50 a ton, the duty remains at 35 per cent. The duty on crude talc, steatite, or soapstone was reduced from $5 a short ton to $2.50. Sawn soapstone or talc in the form of bricks, crayons, blanks, etc., remains dutiable at 1 cent a pound. Talc, ground, or unground, enters Canada under the British preferential tariff at 15 per cent. Imports from the United States are dutiable at 20 per cent.

Pyrophyllite

Pyrophyllite is a soft, white mineral closely resembling talc in appearance and general characteristics, but contains alumina in place of magnesia. It can substitute for talc for many trade uses and is thus often recorded with talc in production statistics. One of its largest uses is in insecticides.

North Carolina is the leading world source of pyrophyllite. Small amounts are derived intermittently from Newfoundland. Some rather low-grade sericitic pyrophyllite occurs at Kyuquot Sound on the west coast of Vancouver Island. Pyrophyllite sells for about the same price as talc.

WHITING SUBSTITUTE

Whiting substitute (also referred to in Canada as domestic whiting) and marble flour are prepared by finely pulverizing white limestone or marble, calcite, or marl. For several years whiting was produced from marl at two plants in Ontario. In 1948, however, the entire Canadian production was from marble and limestone.

White marble and white limestone, low in magnesium carbonate, are pulverized to a fineness of from 200 to 400 mesh in the manufacture of whiting. A by-product, precipitated chalk, prepared from residues from the manufacture of caustic soda by the soda-ash-lime process is classed as whiting substitute. Its use, however, is restricted as it usually contains free alkali. It is not made in Canada.

Production and Trade

Stone Used to Make Whiting

	1947		1948	
	Tons	Value	Tons	Value
Marble	9,242	$111,224	9,995	$120,440
Limestone	7,518	44,005	7,997	51,469
Total	16,760	$155,229	17,992	$171,909

Following is a list of Canadian producers of whiting:

Industrial Fillers, Limited, Montreal, Quebec.
Marlhill Mines, Limited, Thorold, Ontario.
Gypsum, Lime and Alabastine (Canada), Limited, Winnipeg, Manitoba.
Beale Quarries, Limited, Vananda, Texada Island, British Columbia.

For some uses imported chalk whiting is necessary. However, many consumers now use the domestic whiting substitute satisfactorily.

Little or no whiting substitute is exported.

Imports of whiting, gilders whiting, Paris white, and crude and prepared chalk amounted to $403,637 in 1948 and to $409,679 in 1947. Of the 1948 total, imports from the United States were $319,197, from the United Kingdom $57,777, and from France and Belgium, $26,683.

Uses, Specifications, and Prices

Canadian whiting substitute is used as an ingredient in the manufacture of linoleum, oilcloth, certain rubber products, in putty, in explosives, and as a filler in newsprint and other paper. The demand for mineral fillers has been increasing and for certain new applications the superior whiteness of whiting substitute prepared from calcite is important. It is also used in the manufacture of moulded articles and of cleaning compounds and polishes and for other purposes. Pulverized calcite of high purity and of minus 325-mesh fineness is used as an extender in the paint industry.

Marl as a raw material for the manufacture of whiting substitute should be white, free from grit and clayey material, and have a low organic matter content. The last-named impurity renders most marls unsuitable as a filler in putty and paint where it comes into contact with oils. Apart from a much greater oil-absorptive capacity of whiting substitute made from marl, the physical characteristics of both types are much the same.

Prices per ton bagged range from $10 to $15, f.o.b. plants.

III. FUELS

COAL

Coal production in Canada in 1948 was slightly lower than in 1942, the peak year, but a new high was reached in the value of output. Alberta contributed 44 per cent of the output and Nova Scotia 35 per cent. The remainder came from British Columbia, Saskatchewan, and New Brunswick. The Canadian consumption of coal in 1948 including briquettes was 4,237,000 tons higher than in 1947, and amounted to 47,383,000 tons; 64 per cent of it was imported.

Developments

Because of fuel shortages, and because certain Alberta coals have found favour in some areas of Ontario, the movement of Alberta coal into Ontario continued to increase. Approximately 282,600 tons of Alberta coal was shipped to Ontario, compared with 160,721 tons in 1947. Approximately 206,700 tons were for domestic use, and consisted of 140,000 tons of sub-bituminous and bituminous non-coking coal, 9,500 tons of semi-anthracite, 2,500 tons of bituminous coking coal, and 54,700 tons of briquettes.

Mechanization of Canadian coal mines is being accelerated by the development of new and improved types of cutters, loaders, and conveyers to suit varying conditions, and involves the necessity of extending and improving coal washing and sizing facilities. In conjunction with the mechanization in Nova Scotia it is anticipated that new modern coal preparation plants will be installed, allowing for the production of varying types of improved products.

Strip coal mining is conducted in all mining provinces, the total strip-mined coal in 1948 amounting to 5,045,562 tons, compared with 3,599,335 tons in 1947. Strip-mined coal was 27 per cent of the total Canadian output in 1948, compared with 23 per cent in 1947. In Saskatchewan, 89 per cent of the coal mined was produced by strip methods in 1948.

Much experimental work is in progress toward improving the physical and chemical qualities of coal by washing and sizing, and it is anticipated that within a few years most of the coal produced in Canada will be systematically prepared to meet the more exacting markets arising from the competition between various types of fuels.

Consumption of briquettes increased from 579,121 tons in 1947 to 601,208 tons in 1948. These consisted of 34,621 tons made from carbonized Saskatchewan lignite, 288,030 tons made from low-volatile bituminous and semi-anthracite coals from the Nordegg and Cascade areas in Alberta, 33,544 tons made from medium-volatile bituminous coal from the Crowsnest area of Alberta, and 245,013 tons imported from the United States and prepared from low-volatile bituminous coals and anthracite alone and mixed. A plant for the production of briquettes from medium-volatile coal in the Alberta Mountain Park area was under construction, and a smaller plant was being considered for semi-anthracite in the Cascade area. Experimental work at the Mines Branch, Ottawa, was continued on the briquetting amenability of Drumheller and Brooks area coals, and it is expected that in the near future briquettes made from sub-bituminous coals of these areas will be manufactured for distribution in Western Canada.

Use of the process developed in the Mines Branch, Ottawa, for the improvement of blower coal by chemical treatment was continued in Quebec and Ontario. Approximately 1,347,436 tons of coal was imported from the United States for stoker use, about 90 per cent of which was high-volatile bituminous coking, and 10 per cent low-volatile bituminous coking. Saskatchewan lignites and Alberta non-coking coals were also used more extensively for domestic stokers, and recent developments in improved equipment to give complete automatic operation may further increase the use of stokers and thus increase the demand for the smaller sizes of coal.

Production and Trade

Imports of Coal for Consumption

(Tons of 2,000 pounds)

From	1947			1948		
	Anthracite	Bituminous	Total	Anthracite	Bituminous	Total
United States	4,230,022	24,427,583	28,657,605	5,082,483	25,528,028	30,610,511
United Kingdom	51,660	1,117	52,777	162,354	196	162,550
Other countries	.....	436	436	.....	14	14
Total	4,281,682	24,429,136	28,710,818	5,244,837	25,528,238	30,773,075

Exports of Coal

(Tons of 2,000 pounds)

Destination	1947	1948
United States	303,772	324,109
Newfoundland	320,132	402,777
Argentina	17,469	51,527
Japan[1]	.....	481,102
Other countries	73,176	13,747
Total	714,549	1,273,262

1 Coking coal from British Columbia for the preparation of metallurgical coke.

Production in Nova Scotia was 56 per cent higher than in 1947, and was 0·7 per cent lower than the 1934-1946 average. Medium- and high-volatile coking bituminous coals are produced in the Sydney, Cumberland, and Pictou areas, and some non-coking bituminous coal is mined in the Inverness area. The production from Nova Scotia and New Brunswick is used mainly to supply the requirements of the railways of the area, the steel and paper industries, the local domestic market, and for the production of electric power.

Production in New Brunswick in 1948 was 51 per cent higher than in 1947 and was 5 per cent higher than the 1934-1946 average. About 3 per cent of the total Canadian production of bituminous coking coal was mined in the Minto field.

In Ontario, lignite of a lower grade than that found in Saskatchewan is available in the Onakawana area, but there has been no commercial production.

Production of Coal by Provinces [1]

(Tons of 2,000 pounds)

	1947				1948			
	Bituminous *	Sub-bituminous	Lignite	Total	Bituminous *	Sub-bituminous	Lignite	Total
Nova Scotia	4,118,196	.....	.....	4,118,196	6,430,991	.....	.....	6,430,991
New Brunswick	345,194	.....	.....	345,194	522,136	.....	.....	522,136
Saskatchewan	.....	.....	1,571,147	1,571,147	.....	.....	1,589,172	1,589,172
Alberta	4,835,371	3,235,059	.....	8,070,430	4,934,458	3,188,797	.....	8,123,255
British Columbia	1,763,899	.....	.....	1,763,899	1,780,334	.....	.....	1,780,334
Yukon	.....	.....	.....	.....	3,801	.....	.....	3,801
Total	11,062,660	3,235,059	1,571,147	15,868,866	13,671,720	3,188,797	1,589,172	18,449,689
Total value	$77,475,017				$106,684,008			

[1] Coals classed according to A.S.T.M. Rank—A.S.T.M. Designation: D388-38.
* Inclusive of semi-anthracites from the Cascade area of Alberta.

Production in Saskatchewan was 1 per cent higher than in 1947, and 31·5 per cent higher than the 1934-1946 average. Only lignite is produced, the main producing fields being the Bienfait, Estevan, and Roche Percée division of the Souris area, with the major production coming from the Bienfait division.

Alberta produces almost all ranks 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 fields. In the Lethbridge, Coalspur, Saunders, and several other areas of the foothills a lower rank bituminous coal which is practically non-coking is produced. The coal in the Drumheller, Edmonton, Brooks, Camrose, Castor, and Carbon areas is lower in rank and is classed as sub-bituminous; and that in the Tofield, Redcliff, and several other areas is on the border of the sub-bituminous and lignite. The Cascade area was the only field that produced semi-anthracite in 1948. Sixty-one per cent of the total production in Alberta was bituminous, and 39 per cent sub-bituminous and lignite, but mainly the former. The total production was about 24 per cent higher than the 1934-1946 average. A large part of the sub-bituminous coal shipped from Alberta to Ontario came from several of the stripping operations in the Brooks, Castor, Camrose, and Taber areas. Most of the remainder was deep mined coal from the Coalspur and Drumheller areas.

Production in British Columbia was 1 per cent higher than in 1947 and was 2·6 per cent higher than the 1934-1946 average. Bituminous coking coal ranging from high- to low-volatile is mined on Vancouver Island, and in the Crowsnest, Telkwa, and Nicola areas on the mainland. Lesser quantities of sub-bituminous coal are produced mainly in the Princeton field.

COKE

The sustained demand for metallurgical and domestic coke in 1948 encouraged the expansion of plant capacity and resulted in the construction of new carbonization equipment and the operation of existing plants at maximum capacity.

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, which is produced as a by-product of the gas industry, is a small part of the total coke production and is used mainly to make carburetted water gas for distribution as city gas. The residual stocks of retort coke (about 20,000 tons a year) are sold as domestic coke. The largest urban areas are, in general, supplied with manufactured gas from by-product coke ovens which also produce domestic coke prepared and sized in accordance with the market requirements.

The increasing demand for metallurgical coke and manufactured gas has resulted in the construction of new batteries of coke ovens in Nova Scotia and British Columbia and in plans for the expansion of other coke oven plants. The plants under construction will commence operation in 1949 and will add a total of about 400,000 tons of coal a year to present capacity.

Production and Trade

Coke is produced from the several types of carbonization equipment in use throughout Canada. These include seven by-product coke oven plants, two beehive plants, one Curran-Knowles installation, seven continuous vertical retort plants, and eight installations of horizontal "D" retorts.

Approximately 80 per cent of the coal used in the production of coke in Canada is processed in the five principal plants in Eastern Canada. These are: Dominion Steel and Coal Corporation's plant, Sydney, Nova Scotia, which has

	1947		1948	
	Short tons	$	Short tons	$
Production, from Bituminous Coal				
Ontario	2,273,644	25,748,633	2,621,405	36,959,687
Nova Scotia, New Brunswick, and Quebec	932,025	10,817,667	1,058,351	14,640,521
Manitoba, Saskatchewan, Alberta, and British Columbia	308,482	2,773,591	266,020	3,063,243
Total	3,514,151	39,339,891	3,945,776	54,663,451
Bituminous Coal Used To Make Coke				
Imported	3,532,819	28,800,154	4,077,123	40,818,855
Canadian	1,067,833	7,032,481	1,939,803	8,285,164
Total	4,600,652	35,832,635	6,016,926	49,104,019
Production of Petroleum Coke	78,125	598,215	87,438	1,101,832
Imports, All Types, from United States	832,289	11,483,959	851,791	14,584,678
Exports, All Types				
To:				
United States	126,686	1,150,990	189,989	2,882,148
Other countries	7,284	226,702	9,836	186,028
Total	133,970	1,377,692	199,825	3,068,176

an annual rated capacity of 813,000 tons of coal; Montreal Coke and Manufacturing Company's plant at Ville La Salle in Quebec, which normally produces domestic coke and also supplies Montreal with gas, and has an annual rated capacity of 656,000 tons of coal; Algoma Steel Corporation's 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, which has a rated capacity of 415,000 tons of coal a year; and the coke ovens of Steel Company of Canada, Limited, Hamilton, Ontario, which have a rated capacity of 641,000 tons of coal a year.

The manufacture of beehive coke was continued by two companies in Western Canada, namely, International Coal and Coke Company, Limited, and Crow's Nest Pass Coal Company, Limited, in the eleven plants at Coleman, Alberta, and Michel, British Columbia, respectively. This production is approximately 4 per cent of the coke marketed in Canada.

NATURAL GAS

Canada is on the threshold of natural gas developments that may have far-reaching results on the economy of the country. In the past, natural gas has been produced in relatively small quantities from the Stoney Creek field in New Brunswick to be used as fuel in Moncton and adjoining small centres of population. To a much greater extent natural gas has been an important fuel in southwestern Ontario, but after a long period of production, at one stage of which there were pipelines for gas export to United States, the amount

available, even after intensive search for new supplies, has been scarcely able to meet the demand. In the winter of 1947-48 there was an acute shortage and for a time industrial plants using natural gas were temporarily forced to close even after the strictest measures for conservation had been applied and the supply had been augmented by available propane and enriched artificial gas.

In part at least, severe weather conditions brought on the crisis and to avoid a similar disastrous repetition in the winter of 1948-49 gas was taken from the Becher field and by compression stored during the summer months of 1948 in the underground reservoir of the Dawn field, so that during the winter when withdrawals are heavy a larger supply of stored gas from the Dawn field can be used to augment the normal production. This fact served to show that underground storage in certain fields in southwestern Ontario is feasible and economic.

A vigorous search for new supplies of gas was also undertaken in Ontario in the summer of 1948, and particularly in the Kimball field, Lambton county, was this successful in opening up additional supplies which, although not large in terms of gas reserves in many parts of the North American Continent, were nevertheless a very important addition to the supplies in Ontario from other fields. About 120 gas-development wells were drilled in southwestern Ontario in 1948 and most of these had initial flows under 100,000 cubic feet per day, an amount that would be considered quite small in prolific gas-producing areas. However, in Ontario, where natural gas now sells to domestic consumers at $1 to $1.05 a thousand cubic feet, this is a valuable commercial supply.

In Alberta, developments in 1948 further demonstrated what has been becoming increasingly apparent over a number of years, namely, that enormous natural gas reserves can be developed. It will be recalled that in the development of the Turner Valley field in the foothills southwest of Calgary, beginning with the discovery of the limestone-producing reservoir in 1924, volumes of gas far beyond market requirements were produced to recover the naphtha content and burned in flares. Estimates place this waste as greater than one trillion cubic feet, equal in heat value with efficient burning to 50 million tons of good grade coal. Ultimately, however, conservation measures were applied and Turner Valley still continues as the main gas supply for towns and cities on the Calgary pipeline system. More than 90 per cent of the fuel used in Calgary is natural gas and even though for short periods the rate of peak load consumption exceeds 100 million cubic feet a day, Turner Valley is still capable of meeting most of the demand.

Turner Valley thus can be taken as a rough guide to what may come from similar foothills fields, another of which, southeast of Pincher Creek in the Crowsnest Pass area, was discovered by a well more than 12,000 feet deep completed early in 1948 with a potential open-flow of possibly as much as 60,000 M cubic feet and a distillate content of more than 1,000 barrels a day. Owing to lack of market for natural gas this well has been closed-in, but other wells are being drilled to find the extent of the gas and oil-bearing structure. It is impossible at present to estimate the gas reserves in this field on the basis of one well, but from a knowledge of the type of foothills structure containing the gas there is no doubt a major gas supply has been found.

Excluding the Pincher Creek field, an estimate of the developed natural gas reserves of the Prairie Provinces as computed by Hume and Ignatieff, as of November 30, 1948, was 4·3 trillion cubic feet, an increase from April 1948 of 600 billion cubic feet. In making this estimate, however, only wells providing additional reserves to partly developed fields were considered and all isolated wells in which gas supplies had been measured or observed were excluded because of lack of data concerning the size of the possible new fields that such wells might indicate. A consideration of these wells, however, strongly supports the conclusion that the potential reserves are probably many times the developed reserves.

It can be readily understood that with the market in the immediate vicinity of the gas fields fully supplied, there is no incentive to prove up new supplies until additional markets, made accessible by pipelines, become available. In spite of this the 1948 new gas discoveries are impressive. Among these there is the continued expansion of the Leduc oil field discovered in 1947. One of the productive oil zones in this field has a gas cap with a maximum thickness of more than 100 feet. A demonstration of the volume of oil and gas that was contained in the oil-bearing reservoirs was given by Atlantic No. 3 well that got out of control and flowed wild in the summer of 1948 for several months. It is estimated that on December 1, 1948, the remaining gas reserves in the Leduc field were more than half a trillion cubic feet.

In the autumn of 1948 also the Redwater field 30 miles northeast of Edmonton was discovered. In this field the oil-bearing zone has a relatively low gas content, but higher sands in the Upper and Lower Cretaceous are known to be strongly gas-bearing. Even so, the cumulative volume of gas that will be produced with the oil in this field is exceedingly large.

In addition to wells drilled for oil or for further supplies of gas in such gas fields as Viking-Kinsella, which supplies Edmonton and towns as far south as Red Deer, there were many wells drilled in 1948 that indicated possible new gas fields. North of Edmonton one well near Morinville had a particularly long section of gas-bearing sands, many of which gave large flows on drill stem tests, but in this area there is presently no market beyond what is already supplied with gas and the well was abandoned. To the northeast, at Halfway Lake, another well gave an impressive flow of gas in Lower Cretaceous sands and when the well failed to yield oil it was completed and capped as a gas well.

Further drilling near Foremost in southern Alberta demonstrated additional gas supplies in that area adjoining the developed Foremost gas field and the shut-in Pendant d'Oreille field to the southeast. Also, southeast of Medicine Hat near Dunmore, further gas supplies were found in two sands, one of which was a new discovery for that area. Northeast of Drumheller at Hanna, where gas had already been found, two more wells drilled in 1948 discovered new large supplies. In the Stettler area 40 miles east of Red Deer, another well gave a gas flow estimated at 25 million cubic feet per day in an area where a previously drilled well had indicated some gas to be present. Further gas supplies were also proved in the Blackfoot pool on the Alberta side of the Lloydminster field, where production gas had previously been obtained from the Saskatchewan part of the field close to the town of Lloydminster.

A striking feature of these gas discoveries is that they were made almost exclusively in the search for oil. It is thus safe to conclude that, should the time come when gas is sought for new market outlets, supplies far beyond presently developed reserves will be found.

The developments in recent years in United States have made the public increasingly aware of the value of natural gas as a fuel and as a source of raw material for chemical industries. It was inevitable, therefore, with the discovery of large gas supplies in Alberta that interest should be aroused in the possibility of new outlets by the building of long-distance transmission lines. Applications for charters of incorporation of several pipeline companies were made to the Dominion Government in 1948 and among these were three large gas projects involving expenditures of several hundred millions of dollars for pipeline construction and the proving of adequate gas reserves to ensure the supply over a period of years.

One of these projects involves building a gas transmission line from Alberta to Winnipeg. Another proposes to build a 24-inch line from Alberta through the Crowsnest Pass to Kingsgate in British Columbia and thence to Portland and Seattle in the United States, with branch lines to Trail and Vancouver, B.C. Still

another proposes to build a pipeline from the Alberta side of the Peace River area through British Columbia to Vancouver and thence south into United States. These projects are in various stages of planning and already gas wells have been drilled in the Peace River area of Alberta northeast of Pouce Coupe, B.C., where a gas structure was discovered many years ago. Two gas wells completed on this structure in 1948 yielded flows of 24 and 32 million cubic feet, respectively, and although a reserve sufficient to justify the building of the pipeline has not yet been proved, the results to date are highly encouraging. It is apparent, therefore, that within the next few years remarkable developments in gas-pipeline construction are likely to occur in the Prairie Provinces, and it is not inconceivable that sufficient reserves of gas will be found to justify large diameter pipelines from Alberta to southwestern Ontario, where the partly depleted gas fields offer storage facilities for off-peak summer consumption in order to keep a possible pipeline operating at near capacity for the whole year and thus greatly reducing the year-round cost of long-distance gas transmission.

Production

The volume of natural gas produced in Canada in 1948 reached a record of 58,603,269 M cubic feet valued at $15,632,507, also a record. This compares

Natural Gas Production by Provinces

Provinces and fields	1947		1948	
	M cu. ft.	$	M cu. ft.	$
Alberta				
Turner Valley	27,460,303	.....	28,410,306	.....
Viking-Kinsella	10,494,374	.....	12,736,227	.....
Medicine Hat	3,388,532	.....	3,544,804	.....
Redcliff	1,272,346	.....	1,418,255	.....
Leduc	1,491,088	.....	907,395	.....
Other fields			1,948,230	.....
Total	44,106,643	7,745,886	48,965,217	8,324,087
Ontario				
Tilbury, Romney, Raleigh	2,285,249	.....	2,210,665	.....
Lincoln, Haldimand, Wentworth	1,970,961	.....	1,772,101	.....
Zone	1,251,338	.....	1,488,010	.....
Other fields	2,278,373	.....	3,119,653	.....
Total	7,785,921	5,334,991	8,590,429	6,958,247
New Brunswick				
Stoney Creek	489,810	279,790	420,352	287,446
Saskatchewan	274,193	68,891	477,271	47,727
Northwest Territories	.....	.....	150,000	15,000
Canada, Total	52,656,567	13,429,558	58,603,269	15,632,507

with 52,656,567 M cubic feet valued at $13,429,558 in 1947. Alberta accounted for 84 per cent of the production and 53 per cent of the value, and Ontario 15 per cent of the output and 45 per cent of the value, thus reflecting the much higher cost to the consumer in Ontario.

PEAT

Forty companies produced peat moss in Canada in 1948 and their combined output amounted to 89,800 short tons valued at $2,767,878, compared with 80,018 tons valued at $2,279,821 in 1947, the number of producers in 1947 being forty also.

The figures by provinces follow:

Peat Moss Production

	1947			1948		
	Number of producers	Short tons	Value $	Number of producers	Short tons	Value $
Province						
British Columbia	16	46,104	1,588,349	16	51,496	1,928,651
Quebec	16	21,292	383,795	16	24,622	434,125
Ontario	4	8,250	170,443	4	7,261	189,447
New Brunswick	3	2,527	60,943	3	4,482	136,001
Manitoba	1	1,845	76,291	1	1,939	79,654
Total	40	80,018	2,279,821	40	89,800	2,767,878

The Canadian production is practically all exported to the United States for use as horticultural moss and as poultry and stable litter. More than 80 per cent of it comes from two areas, namely, the Fraser River delta near New Westminster, British Columbia, and Rivière du Loup area, Quebec. The deposits in these areas are being intensively developed. Those in British Columbia are expected to last for 10 to 15 years at the present rate of production, and those in Quebec a somewhat longer period. There are a number of peat bogs in the Maritime Provinces awaiting development.

The leading producers of peat moss in 1948 were:

British Columbia. Western Peat Company, Limited, Box 699, New Westminster; and Atkins and Durbrow, Limited, 302 Royal Bank Building, Vancouver.

Manitoba. Winnipeg Supply and Fuel Company, Limited, 980 Grain Exchange Bldg., Winnipeg, which operates a property near Whitemouth.

Ontario. Atkins and Durbrow (Erie), Limited, Box 500, Port Colborne.

Quebec. Premier Peat Moss, Limited, Isle Verte; Maple Leaf Peat, Limited, 303A La Fontaine St., Rivière du Loup; and Perfect Peat Products, Limited, 303A La Fontaine St., Rivière du Loup.

New Brunswick. Fafard Peat Moss Company, Limited, Shippigan.

Peat is widely distributed in Canada and is found in every province. In its natural state it consists of about 90 per cent water and 10 per cent vegetable matter in various stages of decomposition and disintegration. In general it occurs in two distinct forms, unhumified sphagnum or moss peat, and well-humified grass or sedge peat usually known as fuel peat.

Peat moss is the dead, fibrous moss that has been excavated from peat bogs, dried, shredded, and pressed into bales or smaller packages. Its value depends upon its highly absorptive nature, and its main uses are for stable bedding and poultry litter, and for soil conditioning.

Small amounts of peat fuel have been produced intermittently in Ontario and Quebec. In 1948 there was a small output at Gads Hill Station near Stratford, Ontario.

The operation of a peat bog requires much hand labour. Mechanical diggers and cutters have been tried, but hand digging and stacking are still almost universal. It is generally admitted that mechanization will have to be introduced in Canada in order to reduce the cost of production, especially in view of possible substantial competition from European peat. No recent figures of European production of peat are available, but prior to the war large quantities were produced in Denmark, Sweden, Holland, Germany, and Russia.

Peat for Agricultural Use

A co-operative investigation was started in 1947 by the Departments of Agriculture, and Mines and Resources,[1] Ottawa, to test the value of humified peat as a source of organic matter for depleted and exhausted soils. Comparative tests at test plots at selected areas in Ontario and New Brunswick have indicated that a double application of humified peat is practically equivalent to stable manure for soil improvement.

In November 1948, about 3,000 tons of humified peat was excavated from a bog near Farnham, Quebec, and trucked to eight selected orchards in the Eastern Townships. After being allowed to dry and disintegrate through the winter and spring this material will be used for comparative tests at these orchards, alone, and with addition of various fertilizers, during the 1949 and following seasons.

Price

The price of peat moss varies from $19 to $39 a ton according to location, the average price for the Canadian production in 1948 being about $31 a ton.

CRUDE PETROLEUM

Production of crude oil increased 60 per cent in Canada in 1948 compared with 1947. This is mainly due to a great increase in yield in Alberta but there were also increases in Saskatchewan, Northwest Territories, and Ontario.

In New Brunswick two wells were drilled in 1948 in the search for new fields between Moncton and Sussex but neither was successful.

In Gaspe, drilling was in progress but no significant discoveries were made.

In Ontario, 350 wells were drilled in comparison with 400 in 1947. Of these, 285 were development wells consisting of 120 gas wells with a production of 100 M cubic feet or more a day and 18 oil wells ranging from 2 to 70 barrels a day; the other 147 wells were dry holes. Also 62 wildcat wells were drilled and there were 3 deeper pool tests. One well in Euphemia township, Lambton county, made a new oil territory in the Devonian.

There was no drilling in the Northwest Territories in 1948. The Norman Wells field is capable of considerably larger production than is needed to supply present local demands and production can be taken at an increased rate if this is warranted by available markets. The demand for oil products in the Northwest

[1] Now Department of Mines and Technical Surveys.

Territories, as elsewhere in Canada, was greater than in 1947 and consequently more oil than previously was produced from the Norman Wells field and refined locally to meet the greater requirements.

The production of crude oil in Canada was as follows:

	1947 Barrels	1948 Barrels
New Brunswick	23,128	21,372
Ontario	130,135	176,989
Saskatchewan (Lloydminster)	534,894	847,166
Alberta		
Turner Valley		
Crude oil	5,022,350	4,432,084
Natural gasoline	427,225	468,655
Taber and West Taber	205,236	201,527
Vermilion	138,401	112,331
Wainwright	18,325	17,131
Conrad	202,458	179,627
Lloydminster	304,707	648,055
Princess	106,950	186,393
Leduc-Woodbend	363,363	4,657,371
Redwater	....	36,875
Miscellaneous fields	20,269	33,534
Total, Alberta	6,809,284	10,973,583
Northwest Territories	231,844	349,768
Total for Canada	7,729,285	12,368,878
Value	$19,700,000	$37,700,000

The increase in production in Alberta has brought the time appreciably closer when the Prairie Provinces will be self-sufficient in crude oil. In fact, the great improvement in the availability of light crude oil has had a somewhat detrimental effect on the expansion of heavy crude oil fields, such as Lloydminster. The impetus to exploration given by the discovery of the Leduc field in 1947 was increased by the discovery of the even more important Redwater field, 30 miles northeast of Edmonton, in September 1948. The oil at Redwater is in the equivalent of the D3 or lower zone of the Devonian at Leduc, but unlike Leduc the Redwater field has no defined gas-cap overlying the oil zone. In Redwater, also, the D3 zone has a maximum thickness of 140 feet above the oil-water interface, but the upper 25 feet of this is relatively non-porous. The remainder has good porosity and permeability with sufficient natural gas to make the wells flow. The result is that individual wells have large yields, with initial potentials of 1,500 to 2,000 barrels or more a day. Yield is taken at a much lower rate in accordance with good production practice.

In addition to the discovery of Redwater, the Woodbend extension of the Leduc field, a few miles north of it, was discovered early in January 1948. The exact connection between the Leduc and Woodbend producing areas has not yet been established, but since the oil-water interface occurs at the same level there is reason to believe the two are parts of one field. The initial Woodbend well had a potential on production test of 2,200 barrels a day.

In August 1948, an important oil discovery in Lower Cretaceous strata was made east of the Devonian Woodbend discovery. This opened up a new oil pool. A similar discovery followed on the east edge of the Leduc field but it has not been determined whether the two areas will ultimately join into one producing field.

During 1948 there were 139 wells drilled in the Leduc-Woodbend field, bringing the total at the end of the year to 174 with a production for December 1948, of 21,500 barrels a day. Late in March, Atlantic No. 3 well went out of control. Attempts to repair the well were partly successful but in May the well got wholly out of control. Oil and gas began to come through the formation outside the well, and cratering occurred to such an extent that the drilling rig and derrick finally collapsed. This caused the well to go on fire, but fortunately this did not occur until plans to bring the well under control were almost complete. The fire was extinguished after 2½ days by pumping water into one of two offset wells that had been drilled and deviated towards the wild well to reach it at the depth of the oil horizon. Most of the oil produced by the wild Atlantic well was recovered. During the 6 months that the well flowed unrestricted the oil that was recovered amounted to 1,225,904 barrels, of which 240,730 barrels was returned to the formation and 985,174 barrels was marketed.

The Lloydminster oil field continued to expand and at the end of 1948 there were 321 wells, of which 95 were completed in 1948. The Lone Rock area in Saskatchewan and the Blackfoot area of Alberta were enlarged and new wells were drilled in the Southminster area south of Lloydminster. At the end of the year there were 92 producing oil wells in Saskatchewan. A discovery of heavy oil of about the same quality of Lloydminster was made in July near Compeer on the Alberta-Saskatchewan boundary in township 33. No further drilling was done in 1948.

Early in 1948 Canadian Gulf Oil Company made a gas-distillate discovery about 20 miles southeast of Pincher Creek. This well reached the top of the Palæozoic limestone at a depth of 11,700 feet and completed drilling at a depth of 12,516 feet. Tests were made and the well has an indicated production of 40 to 60 million cubic feet of gas a day with 1,000 to 1,500 barrels of distillate. It had not been put on production by the end of 1948. Two other wells were drilling.

On the Plains a well drilled at Hanna as a follow-up, and 1 mile distant from the original Berry Creek gas discovery, yielded gas with some light oil; and at Stettler the Picadilly-Interleduc Edwards No. 1 well, completed at a depth of 5,723 feet, yielded gas with distillate of 57·5 gravity. This seems to indicate at least a new gas field, but it is yet to be determined how important the area will be from the standpoint of oil production.

All these discoveries, and particularly the success that has occurred in finding large fields such as Leduc and Redwater, have brought about an unprecedented development program. The area from Edmonton north to Athabasca and for a considerable distance beyond had been taken up either by permit or lease by the end of 1948 and many wells were being drilled. Not only is a large increase in production anticipated for 1949 but there is to be considerable expansion of refining facilities. Imperial Oil, Limited has moved the Canol refinery from Whitehorse to Edmonton and it is being enlarged to a capacity of 11,000 barrels. Several other new refineries are to be constructed. Plans are also under consideration for the building of a crude oil pipeline from Edmonton to Regina. Thus, in the near future the Prairie Provinces will be self-sufficient in crude oil with sufficient refining capacity to provide all requirements in oil products.