CANADA

DEPARTMENT OF MINES AND RESOURCES

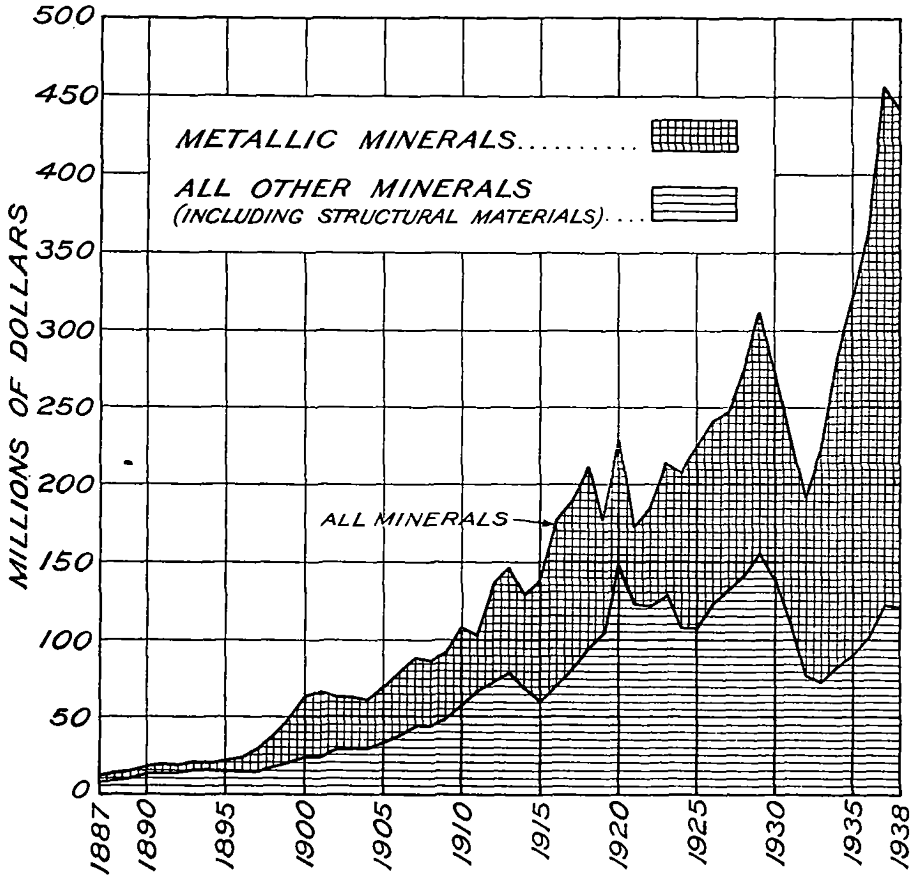
MINES AND GEOLOGY BRANCH

BUREAU OF MINES

THE CANADIAN MINERAL INDUSTRY IN 1938

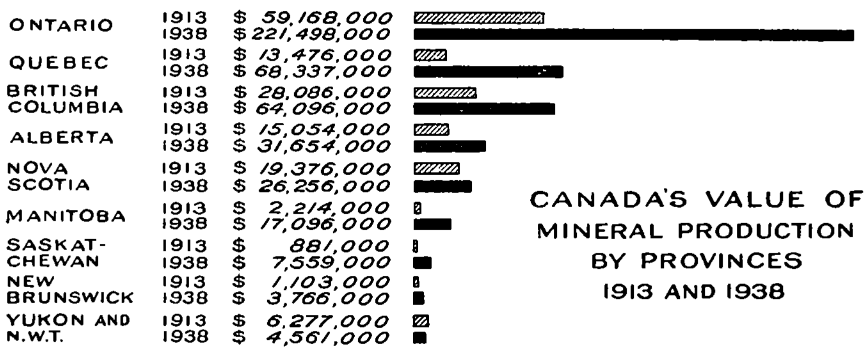
Reviews by the Staff of the Bureau of Mines

Price, 25 cents No. 804



Value of Canada's annual mineral production, 1887-1938.

CONTENTS



Value of Canada's mineral production by provinces, 1913 and 1938.

Annual dividend payments made by Canadian metal mining companies, 1929-1938.

NOTE.—Statistical data relating to production except where noted otherwise, were obtained from published data by the Dominion Bureau of Statistics. The figures of production for 1938 are preliminary figures and subject to revision. Imports and exports are taken from the "Trade of Canada," as issued by the Dominion Bureau of Statistics, and cover the calendar year. Market quotations are obtained from standard marketing reports issued in Montreal, New York, London, or elsewhere.

I. METALS

ALUMINIUM

Canada, largely because of her abundance of cheap electric energy, is a leading producer of aluminium, but the Dominion's requirements of bauxite, the ore of the metal, are all imported as no commercial deposits have as yet been found in the country. Direct delivery of bauxite from British Guiana, which was discontinued in 1930, was resumed in 1935, and since then imports from that country have shown a marked increase, the total in 1938 amounting to 309,954 short tons. There are also substantial imports annually from the United States, and occasionally small amounts are re-exported from Great Britain, most of which is used in the abrasive and chemical trades.

Bauxite for the production of abrasives, or for the chemical trade, is usually calcined in the country of origin. Bauxite from British Guiana, used for the production of aluminium, is washed and dried before being shipped. At Arvida, Quebec, it is treated by a standard chemical process to remove impurities, and pure aluminium oxide is recovered. Cryolite, necessary in the production of aluminium, is imported from the west coast of Greenland, the only known commercial source of supply.

Canada imported bauxite, alumina, and cryolite to the value of $2,919,632 in 1938, as compared with $4,397,782 in 1937. Imports of metallic aluminium and its products were valued at $1,979,622, as compared with $2,181,619 in 1937. Exports of aluminium and its products were valued at $23,743,887, as compared with $18,623,475 in 1937. Aluminium ranked third in 1938 in Canada's exports of base metals. Most of Canada's output of aluminium is marketed in the British Empire.

Aluminium Company of Canada, with a refinery at Arvida, and another at Shawinigan Falls, Quebec, is the only Canadian producer of the metal, and is the largest of three producers of aluminium in the British Empire, the other two being British Aluminium Company, Limited, with three smelters in Scotland, and Aluminium Corporation, with a smelter in Wales. It is also the only producer which mines its own bauxite, Demerara Bauxite Company in British Guiana being a subsidiary enterprise. Aluminum Company of Canada also has two fabricating plants, one at Shawinigan Falls, and the other at Toronto. Other companies, with plants mainly in Ontario and Quebec, manufacture aluminium cooking utensils, automobile parts, and other aluminium ware.

The world output of aluminium in 1938 was 561,800 metric tons (U.S. Bureau of Mines), the principal producing countries in order of output capacity being: United States, Germany, Russia, Canada, and France. World consumption in 1937 was estimated at 450,300 metric tons.

Aluminium metal and alloys, because of their lightness, their high tensile strength, and their resistance to corrosion, are used widely in industry, and the use of many new alloys in structural shapes and sheet metal for railway cars, automobiles, airplanes, skips and cages for the mining industry; and in roofing sheets, shipping barrels, tanks, and industrial equipment of many kinds has been increasing steadily. Aluminium powder is used in paints for the preserving of wood and steel surfaces, more particularly on oil storage tanks, water tanks, tank cars, and other containers. Aluminium foil is an efficient insulator for hot or cold pipe-lines, refrigerator linings, furnace jackets, and similar applications. It is also being used as a wrapper for food products. Many new uses are being found for tubes and other shapes. Alloy pistons, with specially developed surfaces of oxide to reduce wear, are in general use in the construction of automobile and airplane engines.

Aluminium dust is being used experimentally to combat silicosis. The miners are said to gain immunity from silicosis by passing through a chamber of aluminium-dust laden air before entering mines. The discovery is the result of work undertaken by J. J. Denny and Dr. W. D. Robson of the McIntyre mine in co-operation with the Banting Institute of Toronto. The impregnation of mine dust with aluminium powder has been shown to decrease the solubility of the dust.

The United States Tariff Act of 1930 provides for a duty of 5 cents per pound on silicon-aluminium, ferrosilicon-aluminium, and ferro-aluminium-silicon (par. 302). The trade agreement (Nov. 1938) between the United States and the United Kingdom provides for a duty of 6 cents per pound on aluminium and (except those provided for in par. 302) on coils, plates, sheets, bars, rods, circles, disks, blanks, strips, rectangles, and squares in which aluminium is the chief metal of value (schedule IV, par. 374). Under the terms of Article I of the Canadian-United States trade agreement these concessions (if any) are automatically extended to Canadian products.

The nominal price in New York of aluminium metal, 99 per cent pure, remained at 20 cents per pound throughout 1938.

ANTIMONY

Small deposits of antimony ore are known to occur in several parts of Canada Since 1917, however, no antimony ore or refined antimony has been produced, with the exception of occasional small shipments; prior to 1917 small amounts of refined antimony and of antimony ores were produced intermittently in the Maritime Provinces. Consolidated Mining and Smelting Company of Canada, Limited produces an antimonial residue as a by-product of its silver-refining operations at Trail, British Columbia.

The silver-lead-bismuth bullion obtained as a by-product in the treatment of the silver-cobalt-nickel-arsenic ores at Deloro, Ontario, contains small quantities of antimony which is exported to Europe for further treatment. No payment is received for the antimony content, however.

In British Columbia antimony-gold ores were mined on a small scale in 1937 from the Congress and Reliance mines in Bridge River area, British Columbia. Consolidated Mining and Smelting Company completed the erection of a treatment plant at Trail in 1938 for the recovery of high-grade electrolytic antimony from flue dust, a by-product of the company's silver refinery. The plant has a capacity of four tons of refined antimony a day. No production was reported from the plant in 1938.

Canada produced 24,560 pounds of antimony, valued at $2,200 in 1938, all of which represents the antimony in gold ores exported from Nova Scotia.

Canada's requirements of antimony are all imported. In 1938 these imports amounted to 856,986 pounds of antimony metal or regulus valued at $85,461, and 66,016 pounds of antimony salts valued at $9,376. Imports of antimony oxide are not given separately.

The world production of antimony in 1938 is estimated at 32,500 short tons. The decline in output from China was partly offset by the large increase in production in Bolivia. Most of the world production of antimony has come from China, although Bolivia and Mexico have been important producers. During the past few years there has been a marked increase in output from Czechoslovakia and Algeria, and, to a lesser extent, from several other countries.

The market for antimony depends especially upon the demand from automobile manufacturers, as it is used largely in alloys for storage-battery plates, bearing and babbitt metals, solder, rubber goods, paints, and fixtures. The expansion in the manufacture of munitions of war has been an important contributing factor in the increased demand for antimony.

The New York price of antimony (ordinary brand) in 1938 averaged 12·349 cents a pound, as compared with 13·36 cents in 1937.

BISMUTH

Refined bismuth has been produced in Canada since 1928 and is obtained as a by-product from the treatment of the lead-zinc ores of British Columbia, and from the treatment of the silver ores of northern Ontario.

In British Columbia, Consolidated Mining and Smelting Company of Canada erected a plant in 1928 for the electrolytic treatment of bismuth residue resulting from the electrolytic treatment of lead bullion. The plant operates only intermittently.

In Ontario, Deloro Smelting and Refining Company, Deloro, obtains a lead bullion containing bismuth as well as some gold and silver from the treatment of the silver-cobalt-nickel-arsenical ores of Cobalt and adjoining areas. The bullion is exported for refining.

Canada produced 9,516 pounds of bismuth in 1938 valued at $9,754, as compared with 5,711 pounds valued at $5,654 in 1937. No metallic bismuth was produced in 1937 or in 1938. No separate records of exports of bismuth or of bismuth salts are available. Canada imported 297 pounds of metallic bismuth valued at $303, and bismuth salts valued at $16,756 in 1938, as compared with 34 pounds of metallic bismuth valued at $40, and bismuth salts valued at $17,489 in 1937.

World production is estimated at between 800 and 1,000 tons annually. The United States is the principal producer, but no figures are published as most of the output is obtained from two companies, namely, American Smelting and Refining Company, and U. S. Smelting, Refining and Mining Company. Canada appears to hold second place as a source of supply, other important sources being Germany, Spain, Peru, Mexico, and Japan. Bolivia was the principal source of supply for more than half a century, but in recent years its production has decreased considerably. Most of the world's supply is obtained from the treatment of lead refinery slime, and as a by-product in the treatment of gold, tin, and copper ores.

Until recently bismuth had been used chiefly in the manufacture of pharmaceutical products, but it is now used mostly in the making of so-called fusible or low-melting alloys, as for automatic sprinkler nozzles. Fusible bismuth alloys usually include lead, tin, cadmium, mercury, or antimony. An alloy of bismuth, lead, tin, and antimony has been introduced for use in mounting dies and punches. Although the many new applications of bismuth have increased the demand for the metal, the supplies are still far in excess of requirements.

The price of bismuth at New York in ton lots remained fixed at $1.00 a pound from September 1935 to May 1938, when it was raised to $1.05, at which level it remained to the end of 1938. For several years the price in the United States has been maintained a little below that in Europe. Imports into the United States are subject to a 7½ per cent ad valorem duty.

CADMIUM

Cadmium is present in small amounts in most zinc ores and in some lead ores and is obtained as a by-product in the treatment of these ores. Metallic cadmium is produced by the Consolidated Mining and Smelting Company at Tadanac (Trail), British Columbia, and by Hudson Bay Mining and Smelting Company at Flin Flon, Manitoba. The former company commenced the production of the metal early in 1928, and the plant treats the cadmium residue from the company's zinc refinery. Hudson Bay Mining and Smelting Company completed the erection of a cadmium recovery plant with an annual capacity of 180 tons in 1936. The residue treated is from the zinc refinery, and consists of current precipitate, the procedure being similar to that followed at Tadanac.

Canada produced 699,138 pounds of cadmium valued at $561,799 in 1938, as compared with 745,207 pounds valued at $1,222,140 in 1937. The Canadian production is apparently exported chiefly to Europe, although small shipments are made to the Orient.

The world output of cadmium in 1938 is estimated at 4,000 short tons, the production in 1937 being 3,924 tons. The chief producing countries are, in order: United States, Canada, Mexico, Belgium, Germany, Tasmania, Poland, Norway, England, Russia, and France. The Mexican output is contained in ores which are exported for treatment in various countries. Present world production is limited entirely to that recovered as a by-product from the electrolytic refining of zinc and from the manufacture of lithopone.

The market for cadmium has shown some improvement in recent years owing to the increased use of the metal, principally in the manufacture of alloys and of compounds, and as a plating material. The use of cadmium alloys in automobile bearings has also given rise to a strong demand for the metal, and the future of the alloy for this purpose is said to be dependent upon the ability of producers to supply cadmium at a relatively low price. Cadmium is also used in the arts, medicine, dyeing, etc. It is marketed in metallic form, 99·5 per cent pure and better, and as a sulphide. The principal compounds are cadmium sulphide, cadmium oxide, cadmium lithopone, and cadmium selenide.

The price of cadmium in 1938 averaged 80·36 cents a pound as compared with $1.64 in 1937 (London prices in Canadian funds). The price gradually declined from a high of $1.24 in January to 49 cents in December. The price in New York averaged 98·04 cents as compared with $1.22 in 1937. The American product is protected by a duty of 7½ cents a pound.

COBALT

Most of the cobalt produced in Canada has come from the silver-cobalt camps at Cobalt, Gowganda, and South Lorrain in northern Ontario. The greater part of it is obtained as a by-product of silver mining, consequently production varies more or less in accordance with activity in the latter. Some ore is mined, however, chiefly or solely for its cobalt content.

Deloro Smelting and Refining Company's plant at Deloro, Ontario, is the only one in Canada treating ores for the recovery of cobalt. It produces cobalt metal, oxides, and salts, chiefly for the British market. Much of the Canadian cobalt ore is sold for treatment abroad. Small amounts of by-product cobalt are said to be recovered in Europe from the refining of Canadian nickel-copper matte.

There are no known occurrences of cobalt in Canada, aside from those of northern Ontario, which give promise of commercial importance. A stable high price for silver would probably result in a renewal of operations at some of the old silver deposits high in cobalt.

Canada produced 459,060 pounds of cobalt valued at $788,576 in 1938, as compared with 507,064 pounds valued at $848,145 in 1937.

The Dominion imported 736 pounds of cobalt oxide valued at $1,094 in 1938, which compares with 617 pounds valued at $871 in 1937.

Exports were as follows:—

—	1937		1938	
	Pounds	Value	Pounds	Value
		$		$
Cobalt contained in ore	92,400	58,712	66,400	40,983
Cobalt alloys	51,939	84,629	49,674	79,278
Cobalt metallic	7,576	10,834	83,579	122,101
Cobalt oxides and salts	597,869	754,965	382,408	523,218
	749,784	909,140	582,061	765,580

The annual world output is estimated to be approximately 4,500 short tons. The greater part of the requirements are now supplied from the extensive deposits of the Belgian Congo and Northern Rhodesia, the remainder being contributed mainly by Canada, India, and French Morocco. Other producing countries are Australia, Japan, Germany, and Russia.

About 75 per cent of the world's production of cobalt is used in the metallurgical industry, and the remainder is used in the ceramic industry. The metallurgical uses are for high-speed cutting steels; for making stellite (alloys of cobalt, chromium, and usually small quantities of other metals) which is used for cutting metals at high speed; and for making permanent magnets. The use of stellite continues to increase and the alloy is of great value in the manufacture of valves for airplane engines. Small quantities of cobalt used with other chemicals in nickel-plating solutions are said to produce a bright nickel electro deposit as an undercoating for later chromium plating. The development of a new cobalt steel, employing 36 per cent of cobalt, for use in fine machine operations was reported in 1937, the other metals being molybdenum, chromium, and small quantities of carbon and vanadium. Large quantities of cobalt are now used for catalytic purposes.

Cobalt oxide, owing to its fine colouring properties, is used mainly in the ceramic industry. Other compounds of cobalt are used as driers in paint and varnish.

Owing mainly to an agreement reached in 1935 among the principal producers, the price of cobalt has remained fairly steady in recent years. The nominal New York price for cobalt metal imported from Belgium remained at $1.92 per pound. The price for cobalt ore, 13 per cent grade, f.o.b. cars, Ontario, was 47½ to 52½ cents per pound from January to July, 1938, and 75 cents per pound from August to December. The Cobalt Association comprises leading Canadian, Belgian, Northern Rhodesian, and Moroccan producers, the Association of German Cobalt Producers, and the Vuoksenniske Company of Finland. It now controls probably about 90 per cent of the world's output. The agreement, which was to expire in August 1936, was renewed for five years.

COPPER

Most of Canada's output of copper is obtained from ores that are mined as much for the recovery of other metals, principally nickel, gold, silver, and zinc, as for their copper content.

About 56 per cent of the output in 1938 was obtained from the copper-nickel ores of the Sudbury area in Ontario, while the remainder of the output came from the copper-gold ore of the Noranda mine, the copper-zinc ores of Waite-Amulet and Normetal mines, and the copper-pyrites ores of the Aldermac and Eustis mines in Quebec; the copper-zinc ores of the Flin Flon and Sherritt-Gordon mines in northern Manitoba; the copper-zinc-pyrites ore of the Britannia mine, and the copper ore of Copper Mountain mine in British Columbia. Canada is now contributing about 15 per cent of the total world production of copper.

In British Columbia, Britannia Mining and Smelting Company's mine and its 6,500-ton concentrator at Britannia Beach were operated at full capacity, and the copper and zinc concentrates produced were exported. Granby Consolidated Company, which resumed operations in the summer of 1937, operated its Copper Mountain mine and its 3,600-ton concentrator at Allenby near Princeton; the copper concentrate produced is being exported.

In Manitoba, Hudson Bay Mining and Smelting Company's 5,000-ton concentrator and its smelter at Flin Flon operated at full capacity. Sinking was continued to the 2,750-foot level, where the results of development work have been encouraging both as to the size of the ore-body and the grade of the ore. Preparations are being made to sink a new south main shaft. A research department was established late in 1938. Sherritt-Gordon's 1,500-ton mill also operated at full capacity. The copper concentrate is smelted at Flin Flon.

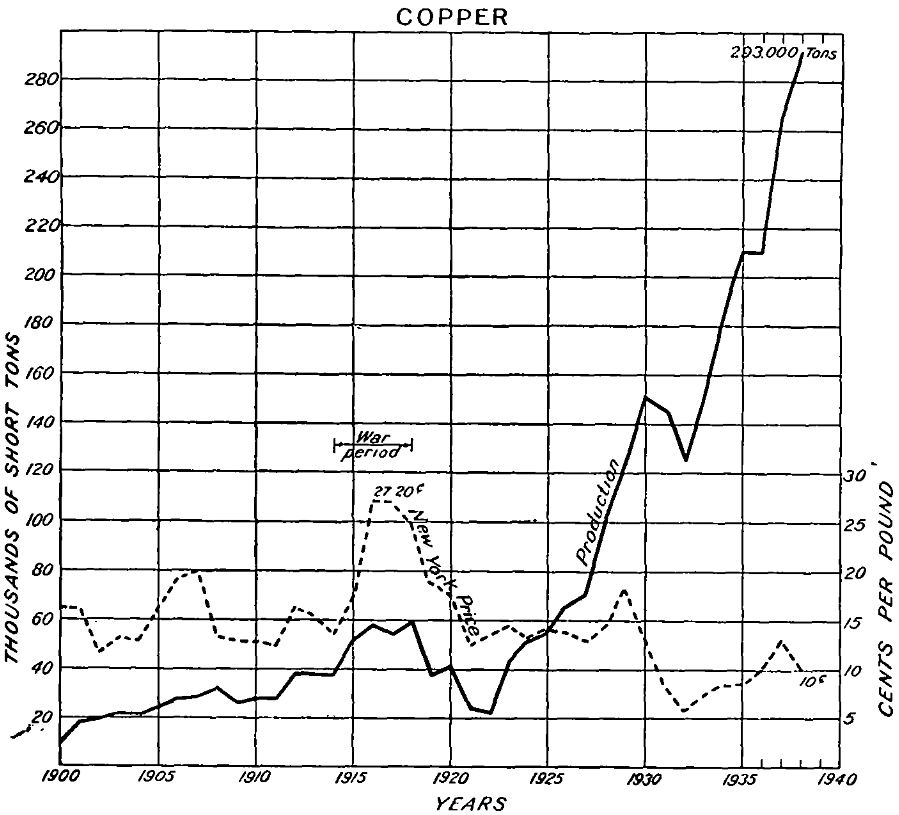
In Ontario, International Nickel Company operated its Creighton, Frood, Garson, and Levack mines. The daily capacity of the company's concentrator was increased during the year by 4,000 tons, and it and the smelter were operated at capacity. No. 2 shaft at the Levack mine was completed to 1,860 feet. Stations were cut at the 1st to 16th levels, and connections were made to the present No. 1 shaft workings. The stripping of overburden and the excavating of hanging-wall rock were commenced at the Frood open pit in July, 1938, in preparation for ore production, and a new crushing and sorting plant for handling the ore was constructed.

Falconbridge Nickel Mines, Limited deepened its No. 5 shaft to 2,450 feet, at which horizon good ore was intersected. Development of the 2,100-foot level between No. 1 and No. 5 shafts was carried out in ore of average grade. Further diamond drilling of the company's Levack prospect disclosed a substantial tonnage of ore. The increase in ore reserves was again greatly in excess of the tonnage of ore mined during the year. The capacity of the reduction plant was increased gradually, and the production in 1938 amounted to 14,800 tons of copper-nickel matte, which was shipped to the refinery in Norway.

Denison Nickel Mines, Limited, Denison Township, northwest of Sudbury, built an electric plant and deepened the shaft from the 500-foot to the 1,000-foot level. Ontario Nickel Company, which owns property in the Sudbury district and in other parts of Ontario, has diamond-drilled its Moose Lake property in McLennan Township, north of Falconbridge.

In Quebec, Noranda Mines, Limited operated its Horne mine and smelter at a normal rate and treated an increasing tonnage of custom ores and concentrates. Exploratory work was continued from No. 5 shaft between the 3,500- and 4,000-foot levels, and a considerable footage of raising was done for fill transfer purposes in preparation for the commencement in 1939 of large-scale back-filling with smelter slag.

Aldermac Mines, Limited operated its 1,000-ton daily capacity concentrator, and Waite-Amulet Mines, Limited, its 500-ton concentrator. At the latter property upwards of 3,393,000 tons of additional copper-zinc ore was disclosed by diamond drilling during the year. The ore occurs at a depth of about 1,000 feet. It averages 6·4 per cent copper, and 4·6 per cent zinc, and contains 0·05 ounce of gold and 1·62 ounces of silver per ton. The company is to sink a central shaft and a ventilating shaft, and is erecting a 1,000-ton mill which is likely to be in operation before the close of 1939.



Copper production and price trends in Canada, 1900-1938.

Normetal Mining Corporation's Abana mine, north of Dupuy station on the Canadian National Railway, started production in 1937 following the erection of a 250-ton concentrator, the capacity of which was increased to 500 tons in 1938. The copper concentrate is shipped to Noranda's smelter and the zinc concentrate is exported to Belgium. The Eustis mine in southern Quebec is Canada's oldest copper mine and is operated by Consolidated Copper and Sulphur Company, Limited. It continued in regular operation in 1938 and its copper concentrates were shipped to the United States.

Canada produced 293,010 tons of copper valued at $58,026,972 in 1938, as compared with 265,014 tons valued at $68,917,219 in 1937. Close to 78 per cent of the total output in 1938 was produced in the refined form, at Ontario Refining Company's plant at Copper Cliff, Ontario, and at Canadian Copper Refineries' plant at Montreal East in Quebec. The former plant is the largest of its kind in the British Empire, and has a rated capacity of 120,000 tons of refined metal annually. The rated capacity of the latter plant was increased in 1938 from 75,000 tons daily to 81,000 tons, and is again to be enlarged in 1939 to 100,000 tons. It treats the anode copper from the Noranda mine in Quebec and the blister copper from the Flin Flon mine in Manitoba, while the refinery at Copper Cliff treats International Nickel Company's entire output of blister copper, which goes in molten form direct to the refinery's anode furnace. At Copper Cliff refined copper is produced from the blister product of both reverberatory and electric furnaces, and a second unit of the electric furnace is under construction. In the special shapes department the production of machine-pointed, vertically-cast wire bars is worthy of note.

Canadian Exports and Imports of Copper, 1938

	Pounds	$
Exports:		
Copper, fine in ore, matte, etc.	109,806,100	7,637,581
Copper, blister	30,527,300	3,056,241
Copper, old and scrap	3,437,400	205,059
Copper in ingot, bar, rod, etc.	363,528,700	35,858,006
Copper in rod, strip, sheet, plate and tubing	53,512,900	5,767,622
Copper wire and cable		435,784
Copper manufacture		354,509
		$53,314,802
Imports:		
Copper in bar, rod, block, pig, ingot, tube, wire and scrap	1,930,523	322,398
Copper manufactures and compounds		640,530
		$962,928

Owing to the special revenue tariff of 4 cents a pound, sales of refined copper to the United States were discontinued in 1933, but were resumed in 1937, and continued in 1938. Concentrates shipped to the United States were chiefly from British Columbia and also from Quebec. They were treated in bond and the metal was sold abroad.

Because of its excellent quality, Canadian refined copper is much in demand and is finding its way into ever-widening markets. For the most part it is exported to the United Kingdom, where the consumption of new copper has been increasing, and is now at a rate of about 250,000 tons annually. The increase can be traced mainly to house building, the improvement in the transportation and engineering industries, and to the increasing domestic use of electricity.

According to the American Bureau of Metal Statistics, the world production of copper amounted to 2,184,267 short tons in 1938, as compared with 2,503,966 short tons in 1937, the record year. The increase in recent years is due largely to the increased use of the metal in Great Britain and Europe, and in Japan.

World consumption of copper, according to the American Bureau of Metal Statistics, amounted to 2,177,809 short tons in 1938, as compared with 2,407,739 short tons in 1937, the previous record year. The United States is by far the greatest consumer, the principal consuming industries being, in order of importance, electrical, manufacturing, automobile, building, electric refrigerator, and air-conditioning. These and other industries in that country used a total of 860,000 tons of copper in 1937. Ordinarily, the building industry is as large a consumer of copper as the automobile industry, but this has not been the case in recent years. In Great Britain, the second greatest consumer of copper, the metal is used chiefly in the electrical industry.

From January to June 1938, the output of member companies of the copper cartel was restricted to 105 per cent of their scheduled capacities, and from July to September it was reduced to 95 per cent. During part of October it was 105 per cent, following which the restrictions were discontinued for a short period, and then placed at 110 per cent for November and December.

The average price of copper (electrolytic) in Canadian funds during 1938 was 9·972 cents a pound, as compared with 13·078 cents in 1937.

GOLD

Gold is by far the greatest single contributor to Canada's mineral output, the value of output of the metal in 1938, which amounted to $165,-867,009, being 51 per cent of the total value of all metals, and 37 per cent of the value of the Dominion's entire mineral production in that year. About 80 per cent of the output is obtained from lode gold mines throughout the country, and from 15 to 20 per cent is recovered as a by-product in the treatment of non-ferrous base metal ores. The remainder is obtained from placer gold deposits, particularly from those in the Klondike area, Yukon. A total of 163 gold mills with a combined capacity of 55,600 tons a day were in operation in Canada in 1938, 38 of which, with a combined daily capacity of 6,300 tons, entered into production during the year. At the close of the year 11 new mills, with a combined daily capacity of 3,600 tons, were under construction.

Nova Scotia's output is from the gold-quartz mines of Seal Harbour, Montague, Caribou, Moose River, Goldenville, and a few other areas. Several old properties again resumed operation on a small scale. The Seal Harbour mill, by far the largest in the province, was enlarged by 100 tons to a capacity of 250 tons.

In Quebec the Noranda copper-gold mine continues to be the chief source of output, but the greater part of the production is now being obtained from the gold-quartz mines in Bourlamaque, Siscoe, Cadillac-Malartic, Arntfield, Duparquet, Rouyn, and Mud Lake areas, all in the western part of the province. East Malartic's 900-ton mill, Francoeur's 200-ton mill, Lapa-Cadillac's 300-ton mill, Sladen Malartic's 300-ton mill, Pan-Canadian's 150-ton mill, and smaller plants at the Payore and Lake Rose mines entered production in 1938.

In Ontario the gold-quartz mines of Kirkland Lake and Porcupine areas are the source of between 45 and 50 per cent of Canada's annual output of gold. Close to 98 per cent of the province's output of the metal is obtained from gold-quartz mines, the source of the remainder being the nickel-copper ores of the Sudbury area. Although Kirkland Lake and Porcupine areas are by far the leading producers, the output from properties that have entered production in Little Long Lac, Sturgeon River, Red Lake, Crowe River, Sachigo River, Lake of the Woods, Larder Lake, Matachewan, Goudreau, and Michipicoten areas within the past eight years has been increasing steadily. The following gold milling plants (daily capacities in brackets) entered production in Ontario in 1938:

Kerr-Addison (700 tons), MacLeod-Cockshutt (600 tons), Madsen (365 tons), Hallnor (250 tons), Moneta, Cline, and Hard Rock (200 tons in each case), Golden Gate, Bilmac, and Tombill (100 tons in each case), and several other smaller mills.

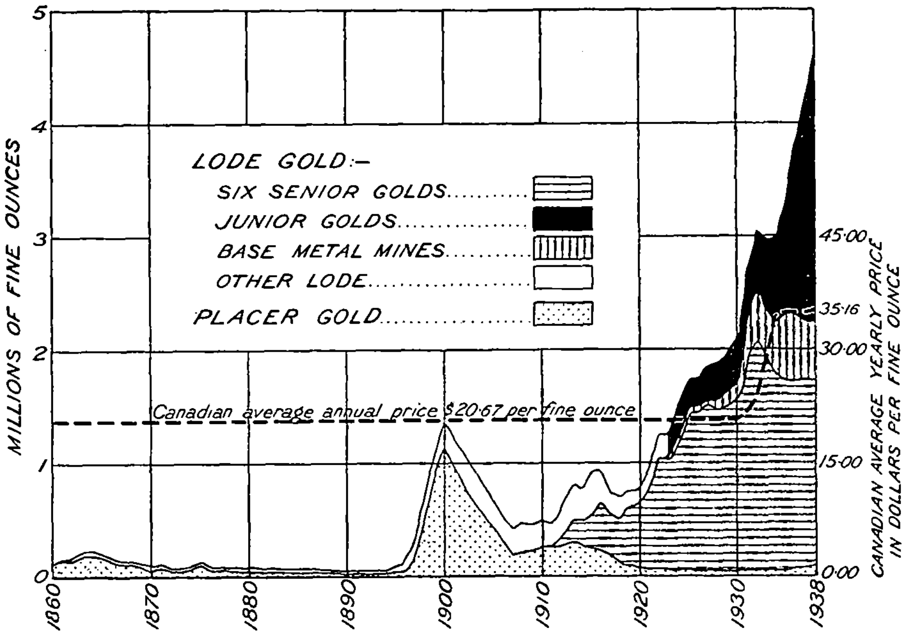
In British Columbia gold is obtained chiefly from the gold-quartz mines of the Bridge River area, other important sources being the gold-quartz mines of the Salmon River, Cariboo, Hedley, Sheep Creek, and Ymir areas, and of the Zeballos River area on the west coast of Vancouver Island. It is recovered also from base metal ores, notably from those of Britannia and Copper Mountain mines. A relatively small amount (50,000 ounces) is obtained from placer operations. Big Missouri's 750-ton mill, the only one in Canada built entirely underground, entered production early in 1938. The list of new producers also included B.R.X. in the Bridge River area (100 tons); Gold Belt in the Sheep Creek area (150 tons); Cariboo-Hudson in the Quesnel area (100 tons); Privateer, Spud Valley, and Rey Oro, in the Zeballos River area; and a few other small mills.

In Manitoba gold is obtained chiefly from the copper-zinc-gold ores of the Flin Flon and Sherritt-Gordon mines, but production from the gold-quartz mines of eastern Manitoba and other parts of the province has been increasing steadily. Saskatchewan's output comes entirely from that portion of the Flin Flon mine lying within the province. No new mills were brought into production in Manitoba in 1938; in Saskatchewan a 1,500-ton mill on Consolidated Mining and Smelting Company's Box property near Goldfields was under construction, and the adjoining Athona property was under development.

Alberta produces a few ounces of placer gold annually.

The Northwest Territories recorded their first commercial production of gold in 1938, the output having been obtained from the Con property in the Yellowknife River area on the north shore of Great Slave Lake. The Negus property in the same area entered production early in 1939. Yukon's gold output is obtained almost entirely from placer deposits, the large-scale dredging of which is carried on chiefly in the Klondike area, mainly in the vicinity of Dawson City.

Plants for the production of fine gold are operated by: the Royal Canadian Mint at Ottawa; Hollinger Consolidated Gold Mines, Limited, Timmins, Ontario; Ontario Refining Company, Limited, Copper Cliff, Ontario; Canadian Copper Refiners, Limited, Montreal East, Quebec; and Consolidated Mining and Smelting Company, Limited, Trail, British Columbia. The Copper Cliff refinery provides a service for several of Canada's gold mines by treating their accumulation of slags, mattes, and other gold-bearing products.



Canada's annual gold production, 1860-1938.

Gold Production in Canada

(By Provinces)

—	1937		1938	
	Fine ounces	$	Fine ounces	$
Nova Scotia	19,918	696,931	26,613	936,112
Quebec	711,480	24,894,685	879,881	30,949,814
Ontario—				
Porcupine	1,120,525	39,207,170	1,258,797	44,278,184
Kirkland Lake	999,446	34,970,615	1,030,747	36,256,526
Other	467,124	16,344,669	607,857	21,381,370
Total, Ontario	2,587,095	90,522,454	2,897,401	101,916,080
Manitoba	157,949	5,526,636	185,672	6,531,013
Saskatchewan	65,886	2,305,351	50,021	1,759,489
Alberta	46	1,610	305	10,728
British Columbia	505,857	17,699,936	596,279	20,974,114
Yukon and N.W.T.	47,982	1,678,890	79,308	2,789,659
CANADA	4,096,213	143,326,493	4,715,480	165,867,009

Excellent headway was made in the development of new mines throughout Canada in 1938, more especially in the Porcupine, Larder Lake, Patricia, and Opeepeesway Lake areas, in Ontario; the Cadillac-Malartic and adjoining areas in western Quebec; the Yellowknife River area in the Northwest Territories; the Goldfields area in Saskatchewan; and the Zeballos River area in British Columbia.

World production of gold in 1938 is estimated at 37,109,400 fine ounces, as compared with 36,266,500 fine ounces in 1937. Canada is headed only by South Africa and Russia as a producer of gold, and contributes about 12 per cent of the world total.

The average price of gold in Canadian funds in 1938 was $35·165 per fine ounce, as compared with $34·99 in 1937.

IRON ORE

No iron ore for blast furnace use has been mined in Canada since 1923, but three large iron and steel-making plants and one merchant furnace are in operation on imported ore. Dominion Steel and Coal Corporation, Sydney, Nova Scotia, obtains its ore from its own mines at Wabana, Newfoundland, while Steel Company of Canada at Hamilton, Algoma Steel Corporation at Sault Ste. Marie, and Canadian Furnace Company at Port Colborne, Ontario, obtain their ore requirements from the Lake Superior region in the United States.

As a result of the bounty of 2 cents a unit offered by the Ontario Government, Algoma Ore Properties, Limited, a subsidiary of Algoma Steel Corporation, started in 1937 to open up its New Helen mine in the Michipicoten district, and expectations are that the property will be brought into production in the early summer of 1939. The deposit is estimated to contain some 100,000,000 tons of carbonate ore, averaging about 35 per cent iron. To fit it for use in the blast furnace, a roasting and sintering plant capable of treating 2,000 tons of ore a day are being built. The sinter will contain about 50 per cent iron.

Iron deposits at Steeprock Lake, north of Atikokan and about 100 miles west of Port Arthur, were discovered in the winter of 1937-38 by diamond drilling through the ice. The deposits were developed during 1938 by Steerola Exploration Company (now Steep Rock Iron Mines, Limited). Diamond drilling has proved the existence of a large deposit of hematite ore, the core analyses having shown an iron content of 51 to 60 per cent. Further development is being carried on (1939) with three diamond drills.

In the Sudbury district, M. A. Hanna Company of Cleveland, Ohio, sampled the old Moose Mountain mine and is reported to have shipped some 60 tons of ore for experimental purposes in 1937. The deposit is estimated to contain at least 33,000,000 tons of proved and probable siliceous magnetite ore, averaging 35 per cent iron. It was operated mostly on an experimental basis for a number of years, and exceptionally high-grade material for the blast furnace was produced by fine crushing the ore, followed by magnetic separation, and sintering of the concentrate. Under present conditions, and with the aid of the Ontario bounty, it may be possible to work this deposit profitably. Bounties on the production of iron ore are offered also by British Columbia.

Imports of iron and its products (including iron ore to the value of $2,830,482) in 1938 were valued at $162,554,216, of which $134,844,204 represented the value of imports from the United States and $21,646,236 of imports from Great Britain. Exports were valued at $2,188,077, shipments to the United States being valued at $1,812,448, and to Great Britain at $217,219.

The demand for primary iron and steel was strengthened during the past two years by the improvement in business, and by the headway made in the automobile, railway rolling stock, agricultural implements, industrial machinery, and other heavy manufacturing industries.

LEAD

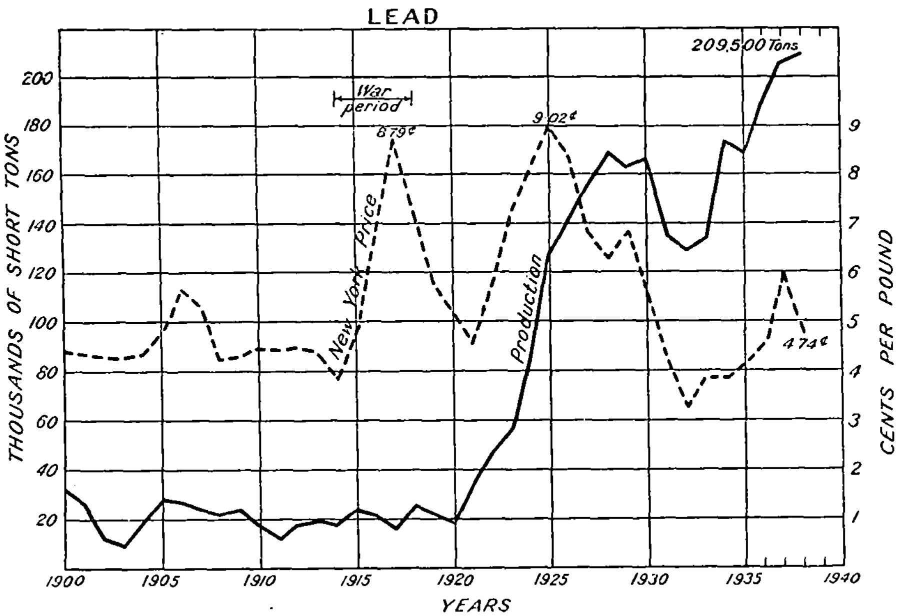
All but a small percentage of the lead produced in Canada has come from the great Sullivan lead-zinc-silver mine at Kimberley, British Columbia. The Monarch silver-lead-zinc mine near Field, and numerous silver-lead and silver-lead-zinc mines in the Kootenay and other districts in the province have also contributed in previous years to the output of the metal. The remainder of the production is obtained from the high-grade silver-lead mines of the Mayo area, Yukon. A lead-zinc mine in Portneuf County, Quebec, and a lead-zinc copper mine at Stirling, Cape Breton, were inactive in 1938. The several lead mines in Ontario have been inactive for years.

The Sullivan mine is owned by Consolidated Mining and Smelting Company of Canada. The lead and zinc concentrates from its 6,500-ton concentrator are shipped by rail 185 miles to the company's smelter and electrolytic lead refinery at Tadanac, near Trail, British Columbia, both of which operated at close to capacity in 1938. The lead refinery has a rated capacity of 205,000 tons of refined metal annually, and it and the smelter are the only such plants in Canada. Some metallurgical improvements were made in the concentrator during 1938, and a new casting wheel equipped for the mechanical handling of pig lead was installed in the refinery. The Monarch mine has been an important producer, and while in operation the company exported its lead and zinc concentrates to Europe. In 1938, however, operations at the property were confined to development, the equipping for production of the adjoining Kicking Horse property, and the overhauling of the 300-ton cencentrator. The mines and concentrators of the Mammoth at Silverton, the Whitewater at Retallack, and the Noble Five at Sandon were active for part of the year, and Lucky Jim, McAllister, Utica, and other properties in the Ainsworth-Slocan area were actively developed and occasional shipments were made from them.

In Yukon, Treadwell-Yukon Company continued to produce from its several small but high-grade silver-lead properties near Mayo.

The Tetreault mine near Notre-Dame-des-Anges, Portneuf County, in Quebec, and the Stirling mine at Stirling, Cape Breton, Nova Scotia, were inactive in 1938. The lead and zinc concentrates, when produced, are shipped to Europe.

Canada in 1938 produced 209,457 tons of lead valued at $14,008,459, which compares with 206,000 tons valued at $21,053,200 in 1937. Exports of lead in ore, pig, etc., in 1938, amounted to 158,513 tons valued at $8,983,181, which compares with 184,835 tons valued at $17,841,000 in 1937; 35 tons of white lead valued at $5,712 were also exported in 1938, as compared with 108 tons valued at $17,842 in 1937. Imports of lead and lead products in 1938 were valued at $2,879,838, as compared with $2,532,563 in 1937.



Lead production and price trends in Canada, 1900-1938.

The world production in 1938 (American Bureau of Metal Statistics) was 1,829,741 short tons, as compared with 1,886,300 tons in 1937, and a peak production of 1,933,000 short tons in 1929. Canada contributes about 11 per cent of the world lead production, the principal producing countries in order of importance being, United States, Mexico, Australia, Canada, Germany, Belgium, India (Burma), and Spain.

Consumption of lead in the United Kingdom has been increasing in recent years, and at present is well in excess of that during 1929. Approximately 59 per cent of the lead consumed in Great Britain in 1937 was used in sheet, pipe, white lead, and oxide; 24 per cent in cable; 6 per cent in storage batteries; and 11 per cent in miscellaneous products.

The average price of pig lead (London quotations in Canadian funds) in 1938 was 3·35 cents a pound, as compared with 5·11 cents in 1937.

The average price at New York was 4·74 cents, as compared with 6·01 cents in 1937.

MANGANESE

The production of manganese ore in Canada has been small and irregular and has been confined mainly to Nova Scotia and New Brunswick, with occasional shipments from British Columbia. The manganese ores that have been mined in the Dominion are pyrolusite, manganite, psilomelane, and bog manganese, all of which, with the exception of bog manganese, have a high manganese content and are fairly free from deleterious constituents.

No manganese ore was produced in Canada in 1938, but there was a production of 85 tons valued at $817 in 1937 and 221 tons valued at $1,596 in 1936.

Imports of "manganese oxide" in 1938 amounted to 21,050 tons valued at $463,673, as compared with 77,226 tons valued at $802,269 in 1937. Imports of manganese ore come mainly from the Gold Coast, West Africa. The ore is used chiefly in the making of ferromanganese.

Although there is a duty of nearly 2 cents per pound of metallic manganese in ferromanganese of a grade of 30 per cent or more, most of the Canadian ferromanganese is exported to the United States.

The world production of manganese ore as estimated by the United States Bureau of Mines, amounted to 6,000,000 metric tons in 1938. Russia is by far the leading producer and is followed in order by British India, West Africa (the Gold Coast), the Union of South Africa, Brazil, Egypt, Japan, and Cuba.

The trade agreement between the United States and Canada which went into effect January 1, 1936, provided for a reduction of the duty on ferromanganese containing not less than 4 per cent carbon imported into the United States. The agreement is still in force.

The metallurgical industry is the greatest consumer of manganese ore, and the battery industry holds second position. The chemical, ceramic, and glass industries consume relatively small quantities.

The price of manganese ore in 1938 at North Atlantic ports for 46 to 48 per cent manganese, Brazilian, decreased from 45 cents per unit in January to 27 cents in December, and averaged 34 cents per unit for the year. For South African ore, 50 to 52 per cent manganese, the price varied from a high of 45 cents to a low of 28 cents per unit, the average price being 35 cents. For chemical grades 80 per cent MnO_2, the price was $47 to $52 per ton during the first six months and $43 to $47 during the last six months.

MERCURY

Occurrences of mercury in the form of cinnabar, or sulphide of mercury, have been reported from a few localities in British Columbia, and from one area in Ontario. Mercury in the form of an amalgam has also been noted in association with the silver ores of the Cobalt area, Ontario. The improvement in the price of mercury in recent years has encouraged further exploration for deposits of the metal in Canada.

In British Columbia development work was carried out on claims in the vicinities of Savona and Minto in the Bridge River area. Empire Mercury Mines, Limited, which has taken over Manitou Mining Company's property in that area, built a 10-ton Gould reduction furnace, which is really a testing unit, and started production in the fall of 1938. The product is marketed in Vancouver, mainly to gold and placer mine operators in British Columbia.

Canada produced 760 pounds of mercury valued at $760 in 1938. No mercury was produced in Canada prior to 1938, with the exception of 138 flasks between 1895 and 1897 from the property near Savona, and of about 12 flasks recovered between 1910 and 1918 in the treatment of silver ores in the Cobalt area.

Canada imported 49,584 pounds of mercury valued at $49,564 in 1938, as compared with 394,354 pounds valued at $371,178 in 1937. In addition, mercury salts were imported to the value of $5,083, as compared with $9,681 in 1937.

The world production of mercury amounts to about 3,000 tons a year, about one-third of which comes from Spain, and the remainder chiefly from Italy, the United States, Mexico, and Bolivia. Despite concern that, due to the civil war, Spanish supplies would be cut off entirely, and that Italy would be unable to make up for the reduced shipments from Spain, the threatened shortage of mercury failed to materialize and industrial nations were able to obtain all of the metal they needed.

Considerable quantities of mercury continue to be used by the gold mining industry, although the demand has decreased following the introduction of "corduroy" blankets for the concentration of gold ores. Substantial quantities are being used as a catalyser in new chemical and metallurgical plants, and also for mercury arc rectifiers. Mercury is used in boiler-compounds, and in the preparation of drugs and chemicals, and it is now being used extensively in the manufacture of artificial silk. Efforts are being made with some success to find other new uses for the metal.

MOLYBDENUM

Molybdenite, the chief ore of molybdenum, is a very soft steel-blue grey-coloured sulphide, usually found in pegmatite dykes and along the contacts of limestones and gneiss. It is commonly associated with greenish grey pyroxenites in which pyrite and pyrrhotite and certain other minerals also occur. So far few commercial deposits of molybdenum have been found in Canada, and the Dominion's production of the mineral is irregular and small. Prospecting for molybdenite, however, continues to be fairly active.

In Ontario, Zenith Molybdenite Corporation (formerly Phoenix Molybdenite Corporation) reported a shipment in 1938 of 7 tons of concentrate valued at $4,500, which was produced in 1937 from its Bagot property in Renfrew County. Most of the shipment went to England and the remainder to France. A sample of molybdenite sent by Regnery Metals, Limited, Hawk Junction, to the Bureau of Mines at Ottawa for testing gave poor results, but subsequent work by the company is reported to have proved a large tonnage of higher grade and cleaner molybdenite. Samples from the Molydor property east of Port Arthur, and from the Amorada property east of Lake Nipigon were also tested by the Bureau. Brough Molybdenum, Limited did some diamond drilling on a property at Cheddar, near Wilberforce, and stripping and shaft-sinking were undertaken by McCoy Molybdenite, Limited on its deposits in Lyndoch Township, Renfrew County. Kashabowie Mining Syndicate diamond-drilled a claim in Conmee Township near Port Arthur but found no commercial ore. Elsewhere in Ontario, activities were confined mainly to the prospecting of claims.

In Quebec, Molybdenite Corporation of Canada commenced the treatment in its 30-ton pilot mill of 2,500 tons of ore mined during the year and in 1937, from its property in LaCorne Township, 20 miles south of Amos. Further information on the extent of the deposits was gained by a program of diamond drilling and prospecting. The old Moss mine at Quyon, 35 miles west of Ottawa, the world's leading producer of molybdenite during the War years, was re-opened in 1938 by Quyon Molybdenite Company. The workings were dewatered, the shaft was retimbered, and a program of trenching and quarrying was carried out on the No. 2 deposit, northwest of the main pit. The company also commenced a geophysical survey of the area. Elsewhere in the province activities were confined chiefly to preliminary development work on properties in Masham and Egan Townships, and near Montcerf, north of Maniwaki.

In British Columbia various companies and syndicates were engaged in the prospecting of properties in different parts of the province, more particularly in the Sheep Creek, Endako, Nanaimo River, Kamloops, and Alvin areas.

Aside from samples shipped to Ottawa for testing, no molybdenum or molybdenum ores were produced in Canada in 1938. During the year the Dominion imported 181,377 pounds of calcium molybdate and 59,317 pounds of molybdenite concentrates for use in the manufacture of steel alloys. The former compound contains about 41 per cent, and the latter about 60 per cent molybdenum. In 1937 a total of 221,300 pounds of molybdate and 63,800 pounds of ferromolybdenum were imported.

The world production of metallic molybdenum has been increasing steadily, and in 1938 amounted to 17,000 tons, as compared with 9,500 tons in 1937, the figure for the latter year being more than double that in 1935. The United States again established a new record in 1938 with an output of 16,500 tons. In Mexico, the second greatest producer of molybdenum, the output comes from operations of Greene Cananea Copper Company, which recovers the metal as a by-product in the treatment of copper ores. In 1938 the company produced 800 tons of molybdenum. In Norway, the output from the Knaben mine was higher than in 1937, when 795 tons of molybdenite concentrates were produced. Several other companies were also in active operation in that country. In Australia, there are several small producers in New South Wales and one in Queensland. Molybdenite is produced also in Peru, Korea, Turkey, and in French Morocco.

Molybdenum is used in a wide variety of alloy steels and irons designed for special applications, and it is used extensively also in ordnance and high-tensile steels, its purpose being to intensify the desirable properties of the alloy metals. The molybdenum is introduced into steel either as calcium molybdate or as ferromolybdenum, but usually the former. Molybdenum alloy steels are outstanding in relation to their uniformity, response to heat treatment, relative freedom from distortion during quenching, and toughness and hardness. They have high impact-strength at sub-zero temperatures, and for this reason are used in automobiles intended for use in cold climates.

The use of carbon-molybdenum steels is increasing, more especially in sheeting and piping. Molybdenum alloys are now used in seamless steel tubing for the construction of airplanes. Practically all of the tungsten tool-steels now contain some molybdenum, and in some instances molybdenum is replacing tungsten in high-speed tool-steels. Molybdenum steels are gaining favour both on the American continent and in Europe for use in hard-wearing and special parts, especially in automobiles. The use of molybdenum in cast iron has increased greatly in recent years. Considerable quantities of molybdenum wire and sheet are used in the radio industry, and the use of the metal in the chemical industry continues to increase. It has been learned recently that molybdenum pigments (orange) have a very high covering power and tinting strength.

Many inquiries were received, particularly from England, in 1938, relative to sources of supply of molybdenum in Canada. Most of the inquiries had reference to regular shipments of a consistent grade over a long period but some of them had reference also to small lot shipments.

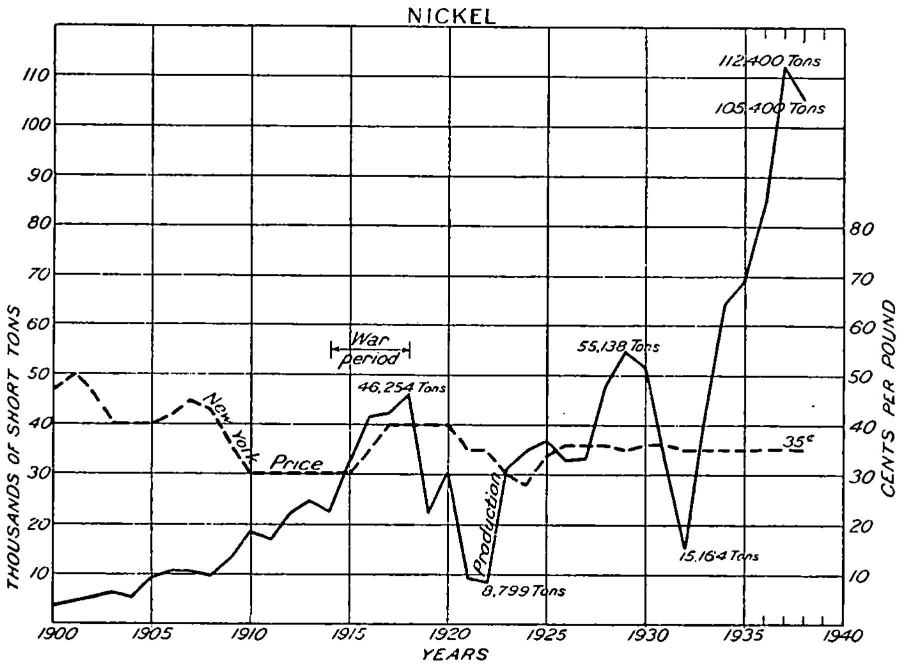
The price at New York of 90 per cent molybdenite concentrate is nominally 42 cents per pound of contained molybdenum sulphide. The price in England declined towards the end of the year and now ranges from 31 cents per pound for 65 per cent molybdenite concentrate to 42 cents for 85 per cent concentrate. The price of calcium molybdate is about 86 cents, and of ferromolybdenum $1.05 per pound of contained molybdenum, f.o.b. Montreal. The duty on ore or concentrate entering the United States is 35 cents per pound of molybdenum content.

NICKEL

Canada is the source of about 90 per cent of the world's nickel requirements, and, with the exception of small quantities which are obtained as a by-product in the treatment of silver-cobalt ores from the Cobalt camp, the entire Canadian output of the metal is obtained from the nickel-copper deposits of the Sudbury area in Ontario.

Production in 1938 came from International Nickel Company's Frood, Creighton, Garson, and Levack mines, and from the Falconbridge mine of Falconbridge Nickel Mines, Limited. The former company is by far the larger producer and its mines are the source of about 85 per cent of the world output of nickel. The capacity of its concentrator was increased by 4,000 tons in 1938, and this plant and the smelter were operated at close to capacity. The No. 2 shaft at the Levack mine was completed to

1,860 feet. Stations were cut from the first to the sixteenth levels, inclusive, and connections were made to the No. 1 shaft workings. The stripping of overburden and the excavating of hangingwall rock were commenced at the Frood open pit in July 1938, in preparation for ore production, and a crushing and sorting plant to handle the ore was erected. International Nickel in 1937 purchased a property near the west end of Shebandowan Lake in the Thunder Bay district on which prospecting and diamond drilling has disclosed the presence of copper-nickel deposits similar in nature to those in Sudbury area.



Nickel production and price trends in Canada, 1900-1938.

The No. 5 shaft at the Falconbridge mine was deepened to 2,450 feet, at which level good ore was intersected. Development of the 2,100-foot level between No. 1 and No. 5 shafts was carried out in ore of average grade. Diamond drilling of the company's Levack prospect revealed a further substantial tonnage of ore. The capacity of the reduction plant was increased gradually, and in 1938 a total of 14,800 tons of copper-nickel matte was produced and shipped to Norway for refining. The increase in the company's ore reserves was again greatly in excess of the tonnage of ore mined during the year.

Denison Nickel Mines, Limited continued to develop its property near Worthington in the Sudbury area, but Ontario Nickel Corporation's Cuniptau mine was inactive.

In British Columbia, Pacific Nickel Mines, Limited, Choate, made some experimental shipments of concentrates to Japan early in 1937, but its mine was inactive in 1938.

Canada produced 105,337 tons of nickel valued at $53,949,311 in 1938, as compared with 112,452 tons valued at $59,507,176 in 1937. Exports amounted to 98,852 tons valued at $52,496,417, as compared with 111,385 tons valued at $58,913,217 in 1937. Imports were valued at $1,401,338, as compared with $1,472,720 in 1937.

The world production in 1938 is estimated at 115,000 short tons, all of which, with the exception of about 10,000 tons, was produced in Canada. The other producing countries are New Caledonia, Greece, India, Norway, and Russia. The estimated world consumption in 1938 was in excess of 100,000 short tons.

International Nickel Company's success in expanding the use of its products is a striking illustration of the effective use of research in solving marketing problems. Before and during the World War the greater part of the nickel output was used in armaments. To-day, all but a small part of it is used by industry for peace-time purposes.

World consumption of nickel by uses in 1938, as given by International Nickel Company, was as follows:—

	Per cent
Steels	60
(Construction steels, stainless steels and other corrosion and heat-resisting steels, and steel castings)	
Nickel cast iron	3
Nickel-iron alloys	1
Nickel-copper alloys and nickel silvers	14
Nickel brass, bronze, and aluminium alloy castings	2
Heat resistant and electrical resistance alloys	3
"Monel", malleable nickel, nickel clad, "Inconel"	9
Electrodeposition	6
Non-metallic materials for the chemical industry nickel salts, ceramic materials, storage battery materials, and catalysts	1
Miscellaneous and unclassified	1

The base spot price of nickel in the United States in 1938 was 35 cents per pound. This price has ruled for the past 13 years.

PLATINUM GROUP METALS

Except for a few ounces of stream platinum recovered annually from British Columbia, and a small production obtained as an impure residue in the refining of gold at Trail in that province, all of Canada's platinum and allied metals are obtained in the form of residues from the treatment of the Sudbury nickel-copper matte. As a result of the successful development of the copper-nickel mines in this area, Canada has become the world's leading producer of platinum and its allied metals.

The residues recovered in International Nickel Company's refineries are shipped to the company's precious metal refinery at Acton in Wales, which has an annual capacity of 300,000 ounces of refined platinum metals. It is operated by Mond Nickel Company, a subsidiary of International Nickel. Platinum metals produced by Falconbridge Nickel Mines, Limited are contained in the nickel-copper matte shipped by the company to

Norway, where a precious metal recovery unit was added to the nickel-copper refinery in 1935.

Canada produced 161,317 ounces of platinum valued at $5,196,504 in 1938, as compared with 139,377 ounces valued at $6,752,816 in 1937. The production of palladium and other metals of the group was 130,893 ounces valued at $3,677,392, as compared with 119,829 ounces valued at $3,179,782 in 1937. Imports of platinum products in 1938 were valued at $292,711, as compared with $310,048 in 1937. Exports in 1938 were valued at $9,364,815, as compared with $8,402,555 in 1937. Export records do not show the metals of the platinum group present in the copper-nickel matte exported.

The world production of platinum and its allied metals in 1938 was approximately 500,000 ounces, and that of platinum, approximately 392,000 ounces. Canada displaced Russia as the leading producer of platinum in 1934. The other principal producers in order of importance are: Russia, South America (Colombia), and South Africa. Canada also leads the world as producer of palladium. World consumption of platinum metals in 1936, the latest year for which complete figures are available, amounted to approximately 400,000 ounces, which compares with 275,000 ounces in 1935.

The continuous increase in the consumption of the platinum metals is in part due to the improvement in the jewellery trade. Activity in the chemical industry, the second largest consumer of platinum, has led to several new developments and to further inquiry for platinum catalysts and laboratory equipment. Industrial uses of the platinum metals continue to increase, particularly in the manufacture of rayon, and in the electrical industry.

Palladium, the cheapest metal of the group, ranks second in consumption, but is tending to displace the other metals. It is used chiefly in dental work, the electrical and jewellery industries being the next largest consumers. Small quantities are used also in the manufacture of chemical ware. Palladium leaf is now finding wide application.

Iridium, which ranks third, is employed chiefly as a hardener for platinum, more particularly in the manufacture of jewellery, in which a 10 per cent iridium alloy is used, and in the electrical industry, in which a 15 per cent alloy is used. It is also used in the making of fountain pen points.

Osmium, rhodium, and ruthenium are as yet consumed only in relatively small quantities. Rhodium, which because of its brilliance and durability has been called "the diamond of the metals", is being used to an increasing extent as a finish for reflectors and for the protection of silverware from tarnish.

The average price in New York of refined platinum was $35.90 per ounce, as compared with $51.77 in 1937.

RADIUM AND URANIUM

Canada's production of radium and uranium in 1938 was obtained from Eldorado Gold Mines' pitchblende deposits at LaBine Point, Great Bear Lake, Northwest Territories, which were discovered in May 1930.

Other occurrences of the mineral have been found elsewhere in the region and at other places as far south as Lake Athabaska.

The Eldorado mine was in continuous production throughout the year. Shaft sinking was carried 300 feet below the 500-foot level, and drifts were started at 650 and 800 feet. Several rich ore shoots were opened up on the No. 3 vein, which was developed during the year to the 500-foot level. Mill equipment was added, thus increasing the milling capacity.

Consolidated Mining and Smelting Company did no work in 1938 on its group of claims at Common Lake which adjoin the Eldorado property. Small amounts of pitchblende have been found in Bear Exploration and Radium's mine at Contact Lake, 10 miles south of LaBine Point, but silver, cobalt, and nickel are the minerals of chief importance. A few tons of concentrate containing pitchblende are reported to have been shipped from the property to the Eldorado refinery at Port Hope in 1938.

No further developments have been reported on the pitchblende discoveries made several years ago at Beaverlodge and Hardisty Lakes, about 100 miles south of Great Bear Lake. Several tons of crude pitchblende ore were shipped in 1934 from the Arden group of claims at Beaverlodge Lake.

Near Goldfields, on Lake Athabaska, in Saskatchewan, pitchblende occurs in extremely narrow veinlets with cobalt and nickel. Samples of the vein material have yielded high gold assays. Underground prospecting on one of the claims was reported during 1938.

In Ontario, Canada Radium Mines, Limited discontinued the underground exploration of its property at Cheddar in Haliburton County in 1937. The pegmatites are reported by the company to contain radio-active, and other valuable minerals.

Additions to Eldorado's radium refinery at Port Hope, Ontario, have more than doubled the capacity of the plant, and it is now capable of producing about 8 grammes of radium a month. Products made comprise radium bromide, yellow and orange sodium uranate, and black uranium oxide, which are used as colouring agents in the ceramic trade; silver, recovered as silver sulphide; and minor amounts of other uranium salts. Most of the radium is sent to England where it is measured and loaded into needles. The uranium salts are shipped principally to England and to the United States, while the silver sulphide is sent to the United States for final refining. The new plant also provides for the recovery in chloride and oxide form of radio-lead, for which industrial use has been found, and of which about one ton is present in 20 tons of ore. Investigations have been conducted by the National Research Council, at Ottawa, into the possibility of recovering polonium and ionium from the refinery residue.

Figures of production of ore and refinery products in 1938 are not yet available, but there was a substantial increase over 1937, in which year 23,827 tons of ore was milled with a recovery of 475 tons of jig and table pitchblende-silver concentrates, and 193 tons of flotation silver-copper concentrate. A total of 36·7 tons of crude high-grade pitchblende and silver, and 6 tons of cobalt were recovered. By the end of 1937, a total of 1,235 tons of pitchblende had been produced in Canada, from which 54 grammes of radium and 255 tons of uranium salts were recovered.

Eldorado Gold Mines, Limited and Belgian Société Générale Métallurgique de Hoboken, a subsidiary of Union Minière du Haut Katanga, which obtains its ores from the Belgian Congo, produce all but a small part of the world's output of radium and uranium salts. Small amounts of radium and uranium are produced at Joachimsthal, in Czechoslovakia (now German), and by two American companies which treat carnotite ore from Utah and Colorado. No statistics are available on radium and uranium production and trade.

The value of radium imported into Canada for medical and scientific use during the past five years is as follows: 1934, $211,140; 1935, $150,643; 1936, $109,032; 1937, $6,402; 1938, $22,559. To a large extent, however, these values represent radium imported on a temporary rental basis and also radium of Canadian origin sent to London for loading into needles and then shipped back to Canada.

Radium is used chiefly for the treatment of cancer. It is recovered in the form of the bromide salt (90 per cent pure) but is usually converted into sulphate for hospital use for which purpose the salt is loaded into fine gold or platinum needles containing only a few milligrams. Larger dosages are given by means of so-called radium " bombs " which contain up to 5 grammes. It is also employed at certain clinical centres for the production of radon, or radium emanation, a heavy gas which quickly loses its radio-activity. Radium is being used more extensively by metallurgists for inspecting flaws in metal castings, for which purpose it is more easily handled than are X-rays. Much of the radium used in hospitals, research, and for other purposes is hired or loaned.

Uranium is used chiefly in the form of various salts, more particularly sodium uranate or oxide, which are employed as colouring agents in the ceramic industry. The metal, as ferro-uranium, imparts desirable properties to steel and to other ferro-alloys.

Chemically pure uranium is difficult to prepare, but recently metal of 98 per cent purity has been made in the form of a powder by the hydride process. Production of a new binary alloy of uranium and nickel, with an uranium content of 66 per cent is reported to be highly resistant to corrosion, and is attacked with difficulty even by aqua regia. It has a low melting point and mixes rapidly in molten steel, nickel, or copper. Another alloy of uranium and copper, containing up to 20 per cent uranium, is reported to be highly resistant to corrosion, and to have a high conductivity.

Radium, because of its rarity, is the most precious of all metals, its value at present being currently reported as being from $25,000 to $35,000 a gramme. Prior to the discovery of the silver-pitchblende deposits at Great Bear Lake, it was even more valuable—$125,000 a gramme in 1912; later, following the discovery of pitchblende in the Belgian Congo, the price fell to $70,000 a gramme. The price of uranium has also been greatly reduced as a result of the developments at Great Bear Lake. There is no open market for radium, the sales usually being based on individual tender and contract, which gives rise to intensive price-cutting. Eldorado and the Belgian companies are reported to have reached a five-year agreement whereby world sales are to be shared on a 40 to 60 basis, respectively.

The price of sodium uranate was increased from $1.50 a pound to $1.75 a pound in October 1938, and that of black oxide from $2.05 a pound to $2.50. World demand for both radium and uranium salts is reported to be showing a steady increase, one reason being the large-scale programs for hospital use undertaken by both the British and American Governments.

SELENIUM

Selenium, although fairly widely distributed, in no case occurs in sufficient quantities to be mined for itself alone. It occurs in association with sulphur, and frequently accompanies the sulphides of heavy metals in the form of selenides. Selenium is recovered commercially from the slime or residue produced in the refining of copper. In Canada it is recovered during the refining of blister copper produced in Manitoba, Ontario, and Quebec.

It was first produced in Canada at Ontario Refining Company's copper refinery at Copper Cliff, Ontario, in 1931. Canadain Copper Refiners, Limited, Montreal East, Quebec, the only other producer of selenium in Canada, started production of the metal in November 1934.

It is obtained along with tellurium in the refinery slime, the Copper Cliff product being derived from the treatment of the copper-nickel ore of Sudbury district, while that at Montreal East is obtained from the treatment of the gold-copper ore of the Noranda mine in Quebec, and of the gold-copper-zinc ore of the Flin Flon mine on the boundary between Manitoba and Saskatchewan. Owing to adverse market conditions, production was curtailed at the Copper Cliff plant during the last six months of 1938.

Canada produced 358,929 pounds of selenium, valued at $622,742 in 1938, as compared with 397,227 pounds, valued at $687,203 in 1937. Most of the production is exported, chiefly to Great Britain, but no separate records of exports or of imports are published.

Canada appears to be the only country that publishes annual figures of production. The United States and Canada are the principal sources of supply, but small quantities are produced by several countries, including Russia, Japan, and Mexico.

Selenium is used chiefly at present in the glass and pottery industries, both as a colouring agent—as in ruby glass—and to neutralize the effect of objectionable oxides. Probably the most important development is its use in the photo-electric cell, or electric eye, which is finding many industrial applications. Selenium is being used in the alloying of stainless steel for screw and bolt stock, where it improves the cutting and threading qualities. A large potential market exists in certain rubber-compounding industries, and the metal is now being used for vulcanizing and fireproofing switchboard cables, and to increase the resistance of rubber to abrasion. These uses are still subjects of research. It is used in the manufacture of certain kinds of paint and of certain dyes; selenium oxychloride is a powerful solvent of many substances. The use of selenium in the production of improved cutting-tool steels and in the vulcanizing of rubber seems to offer the best opportunities for market expansion.

Selenium is marketed as a black to steel-grey amorphous powder, but cakes and sticks are also obtainable. Ferroselenium, sodium selenite, selenious acid and selenium dioxide are other products marketed.

A nominal price for selenium, black powdered, 99·5 per cent pure, of $2 per pound at New York has prevailed for the past few years, but in August 1938, the price dropped to $1.75, at which level it remained to the end of the year.

SILVER

Canada's output of silver is obtained chiefly as a by-product from the treatment of non-ferrous base metal ores, and also from the silver ores of Ontario and British Columbia; the gold-quartz ores throughout the Dominion; and from gold alluvial deposits. Close to 45 per cent of the Canadian production, however, comes from Consolidated Mining and Smelting Company's Sullivan mine at Kimberley in British Columbia.

In Quebec the production of silver has increased notably in recent years as a result of the rapid expansion of mining in the western part of the province, the sources of output being the copper-gold ores of Noranda; the copper-zinc ores of Waite-Amulet; the copper-pyrites ores of Aldermac; and the many gold-quartz mines. The Eustis mine and the lead-zinc mines in Portneuf County have also contributed to the output.

In Ontario the output from the silver-cobalt mines in the Cobalt and adjoining areas has been declining steadily, but the demand for cobalt is helping to keep several small properties in operation. Most of Ontario's production of silver, however, is obtained from the nickel-copper ores of the Sudbury area.

Manitoba obtains most of its output of silver, and Saskatchewan all of its output of the metal, from the copper-zinc ores of the Flin Flon deposits, which straddle the boundary line between the two provinces. In the former province, silver is recovered also in the treatment of the copper ores from the Sherritt-Gordon property, and from the treatment of gold-quartz ores.

In British Columbia, aside from the Sullivan mine, the chief sources of silver are the Silbak-Premier, Bralorne, Pioneer, and other gold-quartz mines; and the silver mines of Beaverdell camp. Several small silver-lead-zinc mines also contribute to the output.

In Yukon production is mainly from the silver-lead ores of the Mayo district.

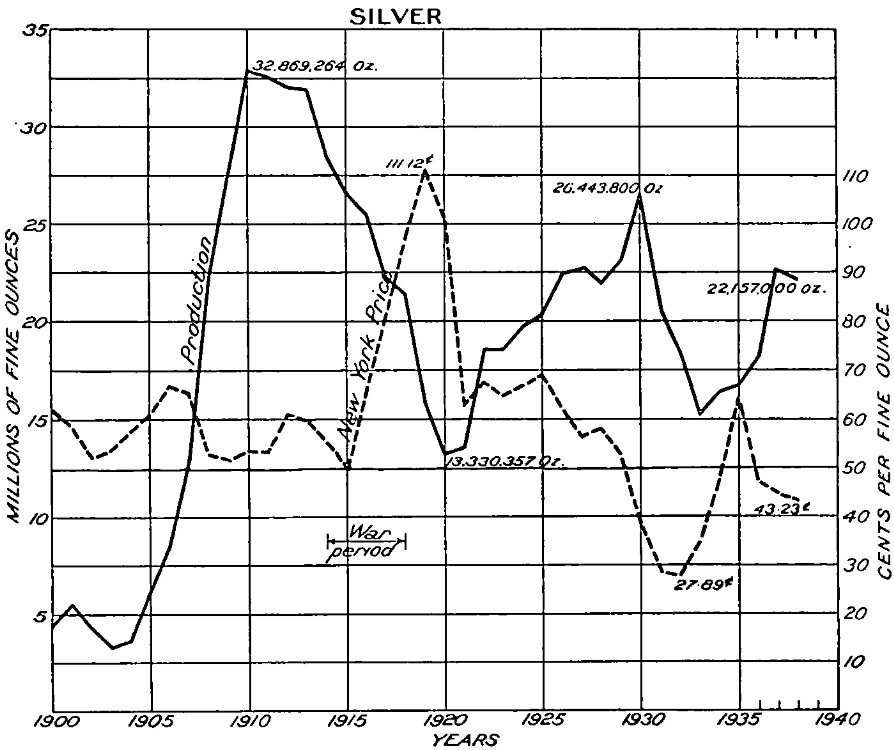
In the Northwest Territories the output of the metal is obtained entirely from the silver-radium ores of the Eldorado mine at Great Bear Lake.

Plants for the production of fine silver are operated by the Royal Canadian Mint, Ottawa; the Hollinger mine, Timmins, Ontario; Ontario Refining Company, Copper Cliff, Ontario; Canadian Copper Refiners, Montreal East, Quebec; and Consolidated Mining and Smelting Company, Trail, British Columbia. A new electrolytic silver refinery is to be erected at Trail in 1939.

Canada produced 22,157,154 fine ounces of silver in 1938 valued at $9,633,265, as compared with 22,977,751 fine ounces valued at $10,312,644 in 1937.

The Dominion exported 22,682,687 fine ounces of silver bullion valued at $9,838,462 in 1938, while the silver content of ore and concentrates exported amounted to 5,868,827 fine ounces valued at $2,540,860. Canadian silver coins were exported to a value of $32,325.

Imports in 1938 included unmanufactured bullion to the value of $850,488, and manufactures of silver to the value of $293,193.



Silver production and price trends in Canada, 1900-1938.

The world production of silver in 1938 is estimated at 267,135,000 fine ounces, which compares with 274,700,000 fine ounces in 1937. World consumption is estimated at 494,000,000 ounces, which compares with 478,500,000 ounces in 1937. The United States Government purchased 403 million ounces of silver in 1938, while purchases by India amounted to 14 million ounces. A total of 23 million ounces was used for coinage, and 54 million ounces were consumed by the arts and industries.

By the President's proclamation of December 31, 1938, the United States is to continue its subsidy to producers of silver in that country until

June 30, 1939. The price remains at 64·65 cents an ounce as fixed in the President's proclamation of December 30, 1937. Between December 31, 1933, when the silver purchase program began, and September 30, 1938, the American Treasury bought 235,713,400 ounces of domestic silver. The estimated holding by the Treasury amounts to 2,575 million ounces. Under the American Silver Producer's Research Project, investigations are being carried on to find new uses for silver.

The average price of silver in 1938 was 43·477 cents a fine ounce, which compares with 44·881 cents in 1937 (New York prices in Canadian funds).

TELLURIUM

Tellurium occurs native and as an essential constituent of several minerals, none of which has been found in quantities large enough to constitute commercial ore. Tellurium-bearing minerals also occur in minute quantities in association with other metallic ores, and the element may be recovered as a by-product in the refining of copper or lead, and also when sulphuric acid is manufactured from certain forms of pyrites. Fairly large quantities of tellurium could be recovered, but the commercial demand, which was non-existent until a few years ago, continues to develop slowly. In Canada, ores containing tellurium occur in British Columbia, Saskatchewan, Manitoba, Ontario, and Quebec.

Both of the electrolytic copper refineries operating in Canada have plants for the recovery of tellurium from their refinery sludges, and for the production of the refined metal. That of the Ontario Refining Company at Copper Cliff, Ontario, started production in 1934, while Canadian Copper Refiners' plant at Montreal East, Quebec, entered production in 1935. The former company's plant treats the slime from the refining of the blister copper produced by International Nickel Company at Copper Cliff, but owing to adverse market conditions it produced no tellurium in 1938. The latter plant treats the slime from the refining of copper from the Noranda mines in Quebec, and from Hudson Bay Mining and Smelting Company's Flin Flon mine on the boundary line between Manitoba and Saskatchewan. So far no tellurium has been recovered in Canada from the sludge of sulphuric acid chambers.

Canada produced 48,237 pounds of tellurium valued at $82,967 in 1938, as compared with 41,490 pounds valued at $71,777 in 1937. Most of the output was marketed in the United Kingdom and a small amount was sold for use in Canada.

Metallic tellurium, until quite recently, was used very little in industry; formerly it was used to a very small extent in some radio work. Recent industrial research has shown that tellurium greatly increases the hardness, toughness, tensile strength, and corrosion resistance of lead, but the amount of tellurium so required is so small that about 65 tons of it would treat all the lead used in the United States for chemical plants and for general building construction. The United States Bureau of Mines advises, however, that the market for tellurium in that country could be more than doubled should tellurium lead come into general use for lead cable coverings.

Tellurium, like selenium, imparts free-cutting properties to alloy and plain carbon steels. In the very finely powdered form it is used in the compounding of rubber, in which case it shortens the time of curing, and greatly improves the resisting qualities of the product. These latter two uses have increased the commercial demand for the metal. Tellurium is used to a slight extent as a colouring agent in the ceramic industry, and is used also in the photographic arts, and for the blackening of art-silver.

A nominal price for tellurium of $1.75 per pound at New York prevailed throughout 1938.

TITANIUM

All known occurrences of titanium in Canada of any possible economic interest are in Quebec and Ontario.

Ilmenite, or titanic iron ore ($FeTiO_3$), in commercial quantities and containing from 18 to 25 per cent titanium, is found at St. Urbain in Charlevoix County, and at Ivry in Terrebonne County, Quebec. Rutile (TiO_2) is found mixed with the ilmenite in parts of one of the St. Urbain occurrences in quantities sufficient to make it of possible importance for the mining of it alone. The St. Urbain occurrence is the only known workable deposit of titanium ore in Canada. Titaniferous magnetite (magnetite carrying 3 to 15 per cent titanium) deposits occur on Saguenay River, near Lake St. John, and at Bay of Seven Islands, both in Quebec, and also on the shores of Seine Bay and Bad Vermilion Lake in western Ontario.

A few thousand tons of ilmenite are shipped annually from the St. Urbain deposits to Niagara Falls, New York, presumably for use in the manufacture of ferrotitanium, and to General Electric Company's plants in the United States. No shipments from the Ivry deposits have been reported for a number of years.

Canadian Titanium Pigments, Limited was established in 1937 to manufacture titanium oxide in Canada. The Canadian market for titanium pigments is not believed to be large enough to justify the immediate establishment of a plant in Canada, but the future possibilities of such a market are being considered.

Canada produced 207 tons of titanium ore valued at $1,449 in 1938, as compared with 4,229 tons valued at $26,432 in 1937. Imports of titanium are not reported separately. According to the Dominion Bureau of Statistics, the Canadian paint industry consumed 3,748,341 pounds of titanium pigments valued at $362,869 in 1937, as compared with 2,456,265 pounds valued at $269,130 in 1936 (1938 not yet available).

The world production of titanium ore in 1937 (1938 not yet available) is estimated at 225,000 tons. This ore would yield 100,000 tons of titanium pigment, and 3,000 tons of rutile. India is the principal producer of ilmenite; the others being Norway, Malaya, Portugal, and Canada. Brazil is the principal producer of rutile, and Norway holds second position.

Titanium continues to be used chiefly in the manufacture of white pigment, but various other fields of use have been developed in recent years. Titanium is not only an effective dioxide and cleansing agent, but also an alloying element. By the addition of titanium, chrome-nickel steels are made more resistant to corrosion, and chrome-molybdenum steels become easier to weld. In aluminium and sundry non-ferrous alloys, titanium refines the grain and otherwise contributes to a better structure. A variety of carbon-titanium alloys are now available. Titanium-treated rails are said to be superior to silicon-treated rails. In other industries titanium compounds have many different uses.

The New York quotations in 1938 for ilmenite, 45 to 52 per cent TiO_2, f.o.b. Atlantic seaboard, were $10 to $12 per gross ton, according to grade and impurities. These quotations have remained unchanged for several years and are evidently nominal. The price of carbon titanium alloys, f.o.b. plant, was $142.50 per ton throughout 1938.

TUNGSTEN

Tungsten-bearing minerals, chiefly scheelite, are known to occur in Nova Scotia, New Brunswick, Manitoba, British Columbia, and Yukon, but with the exception of the output of a few hundred tons of concentrate between 1912 and 1917, no tungsten ore has been produced in Canada.

In Nova Scotia development work has been carried on to a limited extent at the Indian Path mine near Lunenburg, in recent years, but deposits in the Moose River area have been inactive for years. In New Brunswick a deposit at Burnt Hill Brook, York County, was worked during the War years.

In British Columbia an old deposit on Hardscrabble Creek, Cariboo District, has received some attention in recent years, while in Yukon small quantities of scheelite sands have been recovered from alluvial deposits in the Mayo district.

Ferberite, a very rare tungsten mineral, has been noted in some of the gold-bearing zones on Outpost Island, Great Slave Lake, Northwest Territories.

Imports in 1938 of chromium and tungsten metal for alloying purposes totalled 43,527 pounds valued at $30,328, as compared with 122,288 pounds valued at $96,900 in 1937. Imports of metallic elements and tungstic acid for use in the manufacture of metal filaments for electric lamps were valued at $71,730, as compared with $128,781 in 1937.

The world production of tungsten ore amounted to 38,000 metric tons (concrete containing 60 per cent WO_3) in 1937. (Figures for 1938 not available.) The principal producing countries are: China, British India (Burma), Federated Malay States, United States, Bolivia, and Portugal.

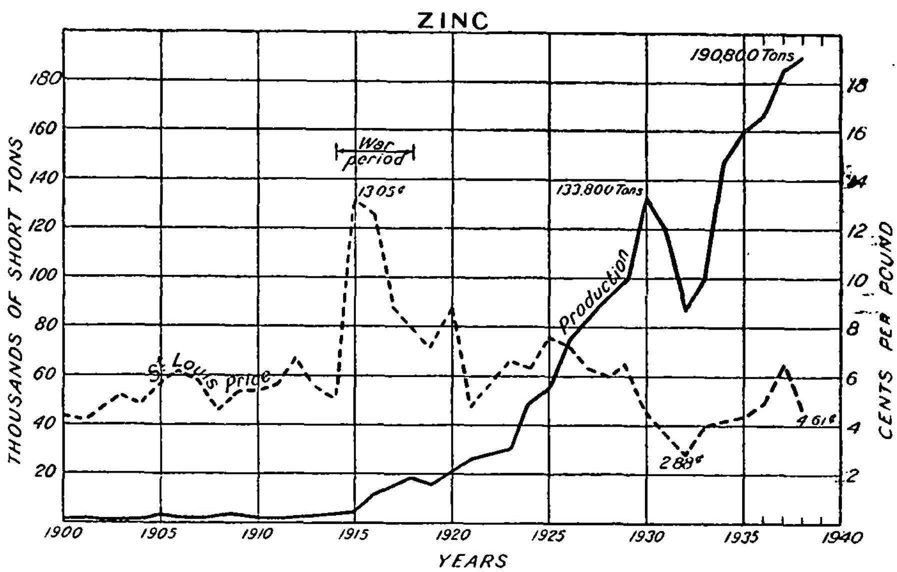
Tungsten is used chiefly in the manufacture of high-speed tool steels, stellites, electric lights, and radio tube filaments; in the preparation of pigments and other chemicals; and in the tanning of leather.

The price of domestic tungsten ore (scheelite) in New York, per unit of WO_3 dropped from $22 to $25 in January to a minimum of $17 to $20 in December. The price of Chinese wolframite dropped from $25 in January to $20 in December.

ZINC

Close to three-quarters of the zinc produced in Canada in 1938 came from the Sullivan silver-lead-zinc mine near Kimberley, British Columbia. The remainder of the output was obtained from the Flin Flon deposits on the boundary line between Manitoba and Saskatchewan; from several small lead-zinc properties in West Kootenay district, British Columbia; and from the Normetal and the Waite-Amulet mines in western Quebec.

In British Columbia the capacity of Consolidated Mining and Smelting Company's zinc plant at Trail has been increased in recent years by additions and improvements, its rated capacity at present being 145,000 tons of slab zinc a year. The plant was operated at close to capacity in 1938, as were the company's Sullivan mine and 6,500-ton concentrator at Kimberley. Extensive development work was carried out during the year at Base Metals Mining Corporation's Monarch mine, near Field, the mill on which has been idle since 1935. The Britannia mine on Howe Sound produced no zinc concentrates in 1938.



Zinc production and price trends in Canada, 1900-1938.

In Manitoba, Hudson Bay Mining and Smelting Company's 5,000-ton concentrator and its zinc refinery, with a rated output of 30,000 tons of slab zinc a year, were operated at capacity. Some improvements to the refinery were made possible as a result of test work in the company's research department. Shaft sinking was continued to the 2,750-foot level, where development work is being attended by very encouraging results. Work on the sinking of the south main shaft is proceeding. Ore reserves at the Flin Flon mine showed a substantial increase as compared with 1937. The ores of the Sherritt-Gordon mine at Sherridon in Manitoba contain zinc as well as copper, but no zinc concentrates have been shipped from the property since it was re-opened in 1937.

In Ontario, Sudbury Basin Mines' copper-zinc-lead property in the Sudbury area remained idle in 1938.

In Quebec the Waite-Amulet and Normetal mines, both with 500-ton mills, were in operation, but the Tetreault mine in Portneuf County was idle.

In Nova Scotia the Stirling copper-lead-zinc property in Cape Breton ceased operations in 1937.

Canada produced 190,753 tons of zinc in 1938 valued at $11,723,697, as compared with 185,169 tons valued at $18,153,949 in 1937. Exports, which were chiefly in the form of spelter, were valued at $9,816,008, as compared with $15,491,186 in 1937. Imports of zinc products, including oxide and chemicals, were valued at $1,925,020, as compared with $2,484,425 in 1937.

The world production of refined zinc amounted to 1,751,870 short tons in 1938, according to the American Bureau of Metal Statistics. This compares with a total production of 1,830,300 short tons of zinc in 1937. The principal countries producing zinc from ores of domestic origin are, in order: United States, Canada, Australia, Poland, Russia, and Mexico. Canada contributes about 10 per cent of the world's total output, and holds fourth position as a producer of slab zinc.

The world consumption in 1938, as given by the American Bureau of Metal Statistics, was 1,487,200 metric tons, as compared with 1,635,800 metric tons in 1937.

Zinc is used chiefly in the galvanizing of sheets, wire, tubes, shapes, etc., and large quantities are used also in the manufacture of brass and of die castings; in paint pigments; in radio and flashlight batteries; and for making zinc oxides.

The average price of zinc for 1938 in Canadian funds, based on London quotations, was 3·07 cents per pound, as compared with 5·59 cents in 1937.

II. INDUSTRIAL MINERALS

ARSENIOUS OXIDE

Arsenic is obtained in Canada as a by-product in the treatment of the silver-cobalt-arsenic ores of northern Ontario, and to a lesser extent from the gold arsenical ores of the Beattie and the O'Brien mines in Quebec, and the Little Long Lac mine in Ontario. The Bralorne, Hedley, and certain other mines in British Columbia export arsenical gold concentrates to the United States, but no payment is made for the arsenic content. Deposits containing arsenopyrite associated with gold are known to occur in several parts of Canada, some of which in British Columbia, Ontario, Quebec, and Nova Scotia are being operated for the recovery of gold. Were it profitable to do so, they could supply considerable amounts of concentrate suitable for the production of arsenic.

Refined white arsenic (As_2O_3) and arsenical insecticides are made in Canada by one company only, namely Deloro Smelting and Refining Company, Limited, Deloro, Ontario, which obtains its ores from the silver-cobalt-arsenic mines of northern Ontario.

Baghouses to extract arsenic from the fumes of roasting plants where gold is recovered from arsenical concentrate have been installed at the Beattie, Little Long Lac, and O'Brien gold mines. The roasting plant at the Beattie mine has a capacity of about 225 tons of concentrate a day, while the plants at the other two mines each treat from 8 to 10 tons a day.

Canada produced 2,175,646 pounds of arsenious oxide valued at $56,538 in 1938, as compared with 1,389,426 pounds valued at $41,032 in 1937. Exports amounted to 1,378,300 pounds valued at $32,590 in 1938, as compared with 735,000 pounds valued at $26,938 in 1937. Imports were: arsenious oxide 201,009 pounds valued at $3,854, as compared with 7,604 pounds valued at $462 in 1937; and other compounds of arsenic valued at $48,464, as compared with $33,155 in 1937.

Although the world consumption of white arsenic has fluctuated considerably during the past ten years, the quoted price of 3½ cents a pound has remained unchanged. Most of the output is a by-product of metal recovery, and the potential supply is far in excess of any probable demand, and thus there seems to be little likelihood of any sustained increase in price. It is estimated that 40,000 tons of white arsenic—roughly equivalent to the world's total consumption—is extracted annually from roaster gases at the Boliden mine in Sweden alone. Only a small part of this arsenic is refined for sale and appears in production returns. The remainder, in the form of crude arsenic, is placed in huge storehouses, in the hope that through research a use may ultimately be found for it.

Arsenic is used chiefly in insecticides, weed killers, sheep and cattle dip, wood preservatives, and in the manufacture of glass, and in minor quantities in pigments, tannery supplies, and pharmaceutical preparations.

The nominal price of arsenious oxide in New York remained at 3 cents a pound in 1938.

ASBESTOS

Asbestos produced in Canada is all of the chrysotile variety and comes entirely from areas of serpentinized rock in the Eastern Townships of Quebec, the centres of production being Thetford Mines, Black Lake, Vimy Ridge, East Broughton, and Asbestos (Danville). Deposits of chrysotile asbestos are known in other parts of Quebec, as well as in Ontario and British Columbia, and several of these deposits have been worked from time to time, but they are not now in production. In 1937 Rahn Lake Mines Corporation, Limited undertook the development of a chrysotile asbestos deposit in Bannockburn Township, Matachewan area, Ontario, and the company is building a mill to handle 200 tons of crude per day.

Many deposits of other varieties of asbestos, including anthophyllite, and fibrous tremolite and actinolite, all of which are known commercially as amphibole asbestos, occur in Canada. The fibres are harsher and weaker than those of chrysotile and are in little demand, and none of the deposits is being worked. Deposits reported during 1937 and 1938 in Manitoba east of Lake Winnipeg, and in the Lake of the Woods district, and 260 miles north of North Bay, in Ontario, are of the amphibole variety.

Production has been continuous from the Thetford district since 1878, and reserves of asbestos-bearing rock are enormous. Core-drilling to depths greater than 1,700 feet has revealed the presence of fibre comparable in quantity and quality with that in the present workings. In 1938 nine properties were operated by five companies. Most of the output consists of vein fibre obtained from veins ¼ to ½ inch in width, though veins exceeding 5 inches in width do occur. The fibres run crosswise of the veins, and thus the width of the vein determines the length of fibre. Slip fibre, occurring in fault planes, is obtained largely in East Broughton district. The yield of fibre from the Quebec deposits averages about 5 per cent of the rock mined, and 7·7 per cent of the rock milled.

The asbestos-bearing rock is mined both by open pit and underground methods. In 1934 the block-caving method was adopted at the King mine of Asbestos Corporation, Limited and has resulted in a remarkable reduction in the cost of mining and improvement in the grade of mill feed. In 1938 a vertical shaft was sunk to a depth of 1,153 feet at the King mine, and several of the other companies have sunk vertical shafts and are proceeding with underground mining. One company is following the block-caving method used at the King mine.

Canada produced 289,877 tons of asbestos valued at $12,893,806 in 1938, as compared with 410,026 tons valued at $14,505,791 in 1937, the record year. The quantity and value of the several grades produced in 1938 were as follows: crudes 2,911 tons valued at $955,424; fibres 163,097 tons valued at $9,714,509; cement stock, floats and shorts 123,182 tons valued at $2,223,873.

World production in 1937, the latest year for which statistics are available, amounted to 657,561 tons, having a value of $24,815,920. The data include an estimated production of 125,000 tons from Russia, the next largest asbestos-producing country to Canada, the other producing countries in order of their importance being Rhodesia, Union of South Africa, Cyprus, and the United States. Despite the rapid growth of asbestos mining in Russia, Rhodesia, and the Union of South Africa, Canada has been able to more than maintain its position in world markets. In 1937 Canadian production comprised 62·3 per cent of the tonnage and 58·5 per cent of the value of the world's production, whereas in 1934 the corresponding figures were 48·2 per cent and 33·8 per cent.

Most of the Canadian production of asbestos is exported, chiefly to the United States, other countries to which large shipments are made being Japan, Belgium, Germany, France, and the United Kingdom. Exports in 1938 were as follows: asbestos, 165,744 tons valued at $10,872,435; asbestos sand and waste, 123,143 tons valued at $2,237,751; and manufactures of asbestos valued at $206,372. This compares with 1937 exports of: asbestos, 196,511 tons valued at $10,972,852; asbestos sand and waste, 194,530 tons valued at $3,242,457; and manufactures of asbestos valued at $330,061.

Imports in 1938 consisted of 47 tons of asbestos packing valued at $45,866; brake and clutch linings valued at $257,037; and other products, not specifically designated, valued at $581,989.

Asbestos has many uses, but is employed chiefly for the manufacture of automobile brake-band linings; heat insulation materials; and building materials, such as roofing shingles, corrugated sheeting, and tiles. For the latter uses the short non-spinning grades of fibre are mainly employed.

Prices, which remained stable in 1938, were as follows: No. 1 crude, $700 per ton; No. 2 crude, $150 to $350; spinning fibre, $110 to $170; shingle fibre, $57 to $75; paper fibre, $40 to $45; cement stock, $21 to $25; floats, $18 to $20; shorts, $12 per ton.

BARITE

Several occurrences of barite are known in Canada, principally in Nova Scotia, and also in Quebec, Ontario, and British Columbia, but there has been no important production of the mineral since 1917, and none whatever in 1938.

Many of the deposits are large enough to supply a moderate tonnage of ore, but competition of cheaper foreign barite, high freight rates, and the necessity for concentration to remove impurities in the case of certain of the deposits, have combined to discourage operations.

Most of the output in recent years has come from Lake Ainslie district, Cape Breton, Nova Scotia, and was consumed locally. Tests have been run in the Bureau of Mines' Laboratories on small lots of this ore for the removal of impurities. Some of it contains appreciable amounts of fluorspar that might be recoverable as a by-product. Other deposits in the province occur in Colchester, Hants, and Pictou Counties, but there has been no mining for many years.

The deposits in northern Ontario have attracted the most attention in recent years, and a few small shipments of both crude and milled ore have been made. Canada Baryte Mines, Limited, 305 Kent Building, Yonge Street, Toronto, was formed in 1938 to take over an idle property in Langmuir Township, in the Porcupine area, with a view to supplying barite for rotary oil-well drilling in Turner Valley, Alberta.

Interest in domestic barite in recent years has been centred largely on the possibility of exporting the mineral to Trinidad for use in oil-drilling operations, but so far this project has not materialized. As lithopone and barium chemicals are manufactured in Canada, there is no demand for crude ore. Domestic requirements for powdered barite are met chiefly by imports from Germany and the United States.

Barite (barium sulphate) is the principal, and practically the only barium mineral of commerce. It serves a variety of industrial uses in the ground natural state and is used also as the raw material for the manufacture of barium chemicals and metal, and of the important pigment lithopone, a mixture of barium sulphate and zinc sulphide. Witherite (barium carbonate), the only other barium mineral of commerce, is produced chiefly in the United Kingdom, the output in 1937 being about 12,000 long tons.

Most of the Canadian output of barium—41,210 tons since 1885—has come from deposits in Nova Scotia, although small tonnages have been obtained also from Quebec and Ontario. Production has been sporadic and relatively insignificant during the past fifteen years, and has seldom reached 100 tons in any one year.

World production of barite in 1937 was about 916,000 long tons. Germany is the leading producer, supplying about 48 per cent of the total, and is followed by the United States, with nearly 36 per cent. The remainder is chiefly from the United Kingdom, Italy, France, and India.

Imports of ground barite in 1938 totalled 2,187 tons valued at $38,012, as compared with 2,078 tons valued at $32,869 in 1937. Of the 1938 imports, 1,266 tons came from Germany, 562 tons from the United States, 163 tons from the United Kingdom, and 3,898 tons from Italy. The figures for 1938 do not include about 200 tons contained in the proprietary material "Baroid," imported from the United States and used for drilling in Turner Valley, Alberta.

The harder, crystalline variety of barite is usually marketed in the crude state, and is employed for the manufacture of lithopone and barium chemicals, including barium metal. The softer barite, which is more readily powdered, and which yields a white product, is preferred for the production of ground barite. The best grades of the latter often require bleaching with acid to remove adhering iron oxide or iron stain; and sometimes roasting, followed by magnetic separation or screening, is employed.

Ground barite is used as an inert filler or loader in many products, including rubber, paper, oilcloth, textiles, leather, plastics, and resins. To some products it adds desirable properties, and in others its main function is to impart weight and volume. In paints it has long service as a pigment and as an extender. Increasing amounts are now being used in rotary oil-well drilling. Depending on the use, various grades and degrees of fineness are employed, from off-colour material to prime, bleached barite. Low-iron barite (less than 0·1 to 0·4 per cent Fe_2O_3) is finding increasing use as an ingredient of moulded flint glass batches, for which a relatively coarse, granular product (minus 16 to plus 100 mesh) is generally specified. This use is already consuming important tonnages. Barite is used also for its fluxing and scavenging properties in ferrous and non-ferrous founding.

No standard tests or specifications for ground barite are in use, but a minimum of 95 to 96 per cent $BaSO_4$ content, with not over 1 per cent Fe_2O_3 is a general stipulation.

Barite is a relatively low-priced mineral. Using the United States as an index of recent consumption and price trends, average f.o.b. value of crude ore shipped in 1937 was $6.25 per short ton. Prices in 1938 showed little change from those of 1937. Ground barite has sold for several years at $23 per ton f.o.b. Missouri mills. As a result of the strong demand for crude in 1937, the production in that year showed an increase of more than 30 per cent as compared with 1936. The consumption of ground barite reached an all-time high of nearly 150,000 tons in 1937, almost double that of 1936, and only 12,000 tons less than the quantity of crude used in lithopone manufacture. Close to 75,000 tons, or about one-fifth of the total consumption of crude, was used to make barium chemicals. The United States produced 360,000 tons and imported 65,000 tons in 1937, the latter figure being about double that for 1936.

Canadian Trade Journal quotations in 1938 on imported ground barite were $39.45 per ton for No. 1 white grade, and $20 to $28 per ton for off-colour grades. Natural barium carbonate (witherite), which shares the market for this salt with the artificial product made from barite, sold in Canada and the United States at $42 to $44 per short ton. Barite enters Canada free of duty under the British preferential tariff, while imports from other countries are subject to a 25 per cent ad valorem duty. The United States imposes a duty of $4 per ton on imports of crude barite, and of $7.50 per ton on imports of ground, or otherwise manufactured material.

BENTONITE

Bentonite is the name originally given to a peculiar clay resulting from the alteration (hydration), in place, of the glassy substance of volcanic dust or ash beds. The principal clay constituent is usually the mineral montmorillonite, a hydrous silicate of alumina, which is generally mixed with gritty impurities, such as fine grains of quartz or mica. The particles of clay material are exceedingly fine and are often colloidal.

More recently, the term bentonite has been extended to include a rather broad class of clays which, in general, are petrographically similar to the typical bentonite, but which differ considerably from it in physical properties. Many such clays come within the activable bleaching clay group which are now being utilized more and more extensively in the activated, or acid-treated form for the bleaching of mineral, vegetable, and animal oils. Some of them bear little resemblance to the original colloidal bentonite; and unlike the colloidal material, they do not swell noticeably when wetted, nor do they form gels, and settle rapidly from thin water dispersions. The general suitability of such clays for bleaching, and their relative efficiency can be determined only by activation and decolorizing tests. Broadly speaking, the typical colloidal bentonites are most widely distributed over the northern (plains) section of the American continent, including the Prairie Provinces of Canada, whereas the activable varieties are most prevalent in the southern and southwestern regions.

All but 43 tons of Canada's output of bentonite in 1938, which amounted to 1,179 tons valued at $3,659, came from deposits at Drumheller in Alberta. It was shipped to Calgary for preliminary processing for use in oil-well drilling in the Turner Valley field. The remainder of the output was obtained from the beds at Princeton in British Columbia. In 1937 production of bentonite in Canada amounted to 163 tons valued at $1,971. Occurrences of bentonitic clay, however, are numerous in the Prairie Provinces. They are mostly of the colloidal type and are probably adequate to meet domestic requirements for this type of clay. Some of the deposits in other parts of Canada are probably thick enough to be of economic importance. Only a few of the known deposits, notably those at Princeton, in British Columbia, Edson and Drumheller, in Alberta, and Morden, in southern Manitoba, have as yet received any attention as sources of production. The beds in the Princeton-Merritt area are thick (maximum about 9 feet) and are probably the most important of the known reserves in Canada. They are less highly colloidal than those in Manitoba, but no data are available on their activable properties. A few carloads have been mined annually from the deposits in recent years and the material is shipped to Vancouver for grinding. It is used mainly in the refining of oil and gasoline, and as a concrete admixture.

Small shipments have been made to Winnipeg in recent years from the deposits at Morden. The clay, after being ground, is used in foundry work. The material, after activation, was found by the National Research Council, at Ottawa, to possess high bleaching power, and small-scale experimental work along commercial activation lines was carried out in a Winnipeg plant in 1937. Morden Bentonite Company, Toronto, hopes to develop the deposits to produce ground clay for foundry use, bleaching, water purification, etc., and eventually perhaps to engage in activation.

Canada exports no bentonite but imports appreciable tonnages of activated clay from the United States for use in bleaching in the oil industry and it is possible also that some ground natural bentonite is used for the same purpose. High-grade activated clay of German origin is employed for bleaching in packing-houses in Canada and some ground colloidal bentonite is imported from the United States for foundry use. Both crude and activated bentonite are often marketed under a variety of trade names and it is even sold as common clay. Thus it is difficult to obtain accurate figures of the amounts imported and consumed in Canada, more especially as users of the material are frequently not aware of its bentonitic nature. Owing to the various trade designations, it is virtually impossible to obtain even approximate figures on world trade.

As bentonite is rather an indefinite type of clay no figures on world production are published. The United States has long been the principal producer, but it is only recently that any attempt has been made in that country to report output on the basis of a strict classification. Bentonite sold by producers in the United States in 1937 amounted to 194,768 tons valued at $1,500,758.

Bentonite was first developed industrially in the United States, and it was believed for a time that occurrences were confined to the North American continent. It is now known, however, that bentonite is widely distributed throughout the world and deposits are now being exploited in a number of countries. It has a variety of uses which are dependent largely upon the various physical properties of the material. Bentonite clays may be conveniently classed as those which (*a*) swell and (*b*) do not swell when wet. Swelling is a measure of relative water absorption which is determined by the colloidal and gel-forming properties of the clay, in combination with, in many cases, the ability to form comparatively stable dispersions or suspensions. The more highly colloidal bentonites are used chiefly in foundry work, where they are employed as a bonding ingredient for the moulding sand, and also to rejuvenate spent sand; and in core washes. They are used extensively in soaps and detergents, for laundering; in many cosmetic, medicinal and pharmaceutical preparations; as a suspending, spreading, and adhesive agent in horticultural sprays and insecticides; as a plasticizing ingredient in ceramic bodies, and in slips and glazes in refractories; to emulsify asphalts, resins, etc.; to improve the workability, flow and water resistance of concrete; in the clarifying of wines, vinegar, etc.; and for a variety of other minor products and processes.

Because of their swelling the highly colloidal bentonites are employed to stop the seepage of water through and around dams, abutments, or other structures; to clarify turbid water supplies; and for the purification of sewage. A novel development is the production of thin sheets or films from centrifuges, or otherwise purified colloidal bentonite. Such sheets, it is claimed, can be produced very cheaply and have high electrical insulating strength and most of the other properties that have hitherto made mica an indispensable mineral for electrical and other purposes. Recent advice is to the effect that bentonite is being used for the processing of beer; as a binder in briquetting mixtures of coal and ore for smelting in vertical furnaces; and as a paste to hold the electrolyte in dry batteries.

Non-swelling (non-colloidal) bentonites are used chiefly in the activated form, following their treatment with sulphuric acid, for bleaching in the petroleum and other industries. They are also used extensively in oil-well drilling, in which case the clay (sometimes specially processed for the purpose or blended with a proportion of swelling bentonite) serves to stabilize the viscosity of the mud column. Both uses have resulted in a large increase in recent years in the consumption of bentonite, and in the United States the production of activated clay is growing rapidly.

Prices of powdered natural bentonite, as reported by Canadian users, have varied in recent years from $23 to $43 per ton, laid down at plant. A leading American producer in 1938 quoted $10.25 per ton for minus 200-mesh material, f.o.b. Wyoming, with a $13.54 freight rate per ton to Montreal. Dried coarsely-crushed material was priced at $8 and crude at $8 per ton; the price of activated bentonite, carload lots, averages around $65 to $75 per ton, delivered eastern Canadian points. The clay from

Drumheller sells at about $40 per ton, as compared with $55 per ton for clay imported from Wyoming.

BERYL

Beryl, a silicate of aluminium and beryllium, with 12 to 14 per cent beryllium oxide, is one of the new natural beryllium compounds and is the only important known source of the element. Though by no means abundant, beryl is not an uncommon mineral. It occurs only in pegmatite dykes, usually in the form of disseminated crystals. Most of the beryl sold is by-product material recovered from the working of pegmatites for their feldspar, mica, or lithium minerals. Beryl-pegmatites are known to occur in several countries, and small tonnages have been produced in different parts of the United States and in India, South Africa, Brazil, Argentina, Madagascar, Scandinavia, France, Portugal, Spain, and Russia. Only a few hundred tons have been produced and sold annually in recent years, but the known reserves are believed to be capable of meeting a considerably increased demand.

In Canada a deposit in Lyndoch Township, Renfrew County, Ontario, and several scattered deposits in the Pointe du Bois district in southeastern Manitoba are among the well known occurrences of beryl of possible commercial importance. The Lyndoch deposit has been operated intermittently on a small scale since 1926 by T. B. Caldwell, Perth, Ontario, Madawaska Minerals, Limited, Renfrew Minerals, Limited, Canadian Beryllium Mines and Alloys, Limited, and other interests. The last-named company was incorporated in 1937 to take over the assets of Renfrew Minerals, Limited and to manufacture beryllium alloys and minerals. At the close of 1938 the company reported that it had stockpiled about 50 tons of cobbed beryl crystals. Small shipments of feldspar have been made from the property, and a few tons of hand-picked mixed rock, containing columbite and certain rare-element minerals, principally euxunite, were recorded. The beryl at Lyndoch occurs as scattered crystals, some of which are large, in localized shoots or zones in the large pegmatite body. On analysis it has shown a beryllium oxide content of from 13·4 to 14·4 per cent. In 1937 International Beryllium Mining Syndicate was formed to prospect for beryl and to mine the mineral in adjacent sections of Lyndoch Township, and in the adjoining Township of Brudenell.

Some of the pegmatites in Manitoba carry beryl as scattered crystals, some of which are large. Small, rich pockets have been found in which the beryl, as small crystals, comprises possibly half of the rock. Occasionally yellow, green, or colourless crystals are found, some of which material has been cut into gem stones for the jewellery trade in Winnipeg.

American requirements, other than those obtained from domestic sources of supply, have come largely from India, but shipments have been made recently from Argentina, the Union of South Africa, and Brazil. No figures of either production or consumption of beryl in the United States are available, but present consumption in that country is estimated to be less than 500 tons a year, or half of the world total. The United States is the only country which uses beryl in any appreciable quantity for the production of beryllium metal and alloys, as well as for beryllium salts and compounds. Although there are comparatively few known occurrences of beryl in the world, American consumers, according to reports, are experiencing little or no difficulty in obtaining their requirements.

No statistics of world production, exports and imports of beryl are published. Except for two tons shipped from Lyndoch property to Germany about 1926, no exports of Canadian beryl are known to have been made.

The exceedingly high cost of extracting the pure metal has been reduced somewhat and in recent years the production of beryllium alloys, chiefly copper-beryllium and nickel-beryllium, has been expanding rapidly. Beryllium imparts high tensile strength to copper, and tools made of these alloys have a hardness and toughness approaching that of steel, and are non-sparking. Where wear resistance to corrosion or high fatigue value, combined with good electrical conductivity are essential, beryllium-copper, with about 2·25 per cent beryllium meets an important requirement. The price of this master alloy is now $23 per pound of contained beryllium in standard commercial shapes and sizes such as sheets, plates, rods, and wire. Many forms of tools made of beryllium-copper are now in the market and the alloy is used also in the firing pins of firearms, in precision bearings, bushings, valve parts, moulding dies, wire cloth for special uses, and for many other purposes. Such articles sold in 1938 at $1.12 per pound, an increase of 23 cents over 1937.

Despite the publicity given to the possible field of use for beryllium as an alloy with the light metals aluminium and magnesium for use in aircraft engines and parts, commercial developments along such lines have so far been unimportant. A beryllium-aluminium master alloy is on the market at a price of $50 per pound of contained beryllium. The addition of beryllium alloys to silver to prevent tarnishing has not proved successful under all conditions. Alloys with nickel, nickel-iron, and nickel-chrome iron show greater promise. They are strong, non-magnetic, resistant to heat and corrosion and find a use in springs of various kinds. Beryllium-iron, with a beryllium content of 10 per cent has been offered at $50 per pound of beryllium. There is little demand at present for metallic beryllium and the various alloys are accordingly being made direct.

The beryllium industry was first developed in Germany, but two companies in the United States, namely, Beryllium Corporation of Pennsylvania, Reading, Pa., and Brush Beryllium Company, Cleveland, Ohio, are now manufacturing beryllium alloys. The latter company also makes a number of beryllium chemicals, including the high refractory oxide. In recent years about 20 per cent of the beryl consumed in the United States has been used in the production of a super-refractory oxide and other compounds. Beryllium salts are used in certain types of glass, in ceramic glazes, refractories (mainly crucibles and insulators) and in lithopone, to increase light-fastness, and in high-duty abrasives.

In 1938 a New York Trade Journal quotations for beryl, carload lots, f.o.b. mines, were $30 per ton for mineral carrying a minimum of 10 per cent BeO, and $35 per ton minimum 12 per cent BeO. These prices, which showed no change from those of 1937, were nominal, as sales were usually made by individual contract.

BITUMINOUS SAND

Deposits of bituminous sand occur along Athabaska River between the 23rd and 26th base lines, in the northern part of Alberta; and the exposures may be seen along both sides of the river and its tributaries. Between 1927 and 1930, a total of 2,000 tons of the material were shipped for laboratory investigations, while another 3,000 tons were used in the construction of demonstration pavements and road surfaces.

During 1938, International Bitumen Company processed a small amount of bituminous sand at its plant at Bitumont, Alberta, from which about 45,000 gallons of fuel oil, upwards of 300 tons of asphalt of varying penetration, and a small quantity of prepared roofing were produced. The fuel oil was disposed of to mining companies and syndicates in the Northwest Territories, and part of the asphalt was shipped to a manufacturer of roofing products in Indiana and part to the City of Edmonton. The company's equipment at Bitumont includes a separation plant, a refinery with a capacity of 350 barrels per day, a shipping dock, and complete housing facilities.

Abasand Oils, Limited continued construction work on its separation, distillation, and refining units on Horse River near McMurray. The separation plant has a throughput of 400 tons of bituminous sand per day, and the distillation and refining equipment has a capacity of 600 barrels per day. It is proposed to produce gasoline, tractor fuel, Diesel fuel, road oils, asphalt, and coke.

The Bureau of Mines at Ottawa has been conducting comprehensive investigation of these deposits of natural asphalt. In addition to field exploration during fifteen seasons, extensive laboratory studies of the bituminous sand and of bitumen separated from it have been made. Various industrial applications for the separated bitumen, including its use in the manufacture of certain rubber goods, are also being investigated. The results obtained have directed attention to the extent and potential economic importance of the deposits. Products that may be derived include motor fuels and other liquid hydrocarbons, and certain solid and semi-solid bitumens.

CEMENT

Portland cement, the principal raw materials for which are limestone and clay, is manufactured in five provinces of Canada. Canada Cement Company, Limited operates plants at Hull and at Montreal East in Quebec, Port Colborne and Belleville in Ontario, Fort Whyte in Manitoba, and Exshaw in Alberta. St. Mary's Cement Company, Limited operates a plant at St. Mary's, Ontario; Medusa Products Company of Canada, Limited has a plant at Paris, Ontario; British Columbia Cement Company operates at Bamberton, British Columbia; and Coast Cement Company, Limited has a plant at Vancouver for the grinding of imported clinker. The plants have a total daily rated capacity of about 35,000 barrels.

Medusa Products Company of Canada, Limited began in June 1938 to manufacture white Portland cement, waterproofed white Portland cement, white masonry cement, cement paints, etc., from clinker imported from the United States, the United Kingdom, and Belgium.

Within recent years all but one of the eight plants making clinker from domestic raw materials have replaced the dry process by the wet, with the result that remarkably uniform products are now being made throughout the country. To further this uniformity, and to obtain a better fluxing of the clinker, iron oxide in the form of residue from burned pyrites is added to the raw mix at certain plants where the raw materials are deficient in this constituent.

A recent development of interest to all manufacturers of cement is the application of froth flotation to remove a portion of the siliceous material from the limestone. This process is in use at several cement plants in various parts of the world, and limestone deposits advantageously situated, but unsuitable for use in their natural state, can now be utilized for the manufacture of cement.

Canada produced 5,519,102 barrels of cement valued at $8,241,350 in 1938, as compared with 6,168,971 barrels valued at $9,095,867 in 1937. Sales were well maintained during the first half of the year but declined in the second half.

Cement is manufactured in most countries, and in 1936, the latest year for which complete data are available, the world's production amounted to 75,080,000 metric tons, of which Canada contributed 784,000 metric tons. The principal producing countries in order of tonnage were United States, Germany, United Kingdom, Russia, Japan, France, Italy, and Belgium.

Canada exported 89,419 barrels of cement valued at $101,059 in 1938, a marked increase over the 72,568 barrels valued at $82,978 exported in 1937. Trinidad took 34·4 per cent and Colombia 16·7 per cent, other countries being Newfoundland, British West Indies, Peru, British Guiana, Bermuda, and the United States. Canadian imports of cement totalled 48,497 barrels valued at $105,326, as compared with 61,082 barrels valued at $134,113 in 1937. Belgium supplied 71·4 per cent of the imports, the United States 16·5 per cent, Great Britain 12·0 per cent, and Italy and Japan, the remainder. The imports include some high-priced special cements.

Cement is one of the most important of our structural materials and is used in the construction of bridges, dams, highways, foundations, buildings, etc. The cement products industry, which makes building blocks, bricks, pipe, artificial stone garden furniture, etc., also uses cement as its principal raw material.

The average selling prices of cement per barrel f.o.b. plant in the several producing provinces during 1937 and 1938 were as follows:—

	1937	1938
Quebec	$1.37	$1.35
Ontario	1.38	1.40
Manitoba	2.27	2.28
Alberta	1.99	2.01
British Columbia	1.81	1.87

CHROMITE

Practically all of the Canadian output of chromite has come from the Coleraine area in the Eastern Townships of Quebec, from which area fairly large shipments were made during the War years. Since 1923, however, only a few shipments have been made. Asbestos Corporation of Canada has mined chrome ore at one of its properties in the Thetford asbestos area in recent years. The increasing demand for chromite in recent years can be traced chiefly to the increasing use of chromium alloy steels and of various corrosion- and abrasion-resistant chromium-bearing alloys.

In Ontario, Chromium Mining and Smelting Corporation's property at Obonga Lake, 26 miles south of Collins in the Thunder Bay District, has been under development during the past few years. Experimental shipments have been made from the property to test plants and to the company's large electric smelting plant at Sault Ste. Marie where ferrochrome and ferrosilicon are produced. So far, however, the ferrochrome has been produced mainly from imported ore. The smelting plant at Sault Ste. Marie has been enlarged and has a possible annual capacity of about 10,000 tons of contained chromium. The company is thus in a position to start operations on a commercial scale and it is expected that imported ores will be smelted.

Chromium Mining and Smelting Corporation has developed a new method of adding chromium to steel whereby a high-grade, high chromium-iron ratio chromite raw material is not required. Briefly, the process consists of a two-furnace preferential reduction treatment which is followed by a roasting operation. In the first furnace most of the iron and some of the chromium are reduced. The remainder of the chromium and iron are contained in the slag and are reduced to ferrochromium in the second furnace. The reduction of iron in the first furnace makes possible the production of high chromium-iron ratio ferrochromium from low chromium-iron ratio ore. The ferrochromium is roasted with lime in a rotary kiln, in which process the carbon is burned off and the metals are converted to oxides. The material is then given a second roast at a lower temperature in order to convert a part of the chromium into chromate. This mixture of oxides is mixed with ferrochrome-silicon and is packed into steel barrels for the market.

In British Columbia, exploration and development work has been carried out on several properties, and occasional experimental shipments have been made but no recent activities have been reported.

No production of chromium was reported in Canada in 1938, but shipments to the value of $43,250 were made. Imports amounted to 9,105 tons valued at $142,399. Chromium products imported included:—

Product	*Quantity* lb.	*Value* $
Sodium bichromate	1,776,372	106,150
Potassium bichromate	121,531	10,435
Chrome firebrick	....	47,885
Nickel-chromium bars and rods	43,472	41,805
Chromium and tungsten metals, and scrap alloys of,	43,527	30,328

The world's annual production of chromite is estimated at from 1,300,000 to 1,500,000 metric tons. Russia is the largest producer and is followed closely by the Union of South Africa, Southern Rhodesia, and Turkey. Cuba, New Caledonia, and Yugoslavia are also important sources of supply. It is estimated that about 40 per cent of the world consumption of chromium is used in the manufacture of refractory bricks; 30 per cent in the manufacture of ferrochrome; and 25 per cent in the chemical industry.

For metallurgical uses ores high in Cr_2O_3 and low in iron are desired, and ores with a chromium-iron ratio of 3 to 1 are usually chosen. In the refractory industry hard lumpy ores are preferred, but much ground chromite is used for patching and protecting parts of furnaces. Ores relatively low in chromic acid may be used in refractories provided the percentage of alumina is correspondingly high. Chromite containing less than 45 per cent Cr_2O_3 is not desired in the chemical industry, while chromite concentrates are acceptable. The ore should be low in sulphur, easily crushed, or friable, and should have a silica content of not more than 8 per cent. Aside from the chromite used in the manufacture of chromic acid for electroplating, much of the mineral is consumed in chemicals which are used chiefly in the dyeing, tanning, and pigments industries. The chemical manufactures in New Jersey, Maryland, and Ohio provide the principal outlet in the United States for chemical-grade chromite.

The New York price of 48 to 50 per cent chrome ore per long ton, c.i.f. Atlantic ports, decreased from about $26 in January 1938, to $22 in August, at which price it remained until the close of the year, the average for the year being about $24. The price for 97 to 98 per cent pure metallic chromium remained at 85 cents per pound during 1938.

CLAYS AND CLAY PRODUCTS

The industrial clays of Canada may be classified as common clays, stoneware clays, fireclays, and china clays. Statistically, the clay products industry of Canada is conveniently classified into: (1) Production from domestic clays, which includes building brick, structural tile, drain tile, roofing tile, stoneware, sewer pipe, pottery, and refractories; and (2) production from imported clays, which includes electrical porcelain, sanitary ware, sewer pipe, tableware, pottery, ceramic floor and wall tile, and various kinds of fireclay refractories. The total value of all clay products manufactured in Canada from domestic clays in 1938 was $4,437,100, as compared with $4,516,900 in 1937.

Common Clays

Common clays suitable for the production of building brick and tile are found in all the provinces of Canada. The value of structural clay products (building brick, hollow building tile, drain tile, roofing tile, etc.) was $3,185,506 in 1938, as compared with $3,223,691 in 1937.

Stoneware Clays

The largest producing area in Canada of stoneware clays or semi-fireclays lies in the vicinity of Eastend and Willows in Saskatchewan, where large quantities of the clays are selectively mined and shipped to Medicine Hat, Alberta, for the manufacture of stoneware, sewer pipe, and pottery through the agency of cheap gas fuel.

Stoneware clays and moderately refractory fireclays occur near Shubenacadie and Musquodoboit, Nova Scotia Some of the Musquodoboit clay is used for the production of pottery, but there has been no extensive exploitation of these clays for ceramic use. Stoneware clays, or low-grade fireclays, are also known to occur near Williams Lake, Quesnel, and Chimney Creek Bridge in British Columbia; in the Cypress Hills of Alberta; and near Swan River, Manitoba, but as the deposits are difficult of access, they have not been actively developed.

The value of stoneware articles (sewer pipe, pottery, etc.) produced in Canada from domestic clays in 1938 is reported to have been $1,009,312, as compared with $1,022,419 in 1937.

Fireclays

Fireclay refractories are manufactured from domestic clay at two large and a few small plants in Canada. At one plant, about 50 miles south of Vancouver, B.C., a high-grade, moderately plastic fireclay is obtained by underground mining from the clay beds in the Sumas Mountain, and is manufactured into firebrick and special shapes. At another plant at Claybank, Saskatchewan, the highly plastic, refractory clays recovered by selective mining from the "White Mud" beds of southern Saskatchewan are used.

Small quantities of the most refractory clay in the deposits near Shubenacadie are mined for refractory use by the steel plant at Sydney; and the Musquodoboit clay is utilized to some extent for the production of stove linings. With the exception of a few small enterprises which manufacture refractory specialties, and of companies which produce firebrick, blocks, etc., for their own use, all other manufacturers of fireclay refractories in Canada use imported clay.

The value (sales) of the fireclay bricks and shapes produced in Canada from domestic clays in 1938 was $190,366, as compared with $218,258 in 1937, while the value of such products made from imported clays totalled $659,599 in 1937 (1938 not yet available).

China Clays and Ball Clays

China clay has been produced commercially in Canada only from the vicinity of St. Remi d'Amherst, Papineau County, Quebec. A group of open pits was operated for several years prior to 1923. The property remained idle until 1937, when a reorganized company was formed to extract the kaolinized material by underground mining, and to refine it into high-grade china clay, with washed silica sand as a by-product. A shaft has been sunk to 365 feet, and a modern mill was erected for washing. In 1931 a nearby property was developed, mainly for the production of silica sand, but a small amount of china clay has also been produced.

Important deposits of high-grade, plastic white-burning clays, and buff-burning clays, occur on the Mattagami, Abitibi, and Missinaibi Rivers, in northern Ontario. Some may be classed as china clays, some as fireclays, and others as ball clays. They have attracted considerable interest, but have not yet been developed commercially, owing to their remoteness from industrial centres, and to a lack of transportation facilities.

In British Columbia, along the Fraser River, about 25 miles above Prince George, is an extensive deposit of high-grade clay, parts of which yield a grade of china clay comparing favourably with the best found on this continent. The possibility of transporting the clay by barge to the railway has been considered.

In the manufacture of such products as porcelain, sanitary ware, dinner ware, or ceramic floor and wall tile, etc., china clay imported from England is used almost entirely. Besides clay for ceramic use, large quantities of china clay are imported for use in the production of fine paper, in the rubber industry, and for other industrial purposes. Imports of china clay in 1938 were valued at $324,933 and at $445,073 in 1937.

Ball clays of high bond strength occur in the white mud beds of southern Saskatchewan. Though not large as yet, the market in Canada for ball clay and prospects of developing a profitable export market in the United States are good. The reported value of clays exported from Canada (which are chiefly ball clays) in 1938 is $2,652, as compared with $3,117 in 1937.

Compared to world production, the value of clay products manufactured in Canada is very small, and large quantities of the various kinds of ceramic products are imported annually. The total value of manufactured clay products imported into Canada was $6,872,952 in 1938, and $8,127,943 in 1937.

DIATOMITE

International Diatomite Industries, Limited, Tatamagouche, Nova Scotia, was the only Canadian producer of diatomite in 1938. The company's calcining plant at New Annan operated most of the year, and although the output of the plant was slightly greater than in 1937, sales were lower. The calcined diatomite is treated in a small mill at Tatamagouche station, 12 miles north of the plant. About 20 per cent of the sales were made in Canada, where diatomite is used mainly as a sugar filter-aid, a very carefully prepared product. Diatomite from Nova Scotia was used also as a filler in various trades, for insulation, and as a base for metal polish. Deposits containing diatomite of medium quality are common in some parts of Canada, but owing to foreign competition, and to the comparatively small Canadian demand, only properly prepared diatomite of the highest quality can be marketed in sufficient quantities to warrant the capital outlay required to operate a property.

In the Muskoka region of Ontario, Muskoka Diatomite, Limited, Toronto, ran a few tons of raw material through its mill located south of Gravenhurst, and distributed a small amount of prepared product locally. The plant was closed pending improvements.

In the Cariboo district of central British Columbia some prospecting was done on deposits about 15 miles south of Quesnel. An appreciable quantity of the diatomite mined from the Quesnel area during the past two years is still unsold and, until this is disposed of, further production is unlikely. Less than a car lot was sold by Fairey and Company, Vancouver, from the stock of material mined from the P. G. Lepitich farm near Quesnel on Fraser River.

Canada produced 494 tons of diatomite in 1938, while sales amounted to 414 tons valued at $13,562, as compared with 643 tons valued at $18,606 in 1937. Sales within Canada in 1938 amounted to 85 tons, as compared with 207 in 1937. Export figures for 1938 are not available, but from private sources it is learned that about 42 per cent of the total shipments went to England, and about 34 per cent to the United States. Imports in 1938 amounted to 3,700 tons, as compared with 3,350 tons in 1937. All but a small part of the imports came from California.

The domestic consumption of diatomite showed little change in 1938. About 92 per cent of the diatomite consumed in Canada is used as filter-aids, while about 4 per cent is used for insulation, and the remainder as a filler; concrete admixture; as a base for silver polish; and in chemicals. One, or possibly two companies are manufacturing diatomite insulation bricks and stove pads. The use of diatomite in the paint and varnish industry, a recent application, has demonstrated the advantages of the substance as a flattening agent and as an extender.

In the United States, which is by far the leading producer, seventeen companies contributed to the output in 1938, the total sales for that year being estimated at 125,000 short tons, a decrease of about 5 per cent below the estimated sales in 1937. Denmark, Germany, Japan, Algeria, and northern Ireland are next in order to the United States, their production in each case exceeding 5,000 tons annually.

In England, which is still the world's leading importer, there is a fair demand mainly for a pure white high-quality diatomite, which is being used principally as a filler for composite floorings and hard rubber products.

The present price in Canada varies from $35 to $40 per ton for concrete admixture; $35 to $75 for insulation and filtration; and up to $200 in small lots for material suitable for polishes. The price of imported insulation bricks varies from $85 to $140 per 1,000, according to grade and density.

FELDSPAR

Canada has been a producer of feldspar for almost fifty years, the output of the mineral having reached a peak of 45,000 tons in 1934. By the end of 1938 the total output amounted to more than three-quarters of a million tons.

Pegmatite dykes, the main source of commercial feldspar, are distributed widely throughout the Precambrian rocks of eastern and western Canada, and the known reserves of the mineral are large. Except for a few thousand tons mined in Manitoba from 1933 to 1936, the production has come from mines in Ontario and Quebec. Most of the output in 1938 continued to come from established mines.

In Ontario the large quarry of Bathurst Feldspar Mines in Bathurst Township, Lanark County, was the chief contributor of the output in 1938. There was a small production also from the nearby Macdonald mine, and from deposits in McKellar Township, Parry Sound District, and in Nipissing District. In the early days of the industry, the Verona area, Frontenac County, was the most important centre of production. Later, the Hybla, Mattawa, Sudbury, Parry Sound, and Bathurst areas each in turn became prominent.

In Quebec the entire output in 1938 came from three mines contiguous to the Lièvre River, north of Buckingham, Papineau County. This district is the source of the small tonnage of dental spar produced in Canada.

In Manitoba the mine in the Pointe du Bois area in the southeastern part of the province was in operation from 1933 to 1936, during which time it produced a total of about 7,000 tons, all of which was shipped to a mill at Warroad, Minnesota. No production of feldspar was reported from Manitoba in 1937 or 1938.

Exports of feldspar from Canada in 1938 amounted to 29,242 tons valued at $139,408, as compared with 27,462 tons valued at $197,000 in 1937. Most of the exports comprise crude spar which is shipped to mills in the United States. Under the new trade agreement which came into effect on January 1, 1939, the rate of duty on crude Canadian feldspar entering the United States was reduced from 35 cents per long ton to 25 cents. The duty on ground feldspar was reduced from 30 per cent ad valorem to 15 per cent. A small amount of specially selected high-grade "dental spar" is exported for use in the manufacture of artificial teeth.

Imports of ground spar, all of which came from the United States, amounted to 615 tons valued at $10,083 in 1938, as compared with 1,356 tons valued at $22,937 in 1937. A total of 42 tons of crude feldspar (used to a small extent for blending purposes) valued at $367 was imported in 1938, as compared with 439 tons valued at $21,097 in 1937. Crude feldspar enters Canada duty free, while ground spar from the United States is subject to a duty of 15 per cent ad valorem.

World production of straight feldspar (exclusive of "china stone," a variety of granite mined in the United Kingdom, and used in place of feldspar) totalled close to 380,000 tons in 1936, the last year for which complete figures are available. Canada in that year held fourth position as a producer of the mineral, having contributed about 5 per cent of the total tonnage.

Owing to its comparatively low unit value, the development of deposits of feldspar is dependent upon freedom of the run-of-mine material from iron-bearing impurities and upon the cost of transporting it to the grinding plant. Mechanical (magnetic) methods of cleaning spar have not been adopted as yet in Canada, sole dependence being placed on cobbing and hand-picking. Transport by truck has extended the economical limit of road haul from mine to mill or rail, to distances up to 25 miles.

Frontenac Floor and Wall Tile Company's mill at Kingston, Ontario, and Canadian Flint and Spar Company's mill at Buckingham, Quebec, both of which grind feldspar for use in the ceramic industry, were in steady operation throughout the year, as was also the grinding unit of Bon Ami Company, at Montreal East. The former company obtains its supply from the Bathurst district, in Ontario, and the latter from mines along the Lièvre River, in Quebec. Bon Ami Company, which requires a light-coloured spar, obtained most of its requirements in 1938 from Quebec, and a small tonnage also from New Hampshire, U.S.A.

Domestic prices remained unchanged in 1938. No. 1 ceramic grade was quoted at $5.50 f.o.b. rail or mill. Ground spar sold at $16 per ton, ex mill. In the United States, the average price of ground spar was $17 per short ton for the pottery trade, and $14.50 for the enamel trade. The average price of granular glass spar was $10.30.

Nepheline syenite, a material which is finding increasing use as a substitute for straight feldspar in the glass trade, is doubtless largely responsible for the decreased sales of Canadian feldspar.

In the United States one-half the feldspar now used is consumed in the manufacture of glass. Canadian spar, however, enjoys a high reputation as a standard grade for various ceramic uses. An official survey of the feldspar industry in the United States showed that sales of ground spar in 1937 were distributed as follows to the various consuming industries: glass, 51 per cent; pottery, 37 per cent; and enamel and sanitary ware, 9 per cent. The remainder was consumed in other ceramic uses, scouring preparations, and abrasive wheels. Total grinding capacity of American mills in 1938 was estimated to be close to 600,000 tons, or more than double the tonnage of sales in that year.

The use of the lithium mineral spodumene in the ceramic industry has also been under investigation recently. It is a more active flux than is feldspar and may yet replace that mineral to some extent at least. Pyrophyllite (silicate of alumina) and talc also have valuable ceramic properties, and their production and use for ceramic purposes have been expanding rapidly in recent years as an outcome of which the use of feldspar may continue to decrease. Production in Virginia of a rock termed "aplite," a mixture of feldspar and zoisite, for the purpose of furnishing a granular material for the coloured glass trade was commenced in 1938.

FLUORSPAR

The only deposits of fluorspar of any importance in Canada are those in the Madoc district, in Hastings County, Ontario, and near Grand Forks, British Columbia. Accordingly, practically all of the Canadian requirements for the metallurgical, ceramic, and other industries, which amounted to 12,826 tons in 1937, are imported.

During the War years a number of properties in the Madoc area produced considerable tonnages, but seldom since 1920 has more than 100 tons been produced from the area in any year, and it has been obtained mainly by pick-and-shovel methods from surface workings. Occasional reports of plans to re-open old properties, or to build plants to recover the fluorspar from old dumps have not as yet materialized.

Consolidated Mining and Smelting Company's Rock Candy deposit, near Grand Forks, British Columbia, is by far the largest known in Canada. It was operated intermittently between 1918 and 1929, the total output during that period being estimated at 70,000 tons of crude fluorspar, from which 30,000 tons of concentrate was produced. Some of the material was exported, but most of it was used for the production of hydrofluosilicic acid used in the electrolytic purification of lead at the company's smelter at Trail. Fluorine recovered as a by-product from the phosphate rock used in the large fertilizer plant at Trail has now displaced fluorspar. All of the fluorine recovered is consumed in the lead refinery, but other possible outlets are being considered, such as the use of fluorine in the manufacture of sodium fluosilicate, which in turn is used in the ceramic and glass industries, for laundry purposes, and as an insecticide. Its use in lead and zinc fluosilicates, of value as grasshopper poisons, and in ammonium fluosilicate, a detergent, is also being considered.

Canada produced 217 tons of fluorspar valued at $3,906 in 1938, as compared with 150 tons valued at $2,550 in 1937. The mineral was recovered by a single operator from small surface workings at Madoc, Ontario. It was of gravel grade and was shipped to domestic steel plants.

There were no exports of the mineral from Canada in 1938. Imports amounted to 15,057 tons valued at $212,131, as compared with 11,444 tons valued at $168,082 in 1937. They came from the United States (1,388 tons), United Kingdom (675 tons), Newfoundland (6,092 tons), Belgium (599 tons), Germany (858 tons), and Italy (440 tons).

Fluorspar entering the United States is subject to a duty under the general tariff of $5.60 per long ton if it contains more than 97 per cent of calcium fluoride, and $8.40 per ton if it contains less than 97 per cent. Under the Trade Agreements effective January 1, 1939, the rate on imports of the first-mentioned grade from Canada and the United Kingdom is reduced to $4.20 per ton. Imports of fluorspar into Canada are free of duty.

The recorded world production of fluorspar in 1937 amounted to about 585,000 short tons, of which the United States and Germany each produced more than 150,000 tons. The remainder came mainly from France, the United Kingdom, Korea, Italy, and Newfoundland, in order of tonnage.

Fluorspar is used mainly in the metallurgical industries, chiefly as a flux in the production of basic open-hearth steel ("fluxing gravel" grade), and it is used also in the melting of electric furnace steels, ferro-alloys, non-ferrous metals, and in general foundry work ("foundry lump" grade). The glass and pottery industries consume important amounts of ground fluorspar, and a considerable tonnage ("acid lump" grade) is consumed in the manufacture of hydrofluoric acid, used chiefly for the production of synthetic cryolite, a material which is employed in the extraction of aluminium from bauxite, and, to a smaller extent, in glass and other ceramic products, insecticides, etc. Fluorspar is used in the manufacture of Portland cement, the bonding of emery wheels, and in the making of carbon electrodes, calcium carbide, and cyanamid. Another outlet of some promise is in the manufacture of an organic refrigerating medium (dichloro-difluoro-methane) a compound which is being made by Kinetic Chemicals, Limited, a unit of E. I. DuPont de Nemour Company. According to the U.S. Bureau of Mines, sales of fluorspar from mines in the United States in 1937 were distributed by consuming industries as follows: steel and foundry, 77 per cent; hydrofluoric acid and derivatives, 10 per cent; glass, 7 per cent; enamel, 3·5 per cent; miscellaneous, 2·5 per cent.

Clear, glassy, crystal fluorspar is used in optical instruments for correcting colour and the spherical aberration of lenses; and coloured fluorspar is sometimes used in jewellery, though its softness is a handicap to such use. Fluorspar of optical quality is exceedingly rare and commands high prices. Fine crystals were obtained from the Keene mine, near Madoc, Ontario, during the War. The discovery in Siberia of exceptionally large, clear crystals measuring 4 to 6 inches across was announced recently.

Commercial fluorspar is usually graded according to the following specifications: acid grade, lump or ground, 98 per cent CaF_2, not over 1 per cent SiO_2; glass and enamel grade, ground, 95 per cent CaF_2, not more than 3 per cent SiO_2 and 0·1 per cent Fe_2O_3; fluxing gravel or lump grade, 85 per cent CaF_2, not more than 5 per cent SiO_2.

Marketable grades of fluorspar are usually recovered from run-of-mine ore by hand-picking of the clean lump mineral, followed by crushing, jigging, and tabling of the impure material and fines. Recently, flotation has been tried in the United States for the recovery of the fluorspar in mill tailings, and a plant is in operation in Illinois. The process gives a satisfactory separation of the fluorspar-quartz ores. Reports state that it is used in three German mills, and in a mill in South Africa. The flotation process has so far not proved satisfactory on fluorspar-calcite-quartz ores, the grade of the concentrate and the recovery both being low. The process could probably not be used successfully on ores from the Madoc area which are usually a mixture of fluorspar, calcite, and barite. Concentration tests in the laboratories of the Bureau of Mines at Ottawa on material from Madoc and on fluorite-barite ore from Lake Ainslie district, Nova Scotia, have so far not given good separation and recovery.

GARNET

Commercial garnet belongs to a group of complex silicate minerals of which almandite, the brownish red iron-aluminium silicate is generally considered the hardest and the best for use as an abrasive. Garnet, crushed and suitably graded as to size, is used for making abrasive-coated papers and cloth for special uses in certain manufacturing industries, particularly in the woodworking and shoe leather trades. Canada produces no prepared garnet, and the 110 tons used during 1938 was imported as graded grains. Attempts in the past to produce commercial garnet in Canada have failed, owing to the small extent to which it is used; to the competition from high-quality United States material; and to the fact that garnet possessing abrasive efficiency equal to that obtained in the United States has not as yet been found in sufficient quantities in the Dominion.

In Quebec, Garnet Concentrates, Incorporated did some prospecting on a property near Langlade in the Abitibi region, on which some work was done several years ago. Canada Garnet Company, Montreal, continued with the building of a concentration mill on its property in Joly Township, 2 miles southwest of Labelle. In Ontario, Damigo Mining Syndicate, Toronto, shipped 15 tons of ore to the Bureau of Mines at Ottawa, for concentration tests, the shipment being part of the 400 tons of ore mined in 1937 from property in Ashby Township, east of Bancroft. The concentrate was used in the trial manufacture of cement-garnet pulpstones. Elsewhere in Canada there was little activity in 1938.

Between 90 and 95 per cent of the world's garnet output comes from the United States, where three companies are in active operation, Barton Mines Corporation, North Creek, N.Y., being by far the leading producer. In 1938 the United States produced a total of 3,155 tons, and sales amounted to 2,012 tons. In 1937 production amounted to 5,307 tons and sales to

4,863 tons valued at $382,535. Shipments in 1938 were the lowest in the past 40 years with the exception of 1932, principally because of the increased competition from artificial abrasives.

Outside of North America, England is by far the leading user of garnet, its annual consumption of the graded material being estimated at about 800 tons. The quality of this abrasive is gauged by the United States products, and thus the quality of the Canadian garnet must be equally as high so that it may compete successfully.

Price of the best quality concentrate from which grain is prepared for abrasive papers and cloths is now $76 per ton f.o.b. mines (U.S.A.), and graded grain is $90 per ton. About 30 tons of garnet fines was sold in the United States by manufacturers of sandpaper at about $26 per ton delivered, for use in the surfacing of plate glass. A very small amount of garnet was used for sand-blasting.

GRANITE

(Building, Ornamental, and Crushed)

Large areas in Canada are underlain by granite, much of which is suitable for all the purposes for which the stone is used. The stone quarried consists of granite and related crystalline igneous rocks which are used for building, decorative, ornamental, or constructional purposes, and is obtained from properties in Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba, and British Columbia.

Much of the granite produced in Canada is used for foundations for highways, for permanent ballasting of railway road beds, for heavy aggregate in large concrete structures, for filling breakwaters, and for bridge piers. The curtailment of such operations during the depression years seriously affected production, which is still far below that of certain previous years.

In the Maritime Provinces, the industry has been comparatively quiet, although the search for new deposits of granite suitable for monumental dies has been active.

Quebec is the source of most of the granite for building, the Stanstead, St. Samuel, Lake St. John, and Rivière-à-Pierre areas being the leading producers. Operations, however, have greatly decreased in recent years as a result of the curtailment in building construction. Renewed activity is in evidence in the district south of St. Gerard, Quebec, where Deschambault Quarry Corporation has re-opened the Plamondon quarry and erected a dressing shed at the railway at St. Gerard. The company produces a light grey dimension stone for building. Stone used in the National Memorial at Ottawa was quarried during 1938 from Rivière-à-Pierre district northeast of Three Rivers, from where it was shipped to St. Samuel for dressing. More than 800 tons of dressed granite was used in the erection of the Memorial, and it was necessary to quarry about 7,000 tons to obtain sufficient material free from blemishes, and of proper sizes. The largest block used weighed over 40 tons dressed.

In Manitoba prospecting for granite deposits suitable for both building and ornamental use has been active.

Granite for monumental use, the demand for which is increasing, is produced in the Maritime Provinces, and in Quebec, Ontario, Manitoba, and British Columbia. An appreciable amount of stone, principally black, is still being imported for this use, and the product from a quarry of similar material in Canada should find a ready market. One company producing black granite near Lake St. John, Quebec, has greatly extended its operations and has added gang saws and other equipment. Its product has been employed in a number of public buildings and as monumental dies in the province. Other deposits of "black granite" in the Maritime Provinces, Quebec, Ontario, and Manitoba show promise of yielding stone of good quality. The demand for a certain class of stone for monumental use varies, and a stone of one class after enjoying a steady market for a number of years may be completely superseded by that of another. At present the so-called "black granite" and the "grey" seem to be in most demand for monuments.

Canada produced 491,375 tons of granite valued at $1,126,419 in 1938, as compared with 1,135,099 tons valued at $1,827,433 in 1937. Exports amounted to 657 tons valued at $5,042 (granite and marble unwrought), as compared with 1,234 tons valued at $11,408 in 1937. Imports of granite were valued at $99,103 in 1938, as compared with $114,935 in 1937. Some granite was imported during the year from the United States and Europe for monumental use, but it is likely that such imports will be replaced eventually by Canadian material.

Granite is employed for building purposes mainly in the larger buildings such as public and semi-public structures and institutions. In the building trade coloured granites are being used to an increasing extent in the form of thin polished slabs for trim for buildings where contrast is called for in the main colour scheme.

GRAPHITE

For the past several years the entire Canadian production of graphite has come from the Black Donald Graphite Company's mine at Whitefish Lake, 22 miles west of Calabogie, Renfrew County, Ontario. This mine has been in steady operation for 30 years. The deposit is exceptionally large and rich, and although the graphite flakes are too small for crucible use, the products are well adapted for lubricants and foundry facings. In recent years, the highest grade material has been employed successfully in the manufacture of pencils. It is exported to the United States where it is reduced to the necessary degree of fineness in a new type of impact pulverizer ("micronizer"), which uses high-pressure dry steam. All other graphite mines and mills in Ontario and Quebec have been inactive for many years, and most of the plants have been dismantled.

As has also been the case in the United States, attempts to mine and process graphite for domestic use have usually led to failure. The Canadian climate adds to the difficulties of operators, and the hard, unweathered character of the ore renders milling and refining costly. Then, too, many makers of crucibles in the United States prefer Madagascar flake to either the American or Canadian product.

Canada produced graphite to the value of $41,590 in 1938, as compared with $125,343 in 1937. Exports amounted to 1,150 tons valued at $54,366 in 1938, as compared with 2,948 tons valued at $133,262 in 1937. The tonnage figures include both natural and artificial graphite. Total imports, including ground, unground, and manufactures of graphite, but exclusive of crucibles, were valued at $87,888, as compared with $114,733 in 1937.

World production of all grades of graphite including flake, crystalline (plumbago), and amorphous, amounted to about 140,000 long tons in 1937, the leading producers, in order of tonnage, being Chosen (Korea), Germany, Austria, Ceylon, Madagascar, and Mexico.

No changes of importance occurred during the year in the world graphite industry. The flake and crystalline grades continue to be used chiefly in the crucible and foundry trades, though there has been a marked decrease in recent years in the demand for crucibles. Fine flake graphite is used extensively in lubricants, as well as in paints, and polishes, and to some extent in pencils, though much of the paint and pencil graphite used is of the amorphous variety. Much of the amorphous paint graphite used is relatively impure and contains only 50 to 60 per cent of actual graphite.

Large amounts of amorphous graphite are used in the making of dry batteries and by manufactures of dynamo brushes. The United States Bureau of Mines advises that the use of the cheaper amorphous graphites, obtained largely from Mexico and Chosen, has expanded greatly. Thus, sales of the more expensive crystalline grades have been declining steadily, and such grades now represent only about 10 per cent of the total consumption. A recent survey of the consumption of natural graphite in the United States, by industries, shows that about 20 per cent is used in crucibles, 40 per cent in general foundry work, 15 per cent in pencils and crayons, 15 per cent in lubricants, and 10 per cent in paints, stove polish, and minor uses.

Artificial graphite, made in the electric furnace by the reduction of coal or petroleum coke, is used to an important extent in industry, notably in the form of graphitized electrodes, and also in dry batteries. As a colloid, graphite has an ever-expanding variety of uses, including special lubricants and for coating various surfaces.

The market for graphite is highly competitive, and price quotations as given in trade journals can be regarded only as approximate owing to the intensive competition between Madagascar and Ceylon producers of high-grade crucible and foundry grades. The market is further complicated by fluctuations in currency values. In the American trade, Ceylon lump sold at about 7 cents per pound; Ceylon chip at 5½ cents; and Ceylon dust at 3¼ cents. Madagascar No. 1 flake ranged from 9½ to 17 cents, while No. 2 flake sold at 7 cents, and ground (dust) at 3 cents. Crude amorphous was quoted at $12 to $23 per ton, according to grade, and ground at 3 cents per pound. All prices are f.o.b. New York.

Graphite imports into the United States, under the general tariff, are subject to a duty of 10 per cent ad valorem on natural amorphous and artificial grades, and of 30 per cent on crystalline lump, chip, and dust grades. By the new trade agreements which came into effect on January 1, 1939, these duties are reduced to 5 per cent and 15 per cent respectively, on imports from Canada and the United Kingdom. The Canadian tariff provides as follows: graphite, not ground or otherwise manufactured, British, free; intermediate, 7½ per cent ad valorem; general (including foundry facings but not crucibles), British, 15 per cent; intermediate, 22½ per cent; general, 25 per cent.

GRINDSTONES, PULPSTONES, AND SCYTHESTONES

Grindstones. Canada's output of grindstones during the past few years has been decreasing. Grindstone sales amounted to 292 tons valued at $13,368 in 1938, as compared with 293 tons valued at $14,507 in 1937. Read Stone Company, Sackville, New Brunswick, did no quarrying in 1938, the stones having been made up from material quarried in 1937. Some of these grindstones came from near Stonehaven on Bay of Chaleur, New Brunswick, and a few from Quarry Island, Pictou County, Nova Scotia. Stanley Rule and Level Company, New Britain, Conn., U.S.A., operated the Mic Mac quarry at Woodburn near Merigomish Harbour, N.S., and shipped about 80 grindstones.

Pulpstones. For the first time since 1916, no pulpstones were produced in 1938. In recent years the Canadian output has come entirely from J. A. & C. H. McDonald Company, Vancouver, British Columbia; and from the sandstone beds on the northwest end of Gabriola Island, near Nanaimo, Vancouver Island.

Scythestones. These stones are now manufactured in Montreal by Read Stone Company from material quarried at Stonehaven, New Brunswick and at Wallace, Nova Scotia. Sales amounted to 21 tons valued at $3,408, as compared with 74 tons valued at $4,147 in 1937.

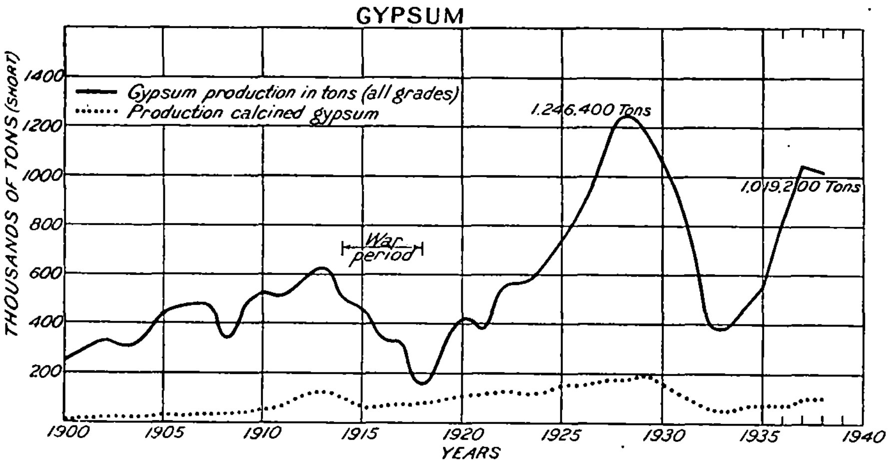
The production of all grades of stone in Canada in 1938 amounted to 311 tons valued at $16,198, as compared with 412 tons valued at $21,429 in 1937. Exports were valued at $5,441 in 1938, as compared with $135 in 1937. Imports, which consisted chiefly of pulpstones, were valued at $118,623, as compared with $185,358 in 1937, and were obtained chiefly from the United States and also from England.

The large-size Canadian grindstones are used mainly to sharpen pulp-mill and tobacco knives. In the United States they are used in the file, machine-knife, granite tool, and shear manufacturing industries. The small stones are used for scythe and axe grinding. Because of the competition from the artificial grinding wheel, and to some extent from foreign natural stones, the use of small stones for this purpose is decreasing.

Good pulpstones are in demand, particularly for use in the large magazine grinders, but, as known Canadian deposits containing thick beds of the proper quality sandstone appear to have been worked out, production for the present has ceased.

GYPSUM

Canada has extensive deposits of gypsum of excellent grade which are favourably situated for commercial exploitation. The materials produced in the Dominion are the hydrous calcium sulphate commonly known as gypsum, the partly dehydrated material known as plaster of Paris or wall plaster, and the anhydrous calcium sulphate known as anhydrite. Nova Scotia is the leading producer and is followed by Ontario, New Brunswick, Manitoba, and British Columbia. Gypsum is marketed in the crude lump form, ground, as "land plaster" and "terra alba," or ground and calcined, as plaster of Paris or wall plaster. Each year an increasing amount of the calcined material enters into the manufacture of wall-board, gypsum blocks, insulating material, acoustic plaster, etc. Anhydrite, the production of which in Canada is small, is used mainly as a fertilizer for the peanut crop in the Atlantic sea-board States of the southern United States.



Gypsum production in Canada, 1900-1938.

In Nova Scotia, National Gypsum Company, Buffalo, N.Y., made shipments throughout the year from its Cheticamp and Dingwall properties to London, England, and to the United States. At its Cheticamp property the company changed from the regular bench operation of drilling and blasting to the use of 6-inch well drill-holes. These are drilled from the top to the bottom of the quarry, an average of about 115 feet. The largest single blast of the season consisted of twenty holes in which about 9,000 pounds of explosive were used. Prima cord fuse, used for the first time in Canada in this blast, proved very successful. Operations at the Dingwall property were increased during the year. Trials were made of dumping the gypsum directly from trucks to a storage pile at the point for water shipment. A ramp was built of the gypsum and the height of the pile gradually increased. The usual tunnel and belt for loading boats was located beneath the stock pile which was open to the weather, and it will be seen later whether the usual building to house the pile is necessary. A start was made on the construction of a loading pier and equipment, and of a paved highway from the loading pier to the quarry. A 2½-yard Diesel shovel is being added to the quarry. The Department of Public Works was dredging the channel so that large boats can be loaded.

Victoria Gypsum Company more than doubled the shipments from its plant at Little Narrows, Cape Breton, Nova Scotia. Two-thirds of the production was marketed in England and most of the remainder went to the

United States. St. Andrews (N.S.) Gypsum Company, Limited was unable to complete its plans for the erection of a plant at Boularderie, but hopes to be active during 1939. The gypsum deposits in the vicinity of Windsor, Hants County, Nova Scotia, were actively developed throughout the year, most of the material having been shipped in the crude form to the United States.

The Canadian Gypsum Company, Hillsborough, New Brunswick, shipped crude gypsum to the United States and produced all grades of plaster and wall boards for the eastern Canadian market.

Moose River Gypsum Company, Limited, Cochrane, has been incorporated to develop some of the extensive deposits of gypsum known to occur in northern Ontario. The gypsum industry in the district south of Hamilton continued to supply all grades of plaster and plaster products to markets in Ontario and Quebec.

The demand for gypsum in the Prairie Provinces was rather light but steady, and was supplied by plants in that section of Canada. Deposits in northern Alberta are distant from markets, but are of good grade.

In British Columbia several deposits of gypsum are known to occur, some of which are being actively developed. Gypsum Lime and Alabastine Company, Canada, Limited carried out considerable diamond drilling on its deposit at Falkland, and made a new opening at a lower level and east of the aerial tram-head. Gypsum from the deposit will be hand-sorted and transported in trucks to the railway. Two carloads of gypsite, produced from the Rogers and Little property at Knutsford, about 3 miles south of Kamloops, were sold for agricultural use. A large tonnage of by-product gypsum is obtained from the production of phosphate fertilizers at Consolidated Mining and Smelting Company's plant at Tadanac, and efforts are being made to find an outlet for the material.

Canada produced 1,019,188 tons of gypsum valued at $1,517,070 in 1938, as compared with 1,047,187 tons valued at $1,540,483 in 1937. The Dominion holds fifth position as a producer of gypsum, and contributes about 8 per cent of the world output. In the British Empire, the Canadian production is exceeded only by that of the United Kingdom.

Canada imported 1,752 tons of gypsum valued at $39,278 in 1938, as compared with 1,769 tons valued at $40,642 in 1937. Exports amounted to 811,567 tons valued at $966,748, as compared with 842,425 tons valued at $990,263 in 1937.

The use of anhydrite in England for the manufacture of sulphuric acid, ammonium sulphate, and special plasters is rapidly increasing, and the shipment of 2,500 tons of anhydrite during 1937 marked the entry of Canada into this market. Eventually, it is possible that anhydrite will be used in this country in the manufacture of special plasters, similar to the material now being marketed in England.

Because of their lightness, durability, fire-resisting, insulating, and acoustic properties, gypsum products are being used to a steadily increasing extent in the building and construction industries. Tiles, wall-boards, blocks, and special insulating and acoustic plasters have been developed. As most of the crude gypsum quarried in Canada is shipped to the United

States for the manufacture of gypsum products, the outlook for the industry is dependent largely upon the trend of industrial conditions in that country.

Crude gypsum is a low-priced commodity, and its selling price f.o.b. quarry is dependent largely upon the quantity produced and upon the productive facilities available.

IRON OXIDES (MINERAL PIGMENTS)

Ochreous iron oxide, sold uncalcined, chiefly for the purification of illuminating gas, constitutes the major production of the minerals classed under this title. The calcined form of ochreous iron oxide is used in the manufacture of paints. Some natural iron oxides, associated with clay-like materials in the form of umbers and siennas, are produced in both the raw and calcined state for use as pigments in the manufacture of paint. The Canadian production of iron oxides is comparatively small and shows little change from year to year. For many years it has come principally from Red Mill and Pointe du Lac in the vicinity of Three Rivers, Quebec, and in 1938 deposits near Lacoste, Labelle County, and at Almaville and St. Adelphe, Champlain County, also contributed to the output from that province. In past years deposits near Ste. Anne de Beaupre, Montmorency County, at Les Forges near Three Rivers, and at St. Raymond in Portneuf County, were in operation. Iron oxide will be recovered as a by-product in the sulphur plant being erected at the Aldermac mine for the production of elemental sulphur from iron pyrites. In British Columbia there has been a small production of iron oxide each year since 1923. It is used chiefly for the purification of gas.

Deposits now idle in Quebec and Ontario could be actively developed if the demand for the cheaper grades of iron oxides for use in the paint trade warranted doing so. Beds of ochre and umber have been worked to some extent in the past in Nova Scotia, and several deposits of ochre are known in Alberta and Saskatchewan, some of which have commercial possibilities. However, as they are difficult of access and as the market is limited they have received little active attention. The same applies to large deposits near Grand Rapids and Cedar Lake in northern Manitoba.

Figures for Canada's production of ochres include in a single item all grades, from the low-priced raw material to the high-priced calcined products. Sales of ochreous iron oxide in Canada in 1938 totalled 5.322 tons valued at $70,019, as compared with 6,197 tons valued at $83,640 in 1937. Production during the past ten years has averaged about 6,000 tons a year.

Canada exported 1,685 tons of mineral pigments valued at $104,814 in 1938, as compared with 1,755 tons valued at $105,240 in 1937. Imports of all kinds of ochres, siennas, and umbers totalled 1,167 tons valued at $37,631 in 1938, as compared with 1,623 tons valued at $56,084 in 1937. In addition, prepared oxides, fillers, and related products, some of which were probably not ochres, were imported to the value of $718,329 in 1938, as compared with $844,149 in 1937.

The demand in Canada for these products is fair. Most of the higher grade oxides, ochres, and umbers used in the paint industry are imported from Europe, and some of the cheaper grades of European oxides even compete with the domestic products, as they do not require calcining to produce the desired colour.

LIME

There is an abundance of limestone suitable for the production of lime throughout Canada, and lime is manufactured in every province in the Dominion with the exception of Prince Edward Island. Saskatchewan's production, however, is intermittent, and is very small. Ontario, the leading producer, supplies more than one-half of the total Canadian output. Because of their proximity to mines and pulp mills, considerable interest has been shown recently in deposits of high-calcium limestone in the northern part of the province. Quebec, which is next in order, is the source of slightly more than one-quarter of the total. Both high-calcium and dolomitic limes are produced in Nova Scotia, New Brunswick, Ontario, and Manitoba, but only high-calcium lime is made in Quebec, Alberta, and British Columbia. Fifty-two plants were in operation throughout the Dominion in 1938. Both of the large plants producing chemical lime at Beachville, Ontario, are now using natural gas, made available in 1938, for fuel instead of coal.

A large new market for white, high-calcium lime has been opened up as a result of the use of calcium carbonate filler in place of imported clay in newsprint and magazine paper. Manufacture of the filler in Canada was begun in 1937. The paper companies using it at present purchase the quicklime and make the carbonate filler at their own plants. It has other uses also, and preparations to manufacture it in 1939 to supply these uses have been made by a newly incorporated company.

Aged lime putty and lime mortar for use in building construction are now available in a number of Canadian cities. Lime mortar is regaining favour as a binder in masonry, and sales of lime for construction may be expected to increase.

Canada produced 418,031 tons of quicklime valued at $2,945,057 in 1938, and 71,053 tons of hydrated lime valued at $591,378, as compared with 466,538 tons of quicklime valued at $3,252,383, and 82,815 tons of hydrated lime valued at $572,534 in 1937.

Exports of lime from Canada in 1938 amounted to 6,381 tons valued at $51,346, as compared with 10,373 tons valued at $85,489 in 1937. The shipments are made chiefly to the United States, but small shipments are made also to Peru, Newfoundland, Colombia, and the British West Indies.

Imports, all of which are from the United States, amounted to 6,940 tons valued at $37,255 in 1938, as compared with 5,661 tons valued at $41,417 in 1937.

Lime is marketed in 50-pound, multi-wall paper bags in the form of quicklime and in the hydrated state, the latter being a specially prepared slaked lime in the form of fine powder. Quicklime, which comprises about 80 per cent of the total sales, is marketed in the lump, pebble, crushed, and pulverized forms. Lump lime and pebble lime are sold either in bulk, or are packed in barrels. Crushed lime (1 inch and under) and pulverized lime (ground to minus 20 mesh, and in some plants to minus 50 mesh) are sold in airtight, multi-wall paper bags. In these various forms lime finds a multitude of uses in chemical and metallurgical processes and in the construction, agricultural, and other industries. It is one of the great basic raw materials of the chemical industry, about 85 per cent of the current production being used in chemical processes.

Prices of the different lime products vary widely depending upon the location of the plants and upon the quality of the lime. Prices in 1938 remained largely unchanged.

LIMESTONE (GENERAL)

Limestone, because of the great variety and importance of its industrial applications, is the most useful of all rocks. It is quarried in all provinces of Canada with the exception of Prince Edward Island and Saskatchewan, but by far the greater part of the production comes from Ontario and Quebec. The production of limestone for all purposes, including the manufacture of lime and cement, comprised well over 90 per cent of the total production of Canadian stone in 1938.

Limestone is available in great bedded formations and in massive, highly metamorphosed deposits, but the former is by far the more abundant and is the source of most of the output. At present most of the Canadian limestone is won by open pit methods, but in recent years underground mining of the rock has been adopted by several companies which produce limestone for chemical and metallurgical uses, and for making lime. Underground methods of mining will undoubtedly be used to a much greater extent in the future, particularly in the production of high-grade stone for chemical uses.

Of significance in connection with the production of pure limestone in the future is the progress being made in beneficiation, whereby siliceous material is in part removed from limestone by flotation. This method of purifying limestone is now in use at several Portland cement plants in various parts of the world.

Canada's production of limestone for general use, exclusive of that used for building stone, lime, and cement, is estimated at 4,499,072 tons valued at $3,667,878 in 1938, as compared with 5,512,865 tons valued at $4,326,649 in 1937. Production for all purposes in 1938 is estimated at 7,000,000 tons as compared with 8,000,000 tons in the previous year. The decrease is due largely to the lesser amount of highway surfacing and railway ballasting in 1938, and to the general decline in industrial activity.

Limestone is quarried on a large scale in all industrial countries. Rarely does it figure to any appreciable extent in international trade, but as foreign limestone can be obtained more cheaply at certain large consuming centres in Canada than can limestone from domestic sources, considerable quantities are imported from the United States and Newfoundland for use as blast furnace flux, and from the United States for road metal and for use in some pulp mills near the International boundary in Ontario. Comparatively small tonnages are exported to the United States for agricultural use and in sugar refineries. No separate record is maintained of the trade in limestone.

For use in Canada limestone is marketed in a variety of forms, ranging from huge squared blocks of dimension stone used in construction, to extremely fine dust used chiefly as a mineral filler. Limestone as quarried is seldom suitable for use without processing, one of the exceptions being the limestone used in the wood pulp industry. Most of the output is crushed and screened for use as road metal, concrete aggregate, railroad ballast, and as flux in metallurgical plants. Large quantities are used in the manufacture of Portland cement, lime, rock wool, and various chemical products. It may be noted that in 1938 Canadian rock wool made from argillaceous dolomite was exported to England, Switzerland, Sweden, Holland, and Argentina.

New uses for limestone are being developed continually. The dolomitic variety, when crushed or when calcined, has long been used as a refractory material for fettling the bottoms of basic open-hearth furnaces, but its applications as a refractory have been limited because of the readiness with which it air-slakes, and also because of its chemical activity. Recently, however, a method has been found of combining dolomite (and also calcium limestone) with silica in the presence of a stabilizing agent to give a refractory product that contains no active lime or silica, does not disintegrate, and is comparable in refractoriness with materials that are several times as expensive. Dolomite is gaining importance in Europe as a raw material for making metallic magnesium.

Canada possesses ample deposits of high-grade dolomite and developments are being watched with interest in this country. Though the necessity of applying limestone or lime to agricultural land in order to maintain or increase soil fertility has been emphasized for years by authorities on agriculture, the quantity so used in Canada is still very small, whereas if the proper quantity were applied it would constitute one of the principal outlets for limestone.

LIMESTONE (STRUCTURAL)

Limestone in blocks of large dimensions for building is quarried in Quebec, Ontario, and Manitoba. In Quebec there are three quarries at St. Marc des Carrieres, Portneuf County, producing grey limestone, and several in and near Montreal producing limestone of similar colour. In Ontario a large quarry near Queenston in the Niagara Peninsula yields silver-grey limestone as well as small quantities of buff and of variegated buff and grey; and at Longford Mills, near Orillia, buff, silver-grey, and brown limestone for use both as marble and building stone are quarried. The three quarries in Manitoba are near Tyndall, and yield mottled grey, mottled buff, and mottled variegated limestone. Along with the large Canadian quarries, the products of which have a wide shipping range, small quarries producing building stone for local use are worked near Quebec City, Montreal, and Hull in Quebec; and at Ottawa, Kingston, Erin, and Wiarton in Ontario, their chief product being rubble.

Some of the quarry companies market stone in all stages of manufacture, from the mill block to elaborately carved material, while others sell stone only in the mill block. Waste material is utilized for crushed stone, rubble, riprap, flagging, chemical and metallurgical purposes, and for the manufacture of lime. The tonnage and value of waste products are not included in the production data given below.

No developments of outstanding importance occurred in the production of limestone for building during 1938, but such production is estimated to have increased by 20 per cent over that of 1937 when it amounted to 30,134 tons, valued at $354,620. The increased production was largely from quarries in Ontario and Quebec. The value figure for 1937 refers only to stone marketed in mill blocks or in the finished condition by the quarry companies, and does not include the value of the work done on the stone by cut-stone contractors. The limestone deposits now being worked for building stone are favourably situated with respect to centres of population, and the supply of stone is adequate for present and future demands.

There is very little trade in building stone between Canada and other countries. Exports are not separately recorded, but exports of all kinds of building stone, except granite and marble, had a value of only $16.383 in 1938. Imports of all varieties of building stone, excepting marble and granite, were valued at $34,754 in 1938, as compared with imports valued at $43,272 in 1937. The imported stone is mostly limestone.

Prices of limestone in the mill block f.o.b. quarry have remained almost stationary in recent years, and range from 50 cents to $1 per cubic foot, depending upon the size of block and the grade of stone.

LITHIUM MINERALS

The principal commercial ores of lithium are amblygonite, a fluophosphate of lithium and aluminium; spodumene, a silicate of these two elements; and lepidolite, or lithia mica, also a silicate. The lithia content of these minerals as mined commonly ranges from 8 to 9 per cent for amblygonite, 4 to 7 per cent of spodumene, and 3 to 5 per cent for lepidolite. Triphylite and lithiophilite, respectively iron and manganese phosphates of lithium, have a theoretical lithia content of from 8 to 9 per cent. They are classed as lithium ores, but are rarely found in commercial quantities, and may often have lost a large part of their original lithia by natural leaching.

All of the above minerals occur in Canada, but as yet production has been small, and has consisted chiefly of lepidolite and spodumene. All of the important deposits are in Manitoba, chiefly in the Pointe du Bois region in the southeastern part of the province, where a number of lithium-bearing pegmatites have been found. The original discovery was made on the Silver Leaf property on the south side of Winnipeg River in 1925, and mining and development work has been undertaken intermittently, chiefly on that property and on the Buck claims at Bernic Lake, between Winnipeg and Bird Rivers. Two trial carloads of spodumene and lepidolite were shipped from the Silver Leaf mine between 1925 and 1928.

At Bernic Lake in Manitoba, 100 tons of spodumene and 50 tons of amblygonite were mined and stock-piled in 1930. In 1936, Lithium Corporation of Canada which controls the deposits, diamond-drilled a number of pegmatite dykes, local zones in which are rich in amblygonite, spodumene, and lithiophilite. In the winter of 1936-37 the company raised 600 tons of rock from the Buck claim which yielded 50 tons of clean, cobbed amblygonite and 30 tons of mixed rock, which contained about 50 per cent amblygonite and small amounts of spodumene and triphylite. It shipped 32 tons of amblygonite, averaging 7·9 per cent to Maywood Chemical Company, Maywood, N.J., in 1937, and hauled out a slightly smaller tonnage to rail at Pointe du Bois. Lithium Corporation has acquired control of lithium deposits at Cat Lake, north of the Bird River, where important amounts of spodumene occur.

A deposit discovered in 1937 near Falcon Lake, 85 miles east of Winnipeg, and 1½ miles from a siding of the Greater Winnipeg Water District Railway, is stated to carry rich concentrations of spodumene. The claims, which are close to the highway, are controlled by R. T. Pickard, of Winnipeg. Some interest has been shown also in deposits of spodumene on the Kobar claims at Wekusko Lake, near Mile 81, on Hudson's Bay Railway, in northern Manitoba.

Lepidolite of doubtful commercial value occurs in small amounts in Wakefield Township, Hull County, Quebec, in the form of large platy crystals in a small pegmatite body. Samples of pegmatite sent to the Bureau of Mines from Lacorne Township, Abitibi County, in 1937 contained a considerable amount of spodumene.

No production of lithium minerals was reported in Canada in 1938. In 1937 the production was valued at $1,694.

The small shipments of lithium minerals from Canada have consisted chiefly of lepidolite and amblygonite which were exported to the United States, the former for use in the glass industry, and the latter for use in the manufacture of lithium chemicals. No exports were recorded in 1938, and there are no imports of such minerals. Trade reports do not show Canadian imports of lithium compounds separately.

Figures of world production of lithium minerals, exports, and trade, are not published. Most of the supply is from deposits in the United States, South West Africa, Germany, and France. Production of amblygonite in South West Africa has been increasing, and in 1938 amounted to 764 tons. Portugal was formerly an important source of the minerals but the output has shown a marked decline since 1933, when 870 tons was shipped. Germany's production consists of the mineral zinnwaldite, a variety of lithium mica which is obtained from the tin-bearing greisen rock of the Erzgebirge. Lithium ores are treated by a few important companies with plants in England, France, Germany, and the United States.

The active and potential world resources of lithium minerals, particularly of spodumene and lepidolite, are unquestionably very large and are widely distributed, and, if necessary, the production could be increased enormously. At present, however, world requirements amount to only a few thousand tons per year.

Experiments conducted in the laboratories of the United States Bureau of Mines show that spodumene can be recovered readily by a relatively simple and cheap process of calcination. On heating, the spodumene decrepitates to a fine powder which can be screened from the admixed impurities. This method has been tried in the laboratories of the Department of Mines and Resources at Ottawa on samples of spodumene from Manitoba with good results. One test made on a shipment from the Kobar claims, Wekusko Lake, yielded a concentrate with a Li_2O content of 6·13 per cent, the recovery being 90·44 per cent.

Lithium minerals have been used chiefly in the production of lithium chemicals and metal, and lepidolite is used also as a constituent of the batch in the manufacture of certain types of glass (Pyrex). The use of lithium in chemicals is comparatively small, but the world consumption of lithium salts is steady. Lithium chloride, one of the most hygroscopic inorganic compounds known, is being tried as a drying agent in air-conditioning. A method was recently devised by the United States Bureau of Mines for recovering the lithium of spodumene in the form of the chloride by volatilization from a charge of the mineral with calcium chloride and limestone. A process has recently been perfected for the making of lithium fluoride in the form of single crystals having valuable optical properties.

Spodumene may be classed as a lithium feldspar as it is relatively high in alumina (27 per cent) in comparison with potash feldspar. It is thus to be regarded as a possible substitute for the latter mineral in glass-making. It may also possibly find extended application in the pottery industry, both for bodies and glazes. The thermal expansion of natural spodumene has hitherto prevented its use in ceramics, but by the above-mentioned decrepitation process for recovering clean spodumene from mixed ore, the mineral is converted to the beta form, which undergoes no further expansion when fired. Use of this process, which recovers the spodumene as a fine powder, is expected to make available the large tonnages of low-grade mineral recently discovered in North Carolina, both for ceramic use and for the lithium chemicals trade by the chloride-volatilization method. The cost of producing the concentrate is estimated at from $10 to $12 per ton. It is reported that amblygonite also is attracting attention as a source of lithium for use in the manufacture of glass.

In August 1938, the recovery was commenced of lithia from the brine of Searle's Lake in California, in the form of lithium-sodium phosphate, containing 20 per cent and upwards of Li_2O. It is understood that the entire production is being shipped to Maywood Chemical Company, Maywood, N.J., the only enterprise in the United States engaged in the treatment of lithium minerals.

Some lepidolites, including that from the Silver Leaf deposit in Manitoba, contain important amounts of the rare elements rubidium and caesium, and methods of recovering these elements from lepidolite that has already been treated for the removal of its lithium content have been investigated.

The price of amblygonite, the most preferred mineral for the manufacture of lithium chemicals because of its relatively high Li_2O content, held between $35 and $40 per ton, f.o.b. American mines in 1938, about the same level as in 1937. Lepidolite sold at $20 to $25; and spodumene, 6 per cent grade, at $5 per unit Li_2O, or $30 per ton. Metallic lithium, 98 to 99 per cent, was quoted at $15 per pound.

MAGNESITE

No magnesite, within the strict meaning of the term, is produced in Canada at present, but deposits of magnesitic dolomite consisting of an intimate mixture of magnesite and dolomite are quarried at Kilmar and Harrington East, Argenteuil County, Quebec, and are processed for use as refractory materials. For many uses these magnesitic dolomite products have proved more suitable than have those made from magnesite, and the deposits are well situated to supply markets for refractory material in eastern Canada. Products at present marketed include caustic-calcined magnesitic dolomite, dead-burned or grain material, bricks and shapes (both burned and unburned), and finely ground refractory cements. In combination with chrome, the dead-burned material is used as an ingredient in certain other types of refractories. Magnesia products made in Canada from imported magnesite and magnesia include fused magnesia (artificial periclase), optical periclase, and "85 per cent magnesia" pipe covering. Further progress was made by Canadian Refractories, Limited in developing refractory products made from magnesitic dolomite.

Deposits of brucite-bearing limestone, recently discovered in Ontario and Quebec, were investigated further and a process of separating the brucite from the limestone was developed that gives hydrated lime as a by-product. Preliminary experiments indicate that the pure brucite recovered from these deposits will yield exceptionally high-grade refractory products and that it also possesses advantages over other materials for the making of metallic magnesium. The deposits are an important addition to the known Canadian resources of magnesium minerals, and plans are being made to work one of them in 1939.

Large deposits of magnesite, containing much silica and alumina occur near Marysville, in British Columbia, between Cranbrook and Kimberley, and have been acquired by Consolidated Mining and Smelting Company of Canada, Limited. Some development and experimental work has been undertaken but so far there has been no commercial production. A number of other deposits of magnesite are known in British Columbia and Yukon, but either because of their limited extent, or of their distance from transportation, they are not of commercial importance at present. Deposits of earthy hydromagnesite occur near Atlin and Clinton, in British Columbia, certain of which in past years were operated on a small scale, but there has been no production in recent years.

Calcined and clinkered magnesitic dolomite valued at $420.261 was marketed in 1938. Prior to 1938 production data published by the Dominion Bureau of Statistics included the value of manufactured products such as refractory bricks and similar materials, but present data show only the value of the calcined material sold, plus the cost value of the calcined magnesitic dolomite used for further manufacture by the producing company. Thus, no direct comparison can be made between the present production and that of 1937, which was valued at $677,207.

Magnesite is available in many countries, the principal exporting countries being Greece, Manchukuo, India, Yugoslavia, and Germany. The German exports originate in the former countries of Austria and Czechoslovakia. Russia is probably the world's greatest producer of magnesite, but almost all of the output is for domestic use. Holland has no deposits, but acts as an important distributing centre for Europe and for exports to the United States and Canada. For export, the magnesite is generally shipped in either the calcined or the dead-burned states.

Exports of magnesitic dolomite products from Canada in 1938 amounted to 3,971 tons, valued at $95,607, as compared with 2,028 tons, valued at $49,401 in 1937. Canada exports refractory products made from magnesitic dolomite to Australia, British South Africa, the United States, Great Britain, New Zealand, Hong Kong, Chile, and Norway. Imports of magnesite products, including brick, caustic and dead-burned magnesite, ground calcined magnesite, and magnesite pipe covering, were valued at $659,778 in 1938, as compared with $787,884 in 1937.

Magnesite is used chiefly for the making of refractory products that are intended to withstand extremely high temperatures; of oxychloride cement; and of magnesium metal. It is the basis of a number of magnesium salts, and has many minor uses. The world-wide demand for magnesium metal, which until three years ago was made almost entirely from magnesium chloride brine, and from waste water used in treating potash minerals, has greatly stimulated interest in magnesitic deposits, and magnesite is now an important source of this light metal.

Competing with magnesite as sources of magnesia products are dolomite, brucite, and sea-water. Dolomite, along with the newly discovered possibilities for the making of refractories, has long been the chief source of basic magnesium carbonate, pure magnesium oxide, and magnesium carbonate, and processes have been developed for the production of magnesium metal from it. Brucite is being quarried in the United States for the manufacture of refractories. The extraction of magnesia from sea-water has now reached the commercial stage in California and England, the material so obtained being marketed in various forms for industrial and pharmaceutical uses, and for use in refractory products.

There are no published quotations on Canadian magnesite or on its primary products, calcined and dead-burned magnesite, because very little is so marketed, but according to Oil, Paint & Drug Reporter, prices of magnesite products f.o.b. New York were as follows in March, 1939: Calcined, domestic, in bags, $56 to $60 per ton; calcined, imported, in barrels, $60 to $65. Prices f.o.b. United States plants as reported by Metal and Mineral Markets for March 30, 1939, are as follows: Per ton f.o.b. California, dead-burned $25; artificial periclase, 94 per cent MgO, $65; 90 per cent, $35; caustic, 95 per cent MgO, white colour, $40; 85 per cent MgO, no colour standard, $37.50. Washington: Dead-burned grain magnesite, $22.

MAGNESIUM SULPHATE

Natural hydrous magnesium sulphate (Epsom salts) occurs in deposits in lake bottoms and in brine lakes in British Columbia, while in Saskatchewan it is found associated with sodium sulphate. Attempts have been made to produce refined salts and there was a considerable production from several of the lakes in British Columbia a number of years ago. Experimental shipments were made also from one of the lakes in Saskatchewan.

The chief single source of output is a deposit at Basque, B.C., which supplies the raw material for a refining plant with a capacity of 10 tons of refined salt a day, owned and operated by Ashcroft Epsom Salts Company, Ashcroft, B.C.

Canada produced 470 tons of magnesium sulphate valued at $9,400 in 1938, as compared with 727 tons valued at $14,456 in 1937. Imports amounted to 1,803 tons valued at $33,018 in 1938, as compared with 1,678 tons valued at $33,116 in 1937.

Magnesium sulphate is marketed in two grades namely, technical and B.P. (practically chemically pure). The technical grade, which should be more than 90 per cent pure, is used chiefly in the tanning of leather, and to a smaller extent in the textile, paper, and enamelling industries, in fire-proofing compounds, and in the manufacture of paints and soaps. The B.P. product is used mostly in the drug trade. Although a large part of the Canadian output is of the technical grade, its purity is sufficiently high to meet pharmaceutical specifications.

Prices for Epsom salts remained steady throughout the year. Quotations for the technical grade, as given by Canadian Chemistry and Process Industries, for Toronto or Montreal delivery, ranged from $35 to $40 per ton in bags, while the B.P. material is quoted at from 2½ to 3 cents per pound in barrel lots.

MARBLE

Marble quarries are operated in Quebec, Ontario, Manitoba, and British Columbia for the production of squared blocks for sawing into slabs, and for the making of monuments, and also for the production of broken marble used in the making of terrazzo, stucco dash, whiting substitute, marble flour, artificial stone, and building rubble. Part of the output from some of the quarries is marketed for chemical use.

In Quebec black marble, and four varieties of clouded grey marble, some of which are tinted and lined with green, are quarried at Phillipsburg by Missisquoi Stone and Marble Company, Limited. Trenton limestone, quarried for building stone at St. Marc des Carrieres, took a good polish and yields a brown marble, and some is so used. Dolomitic marble is quarried and crushed by White Grit Company at Portage du Fort, Pontiac County, and by Canada Marble and Lime Company at L'Annonciation, Labelle County, for the making of terrazzo chips, stucco dash, poultry grit, artificial stone, and for chemical uses. A small quantity of dark red marble is quarried, chiefly for use as tombstones, at Cap St. Martin, near Montreal.

In Ontario black marble is quarried at St. Albert, near Ottawa, by Silvertone Black Marble Quarries, Limited. At Longford Mills, near Orillia, Longford Quarries, Limited is producing buff, brown, and silver-grey marbles, and the stone is used also for building and for sculpture. At Bancroft, Hastings County, a number of handsomely coloured marbles are available, the most striking of which, known as Bancroft Laurentian, is a clouded-grey breccia with a rich chocolate-coloured bond. White marble quarried at Marmora by Bonter Marble and Calcium Company, Limited, and at Haliburton by Bolender Brothers is used for terrazzo chips, poultry grit, stucco dash, and artificial stone. The former company also produces white marble in block form. Buff, red, white, green, and black marbles are quarried near Eldorado, Hasting County, for use as terrazzo.

In Manitoba a number of highly coloured marbles are available, but the production is small, and is for use as terrazzo chips and as building rubble. In Alberta, deposits of calcareous tufa near Calgary have been quarried for terrazzo chips. British Columbia possesses many deposits of marble, but the production is small. White marble is quarried near Victoria and on Texada Island for the production of terrazzo, poultry grit, marble sand, and whiting substitute.

Progress is being made in the finding of new ways of utilizing marble. Thin slabs of semi-translucent, light-coloured marble have been used in large windows of buildings such as railway stations, to give a soft, diffused light, free from the glare of direct sunlight. In England plastic rubber, in place of cement, has been used in the laying of jointless marble terrazzo floors to give a non-slippery, noiseless floor which is easily cleaned. Attention is being given to methods of treating polished marble surfaces so that the polish may be retained when the marble is exposed to the action of the weather; and processes involving the use of lacquers and synthetic varnishes have been patented. White marble sand is being produced for use in white cement mortar and for use with white cement in the making of permanent traffic markings. A promising field for the utilization of marble in lighting and decoration has been opened up by Vermont Marble Company's method of treating specially selected marble to bring out the translucence and beauty of the veining when either white or coloured lights are placed behind it. This company is also marketing an artificially coloured black marble.

Many deposits of beautifully coloured marbles, particularly in Ontario, Quebec, and British Columbia, have never been fully investigated, chiefly because the present demand in Canada for marble of any one colour other than for a staple variety such as white, is comparatively small. The demand for marble of a certain colour also changes from time to time, there being little call at present, for instance, for red and blue, while buff and black marbles are in vogue.

Canada produced 18,896 tons of marble valued at $85,194 in 1938, as compared with 21,642 tons valued at $88,595 in 1937.

Exports of marble are grouped with those of granite, the exports of both products during 1938 having amounted to 657 tons valued at $5,042, as compared with 1,234 tons valued at $11,408 in 1937. Imports of marble reached a value of $81,416 as compared with $89,263 in 1937. Current imports of marble are largely in the form of unpolished slabs and of sawn stock for tombstones, the finishing being done in the marble mills throughout Canada. Most of the imports of marble blocks are from the United States, France, Italy, Belgium, and Great Britain, though practically all of that coming from Great Britain originates in other European countries. Imports of black marble have practically ceased as the Canadian market is now being supplied from domestic quarries, principally from the black marble quarry at St. Albert.

The Canadian market calls for interior decorative marble almost entirely, as very little marble is used for the exteriors of buildings. A considerble quantity is used, however, for tombstones. There has been an increasing demand in recent years for marble in the form of terrazzo for flooring, instead of slabs or tiles, and many inquiries have reached the

Bureau of Mines as to where marbles of various colours can be obtained.

Prices of marble depend upon the quality and rareness of colouring, but they are governed largely by the prices of foreign marbles, many of which enjoy a world-wide market. The market for Canadian marbles is almost wholly domestic, and production therefore depends upon the extent of building activity in the Dominion.

MICA

The production of sheet mica in Canada has at all times been confined almost entirely to the phlogopite ("amber mica") variety, which is derived from adjacent parts of Ontario and Quebec, within an area extending roughly from Kingston, on Lake Ontario, northeastward into Hull and Papineau Counties, in Quebec. The mica-bearing series (pyroxenites) is probably continuous throughout this entire region, but is hidden for some distance south of the Ottawa River by a belt of later sedimentary rocks. In Quebec, the pyroxenites extend for some distance both west and east of the main productive area, into Pontiac and Argenteuil Counties, respectively, but production from these districts has been comparatively small. A few scattered deposits of amber mica are known to occur in the province as far east as Quebec City, but little mining has been carried out on them.

Production of muscovite (white mica) in Canada has been negligible. Small amounts have been recovered occasionally as a by-product from the mining of feldspar, but in general the proportion of sound, merchantable sheet mica in Canadian pegmatites has proved to be too low for the profitable mining of this mineral alone.

For the past several years mica mining in Canada has been restricted to a few major operators who have been working long established mines. Formerly farmers and others who worked small mines on their properties during the off-season made important contributions to the output. Some work was done on properties in Ontario and Quebec in 1938, but the production was small. Some white mica (muscovite) was sold during 1937-38 by small operators in the Saguenay region, lower St. Lawrence; and in Parry Sound District; and near Mazinaw Lake, Addington County, Ontario, the material in the last case having been recovered from old waste dumps. Some of the Saguenay mica was an excellent grade of ruby muscovite. A small amount of sheet black mica (biotite or lepidomelane) was produced in Faraday Township, near Bancroft, Ontario, from deposits opened several years ago as a source of grinding scrap for a mill (now inactive) at Bancroft. This mica occurs in very large crystals and considerable quantities are available, but its splitting quality is poor, and its iron content is high, and thus it would likely be unsuitable for use as an electrical insulator.

An unusual deposit of fine flake muscovite, or sericite, occurs at Baker Inlet, near Prince Rupert, B.C. It is controlled by P. M. Ray, Prince Rupert, who reports further development during 1938, and to date about 200 tons has been shipped to Vancouver for grinding and for use in roofing, the production in 1938 being about 50 tons. The ground product is stated to have sold for $32.50 per ton, f.o.b. Vancouver. Small trial shipments have also been made to the United States. Because of its friability and small particle size, it breaks down to a fine powder, with little destruction of the natural flakes. These flakes are relatively thicker and heavier than those produced by grinding sheet mica, and the use of this mica in the manufacture of roofing is stated to cut the dust loss of powder materially. A report on tests made in the Ore Dressing Laboratories at Ottawa on a shipment of crude mica from this occurrence has been published (Report No. 748, Investigation No. 606).

The mica-grinding plant at the Blackburn mine in Templeton Township, Quebec, continued to produce various grades (mesh-sizes) of ground amber mica from mine and shop scrap, but sales were reported to have been off slightly from those of 1937. The product is used chiefly in the domestic roofing and rubber trades. In a plant in Vancouver small amounts of scrap muscovite, imported from India, are ground for local use in roofing. Scrap mica and some small-sized sheet mica continue to be recovered from the waste dumps of old mines, and are exported to American grinding plants. Although many such old dumps have been worked over, much mine and shop waste still remains, as the price ($9 per ton f.o.b. rail) is not very attractive to possible shippers.

The production in Canada of the five leading mica products in 1937 and 1938 was as follows:—

—	1937		1938	
	Pounds	Value	Pounds	Value
		$		$
Knife-trimmed	203,961	66,852	83,043	46,177
Thumb-trimmed	173,519	11,826	1,380	731
Splittings	72,500	32,495	51,444	22,254
Rough-cobbed	106,917	12,090	....	....
Scrap	1,333,479	10,468	619,165	6,251
Total	1,890,376	133,731	755,032	75,413

In the new trade agreement which came into effect on January 1, 1939, the United States tariff on Canadian phlogopite was revised to some extent. The duty on untrimmed small sheet (yielding rectangular pieces not over 2 x 1 inches) was reduced from 15 per cent ad valorem to 10 per cent, and that on waste and scrap valued at not over 5 cents per pound was reduced from 25 per cent to 15 per cent. The duty on ground mica was reduced from 20 per cent to 15 per cent. Under the British preferential tariff, imports of mica and mica products into Canada are subject to a duty of 15 per cent ad valorem, the duty under both the intermediate and general tariffs being 25 per cent.

World production of mica of all classes and grades in 1937 amounted to about 42,000 long tons, included in which were about 25,000 tons of low-priced grinding scrap, and about 17,000 tons of sheet mica in various styles of trimming and splitting. By far the greater part of the world total was muscovite, as only Canada and Madagascar, which together produced

844 tons, are sources of phlogopite. Canada's share of the world production, although small, is important as the use of amber mica is preferred, if not indispensible for certain purposes.

Exports of mica of all classes from Canada in 1938 were valued at $89,259, as compared with $171,770 in 1937. Imports, which consist mainly of splittings, were valued at $86,803, as compared with $83,596 in 1937.

Sheet mica is used almost entirely as an electrical insulator. It is cut or punched into a great variety of shapes and sizes, and in the form of splittings, is bonded and pressed into large sheets which can be sawn, bored, and machined into any desired article. Some clear mica, mostly muscovite, is used as stove windows, and in lighting equipment. Mica is used in making heavy-duty spark plugs for airplanes, though a new ceramic product of equal efficiency is said to be replacing it. The recent discovery that films or plates having many of the desirable properties of mica, including comparable di-electric strength, can be made from colloidal dispersions of bentonite clay is possibly of importance to the mica industry. Commercial development of the product (Alsifilm) is now being planned, and a "synthetic mica" in sheets or rolls of any desired size and thickness may become possible by use of a low cost process similar to that employed in the making of paper.

Although by far the largest share of the world demand is for the muscovite variety, amber mica is essential for certain purposes, more especially where high heat-resistance is demanded. Canadian reserves of amber mica are still adequate to furnish important supplies, but the Canadian industry in recent years has suffered from the competition of the more cheaply produced Madagascar mica. However, the better grades of Canadian amber mica are considered to be superior, from the viewpoint of heat-resistance to much of the mica from Madagascar, and the improvement in trimming practice in Canada has resulted in a revival of interest among consumers in Britain in Canadian supplies of sheet mica for heaters, and for use in spark-plugs.

Fine flake or powdered mica has become an important industrial product, and is used mostly in the roofing and rubber trade. It is being used also in combination with resin varnishes as a coating for foodstuff cans, and as a base in cleanser compounds. As a protective inert pigment in paints, it is said to impart superior resistance to weathering, and also to corrosion by fumes and liquids. Large amounts of wet-ground muscovite mica are consumed in the manufacture of wall-paper and some is also used in a ceramic type of insulating material.

The demand for phlogopite mica, which showed an encouraging upward trend in 1937, remained rather dull throughout 1938, except for knife-trimmed larger sizes (2 x 4 inches, 3 x 5 inches, and upwards). An active demand for splittings was reported from Japan, but dealers reported business as slack and spasmodic, and trimming-shops were mostly on part-time operation. The larger producers operate their own mica shops, but there are several dealers who purchase rough-trimmed or mine-run mica from small operators, and trim, grade, and split it for sale either to other dealers and brokers, or to consumers. In small rural communities a considerable amount of this work, particularly splitting, is farmed out, the labour being performed mostly by girls who work at home on a piece-work basis.

Mica prices are difficult to ascertain, owing to a lack of reliable market quotations and to the system of trade discounts which prevail. As the price also varies with the quality, the only satisfactory method of getting information is to submit samples to an accredited dealer for a quotation. According to dealers' reports, general price averages in 1938 remained substantially unchanged from those of the previous year, the quotations being approximately as follows:

Knife-trimmed Sheet	Per Pound	*Splittings*	Per Pound
1 x 3 inches	$0.50	1 x 1 inch	$0.45
2 x 3 inches	0.75	1 x 2 inches	0.50
2 x 4 inches	1.00		
3 x 5 inches	1.75		
4 x 8 inches	2.25		
5 x 8 inches	3.00		

Ground mica (phlogopite) continued to sell as follows: 20 mesh, $25 per ton; 60 mesh, $30; 120 mesh, $45; all prices f.o.b. Ottawa, in ton lots.

Vermiculite. There are now four plants in Canada for the expanding by heat-processing of the hydrated variety of mica known as vermiculite. This mineral expands tremendously when heated, and yields an exceedingly light-weight product which is used widely for heat- and sound-insulation, and to some extent for decorative purposes. The three plants owned by Gypsum, Lime and Alabastine, Canada, Limited are in Calgary, Alta., Winnipeg, Man., and Paris, Ont. The other plant was built in Oshawa in 1937 by W. E. Phillips Company, and the expanded product is marketed by Dominion Insulation, Limited, Toronto. All four plants obtain their supply of crude vermiculite from a deposit at Libby, Montana.

As an illustration of the decorative properties of vermiculite, it may be noted that nearly 150 tons of it were used to impart a bright golden finish to the exterior stucco of the San Francisco 1939 World's Fair buildings.

Under the new Canadian–United States trade agreement imports of crude vermiculite from the latter country are subject to a 10 per cent ad valorem duty.

MOULDING SAND (NATURAL BONDED)

Natural bonded moulding sand is produced in every province except New Brunswick and Prince Edward Island. In New Brunswick one deposit was operated in 1918 and another in 1921 and 1922. Prince Edward Island also produced a small quantity of a grade suitable only for light-weight castings. By far the greater part of the Canadian production has come from Niagara Peninsula in Ontario. New deposits, most of them in Ontario and the western provinces, have been opened up occasionally.

A general investigation of moulding sands in Canada was made by the Department recently, the results of which were published in 1936 by the Bureau of Mines in a report (No. 767) entitled "Natural Bonded

Moulding Sands of Canada." The report directs attention to the large number of deposits from which supplies have been obtained for local foundries and to the probability of replacing imported material with Canadian sands.

Canada produced 16,000 tons of moulding sand valued at $15,500 in 1938, which compares with 26,000 tons valued at $26,000 in 1937.

It is estimated that 50 to 60 per cent of Canada's consumption of natural bonded moulding sand is imported, mostly from the United States. It and other sands and gravels enter the country duty free. Small quantities of moulding sands not shown in official records are produced in most of the provinces by foundrymen for their own use from nearby deposits, or by farmers and other part-time operators for local foundries. Silica sands without clay bond, used in steel foundries, are not included in the production figures. The industry gives only seasonal occupation to producers, as foundrymen usually obtain their supplies in the summer and autumn.

NEPHELINE SYENITE

Nepheline syenite is a comparatively new mineral commodity, its production and use on the American continent having commenced in 1936, when a quarry and processing plant were opened near Lakefield, Peterborough County, Ontario. Previously some interest had been shown in the industrial possibilities of a similar material occurring in Russia, where it is recovered as a by-product of phosphate (apatite) mining. The Russian syenite, however, is reported to contain the finely divided iron which cannot be removed by ordinary beneficiation methods, for use in white glass. The Canadian rock contains iron-bearing minerals, principally magnetite and biotite mica, but can be cleaned by a relatively cheap and simple process of magnetic separation of the crushed material, which yields a white product the iron content of which is well below that demanded by the glass trade.

Canadian Nepheline, Limited, which opened a quarry in 1936 at the west end of Blue Mountain, in Methuen Township, Peterborough County, Ontario, ships the rock to a small mill at Lakefield, 27 miles distant, for processing. Designed at first to supply material to the domestic glass trade, the operations were expanded in 1937-38 by the formation of a subsidiary, American Nepheline Corporation, which has erected a 200-ton daily capacity crushing and processing plant at Rochester, N.Y. The capacity of the Lakefield mill was increased in 1937 from 20 tons of finished product daily to 45 tons by the addition of a second magnetic separator and crushing equipment. The product made in both plants is a granular, minus 20-mesh material, consisting of a mixture of soda and potash feldspar and nepheline, which averages about 24 per cent of alumina and which contains only 0·07 per cent of Fe_2O_3.

In 1937, production of nepheline syenite was undertaken near Gooderham, Haliburton County, Ontario, where Messrs. Gooderham-Nepheline opened a large quarry from which nearly 4,000 tons of crude rock had been shipped by the close of 1938. In Dungannon Township two quarries have been operated by New England Nepheline Company, which by the end of 1938 had shipped 6,500 tons of rock to its mill at Keene, New Hampshire. The rock of the Gooderham deposit and of the Hennessey quarry, in Dungannon, is coarsely pegmatitic, consisting largely of straight nepheline, and is used, after processing, for blending with feldspar to raise the alumina content. Other nepheline outcrops in Dungannon Township were prospected during the year by various interests, but there were no important developments. A subsidiary of Messrs. M. J. O'Brien, Ottawa, which holds ground at the east end of the Blue Mountain syenite body in Methuen Township, 24 miles north of Havelock, proceeded with plans for opening a quarry and erecting a mill with a capacity of 10 tons of feed per hour, the output being intended for both domestic sale and export.

Reserves of nepheline syenite in the central Ontario region are undoubtedly large, the Blue Mountain occurrence alone being a massive body about 8 miles long and consisting in large part of such rock. Many smaller outcrops are known in the Bancroft and adjacent areas to the north.

Official figures of nepheline syenite production for 1938 are not available, but the output of quarry rock is estimated at about 40,000 tons, of which Canadian Nepheline, Limited produced about three-quarters. The value for the year was given at $142,737, as compared with $121,481 in 1937, and $37,426 in 1936. Most of the material produced in 1938 was shipped in the crude state to American mills, whereas previously a large part of the output had been processed in Canada. Since the completion of American Nepheline Corporation's large plant at Rochester, the output from the Lakefield mill of Canadian Nepheline, Limited, most of which was formerly exported, is now used mainly to supply domestic needs.

Aside from Russia, the production of which country is not known, Canada is the only known producer of nepheline syenite. Active search for similar deposits has been made in the United States, but although occurrences are known, the rock, like that in Russia, contains too much finely-divided and inseparable iron to be suitable for the manufacture of white glass. Rock of comparable high-alumina character, "aplite," which is also high in iron but which is regarded as suitable for coloured bottle glass, occurs in Virginia, and production of this material is now under way. Anorthosite, a similar type of rock, occurs abundantly in Quebec and could probably be produced in quantity if demand for the material should arise.

Exports of nepheline syenite (practically all crude rock) totalled 22,787 tons valued at $94,877 for the nine months ended December 1938, all of which was shipped to grinding and processing mills in the United States. Exports in 1937 and in the first three months of 1938 were included with feldspar. Nepheline syenite enters the United States under a special provision of the new trade agreement, effective January 1, 1939, which was made following representations by American feldspar producers, notably those in North Carolina, to Washington that imports of the material were likely to affect their business. Under the provision, crude rock has free entry, and the tariff on ground material is cut from the previous figure of 30 per cent ad valorem to 15 per cent. It is specified, however, that these conditions shall apply only to a total quantity not exceeding 50,000 long tons entered for consumption in any calendar year in any form, whether crude or ground, and that should this figure be exceeded, the rate of duty may be revised following consultation between the governments of the two countries.

So far, nepheline syenite is used in industry entirely for the manufacture of glass, for which it is preferred to straight feldspar because of its higher content of alumina (about 24 per cent as compared with 17 to 20 per cent in an average feldspar). One Canadian glass company now uses the material in all of its plants, and four American companies are stated to have substituted it for feldspar. It is claimed that 1,500 pounds of syenite will replace 2,000 pounds of spar in the glass batch on the basis of relative alumina content; and the slightly higher content of alkalis in syenite reduces fusion temperatures, with a consequent saving of fuel and longer tank life. Research is proceeding on the use of the material in other branches of ceramics, such as in the manufacture of sanitary ware, porcelains, and enamels.

The price of finished material, f.o.b. Lakefield, was $10 per ton up to October 1938, when it was advanced to $12. Material from the Rochester, N.Y., plant was quoted at $11 to $15.50 per ton, according to fineness.

PHOSPHATE

The only important known occurrences of phosphate rock in Canada are the Precambrian apatite deposits of the Ottawa-Kingston region, in Ontario and Quebec, and the rather low-grade sedimentary phosphate of the Crowsnest area, just west of the boundary between southern Alberta and British Columbia. A belt of such sedimentary rocks which extends along the Rocky Mountains divide for a considerable distance north of the International boundary, is probably, in part at least, a northerly extension of the richer phosphatic beds of Montana and Idaho. Prospecting has disclosed phosphate horizons at various points as far north as Jasper, Alberta, but in no case have the deposits given promise of being rich or extensive enough to work.

The production of apatite in Canada has been almost negligible for many years, with the exception of 1932, when there was a reported output of 1,316 tons from along the Lièvre River in Quebec. The apatite occurs in mica-bearing pyroxenites, and most of the small output of the past twenty years has been by-product material, recovered in the mining of mica (phlogopite). The apatite is sold mostly to Electric Reduction Company, at Buckingham, Quebec, for the production of phosphorus or phosphorus products. Purchases by the company amounted to only 100 tons in 1937, and to 200 tons in 1938, and in both years practically all of it was stock-piled material from the Blackburn mine in Templeton Township, Quebec. It had an average grade of 83 per cent, and a value of $8.90 per ton. Sales of apatite are usually based on a tricalcic phosphate content of 80 per cent, and there is a spread of about 10 cents per unit above or below this figure.

The sedimentary phosphate in the Crowsnest area was discovered about ten years ago as the result of extensive prospecting by Consolidated Mining and Smelting Company for phosphate rock to supply to its fertilizer plant at Trail, B.C. From two localities in the Crowsnest-Michel area several experimental shipments, totalling nearly 5,000 tons, were made to Trail, but the rock is low grade and so did not prove amenable to concentration. The company, accordingly, discontinued operations, and obtains its supplies mainly from Garrison, Montana. Shipments to Trail from its mine in Montana in 1938 amounted to 71,478 tons. Plants in eastern Canada which use phosphate rock for fertilizer and other purposes obtain their supplies mainly from Florida or Tennessee.

Canada produced (sales) 208 tons of phosphate apatite valued at $1,886 in 1938, as compared with 100 tons valued at $900 in 1937.

The world production of phosphate in 1936, the last year for which fairly complete statistics are available, totalled 11,100,000 tons, most of it sedimentary rock. Output from the United States, the leading producer amounted to 4¼ million tons in 1937, of which more than one million tons were exported. Russia was next on the list, with an output of more than 2 million tons, and was followed in order by the French North African possessions of Tunis and Morocco, each with close to 1½ million tons; Egypt and Algeria, each with more than ½ million tons; and the Pacific Islands of Nauru, Ocean, and Christmas, with a total of one million tons.

Imports of phosphate rock into Canada, almost all of which come from the United States, totalled 128,409 tons valued at $455,697 in 1938, as compared with 113,971 tons valued at $453,599 in 1937. Canada also imported 114,357 tons of superphosphate valued at $1,092,859, as compared with 100,726 tons valued at $952,775 in 1937. Phosphate rock enters Canada duty free. Superphosphate is free under the British preferential tariff, but is subject to ad valorem duties of 7½ per cent, and of 10 per cent respectively under the intermediate and the general tariffs. Superphosphate imports from the United States are subject to a duty of 5 per cent, provided that no restrictions are placed by that country on exports of either crude phosphate rock or superphosphate.

It seems doubtful whether any active revival in the mining of phosphate will occur in Canada, though the reserves of the mineral are probably large, particularly in the Templeton-Lièvre River area, in Quebec. Huge tonnages of apatite are being produced by the concentration of low-grade ores in the Murmansk region, in Russia, the principal world source of the mineral, and small amounts are also recovered in Virginia.

Growing interest has been shown in recent years in improved methods of treating crude phosphate rock for the extraction of its phosphoric acid content, and for the production of concentrated acid and compounds. In the United States attention is being given to the development of new fields of use of elemental phosphorus, and such research work is expected to bring about a large expansion in the phosphorus chemicals industry. The higher-strength superphosphates are now being made by the acidulation of rock with phosphoric acid rather than with sulphuric acid, and this, together with improvements in the removal of contaminating calcium sulphate from the product, has resulted in a large saving in the shipping costs. Production of concentrated phosphoric acids, containing up to 84 per cent of phosphorus pentoxide, from phosphate rock by electric furnace or blast furnace volatilization, in place of acid treatment, is now an established commercial practice.

Investigation of methods of handling phosphorus have shown that this dangerous product can, with proper care, be shipped in steel drums or tank cars without risk. Research on methods of rendering raw phosphate available as plant food by volatilizing the combined fluorine from fused rock, has shown that it is the fluorine which inhibits solubility in the soil. Removal of fluorine is required from acid phosphate which is to be used in stock feeds and food products, and the defluorination of fertilizer superphosphate is also desirable to prevent reversion to the citrate-insoluble form during curing and storage. At Consolidated Mining and Smelting Company's fertilizer plant at Trail the fluorine so removed is now recovered for use in the manufacture of hydrofluosilicic acid, which in turn is used in the electrolytic refining of lead. Thus the employment of fluorspar as a source of fluorine is dispensed with.

Although phosphate will continue to be used chiefly in the making of fertilizers, it seems likely that the use of phosphorus and its compounds will increase. An indication of this is the rapidly expanding use of trisodium phosphate, which is employed as a detergent in laundry work; as a general cleanser; in the prevention of scale on scum in boiler-feed and washing waters; and in the tanning, photographic, sugar, and other industries.

The price of Florida rock, 76 to 77 per cent grade, was $4.35 per long ton, f.o.b. mines, at the close of 1938, the laid-down cost at eastern Canadian points being about $8.50. These prices showed little or no change from those of **1937.**

PYRITES

Pyrites is produced in Canada as a by-product in the treatment of copper-pyrites ores at the Eustis and Aldermac mines in Quebec, and at the Britannia mine in British Columbia. No lump pyrites has been produced in Canada for a number of years.

In Quebec, Aldermac Copper Corporation, Limited, with a mine and concentrator 12 miles west of Noranda, is concentrating 1,000 tons of massive sulphides daily, from which is produced a copper, and a high-grade iron pyrites concentrate. The latter is being stock-piled. In the fall of 1938 the company started the construction of a plant for the production of sulphur and iron oxide, by use of the Westcott Process developed in an experimental plant at Niagara Falls, N.Y. The building will be capable of housing equipment sufficient for a daily production of 100 tons of sulphur. The first unit is to have a capacity of 50 tons of sulphur and 75 tons of iron oxide daily, and is to be equipped for the drying of the pyrites, and for the drying and preheating of the air used to oxidize the iron. Two rotary kilns and condensers for sulphur are to form part of the equipment. The plant is expected to be in operation in 1939, and when operating at its rated capacity, it will consume 250 tons of pyrites a day, the amount contained in the daily output of 500 tons of concentrate.

The Eustis mine, near Sherbrooke, continued to produce flotation pyrites concentrate, part of which is shipped to the United States, and part to Three Rivers, Quebec, where it is used in the Freeman flash-roasting plant. This plant in St. Lawrence Paper Mills Company's mill was in operation during most of the year. It supplies all of the sulphur dioxide and much of the steam required for the operation of the four standard newsprint machines. (The Freeman process of flash-roasting is designed to handle flotation fines recovered as a by-product in the treatment of copper ores. However, as ample supplies of pyrites fines are already available at strategic centres, the process will not necessarily stimulate the mining of such ores.)

In Ontario, Westario Sulphur Mines, Limited diamond-drilled a group of 26 claims, 1½ miles south of Hudson in the Kenora Mining Division. Matachewan Hub Pioneer Mines, Limited was reported to have a fairly large deposit of pyrites, assaying about 40 per cent sulphur, and 39 per cent iron, at its property in the Matachewan area, west of Elk Lake. In 1938 the company's staff was engaged entirely in testing, research, and experimental work. One unit of an experimental pilot plant was in operation in Toronto on a new process of sulphur recovery.

In British Columbia considerable quantities of pyrites are produced at the Britannia mine. Most the output is shipped to Japan, but some shipments were made in 1938 to France. Awaiting more favourable market conditions, the company has stored fairly large quantities of pyrites. Northern Pyrites' Ecstall pyrites property on Ecstall River, 60 miles south of Prince Rupert, has been under development for two years. The orebodies are reported to contain 5,000,000 tons of ore, averaging 49 per cent sulphur, 42 per cent iron, 2·3 per cent zinc, less than 1 per cent copper, and $1 a ton in gold and silver. Should the results of further development prove satisfactory, and should world markets be maintained, a large plant and a railway to tidewater would be required.

No separate records are available which show the quantity of pyrites produced in Canada. The estimated output from all sources (sulphur in pyrites, and sulphur recovered from smelter gases) was 112,395 tons valued at $1,081,647 in 1938, as compared with 130,913 tons valued at $1,154,992 in 1937.

The sulphur content of pyrites exported from Canada in 1938 amounted to 22,109 tons valued at $147,189, as compared with 46,317 tons valued at $251,834 in 1937. Canada exports a large quantity of pyrites to the United States, and in 1938 a few thousand tons were also exported to France. Exports to Japan ceased in the summer of 1938.

No imports of pyrites were recorded in 1938. Imports of sulphur and of sulphuric acid are given in the review on sulphur.

There appears to be no standard price in Canada for sulphur in pyrites, and most contracts are believed to be based on a price of 5 cents (or better) per unit (22·4 pounds) of sulphur per long ton, f.o.b. cars at point of production.

SALT

Common salt (sodium chloride) is obtained in two forms, namely, in solution in a brine from which the salt is extracted by evaporation, and in lump or solid form by direct mining. During 1938 salt was produced in southern Ontario; at Malagash, Nova Scotia; at Neepawa, Manitoba; and at McMurray, Alberta. In Ontario, Manitoba, and Alberta the salt is obtained from brine wells. At Malagash it is recovered by mining rock salt and by evaporating the brine produced by leaching the waste material in the mine.

In Nova Scotia, Malagash Salt Company's production was slightly lower than the record established in 1937. The company continued its extensive underground program by drilling, cross-cutting, and drifting. Work in progress suggests the possibility of finding workable bodies of some of the more valuable salts.

Production in Ontario was steady throughout the year, and all of the well-established plants were in operation. Canadian Industries, Limited made extensions to its buildings at Sandwich, Ontario, for the salt and chemical divisions. The company's new caustic soda-chlorine plant at Shawinigan Falls, Quebec, was placed into operation early in 1938, the salt for which is being supplied from the Sandwich deposits.

At Neepawa, Manitoba, Canadian Industries, Limited recovered the salt from brine by the grainer system, the product from which is passed through a copper-lined centrifuge and then bagged for shipment. Northern Salt Syndicate erected a small experimental open-pan salt plant, using wood for fuel, at salt springs located near the mouth of Red Deer River. The brine contains 5 per cent of total salts, and about 4 tons of salt a day are to be produced. Further drilling is contemplated, and a new company, Northern Salt Company, Limited, is being incorporated.

At McMurray, Alberta, Industrial Minerals, Limited (Dominion Tar and Chemical Company) operated its three-pan salt plant throughout the year. The company erected a temporary rotary dryer late in the fall, and intends to drill two new exploratory wells, one of which will later be conditioned for a second production well.

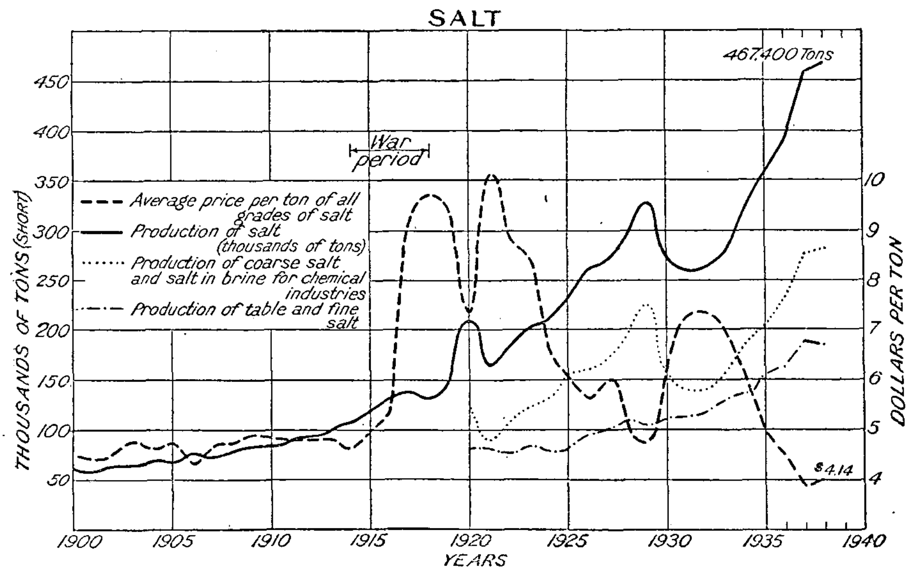
In New Brunswick, further information was obtained as to the extent of the salt basin discovered in 1921 in the vicinity of Gauvreau, south of Moncton, when New Brunswick Gas and Oilfields, Limited penetrated more than 1,500 feet of salt formation at Weldon on the west side of Petitcodiac River. Salt had been encountered previously in another drill hole on the west side of the river, the discovery in 1921 having been made on the east side.

In Nova Scotia a well drilled near Amherst, Cumberland County, by Imperial Oil, Limited, a number of years ago in a search for oil and gas, penetrated 3,200 feet of alternating beds of salt, anhydrite, dolomite, limestone, and shale, of which about 1,440 feet represented the total thickness of salt beds. The salt was encountered a depth of 920 feet, and one 480-foot bed has a sodium chloride content of more than 90 per cent. The apparent great thickness of salt may be due to the dip of the beds.

Canada produced a record total of 468,717 tons of salt valued at $1,941,585 in 1938, which compares with 458,957 tons valued at $1,799,465 in 1937. Sales of salt in Canada have been increasing steadily during the past several years.

The world production of salt amounted to 35,000,000 long tons in 1937, the latest year for which figures are available. Of this total, the British Empire contributed 5,800,000 long tons. Canada in that year was the third greatest producer in the Empire, its output having been exceeded by that of Great Britain and India. The Dominion, however, produces only slightly more than 1 per cent of the world output, and about 7 per cent of that of the Empire.

Canada exported 11,844 tons of salt valued at $68,293 in 1938, as compared with 9,329 tons valued at $61,522 in 1937. Imports amounted to 108,133 tons valued at $453,765, as compared with 116,459 tons valued at $466,190 in 1937. Most of the salt imported is for use in the fisheries of the Atlantic and Pacific coasts for which purpose it enters the country free of duty.



Salt production and price trends in Canada, 1900-1938.

The production, except for small quantities exported, is sold in Canada, principally for use in the chemical, dairy, meat curing, canning, and fisheries industries; as a stabilizer for soils on highways; and as table salt.

Soil stabilization with salt and clay for the foundations of highways and for a surface veneer for gravel roads is now firmly established and the use of salt for this purpose is steadily increasing. An interesting development of soil stabilization is seen in its application for runway bases at the airports of the Trans-Canada Air Lines. Salt-stabilized runway bases have been or are being installed at Edmonton, Calgary, Pagwa, Earlton, North Bay, and elsewhere.

An increasing demand in Canada for salt for use in the chemical industries may be expected, as at present, with the exceptions of caustic soda, soda ash, sodium sulphate, sodium silicate and acid sodium sulphate, practically all of the sodium compounds used in the Dominion are imported.

According to the Canadian Chemistry and Process Industries (Toronto), prices for the several grades of salt continued steady, until October, when they showed increases ranging from 4½ to 18 per cent according to grade. Quotations at the end of 1938 were as follows: specially purified (99·9 per cent NaCl) salt in 280-pound barrels f.o.b. plant, $2.65 per barrel; industrial fine salt in bulk car lots f.o.b. plant, $5.60 per ton, and industrial coarse $7.60 per ton.

SAND AND GRAVEL

Deposits of sand and gravel are abundant throughout eastern Canada, with the exception of Prince Edward Island, where gravels are scarce. Owing to the widespread occurrence of gravels and sands and to their bulk in relation to their value, local needs are usually supplied from the nearest deposits, as the cost to the consumer is governed largely by the length of haul; hence, the large number of small pits and the comparative scarcity of large plants. Some grades of sand which are particularly suitable for certain industries command a much higher price than does ordinary sand.

Canada produced 30,557,306 tons of sand and gravel valued at $11,113,723 in 1938, as compared with 27,001,300 tons valued at $10,492,696 in 1937.

Output by Provinces

—	1937		1938	
	Tons	Value	Tons	Value
		$		$
Nova Scotia	2,992,429	1,457,266	2,120,378	1,021,290
Prince Edward Island	....	....	....	....
New Brunswick	1,136,013	715,652	3,883,950	1,832,273
Quebec	9,476,000	2,637,495	11,710,281	3,180,199
Ontario	8,832,526	3,613,854	8,221,593	2,808,262
Manitoba	1,380,957	551,464	1,411,827	558,642
Saskatchewan	822,447	470,343	767,284	454,122
Alberta	711,966	312,687	803,907	524,240
British Columbia	1,648,963	733,935	1,638,086	734,695

Most of the output of sand and gravel is used in the improvement of roads, in concrete constructions, and as railway ballast. Gravel in particular has proved suitable for the building of all-weather roads at low cost, and its use has increased steadily with the growth of motor traffic. In Ontario, half of the gravel and sand consumed in 1937 was used in the construction and maintenance of roads, the proportion for the other provinces having been still higher.

Most of the gravel used for road work comes from pits that are worked for that purpose. Usually, enough gravel is extracted by a portable or semi-portable plant to supply the immediate needs, following which a sufficient reserve is built up, in the form of stock piles, for two years' requirements. Thus, the output of gravel from year to year depends upon the extent of road construction and improvements. Railway pits may also remain idle for several years.

Part of the gravel used is crushed, screened, and in some cases even washed, and the percentage thus processed is increasing steadily. Some provincial highway departments have been using crushed instead of pit-run gravel on their main highways for a number of years. Most of the large commercial plants are equipped to produce crushed gravel, a product that can compete with crushed stone.

Sand is used chiefly in the building industry, for which purpose it must be free from dust, loam, organic matter, or clay, and contain but little silt. It is usually obtained from local deposits.

Special grades of sand are used in foundries for moulding, in the filtering of water supply, and in glass-making.

Prices per ton of sand, gravel, and crushed stone in the four largest cities in Canada were as follows, at the end of 1937 and 1938. The prices do not include cost of delivery, except in the case of Winnipeg.

—	Montreal		Toronto		Winnipeg		Vancouver	
	1937	1938	1937	1938	1937	1938	1937	1938
	$	$	$	$	$	$	$	$
Sand	1·25	1·25	1·00	1·00	1·50	1·35	1·40	1·40
Screened gravel, ⅜ inch	......	......	1·85	1·85	1·50	......	1·40	1·40
Screened gravel, ¾ inch	......	......	1·75	1·75	1·50	1·50	1·40	1·40
Pit-run gravel	......	......	1·50	1·50	1·50	1·05	1·40	1·40
Crushed stone, ⅝ inch and under	1·10	1·00	1·85	1·85	2·50	2·25	2·00	2·00
Crushed stone, ¾ inch and over	1·15	0·85	1·75	1·75	2·50	2·25	2·00	2·00
Screenings (under $\frac{3}{16}$ inch)	1·00	0·40	1·50	1·50	2·50	2·25	......	......

SILICA

The materials produced are quartz for use as a smelter flux and in the making of ferrosilicon; quartzite for ferrosilicon, silica brick, and as a smelter flux; silica sand for use in the manufacture of glass, carborundum, sodium silicate, etc., and for use also in sandblasting, roofing, and in steel foundries; and silex, the finely pulverized silica used in the ceramics and paint industries. Quartz is produced in Quebec and Ontario; quartzite in Nova Scotia, Quebec, Ontario, Manitoba, and British Columbia; and silica sand in Nova Scotia, Quebec, and Manitoba. Silex is prepared in Quebec.

Quartz, quartzite, and sandstone are used in sizes from ½ inch to 6 inches in the manufacture of ferrosilicon and pure silicon. Some quartz is also crushed to make silica sand. For its use in the manufacture of silica brick, quartzite is crushed to about 8 mesh. Silica sand is being used to an increasing extent in Canada for sandblasting, and for this and other purposes it is generally prepared from a friable sandstone by crushing, washing, drying, and screening to recover different grades of material. In the manufacture of glass the material should range from between 20 and 100 mesh. Silica sand is also prepared from a friable quartz, and from vein quartz. For use in the manufacture of glass and of silicate of soda, silica sand must be of a high degree of purity and uniformity, and Canadian producers must, accordingly, continue to adhere rigidly to specifications and to guarantee regularity of shipments. Silex is the washed sand or pure quartz that has been crushed and ground in some form of mill, and then either air- or water-floated to recover the fine flour. The ceramic industry requires 150 mesh or finer, while the paint industry requires air-floated material, 250 mesh or finer.

In Nova Scotia, the deposit of silica sand near River Denys, Inverness County, was inactive in 1938. The sand is of good quality and is suitable for a number of uses and should find a ready market in the Maritime Provinces, especially in the steel foundries.

In Quebec, Ottawa Silica and Sandstone Company, Templeton, Quebec, produced sand of different grades for steel foundries, the glass industry, for sandblasting, etc. The company's production, however, was slightly lower than in 1937. Canadian Kaolin Silica Products, Limited made regular shipments of silica sand from its property at Lac Remi, Papineau County, mostly to manufacturers of glass and to other companies in the Montreal district. Its re-built concentration mill has a capacity of 500 tons per day. A large part of the output consists of sandblasting materials, and other abrasives.

Canada China Clay Company, at Lac Remi, has sunk a shaft to a depth of over 300 feet, and has carried out an extensive development program on the 250-foot level. The company has erected two large mill buildings, one for the preparation of clay, and the other to house equipment for the production of silica sand. The output is to consist of china clay and high-grade silica sand. H. C. F. Sands, Limited, New Liskeard, Ontario, did not operate its property at Guigues, Temiscamingue County, in 1938. Canadian Flint and Spar Company, with a crushing plant at Buckingham, Quebec, produced a small tonnage of high-grade quartz which was used as an abrasive. Most of the silica sand produced by Canadian Carborundum Company at St. Canute was used by the company for the manufacture of carborundum at its plant at Shawinigan Falls. St. Lawrence Alloys, Limited used sandstone from Melocheville, Quebec, in the production of several grades of ferrosilicon and of metallic silicon in electric furnaces at Beauharnois. The sandstone is trucked the 2 miles from the quarry to the plant where it is crushed to pass a 3-inch screen and to be retained on a ⅝-inch screen. The silicon is marketed mainly in Canada, and the ferrosilicon both in Canada and abroad.

Appreciable quantities of ferrosilicon low in silicon are produced by two companies at Niagara Falls, one at Chippawa, and one at Thorold, in Ontario, and by one company at Arvida in Quebec as a by-product in the manufacture of aluminous abrasive, the silica being present in the bauxite used by the five companies.

Silica used as a flux is in most cases obtained from the nearest possible source, and in many cases the smelting companies prefer a siliceous ore containing small amounts of the precious metals. The nature of the silica used in the manufacture of ferrosilicon and silica brick depends upon the use made of the finished product.

The demand for high-grade silica sand was steady in 1938 and although appreciable quantities of Belgian sand are still being shipped to Montreal as ballast, and hence at a comparatively low cost, Canadian producers continue to make headway. Interest in the development of silica deposits is active and in western Canada concerted efforts are being made to find high-grade deposits that are strategically situated to supply the western markets. Practically all of the silica used west of Winnipeg is imported. Encouraging results are being obtained in the search for high-grade quartz or quartz crystals suitable for the manufacture of fused silica ware. There is a good demand also for high-grade quartz crystals from which plates could be cut for use in radio work.

Canada produced 1,470,991 tons of quartz and silica sand valued at $993,460 in 1938, as compared with 1,377,448 tons valued at $1,129,011 in 1937. A total of 1,788 M silica brick valued at $100,403 were also produced, as compared with 3,744 M valued at $181,126 in 1937. No exports of silica or silica products were recorded in 1938. Imports of the various grades of silica amounted to 176,507 tons with a value of $436,481, as compared with 221,331 tons valued at $522,296 in 1937. Imports of silica brick in 1938 were valued at $240,184, as compared with $539,253 in 1937.

The price per ton of the several grades of silica varies greatly, depending upon the purity of the silica and upon the purpose for which it is to be used. Silica generally is a low-priced commodity, and hence the location of a deposit with respect to markets is of great importance. Silica is marketed chiefly in Quebec and Ontario, and any new deposits that may be opened should be within economic reach of either Toronto or Montreal. In western Canada the main markets are in Alberta and Manitoba.

SODIUM CARBONATE (NATURAL)

Deposits of natural sodium carbonate in the form of "natron" (sodium carbonate with 10 molecules of water) and also as brine occur in a number of "lakes" in the central part of British Columbia, chiefly in the vicinity of 70 Mile House, Clinton Mining Division, and in the neighbourhood of Kamloops. Several of these deposits have been operated intermittently on a small scale since 1921, the product being marketed in Vancouver for use in soap manufacture.

Production in Canada in 1938 amounted to 252 tons valued at $2,268, as compared with 286 tons valued at $2,574 in 1937. All shipments in 1938 were made from the Clinton area. Imports of soda ash, or barilla, totalled 1,454 tons valued at $41,831, as compared with 5,051 tons valued at $113,219 in 1937.

Sodium carbonate, or soda ash, has many industrial uses, but is used chiefly in the manufacture of glass, soap, and in the purification of oils.

SODIUM SULPHATE (NATURAL)

(Glauber's Salt and Salt Cake)

Canada produces both hydrated sodium sulphate, known as Glauber's salt, and anhydrous sodium sulphate, known to the trade as "salt cake." The former occurs as crystals (Glauber's salt), and the latter in the form of partly saturated or saturated brines in many lakes throughout western Canada, where the operating plants are now capable of producing more than 800 tons of dried salts a day. Except for an output of 64 tons from a deposit in Alberta, Canada's entire output of sodium sulphate comes from Saskatchewan, the principal producers in 1938 being Natural Sodium Products, Limited, Horseshoe Lake Mining Company, and Midwest Chemical Company, their respective operations being located at Bishopric, Ormiston, and Palo, Saskatchewan.

Investigations by the Bureau of Mines of sodium sulphate deposits, which were commenced in 1921, have shown the presence of more than 120,000,000 tons of hydrous salts in the few deposits which have been examined in detail.

Natural Sodium Products' sodium sulphate plant now contains five drying units (direct oil-fired rotary kilns) and has a capacity of about 400 tons per 24 hours. Horseshoe Lake Mining Company made extensive alterations to its productive facilities in 1938, including the erection of a dehydrating plant, and the process now in use is essentially the same as the direct-fired rotary kiln process used in other plants in the province. The two kilns are each 110 feet long by 8 feet in diameter, and are heated by coal-fired furnaces which use Estevan lignite, and which are equipped with travelling chain grate stokers. The new plant is stated to have a capacity of 200 tons of dried salts per 24 hours.

Sodium Corporation at Alsask, Saskatchewan, was idle throughout the year, but a few tons were produced for local consumption by a party who has a lease on a small portion of the company's deposit.

Midwest Chemical Company's property in the central part of Whiteshore Lake was in steady operation until October 9, when the plant was destroyed by fire. The new plant is located about one mile east of the old plant. A bay of Whiteshore Lake has been dammed to form a reservoir of 23 acres, where the brine can crystallize and where pure Glauber's salt will be available adjacent to the new plant. The magnesium sulphate will remain in the brine and will be drained into the lake. Each of the three new rotary dryers are 80 feet in length; two of them are 8 feet in diameter, and the other, 6 feet. Either coal or oil can be used as fuel. A capacity of 200 tons of dried salts per day is expected.

Oban Salt Company's plant at Oban, Saskatchewan, was closed during the year pending the consideration of plans for increasing its capacity to 50 tons per day.

Muskiki Sulphates, Limited, which holds leases on Muskiki Lake, 60 miles east of Saskatoon, has erected a 20-ton experimental plant designed to recover anhydrous sodium sulphate from brines formed by dissolving Glauber's salt crystals in their own water of crystallization. The precipitated salts are removed continuously from the brine by a screw conveyer, following which they are thoroughly agitated in a salt basket from which spent brine is removed, and they are then passed through a steam-jacketed centrifuge. The company produced no sodium sulphate in 1938.

The 64 tons of crude Glauber's salt produced in Alberta came from small deposits east of Cereal and was used within the province to supply cattle licks.

No production was reported from British Columbia in 1938, but in a number of deposits sodium sulphate is the predominant salt, and during the past year several of these deposits were prospected.

New Brunswick Gas and Oilfields, Limited, in drilling for gas at Weldon in New Brunswick, has proved the existence of large thicknesses of rock salt (sodium chloride). Two drill holes, 3,500 feet apart, from which cores have been obtained, have shown the presence of a bed of glauberite (Na_2SO_4 $CaSO_4$) from 60 to 100 feet in thickness, with a sodium sulphate content of from 25 to 30 per cent. The bed mostly overlies the rock salt and it is probable that the deposits contain many millions of tons of sodium sulphate. Further exploratory drilling and experimental work is to be carried out in 1939. The Bureau of Mines at Ottawa has investigated the material recovered in the cores, and a probable method of recovery of the sodium sulphate has been found.

Canada produced 62,849 tons of sodium sulphate valued at $551,210 in 1938, as compared with 79,884 tons valued at $618,028 in 1937. The decrease in the production was due partly to the fact that two plants were closed down during the producing season, and partly to the destruction by fire of one plant at the height of its activity.

No complete figures for the world production of salt cake are available, and it is difficult to compare the returns from different countries as the production comes both from chemical plants and from natural deposits. Germany is probably the leading producer of salt cake, while Canada, however, is also an important producer.

SULPHUR

Sulphur occurs in combination with copper, lead, zinc, nickel, or iron in many base metal ore-bodies in various parts of Canada. No deposits of elemental sulphur of commercial grade have been found in the Dominion.

Two Canadian companies, namely, Consolidated Mining and Smelting Company, at Trail, British Columbia, and Canadian Industries, Limited, at Copper Cliff, are manufacturing sulphuric acid direct from sulphur dioxide recovered from smelter gases that were formerly wasted. The former company recovers the sulphur dioxide from its own smelter gases, and has a plant with a capacity of 600 tons of sulphuric acid a day. The latter company uses sulphur dioxide recovered from International Nickel Company's smelter gases, and has a plant with a capacity of 150 tons of sulphuric acid a day. Some of the acid made at Trail is marketed, but most of it is used by the company, chiefly in the manufacture of fertilizers. The acid made at Copper Cliff is sold for use in various iudustries. Consolidated Mining and Smelting Company also recovers elemental sulphur from its smelter gases. The plant, which entered production in 1936, has a capacity of 150 tons a day.

In Quebec, Aldermac Copper Corporation, Limited is concentrating 1,000 tons of massive sulphides daily at its property 12 miles west of Rouyn, from which a copper concentrate and a high-grade iron pyrites concentrate are being produced. The latter is being stock-piled. (For information on the company's plant which is being erected for the production of sulphur and of iron oxide see review on pyrites.)

Canada's production of sulphur, including elemental sulphur and the sulphur content of sulphuric acid and of pyrites, amounted to 112,395 tons valued at $1,081,647 in 1938, as compared with 130,913 tons valued at $1,154,992 in 1937.

Imports of sulphur in all forms amounted to 93,697 tons valued at $1,471,741, as compared with 225,684 tons valued at $3,669,082 in 1937. Imports of sulphuric acid amounted to 95 tons valued at $10,944, as compared with 108 tons valued at $12,437 in 1937.

Exports were as follows: pyrites (sulphur content), 22,109 tons valued at $145,189, as compared with 46,317 tons valued at $251,834 in 1937; sulphuric acid, 1,260 tons valued at $17,900, as compared with 1,608 tons valued at $20,276 in 1937. No exports of elemental sulphur are recorded.

Sulphur is used chiefly in Canada in the production of sulphite pulp, which in turn is used for the making of artificial silk and of newsprint. Important quantities of sulphur are used also in the manufacture of sulphuric acid, explosives, rubber, and fertilizers.

Sulphur was quoted at $16 per long ton, f.o.b. cars at the mines in 1938. Prices at consumers' plants in Canada vary according to location, the variation being due to transportation costs.

TALC AND SOAPSTONE

Records of talc production in Canada date back to 1886, between which year and 1905 there was a small annual output, most of it low-grade material from deposits in the Eastern Townships of Quebec, and part of it from Nova Scotia and Ontario. In 1906 active development of a deposit of high-grade white talc in the Madoc district, Ontario, was commenced and since that year this area has been the chief contributor to Canada's output of talc. Small amounts of talc have been produced intermittently in recent years from deposits in British Columbia, and there is a small output from Quebec, which province since 1922 has also recorded a small annual output of soapstone.

The talc of the Madoc area is of the foliated variety, has a good white colour, and occurs as a series of vertical veins or bands in white, crystalline dolomite. A successful process for separating talc from a talc-magnesite ore by flotation has been developed by the United States Bureau of Mines, and flotation should be applicable to the beneficiation of the Madoc dolomite-talc. The pure talc possesses fine white colour and good slip, and the removal of dolomite might enable it to compete in the higher-priced field with imported talc used for cosmetic and other purposes. The two producing properties in the area are being operated by Canada Talc, Limited, and the mill output is marketed in six grades according to purity and fineness. The products are used chiefly in the textile, cosmetic, rubber, paper, and roofing industries in Canada and the United States, and some of them are exported to Great Britain. The annual production from the Madoc area in recent years has averaged about 12,000 to 15,000 tons.

Madoc Talc and Mining Company, Trenton, continued the development of a body of talc in Cashel Township, Hastings County. The ore is a grey talc, partly soapstone in character. Plans call for a grinding plant at Trenton. No further development was reported on the Bell soapstone property in Pakenham Township, Lanark County, Ontario.

In Quebec small amounts of talc, including ground soapstone and soapstone sawing dust, are produced in the Broughton-Thetford Mines district, Eastern Townships. The talc occurs in the form of narrow seams or veins which traverse the soapstone bodies, and as bands bordering the latter. Part of it, along with soapstone quarry and sawing waste, is ground in small mills at the mines, and some of it is also shipped to the grinding plant of Pulverized Products, Limited, at Montreal. A large part of the output is used in the roofing and rubber industries, which also consume most of the soapstone sawing dust.

Broughton Soapstone Quarry Company, the largest of the four operators in Quebec, produced intermittently during 1938, and supplied sawn blocks and bricks for the pulp-mills. The company is the first Canadian producer of soapstone, and has been in operation in the Broughton district since 1922. Shipments are made as far west as Dryden in western Ontario, but most of the output is used in mills in Quebec. Along with furnace stone, the company has fashioned soapstone monuments, stoves, mantels, slabs and other interior trim, and a variety of turned ornamental objects and crayons. The capacity of its grinding mill was increased considerably during the year. L. C. Pharo, Charles Fortin, and Louis Cyr also produced soapstone intermittently in 1938, the first two in Thetford Township, and the latter in Leeds Township. All three have been in operation since 1935.

The soapstone of the Thetford district occurs as a persistent band or belt which traverses the hilly country north of the valley of the Quebec Central Railway, and outcrops are frequent along the flanks and upper levels of the ridges. The stone varies in character from fairly coarse-grained rock to fissile talc schist, and averages 180 pounds to the cubic foot. The schist variety is the purer stone, and yields a fine grade of off-colour talc powder—substantially carbonate. It is grit-free and possesses high slip, but it is prone to spall in cutting and handling, for which reason the granular stone is preferred for sawn shapes. As the result of the introduction of a new type of water-cooled alkali-recovery furnace, sales of domestic soapstone have shown a considerable decrease in the past few years and the price of cut stone has decreased to about $2 a cubic foot, which is only half the former price.

Further progress was made by Baker Mining and Milling Company, Montreal, in the development of a talc deposit near Highwater, in Potton Township, Brome County, Quebec. The new mill has a capacity of 5 tons of finished product per hour.

In British Columbia the ground grey talc produced is used chiefly in the local roofing industry. The material comes from near McGillivray

Falls (Anderson Lake) on the Pacific Great Eastern Railway, and from Wolfe Creek, near Sooke, on Vancouver Island. The talc from Anderson Lake is shipped to Vancouver for grinding, and that from Sooke is ground at the mine. Both mines were inactive in 1937 and 1938.

Canada produced 10,853 tons of ground talc valued at $109,810 in 1938, as compared with 12,457 tons valued at $123,301 in 1937. The output of soapstone in 1938 was valued at $35,038, as compared with $40,513 in 1937. The figures include sawn stone, and quarry and sawing waste sold for grinding, along with a small amount of sawdust from the cutting plants. With the exception of a shipment of 1,000 cubic feet to Australia in 1937, the entire output of cut soapstone blocks and bricks is used in Canada chiefly in kraft mills.

The Dominion exported 6,952 tons of talc valued at $70,742 in 1938, as compared with 8,698 tons valued at $85,953 in 1937. Imports totalled 2,647 tons valued at $40,386, as compared with 3,184 tons valued at $48,079 in 1937.

In the Canada-United States trade agreement which came into effect on January 1, 1939, ground talc, steatite, or soapstone valued at $14 or less a long ton, is subject to an ad valorem duty of 17½ per cent on entering the United States. Previously, that country levied a duty of 25 per cent on material valued at $12.50 or less a ton. On products valued above $14 per ton, the duty remains at 35 per cent. Crude mineral is subject to a duty of ¼ cent per pound, while the duty on cut soapstone or talc, in the form of bricks, crayons, blanks, etc., is 1 cent per pound. Under the British preferential tariff, talc, ground or unground, entering Canada is subject to a duty of 15 per cent ad valorem, while under the intermediate and general tariffs, the duty is 25 per cent.

World production of talc in 1937 amounted to about 500,000 long tons. In the United States, the leading producer, the output amounted to 200,000 long tons. Manchuria was next with 100,000 tons, and was followed in order by France and Italy, each of which produced 5,000 tons. Canada held eighth position in 1937, but her output was less than 3 per cent of the world total.

No new industrial outlets of importance for talc were developed during the year, but world production and consumption have been showing a steady increase. In the United States the amount of talc used in the ceramic industry has shown a considerable increase in recent years. Ground talc, including soapstone, is used mainly in the paint, paper, rubber, and roofing industries, and large quantities are used also in the textile (bleachery) and cordage industries. Talc is also used in foundry facings, lubricants, concrete mixtures, plasters, insecticides, and for a wide variety of minor industrial purposes, including the polishing of rice and other grains, glass, and turned wooden articles. The finest grades are used extensively in cosmetic products of all kinds, notably talcum powder.

So many grades of ground talc are on the market that prices range between wide limits. The price is largely dependent upon purity (governed by freedom from grit and slip), colour, particle shape, and fineness of grinding, the specifications for which vary in the different consuming industries. The cheaper, impure, grey talcs (in part soapstone) sold in Canada in 1938 at from $5.50 to $7 per ton, f.o.b. mills, depending on fineness, which commonly ranges from 80 mesh to 150 mesh. These grades are used mainly in the roofing and rubber industries. Quotations for white, foliated talc from the Madoc district were $30 and $17 for the two best grades, and $12 to $8 for the four lower grades. Imported superfine Italian talc, cosmetic grade, sells at $80 to $100 per ton, eastern points.

The average value of all grades of ground talc (including soapstone) produced in the United States in 1937 was slightly in excess of $11 per ton. In February 1939, trade journal quotations on individual grades ranged from $6 to $14 for the cheaper grey talcs from Georgia and Vermont; $14 to $17 for 325-mesh, fibrous, white talc from New York; and from $17 to $20 for the high-grade white talc from California, all f.o.b. mills. Imported French talc is quoted at $23 to $60, according to quality, and Italian talc (cosmetic grade) at $60 to $67, ex dock, New York.

The Dominion Bureau of Statistics advise that the roofing industry consumed 2,696 tons of talc (including ground soapstone) in 1937. The paint industry, which was next in order, used 2,063 tons, while the pulp and paper industry used 865 tons. A total of 400 tons was used in toilet preparations and of 151 tons in soaps and cleansers. Large quantities are used also in the rubber industry, but the figures are not available.

Pyrophyllite. Pyrophyllite (hydrous silicate of alumina) closely resembles talc in appearance and physical character, and it can be used for the same purposes as talc in many instances. It is far less common than talc and commercial deposits of it are relatively scarce. Most of the world production is obtained from North Carolina and a large part of the output is used in the ceramic industry. When fired, pyrophyllite does not flux as does talc, and it is of value in the manufacture of high-grade refractory ceramic products and cements. Some attempts have been made to develop extensive deposits which occur in Newfoundland, and in 1935 some of this material was shipped to Canada.

No important occurrences of pyrophyllite are known in Canada, but some rather low-grade material exists at Kyuquot Sound, on the west coast of Vancouver Island. The deposits are reported to be extensive, but contain much admixed sericite and finely divided silica. About 1910, a small quantity was shipped from the deposits to a pottery in Victoria for use in refractories, and to a plant at Esquimalt which makes polishing powders, soaps, and cleansers. In Quebec, several occurrences of pyrophyllite are recorded in early reports of the Geological Survey of Canada. They appear to be restricted to areas of altered aluminous igneous rocks, notably dacites, trachytes, etc., or of tuffs derived from such rocks.

Pyrophyllite was quoted in trade journals at the close of 1938 at $7.50 to $12 per ton for 200-mesh and 325-mesh material respectively, f.o.b. North Carolina mills.

VOLCANIC DUST

Deposits of volcanic dusts (pumice dust) are found in Saskatchewan, Alberta, and British Columbia. The material is used mainly as the abrasive base in the scouring and cleaning of compounds and to a small extent in acoustic plaster and concrete admixture. It has been produced intermittently from Waldeck near Swift Current, Saskatchewan, and from near Williams Lake in British Columbia, but there has been no production since 1934, when 31 tons valued at $310 was produced at Waldeck.

Deposits of volcanic dust, all of which are grey to buff in colour, occur also 5 miles north of Braddock, west of Beverly, and near St. Victor in Saskatchewan, and a deposit of white volcanic dust was discovered recently 5 miles west of Rockglen. Tests are now being made on the latter material. Several deposits are known to occur in British Columbia, the purest of which is a snow-white, fine-grained volcanic dust from the Deadman River, north of Kamloops Lake. So far, however, there has been no production from the deposit.

Imports are grouped with a number of similar products—pumice, pumice stone, lava, and calcareous tufa—the imports of which in 1938 were valued at $24,688, as compared with $26,238 in 1937.

In the United States some twenty companies are actively engaged in the production of volcanic dust and pumice, and shipments in that country now exceed 70,000 tons annually, the value of which is approximately $300,000. About 70 per cent of the output is used for cleansing and scouring compounds, 20 per cent for light-weight concrete and aggregates, 5 per cent for acoustic plaster, and the remainder for asphalt filler, road-grading, chicken litter, filtering, insulation mediums, paint filler, floor sweep, dusting inside tires, and in abrasive uses, such as glass bevelling, polishing aluminium, etc. Volcanic dust was used in the United States in 1938 also in the manufacture of fireproof walls, building tiles and slabs, and in the refining of petroleum.

WHITING SUBSTITUTE

Whiting substitute, as the name implies, is used chiefly as a substitute for whiting made from chalk, from which it differs in certain of its characteristics, and hence it also has a field of usefulness of its own. It is generally much whiter than chalk, has a lower capacity for absorbing oil, and the individual particles are subangular rather than rounded as in chalk. Whiting substitute is used chiefly in the manufacture of oil cloth, linoleum, certain kinds of rubber products, putty, and explosives, and to a lesser extent in the manufacture of moulded articles, cleaning compounds and polishes, as a ceramic glaze, and for a number of other purposes.

All of the whiting substitute being produced in Canada at present is made from white marble or white limestone containing only a small amount of magnesium carbonate, though in the past a whiting substitute made from white dolomite was produced in eastern Canada for making putty. The marble and limestone are pulverized to a minus 325-mesh fineness, though for certain uses 200-mesh material is suitable. Carbonate filler, a product closely akin to whiting substitute, and made by introducing carbon dioxide gas into milk-of-lime made from high-calcium quicklime, has been produced in Canada for the past two years. So far, it has been used as a filler in newsprint and book paper, and its manufacture has been undertaken by the paper companies using it. Investigations were continued by several companies in eastern Canada in 1938 into the possibilities of producing whiting substitute from deposits of calcite and marl, and in the case of White Valley Chemicals, Limited, Toronto, the investigations have reached a stage where a mill is being planned.

Whiting substitute is manufactured by Pulverized Products, Limited, Montreal; Claxton Manufacturing Company, Toronto; Gypsum, Lime and Alabastine, Canada, Limited, Winnipeg; and by F. J. Beale, Limited, Van Anda, Texada Island, British Columbia. During 1938 F. J. Beale, Limited equipped its plant at Van Anda for the production of a more finely ground product than was formerly made by the company.

By-product precipitated chalk, made from waste sludge resulting from the manufacture of caustic soda from soda ash and lime, is classed as a whiting substitute, but as it almost invariably contains a small amount of free alkali its use is restricted. Although the raw materials are available, precipitated chalk is not being made in Canada.

Separate figures of the production, imports, and exports of whiting substitute are not published by the Dominion Bureau of Statistics, but the growth of the industry has been steady in recent years, as improvements that have been made in grinding equipment and the maintenance of close technical control have enabled the marketing of a product which is very consistent both in chemical and physical properties. Many manufacturers now use the domestic product in place of imported whiting with entire satisfaction.

Little or no whiting substitute is exported from Canada, but a considerable quantity of specially processed whiting substitute is imported from the United States. Imports of chalk whiting in 1938 amounted to 10,201 tons valued at $116,923, as compared with 11,992 tons valued at $126,015 in 1937. The imports of chalk whiting originate in England, France, and Belgium.

III. FUELS

COAL

The Dominion possesses large reserves of coal, but the deposits are distributed only in the Maritime Provinces and in western Canada. Ontario and Quebec, with more than 60 per cent of the total population, and with the larger part of the manufacturing industry, have no coal deposits, except undeveloped beds of low-grade lignite southwest of James Bay. As they are more conveniently situated to the coal fields of Pennsylvania and neighbouring States than to coal fields in Canada, the two provinces obtain a large share of their requirements of coal from the United States. Nova Scotia, New Brunswick, and Yukon produce only bituminous coal, and except for a small quantity classified as lignitic, all of the coal produced in British Columbia is bituminous. Alberta's production includes bituminous, sub-bituminous, and lignitic coals, while Saskatchewan and Manitoba produce only lignitic coal.

Developments in Nova Scotia during the past few years include changes in and improvements to the washing and screening plants of Dominion Steel and Coal Corporation, which permit a wider range of coal preparation for special purposes. A consolidation of the company's various collieries has been under way, the purpose being to increase production at a decreased cost by the construction of cross-measure tunnels to cut the coal seams at depths sufficient to allow the complete extraction of the coal in the submarine area. Acadian No. 3 mine at Thorburn, Nova Scotia, was finally closed in 1938, and following a full investigation by a Royal Commission it was decided that, for the present, no new mines would be opened in this area, although the McBean seam is available for exploitation. Operations at No. 1 mine of Inverness Coal Mines, under Government control, were discontinued and production is now confined to No. 4 mine. Port Hood Coal Mines, Limited has made an assignment under the Bankruptcy Act, but it is not known whether or not the company is to continue its operations.

The plant at Taylorton, Saskatchewan, for carbonizing and briquetting lignite from that province, which has been purchased and re-conditioned by Dominion Briquette and Chemicals Company, Limited, continued to manufacture briquettes. Production up to December 15 amounted to about 20,000 tons, or more than double the output in 1937. The briquettes are marketed in Manitoba and Saskatchewan. Brazeau Collieries, Limited operated a plant in Alberta in which the bituminous coal fines are briquetted with an asphalt binder and are then returned to the run-of-mine coal, which is sold for railway use. Cadomin Coal Company, Limited operated its coal cleaning plant, and another such plant, erected during the year by Mountain Park Coals, Limited, is being operated for the preparation of a special low-ash coal for use in the manufacture of coke and for steam-raising.

The coal reserves in Nanaimo No. 1 mine of Western Fuel Corporation, Limited, on Vancouver Island, have been exhausted and the property has been closed. Production is now being obtained as a result of an expansion of Canadian Collieries' (Dunsmuir) Northfield mine in the same locality. British Columbia Electric Company continued to manufacture briquettes from a mixture of coke breeze and coal. Following the destruction by fire in October 1937, of its surface plants at Michel Mines, Crow's Nest Pass Coal Company, Limited, in British Columbia, erected a new bankhead, complete with wet and dry cleaning equipment, which has since been placed in operation. The tipple is probably the most modern of its kind in Canada.

Canada produced 14,247,783 tons of coal valued at $43,912,204 in 1938, as compared with 15,835,954 tons valued at $48,752,048 in 1937. Nova Scotia contributed more than 43 per cent of the total, Alberta 36 per cent, British Columbia about 10 per cent, and Saskatchewan 7 per cent. Nova Scotia's output, which amounted to 6,231,923 tons, showed a decrease of 14 per cent as compared with that of 1937.

Canada imported 13,464,060 tons of coal in 1938, as compared with 16,023,147 tons in 1937. Of the 3,716,447 tons of anthracite imported, 53 per cent was from the United States, and 32 per cent from Great Britain, the remainder being from Germany, Russia, Belgium, the Netherlands, French Indo-China, and Morocco. Imports of bituminous coal amounted to 9,744,652 tons, and came mainly from the United States.

Canada exported 353,181 tons of coal in 1938, as compared with 355,268 tons in 1937. Included in the exports in 1938 were 343,731 tons of bituminous coal and 9,450 tons of lignite.

A total of 2,041,940 net tons of Canadian coal were moved under Federal Government assistance in 1938, as compared with 2,637,345 net tons in 1937. The decline was due to the decrease in the fuel requirements of industrial plants and the railways. In general, the assistance is intended as a means of enabling Canadian coal to compete on even terms with imported coal at points of consumption. Declining prices of coal from the United States necessitated an increase in November 1938, in the rates of assistance granted to Nova Scotia coal moving to points in Ontario. Since 1928, when the assistance came into effect, a total of 16,243,727 tons of coal has been moved under subvention, at a cost to the Government of $15,309,511. The assistance is administered by the Dominion Fuel Board

Research work on coal preparation, storage properties, and general characteristics of coal seams was carried out in the Fuel Research Laboratories of the Bureau of Mines at Ottawa, in an endeavour to extend the use of these coals in Canadian plants at the expense of the imported product. A study was commenced of the physical and chemical characteristics of the coals from New Brunswick, and is of primary importance as an aid to the solution of the problems of this coal field. Research work on the amenability of various Canadian coals to hydrogenation was under way throughout the year. Such work will provide information that should prove of real value when the time is ripe for the commercial application of the hydrogenation process to Canadian coals.

Progress was made in the mechanization of coal mines throughout Canada. The introduction of modern electrically operated coal-cutting machines at Dominion Coal and Steel Company's No. 20 colliery caused a stoppage of work and has been the subject of a controversy between the miners and the company. Further mechanization of the coal mines in Nova Scotia is urgently needed in order that they may compete successfully with cheaper coal from the United States, according to officials of Dominion Coal and Steel Company. Even with the aid of subventions, difficulty was encountered in 1938 by operators in Nova Scotia in meeting the competition of imported coals.

COKE

Coke from coal was produced in all provinces with the exceptions of Prince Edward Island and Saskatchewan in 1938. A total of twenty-five plants were in operation, the list including two beehive, eight by-product, six vertical retort, and nine horizontal retort plants. Petroleum coke was produced at refineries in Nova Scotia, Quebec, Ontario, Saskatchewan, and Alberta, while pitch coke was produced by distillation in Manitoba. The demand for coke in the domestic market has been increasing steadily in recent years.

In Cape Breton, Nova Scotia, Dominion Steel and Coal Corporation produced coke for its own use and as a domestic fuel for use in the Maritime Provinces.

In Quebec, Montreal Coke and Manufacturing Company's coke ovens were in continuous operation, about 35 per cent of the coal used being from Nova Scotia, while the remainder was imported. Quebec Power Company, equipped with a vertical retort plant, used Canadian coal only, and sold about 68 per cent of its coke to consumers in Canada. The remainder of the output was used for the manufacture of gas and in the operation of the plant.

In Ontario, sales of coke produced by Hamilton By-Product Coke Ovens, Limited, and by Steel Company of Canada, Limited, in their plants at Hamilton, and by Algoma Steel Corporation in its plant at Sault Ste. Marie, showed an increase as compared with 1937. Consumers' Gas Company of Toronto, equipped with both vertical and horizontal retort plants, sold 41 per cent of its output of coke to domestic consumers, while the remainder was used for the manufacture of gas and in the operation of its plants. The gas plant of Owen Sound city was placed in operation in 1938. The plant, which consists of three ovens, employs the Curran-Knowles system of carbonization, and is designed to supply local requirements of gas and coke. It will produce yearly 10,000 tons of coke and 21,000 M cubic feet of gas from between 12,000 and 13,000 tons of coal.

In Manitoba, Winnipeg Electric Company, which formerly used only United States coal, is now using Canadian coal entirely in its ovens at Winnipeg for the manufacture of domestic coke. The blending plant, erected in 1937, permits the use of coal from more than one source.

In Alberta, International Coal and Coke Company at Coleman continued to supply the requirements of Consolidated Mining and Smelting Company's smelter at Trail, B.C., with beehive oven coke.

In British Columbia, British Columbia Electric Power and Gas Company's coke and gas plant at Vancouver continued to supply an improved quality of coke for domestic use in that city. Most of the coke exported was marketed in Seattle. Beehive oven coke was manufactured by the Crow's Nest Pass Coal Company, Limited, mostly for industrial use.

The total production of coke from coal in Canada in 1938 was reported at 2,356,055 tons, of which Nova Scotia, New Brunswick, and Quebec contributed a total of 754,961 tons; Ontario, 1,369,311 tons; and Manitoba, Alberta, and British Columbia, a total of 231,783 tons. A total of 3,279,771 tons of coal was used for making coke, 32 per cent of which was Canadian coal. Petroleum coke, produced at the oil refineries, amounted to 62,015 tons in 1937, of which about 5 per cent was consumed by the refineries.

Canada exported 30,537 short tons of coke made from coal and 11,370 tons of petroleum coke in 1938. Coke from coal imported amounted to 414,682 tons, while imports of petroleum coke amounted to 81,218 tons.

NATURAL GAS

Natural gas has been found in most of the provinces of Canada, but is produced chiefly in Alberta, Ontario, and New Brunswick. It is also produced in small quantities in Saskatchewan, Manitoba, Quebec, and the Northwest Territories.

In British Columbia drilling was done in 1938 on Sage Creek and in the Boundary Bay district.

In Alberta most of the output comes from the Turner Valley field, which supplies the cities of Calgary and Lethbridge and intermediate points and which also supplies the gas used to repressure the Bow Island field. The remainder is obtained from the Viking field, which supplies the Edmonton area; the Medicine Hat field, which supplies Medicine Hat and Redcliff; the Fabyan field which supplies the town of Wainwright; and the Brooks field which supplies the town of Brooks. Some gas is exported intermittently by Range Oil and Gas Company to the United States from its isolated well in southern Alberta. The Petroleum and Natural Gas Conservation Board, with headquarters at Calgary, was established during the year. By its regulatory measures the Board has succeeded in decreasing the wastage of natural gas in Turner Valley and plans are under way to reduce this wastage still further by returning excess gas to the producing horizon. Exploratory drilling has been done in the Pouce Coupe and Brazeau areas, and also at Grease Creek, Steveville, and in the Border area, north of the International boundary.

In Saskatchewan, Lloydminster is being served with natural gas from wells near the town. A gas well near Lloydminster with a flow of 6,750,000 cubic feet per day was brought in during the year, and a small flow was obtained near Kamsack from a well of shallow depth. Test drilling was carried out at Riverhurst, Verigin, and Thunderhill.

In Manitoba some further drilling was done at Pilot Mound in the southwestern part of the province.

83554—8

In Ontario most of the production comes from the southwestern part of the province, the principal fields being: Tilbury, Haldimand, Dawn, De Clute, Brownsville, Dover, Norfolk, Welland, and Onondaga. A network of pipe-lines transmits the gas to nearby towns and cities for distribution, and practically all the centres of population in that part of the province are served with natural gas. The year was featured by the large production obtained from both old and new wells in the Brownsville field. Seventy-one wells were in production in this field at the close of 1938, as compared with 51 at the end of 1937. The largest of the new wells was estimated to be capable of producing 12,000,000 cubic feet of gas per day. The field has been extended westward and a little south, some of the new wells being in Elgin County. Two new purifiers have been erected to treat the gas, which now serves the town of Aylmer. Four new wells with a total daily flow of 12,000,000 cubic feet are reported to be in production in the De Clute field in Raleigh Township, Kent County, the productive horizon being about 1,550 feet below the surface. Three new wells entered production in the Tilbury field at a depth of about 1,300 feet. Two small wells in Haldimand County, one in the Eden field, Elgin County, and one in Brant County, also entered production in 1938.

In Quebec natural gas is obtained from a number of small wells along the St. Lawrence River and is used locally in private dwellings.

In New Brunswick the only field of importance is at Stony Creek, which supplies the city of Moncton and the town of Hillsborough.

Canada produced 33,441,139 M cubic feet of natural gas in 1938, compared with 32,380,991 M cubic feet in 1937. The figures do not include the gas from Turner Valley used for repressuring or the waste gas in that field.

A total of 133,062 M cubic feet of a mixture of artificial and natural gas valued at $87,311 was imported from Buffalo, New York, for distribution in the Welland area, Ontario, in 1938, the corresponding figures for 1937 being 114,275 M cubic feet and $74,799.

OIL SHALE

Large deposits of oil-bearing shale are known to exist in different parts of Canada, the largest and best known occurrences being in Pictou and Antigonish Counties, Nova Scotia, and Albert and Westmorland Counties, New Brunswick. As shale oil cannot compete with petroleum at present prices, none of these deposits has as yet been actively developed on a commercial scale.

Experimental plants were erected in 1929-30 near Rosevale, New Brunswick and New Glasgow, Nova Scotia, to treat local shales but they operated only for short periods. No oil shale is now being mined in Canada nor is any being imported. Activity has been confined chiefly to field explorations and to laboratory investigations. Laboratory work by the Department of Mines and Resources at Ottawa has included the determination of the petroleum content of representative samples from various localities; the determination of important factors affecting the recovery of crude petroleum by destructive distillation and of the character of the petroleum recovered; and the investigation of the processes designed for the distillation of oil shales.

For many years the large-scale production of oil shale was limited to Scotland, but deposits in Manchuria and Esthonia are now being developed on a large scale. The production of the three countries is as follows:—

	1936 Tons	1937 Tons
Scotland	1,409,415	1,460,729
Esthonia	754,306	1.213.680
Manchuria	3,383,000	3,000,000 (estimated)

Austria, France, Germany, Italy, Spain, and Russia also produce small quantities of oil shale.

The increasing interest in oil shales in Europe was responsible for the holding of an International Conference on Oil Shale and Cannel Coal in Glasgow in June, 1938, during which a paper* was presented dealing with the oil shales of Canada.

PEAT

Peat is found in every province of the Dominion. It is a combustible substance produced by the incomplete decomposition of vegetable matter in water, or in the presence of water, under such conditions that atmospheric oxygen is excluded. The character of the peat depends upon the conditions under which it has been formed and upon the nature of the vegetation which has contributed to its formation. Many species of plants are found in peat bogs, the most prominent of which are: mosses, such as sphagnum and hypnum; marsh and heath plants; grasses, rushes, etc.; marine plants; and sometimes trunks, roots, and leaves of trees. The peat contained in a bog is described according to the plants that predominate in the formation.

Peat Fuel

Small amounts of peat fuel have been produced intermittently from bogs in Quebec and Ontario for several years, the output in recent years having come from bogs at St. Arsène, in Quebec; and at Galt, Gad's Hill, Grand Valley, Linwood, Morewood, and St. Ann's in Ontario.

At St. Arsène and Gad's Hill the peat is put through macerators before it is placed on the drying racks. At its East Luther bog near Grand Valley, Industrial Compounds, Limited excavates the peat by use of a suction pump capable of handling 1,400 gallons of peat pulp per minute. The pulp is piped to a settling tank equipped with a peat-flow regulator, and the wet solids are then piped to a series of level drying beds. The products of the plant are peat fuel and fertilizer filler.

Sales of peat amounted to 500 tons valued at $3,000 in 1938, as compared with 475 tons valued at $2,676 in 1937. The average annual output between 1932 and 1936 was about 1,800 tons.

Imports and exports of peat fuel are not separately recorded by the Dominion Bureau of Statistics.

* "Oil Shales of Canada," by A. A. Swinnerton, Department of Mines and Resources, Ottawa.

Peat Moss

Bogs at Isle Verte and Waterville in Quebec; at Clinton, Grand Valley, and Vars in Ontario; at Cowan in Manitoba; at Melford in Saskatchewan; at Edmonton West in Alberta; and near New Westminster in British Columbia, have been operated intermittently in recent years for the production of peat moss for use as insulation material, packing litter, or fertilizers. Insulating moss has been produced at Isle Verte, Clinton, Vars, Cowan, Melford, and Edmonton West, while packing moss is produced at Waterville as loose material, and at New Westminster in the form of sawn boards. Litter, or humus is produced at Isle Verte and New Westminster, and fertilizer filler at Isle Verte and Grand Valley. Information on the production of peat moss is not available.

Canada exported approximately 2,700 tons of peat moss to the United States in 1936, and approximately 3,000 tons in 1937. Canada imported 433 tons of peat moss and 891 tons of cleaned, sized, and ground mosses in 1938.

CRUDE PETROLEUM

Crude petroleum is produced in Canada in Alberta, Ontario, New Brunswick, and the Northwest Territories; the product varies from a highly volatile naptha to semi-solid bitumen.

Close to 97 per cent of the total Canadian output is now being obtained from the Turner Valley field in Alberta, about 50 miles southwest of Calgary. The long-cherished hope that this field would become a producer of petroleum was realized in June 1936, when a large flow of high-quality crude was struck in Turner Valley Royalties' well. Other wells were drilled in rapid succession and at the close of 1938 about sixty-eight wells were producing crude oil, and seventeen others were being drilled for oil.

As a result of information obtained from drilling and geological mapping the limits of the oil-bearing field are being rapidly determined. The southern or main producing area has a proved length of nearly 5 miles and a width of about 2 miles. The depth of the oil-producing rocks varies, the deepest well being over 10,000 feet. North of this field, about 9 miles, is the northern area of Turner Valley where as yet only a few wells are in production, but which is now the centre of increasing attention. Many wells need to be drilled between the southern and northern areas before the full possibilities of the intervening 9 miles can be known. Should all of this prove to be productive, the Turner Valley oil field would have a proved length of at least 17 miles.

The production of crude oil from the Red Coulee field, Wainwright, Ribstone, Taber, and Moose Mountain areas in Alberta, is small but regular. Elsewhere in Canada oil is produced in commercial quantities at Petrolia, Oil Springs, and Bothwell, and in the Townships of Dawn, Warwick, West Dover, and Mosa in southwestern Ontario; at the Stony Creek field, about 9 miles southwest of Moncton in New Brunswick; and at Norman, about 50 miles west of Great Bear Lake in the Northwest Territories. Some bitumen is also obtained from deposits near McMurray in northern Alberta.

Throughout the year the production in the Turner Valley field was prorated in order that the output would not exceed the demand, and to allow also for the available storage and transport facilities. The Petroleum and Natural Gas Conservation Board, formed during the year by the Provincial Government, now fixes the allowable production of each well periodically according to a formula in which the so-called "potential" production enters only as one factor. The demand reached a peak in September when production in Turner Valley amounted to 862,413 barrels, and during the period from September 12 to 24, the allowable production was placed at 28,300 barrels daily. Near the end of the year this had declined to 12,500 barrels.

Thirty-eight producing wells were brought into production in the southern area of Turner Valley in 1938. The oil from this area is a light crude which ranges from 40° to 50° A.P.I. gravity. The successful use of hydrochloric acid for increasing and periodically reviving the yield from the wells has been an important factor in the development of the area.

In the northern area of Turner Valley, the successful completion early in 1939 of Home-Millarville No. 2 well was an event of significance, as the favourable structure is known to extend for several miles to the north of the well. Drilling in the southern area has proved the presence of oil throughout most of the porous horizons in the limestone and encouraging results have been obtained also from drilling in the northern area. Much of the undrilled area also shows promise of commercial production.

Further drilling in Alberta has been done at Taber, east of Lethbridge; at Moose Dome, west of Calgary; at Ribstone, southwest of Lloydminster; at Del Bonita, in the International Boundary area; at Pouce Coupe, in Peace River country; at Bearberry, west of Olds; at Steveville, northwest of Medicine Hat; at Lundbreck, in Crow's Nest Pass area; and in the Brazeau and Highwood areas.

In Saskatchewan, wells have been drilled for oil from Vera, east of Wainwright, north to near Lloydminster, and there has been a small production of heavy asphaltic crude.

In Ontario, wells were drilled with encouraging results in the southwestern part of the province, and on Manitoulin Island. Among the more important developments was the discovery of oil at a depth of from 375 to 500 feet in Warwick Township, Lambton County. An area 6 miles long by 3 miles wide was tested with a large measure of success. The oil is of good quality, with a gravity of from 37° to 43° A.P.I. The wells, which have to be pumped, yield upwards of 110 barrels per day, flush production. The output from this field is responsible for most of the increase in the production of crude oil in Ontario in 1938 as compared with that of 1937. Part of the increase, however, can be traced to the re-conditioning of old wells in the Bothwell field and to the success of drilling in that field. It has been estimated that some 300 wells are on the pump in the Bothwell field, and that deliveries during the year amounted to about 54,000 barrels.

Production of Petroleum in Canada

(Barrels of 35 Imp. gallons—42 U.S. Gallons)

	1937	1938
Alberta..	2,749,085	6,742,039
Ontario..	165,205	172,059
New Brunswick..	18,089	19,277
Northwest Territories..	11,371	22,854
Total..	2,943,750	6,956,229

Production of Petroleum in Alberta,[1] *1938*

Turner Valley, limestone[2]..	6,681,883
Turner Valley, shallow crude..	9,192
Red Coulee, light crude..	14,458
Wainwright, heavy crude..	18,344
Taber..	15,098
Moose Dome..	3,064
Total..	6,742,039

[1]Figures by Department of Lands and Mines, Alberta.
[2]Includes both naphtha and light crude

Exports of petroleum and its products from Canada in 1938 reached a value of $877,553, while exports of gasoline and naphtha amounted to 4,984,879 Imperial gallons valued at $458,997. Imports of petroleum, asphalt, and their products were valued at $55,606,622 in 1938, in which year 1,228,560,309 Imperial gallons of crude petroleum were imported, 74 per cent of it from the United States, 6 per cent from Venezuela, 16 per cent from Colombia, and 4 per cent from Peru. Gasoline and naphtha imports amounted to 11,038,120 Imperial gallons valued at $7,719,907, the United States having supplied 84 per cent of the total, Peru 15 per cent, and Alaska, the remainder.

Based on gasoline tax returns, it is estimated that retail sales of gasoline in Canada amounted to 762,591,000 gallons in 1938. All but a few of the refineries in Alberta, Saskatchewan, and Manitoba now use Turner Valley crude, and imports of crude oil to these provinces during 1938 were only slightly in excess of 500,000 barrels. Several of the refiners were installing better equipment in order to reduce refining costs. The producing companies in Turner Valley have enlarged their storage facilities considerably, and the pipe-line capacity from the field to Calgary has been increased to 24,000 barrels of crude oil a day. Transportation costs both by pipe-line and by rail to refining centres have been lowered. Owing to the lower cost of crude oil, retail prices for gasoline and other petroleum products have been materially reduced in the Prairie Provinces.

Ball clay

Slip
Plasticizing agent
Centrifuge