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THE CANADIAN MINERAL INDUSTRY IN 1940.

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THE CANADIAN MINERAL INDUSTRY IN 1940

(by Staff, Bureau of Mines, Ottawa)

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	Product	Article Number	Author
I - METALS:	Aluminium	(1)	Buisson, A.
	Antimony	(2)	Buisson, A.
	Bismuth	(3)	Buisson, A.
	Cadmium	(4)	Buisson, A.
	Chromite	(5)	Eardley-Wilmot, V.L.
	Cobalt	(6)	Buisson, A.
	Copper	(7)	Buisson, A.
	Gold	(8)	Buisson, A.
	Iron Ore	(9)	Buisson, A.
	Lead	(10)	Buisson, A.
	Manganese	(11)	Eardley-Wilmot, V.L.
	Mercury	(12)	Eardley-Wilmot, V.L.
	Molybdenum	(13)	Eardley-Wilmot, V.L.
	Nickel	(14)	Buisson, A.
	Platinum	(15)	Buisson, A.
	Radium and Uranium	(16)	Spence, H. S.
	Selenium	(17)	Buisson, A.
	Silver	(18)	Buisson, A.
	Tellurium	(19)	Buisson, A.
	Titanium	(20)	Buisson, A.
	Tungsten	(21)	Eardley-Wilmot, V.L.
	Zinc	(22)	Buisson, A.
II - INDUSTRIAL MINERALS:			
	Arsenious Oxide	(23)	Buisson, A.
	Asbestos	(24)	Goudge, M. F.
	Barite	(25)	Spence, H. S.
	Bentonite	(26)	Spence, H. S.
	Beryl	(27)	Spence, H. S.
	Bituminous Sand	(28)	Ells, S. C.
	Brucite (see Magnesite)		Goudge, M. F.
	Celestite	(29)	Spence, H. S.
	Cement	(30)	Goudge, M. F.
	Clay and Clay Products	(31)	Phillips, J. G.
	Diatomite	(32)	Eardley-Wilmot, V.L.
	Feldspar	(33)	Spence, H. S.
	Fluorspar	(34)	Spence, H. S.
	Garnet	(35)	Eardley-Wilmot, V.L.
	Granite	(36)	Cole, L. H.
	Graphite	(37)	Spence, H. S.
	Grindstones	(38)	Eardley-Wilmot, V.L.
	Gypsum	(39)	Cole, L. H.
	Iron Oxides	(40)	Buisson, A.
	Kaolin (see Clays)		Phillips, J. G.
	Lime	(41)	Goudge, M. F.
	Limestone (General)	(42)	Goudge, M. F.
	Limestone (Structural)	(43)	Goudge, M. F.
	Lithium Minerals	(44)	Spence, H. S.
	Magnesite and Brucite	(45)	Goudge, M. F.

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	Product	Article Number	Author
II - INDUSTRIAL MINERALS cont'd.:			
	Magnesium Sulphate	(46)	Cole, L. H.
	Marble	(47)	Goudge, M. F.
	Mica and Vermiculite	(48)	Spence, H. S.
	Moulding Sands	(49)	Freeman, C. H.
	Nepheline Syenite	(50)	Spence, H. S.
	Phosphate	(51)	Spence, H. S.
	Pyrites	(52)	Buisson, A.
	Salt	(53)	Cole, L. H.
	Sand and Gravel	(54)	Picher, R. H.
	Silica	(55)	Cole, L. H.
	Sodium Carbonate	(56)	Cole, L. H.
	Sodium Sulphate	(57)	Cole, L. H.
	Sulphur	(58)	Buisson, A.
	Talc and Soapstone	(59)	Spence, H. S.
	Vermiculite (see Mica)		Spence, H. S.
	Volcanic Dust	(60)	Eardley-Wilmot, V.L.
	Whiting	(61)	Goudge, M. F.
III - FUELS:	Coal	(62)	Burrough, E. J.
	Coke	(63)	Burrough, E. J.
	Natural Gas	(64)	Warren, T. E.
	Oil Shale	(65)	Swinnerton, A. A.
	Peat	(66)	Leverin, H. & Buisson, A.
	Petroleum	(67)	Warren, T. E.

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NOTE: The figures of production are preliminary figures, as published by the Dominion Bureau of Statistics.

Imports and Exports are taken from the "Trade of Canada", Dominion Bureau of Statistics, and cover the calendar year.

The market quotations are obtained chiefly from standard marketing reports issued in Montreal, New York and London.

OTTAWA, MARCH, 1941.

ALUMINIUM IN 1940

Canadian requirements of bauxite, the ore of aluminium, are imported, no commercial deposit having as yet been found in Canada. Direct delivery of bauxite from British Guiana, which was discontinued in 1930, was resumed in 1935; and each year since then these imports have shown a marked increase. 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. It is largely because of the abundance of cheap hydro-electric energy in the Dominion that Canada has become a leading producer of aluminium and its products.

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.

Aluminum Company of Canada, which has a refinery at Arvida and another at Shawinigan Falls, Quebec, is the only Canadian producer of the metal, and is by far the largest of the three producers in the British Empire. It is also the only Empire producer which mines its own bauxite, Demerara Bauxite Company in British Guiana, where the ores are mined, being a subsidiary enterprise. British Aluminium Company, Limited, with three smelters in Scotland, and Aluminium Corporation, with a smelter in Wales, are the other two Empire producers. Aluminum Company of Canada also has two fabricating plants, one at Shawinigan Falls, and the

other at Toronto, Ontario. A number of other companies with plants mainly in Ontario and Quebec, manufacture aluminium cooking utensils, automobile parts, and other articles of aluminium.

In the latter part of 1939 the British Government signed with Aluminum Company of Canada, a contract under which the United Kingdom takes the entire Canadian exports, although provision was made whereby contracts signed prior to the war would be fulfilled. In effect this means that the British Government has first call on about 90 per cent of the present capacity output. Additions made to plants in 1940 allow for a considerable increase in Canada's annual productive capacity.

Canadian production and trade figures are not available for publication owing to the war.

The world output of aluminium in 1939 (1940 figures are not available) was 647,400 metric tons compared with 578,800 metric tons in 1938, as reported by the United States Bureau of Mines. The principal producing countries, in order of output were: Germany, United States, Canada, Russia, and France. Because of the large amounts of secondary metal, world production of primary aluminium is considerably below the world consumption of aluminium. Primary production of aluminium in the United States in 1940 totalled 206,280 short tons, an increase of 26 per cent over the peak production of 1939. To meet requirements of that country's national defence program, the production is to be increased in 1941 and 1942 at the five American reduction plants of Aluminum Company of America and at the new plant of Reynolds Metals Company.

Aluminium and its alloys are used widely in industry owing to the special properties of the metal, such as lightness, high tensile strength, ductility and malleability, high heat-conductivity and reflective power, electrical resistivity, and resistance to corrosion. They are consumed in the transportation, electrical

conductors, cooking utensils, machinery and electrical appliances, iron and steel metallurgy, foundry and metal working, building construction, chemical, and food and beverage industries, and in miscellaneous industries.

Many new alloys have found continually wider use in structural shapes and sheet metal for railway cars, automobiles, aeroplanes, skips and cages used in mining, and in roofing sheets, shipping barrels, tanks, and industrial equipment of many kinds. Aluminium powder is used in paints for preserving wood and steel surfaces such as those of 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, and it is 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 aeroplane engines.

The main markets for the Canadian aluminium industry are within the British Empire.

The United States "Tariff Act of 1930" provides for a duty of 5 cents per pound on silicon-aluminium, ferro-silicon-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 alloys (except those provided for in paragraph 302, above mentioned) entering the United States, in which aluminium is the component material of chief value, in coils, plates, sheets, bars, rods, circles, disks, blanks, strips, rectangles and squares (Schedule IV, Par. 374). Under the terms of Article I of the "Canadian-United States Trade Agreement", these concessions are automatically extended to Canadian products.

Permits and licences are required for the exportation of bauxite, alumina, aluminium, and artificial abrasives from Canada.

The nominal price in New York of aluminium metal 99 per cent pure was 20 cents per pound during the first four months of 1940, 19 cents from May to August, 18 cents from September to November, and 17 cents in December. The average for the year was 19 cents.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

ANTIMONY IN 1940

Antimony ore in the form of stibnite occurs in various parts of Canada. With the exception of small experimental shipments made in 1939 and 1940 from the Fort St. James deposit in northern British Columbia, no antimony ore has been produced in Canada since 1917. For a number of years prior to 1917, small amounts of refined antimony as well as antimony ore were produced intermittently in the Maritime Provinces. The Canadian output is at present derived mainly from the treatment of the antimonial residue produced as a by-product of silver refining at Trail, British Columbia. The present high price for the metal and the difficulties facing the industry in China as a result of war are an incentive to explore for new deposits and to resume development at those already known in Canada.

In Nova Scotia, a small amount of surface trenching was done on the antimony property near West Gore, Hants county. Due to difficulty of shipment of the ore to the United Kingdom, no stibnite was produced during the year.

In New Brunswick, extensive deposits of stibnite are known to occur at Lake George, York county, and stibnite-bearing boulders occur at Marrtown, Queens county, and at Stewarton, Kings county. No work was done at any of these localities in 1940.

In Quebec, some preliminary exploration work was undertaken on an old antimony deposit on lot 28, range I, South Ham township, Wolfe county. A considerable amount of surface trenching was done on an antimony-gold deposit on lot 9 range VI, New Richmond township, Bonaventure county.

In Ontario, the silver-lead-bismuth bullion obtained as a by-product in the treatment of the silver-cobalt-nickel-arsenical ores at Deloro, contains small quantities of antimony. This was formerly exported to Germany for further treatment, but no payment was received for the antimony.

In British Columbia, only one of the several known antimony prospects was in active operation. Pioneer Gold Mines of British Columbia, Limited, carried on underground development on its antimony property at Stuart lake, near Fort St, James. Trial shipments of ore were made to the smelting plant of Texas Mining and Smelting Company at Laredo, Texas. Operations ceased late in November.

A plant completed in 1938 at Trail, British Columbia, commenced the production of high grade electrolytic antimony in the last quarter of that year. The antimony is recovered from flue dust, a by-product of Consolidated Mining and Smelting Company's silver refinery. The production has been gradually brought up to the capacity of the plant.

The smelter at Trail does not accept custom antimonial ore. In the United States, Texas Mining and Smelting Company, with plant at Laredo, Texas. handles Mexican and South American antimony ores. Early in 1940, the Bunker Hill smelter, Bradley, Idaho, put in operation a new plant for the recovery of antimony in the form of antimony oxide and electrolytic antimony, using the new "Lee-Muir Process", which separates the silver, copper, antimony, and bismuth components of tetrahedrite. Menardi Metals Company operate a plant for the recovery of antimony at Los Angeles, California. American Smelting and Refining Company is said to be considering the production of antimony at its Perth Amboy plant in New Jersey.

Canadian production and trade figures are not available for publication owing to the war.

The world production of antimony in 1939 (1940 figures not yet available), as published by the United States Bureau of Mines, amounted to about 32,000 metric tons. The production in 1937 was 37,300 metric tons, the highest figure since the 1914-1918 war years. The decline in output from China has been more than made up by the large increase in production in other countries.

Most of the production of antimony has come from China, although Bolivia and Mexico have been important producers for years. During the last few years, there has been a marked increase in output from Bolivia, Mexico, Yugoslavia, and Algeria and, to a lesser degree, from several other countries. In 1939 Bolivia produced 29 per cent of the world output of antimony; Mexico, 23 per cent; China, only 20 per cent; and Yugoslavia, 10 per cent. Most of the refined antimony is produced in the United States, Great Britain, France, and Belgium from ores of foreign origin.

Canada's requirements are now supplied mainly from the plant at Trail, which explains the noticeable decrease in our imports.

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 use of antimony in the manufacture of chemicals has increased considerably during the last two years. The principal compound is the oxide of antimony which is employed extensively as a pigment in sanitary enamelware and nitrocellulose enamels. The expansion in the manufacture of munitions of war is also an important factor in the increasing demand for antimony. Since December, 1935, the Chinese antimony trade has been under government control.

The New York price of antimony (ordinary brand) in 1940 remained fixed at 14 cents a pound. In 1939 the price had risen gradually from about 11½ cents in January to 14 cents in October, when it became fixed. The price for Chinese brand, duty paid, remained at 16½ cents from January, 1940, to the end of November, the price in December being 16 cents.

The United States tariff on antimony is: antimony as regulus or metal, two cents per pound; needle or liquated antimony, ½ cent per pound.

ISSUED BY THE BUREAU OF MINES,
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OTTAWA, MARCH, 1941.

BISMUTH IN 1940

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. Some bismuth is obtained also as a by-product from the treatment of the silver ores of northern Ontario. Most of the world's supply is obtained from the treatment of lead refinery slime and as a by-product of the mining of gold, tin, and tungsten ores.

In British Columbia, Consolidated Mining and Smelting Company of Canada operates a plant for the electrolytic treatment of bismuth residue resulting from the electrolytic treatment of lead bullion. The operation of the plant has been intermittent since it was constructed in 1928.

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

Canadian production and trade figures are not available for publication owing to the war.

Statistics of the world production of bismuth are incomplete, but the output is estimated at about 1,500 tons annually. The United States is the principal producer, but the publication of figures is withheld. American Smelting and Refining Company produces bismuth-lead alloy at its plants at Selby, California, Perth Amboy, New Jersey, and Monterrey, Mexico, and the alloy is refined at the company's refinery at Omaha, Nebraska. Anaconda Copper Mining Company obtains its bismuth from the Montana copper and the Utah lead ores, the final bismuth recovery being made by International Smelting and Refining Company at East Chicago, Indiana. United States Smelting, Refining, and Mining Company operates a bismuth refinery at East Chicago, where slimes from the Belts electrolytic lead process are treated for their bismuth content. In 1940, Bunker Hill and Sullivan Mining and Concentrating Company began the operation of a new plant for the production of refined bismuth from the residues produced at the company's lead refinery at Kellogg, Idaho.

Canada holds third place as a source of supply of bismuth, other important sources being Peru and Mexico. For more than half a century Bolivia was the principal source, but in recent years its production has decreased considerably. The United States Bureau of Mines reports that about 90 per cent of the world production is obtained from the United States, Peru, Canada, and Mexico, while the remainder is obtained from Argentina, Belgium, Bolivia, France, Germany, Japan, and Spain.

Bismuth is used mostly in the manufacture of pharmaceutical products. A much larger portion than formerly is now used in the making of so-called fusible or low-melting alloys, as for example, the nozzles of automatic sprinklers. 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. The Ekko process evolved by United States Rubber Company of Detroit, for electroforming with iron may provide an outlet for bismuth in the form of "cerrobase", a nonshrinking bismuth-lead (Bi-Pb) alloy with a melting point of 25.5°, patented by Cerro de Pasco Copper Corporation. One application of the Ekko process is the production of dies or molds from which a photographic likeness can be transferred to iron. Although many applications of bismuth, introduced in recent years, have increased the demand for this metal, potential supplies greatly exceed the present

demand. The war has restricted international trade in bismuth and encouraged the use of substitutes.

The price of bismuth at New York in ton lots remained fixed at $1.25 a pound throughout 1940. The price in 1939 was $1.00 for January and February, $1.10 from March to October, and $1.25 for November and December. For several years the United States price has been maintained at a little below the European parity, plus duty of 7½ per cent ad valorem, chargeable upon imports into the United States. For several years the price has been well controlled.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

CADMIUM IN 1940

Cadmium is present in small amounts in most zinc ores and in some lead ores and is obtained as a by-product in the production of these metals.

Metallic cadmium is produced by Consolidated Mining and Smelting Company at Tadanac (Trail) British Columbia, and by Hudson Bay Mining and Smelting Company at Flin Flon, Manitoba. The former plant started to produce early in 1928 and like the latter, which has been in operation since 1936, treats the cadmium residue from the zinc refinery, the procedure being similar.

The cadmium plant at Flin Flon was in continuous operation and treated all current purification precipitates from the zinc plant. A few minor changes were made in the plant's process and equipment. The production of metallic cadmium was somewhat lower than in 1939.

Canadian production and trade figures are not available for publication owing to the war:

The world production in 1940 is estimated at 5,000 short tons, the production in 1938, the latest year for which figures are available being 4,200 short tons. The chief producing countries in order of output are: the United States, Germany, Canada, Mexico, Belgium, Australia (Tasmania), Poland, Norway, England, Russia, and France. The Mexican output is contained in ores exported for treatment in various countries. The United States production in 1940 was 3,050 tons, and sales were 3,057 tons, the highest on record.

Production is limited entirely to the by-product recovery from electrolytic zinc and from the manufacture of lithopone, and is thus dependent on the output of these products.

Cadmium is used in the manufacture of alloys and compounds and as a plating material. The use of cadmium alloys in automobile bearings has created a strong demand for the metal in recent years and the future of the alloy for this purpose is said to depend upon the ability of the producers to supply the metal at a relatively low price. Cadmium is used also in the arts, medicine, and 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 1940 averaged $1.16 a pound, compared with 70.47 cents in 1939 (London prices in Canadian funds). The price of metallic cadmium, f.o.b. New York, in commercial sticks remained at 80 cents a pound. The American product is protected by a duty of 7½ cents a pound. Previous to the Trade Agreement of November, 1938, the duty was 15 cents a pound.

ISSUED BY THE BUREAU OF MINES,
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OTTAWA, MARCH, 1941

CHROMITE IN 1940

Pure chromite ($FeCr_2O_3$) contains 68 per cent chromic oxide, but in nature it always contains, besides iron, varying amounts of magnesia and alumina. It is a heavy, almost black, lustrous and brittle mineral, and the commercial ore usually occurs in dunite bands in serpentine rocks. Fresh dunite is a fine-grained dark grey-green olivine rock. Chromite may be distinguished in the field from other black minerals of similar appearance by its chocolate brown powder or streak when struck or scratched with a hammer.

Since records were first kept in 1886, Canada has produced 169,300 tons of chromite, of which 163,200 tons were from the Eastern Townships of Quebec, mainly from the Coleraine district. During the last war and in the two succeeding years, the total output amounted to 93,000 tons, the record of 24,000 tons being in 1917. For the past twenty years, production has been small and irregular.

In Quebec, production was maintained in 1940 by H. Bruce Fletcher of Sherbrooke, who up to December 31st, had shipped a few car lots of hand cobbed ore from a property near Webster lake in Orford township, about 15 miles west of Sherbrooke. The ore occurs in small lenses and is extracted by open-pit methods from the side of a steep hill. The cobbed rejects are being stock piled for future milling. Asbestos Corporation mined some ore from the Beaver pit, near Thetford, and shipped a few car lots of 46 per cent Cr_2O_3 in January 1941 for refractory use. The total Quebec production of about 1,200 tons between 1934 and 1937 was from the Beaver pit.

In the autumn of 1940, Chromite Limited, Montreal, re-opened the old Sterrett property, near St. Cyr, in Cleveland township, about 30 miles north of Sherbrooke. During 1917 and 1918 this mine was one of the principal Canadian producers and during the two years a total of 13,000 tons of crude ore and 900 tons of concentrate were sold, the grade of the crude being 32 per cent, and of the concentrate, 48 per cent. The area was mapped in detail recently by the Bureau of Geology and Topography, Ottawa. The company intends to explore the orebody at depth by drifting from the bottom of an old 200-foot shaft, and to erect a mill if sufficient tonnage of commercial ore is indicated. Two samples of the Sterrett ore, totalling 1,000 pounds, were sent to the ore dressing laboratories at Ottawa for concentration tests, and the results obtained were satisfactory. Several properties in the Coleraine area were prospected, but no shipments were made during 1940 other than a trial car lot by A.T. Ward from Coleraine, range X, lot 7, to ascertain its suitability for refractory use.

In British Columbia, prospecting was carried out on chromite properties north of Ashcroft; near Cascade, close to the United States boundary; and near Westbank, 25 miles west of Okanagan Lake.

Canadian production and trade figures for 1940 are not available for publication owing to the war. The world annual production just prior to the war was about 1,300,000 tons. Russia, Turkey, South Africa, and Southern Rhodesia are or were producing 200,000 tons or more a year. Countries producing 50,000 tons or over are the Philippines, Cuba, New Caledonia, Yugoslavia, and Greece. Russia is probably the largest producer, but no records are available since 1936, when the output was about 217,000 tons. The most important deposits are in the Saranov district of the Ural Mountains. The exports are said to be small as the output is consumed in domestic industries.

In Turkey, the deposits are widely distributed, but in recent years much of the ore has come from the Guleman mines in Eastern Anatolia, now a leading producer of chromite. The ore is lumpy and of good metallurgical grade (49 to 52 per cent Cr_2O_3), low in silica, and has a chrome-iron ratio of three to one. The deposits are controlled by the Eti bank.

Chromite represented 45 per cent of Turkey's total mineral output in 1939, and more than 60 per cent of it went to Germany, the percentage of shipments to that country being still higher in 1940 as a result of the trade agreement in July.

The output from the Union of South Africa in 1940 was close to 200,000 tons, the Rustenburg district being one of the principal producing centres. The iron content is somewhat high, but ore containing 43 to 46 per cent Cr_2O_3 is available in large tonnages. Most of the shipments go to England.

In Southern Rhodesia, production reached a world peak of 275,617 tons in 1937, but in 1939 the output was only half of that tonnage. Chrome Producers, an association of five independent producers, obtains its supply from the Great Dyke seam, which extends north from Darwindale for 70 miles, and the shipments are made from Beira. Rhodesian Corporation ships from the deposits in the Selukwe district. When more labour is available and when transportation difficulties are overcome, it is expected that the output will reach 300,000 tons annually. Most of the ore comes from underground workings and is hand sorted and shipped in lump form and in two grades; No. 1 grade is guaranteed to meet all specifications for metallurgical ore, while No. 2 grade is semi-friable, tends to crumble in transit, and its chrome-iron ratio is less than three to one.

The Philippine Islands has been an important producer of chromite in recent years. The mineral is known to occur in twelve scattered areas, the principal of which is the Luzon zone in Zembales Province, where ore of a grade in excess of 51 per cent has been shipped. The largest single deposit, near Masinloc, is reported to contain 10 million tons of low grade (33 per cent) ore, suitable for refractory uses. Many large areas in which chrome may occur are as yet unexplored. Exports of Philippine chrome ore in 1939 amounted to 73,068 metric tons.

The entire Cuban production, which in 1939 amounted to 67,061 metric tons, is shipped to the United States. As the ore has a low chrome content, it is used mainly in the refractory industry.

In British India, the States of Mysore and Baluchistan are the principal sources of supply, the total annual output being about 50,000 tons. Canada imported about 8,000 tons from British India in 1940, close to half of which was used for refractories. The imports included ore for Canadian Government stock piling. The grade is from 45 to 50 per cent Cr_2O_3, the silica content being 0.66 per cent. The Mysore Government has approved of a plan to establish a factory at Belagla to make about 1½ tons of sodium bichromate daily from local ore.

The French Colony of New Caledonia, an island off the east coast of Australia, has been shipping over 50,000 tons a year for a number of years, the mines being operated by British and American concerns. The ore grades about 55 per cent Cr_2O_3.

Production in the United States is mostly from California and increased from 812 long tons in 1938 to 3,614 tons in 1939. United States Chrome Mines, Incorporated is the principal producer, and its holdings include the Pillikin mine in El Dorado county, California. This mine was the chief producer during the last war and in 1939 it was the source of all but a small part of the American output. A 300-ton mill has recently been erected at the property. The company is reported to own two-thirds of the chrome properties in California, Oregon, and Washington. The United States imported 630,000 long tons of chrome in 1940, the figure being about double that of 1939.

Owing to the great difference between domestic production and consumption, chromite is considered as one of that country's principal 'strategic' minerals. Stock piling through the Procurement Division of the Treasury Department started following the signing of the Strategic Minerals Act of June 1939, but in recent months activities have been hampered by lack of shipping and high ocean rates and prices. Purchases have thus been limited to metallurgical grade only, though purchases of refractory and chemical ore were started late in 1940 by the newly created Metals Reserve Company (see below for specifications of grades). The United States Bureau of Mines and Geological Survey are conducting exploratory work in Montana, Oregon, Washington, and Alaska where chrome deposits are being mapped, test pitted, and drilled. The largest reserve indicated to date is in Sweetgrass and Stillwater counties, Montana, but the ore is low in grade, though tests by the Bureau of Mines indicate that it can be concentrated and made suitable for the chemical industry at least. As a result of the great expansion by the United States Chrome Mines Incorporated and of Government research, it is likely that the United States production of chromite will show a substantial increase.

Chromium is one of the principal elements used in the manufacture of alloy steels, more particularly those that are stainless and resistant to corrosion. The chrome ore is usually converted to ferrochromium before being added to the steel bath. Standard grades of ferrochrome contain a minimum of 60 to 70 per cent chromium and are produced in two grades, one being a high carbon ferro containing four to six per cent carbon, and the other, a low carbon grade containing less than two per cent carbon. Chromium Mining and Smelting Company, Sault Ste. Marie, Ontario, produces an addition agent known as Chrom X, an exothermic alloying agent compounded with chromium and silicon. Both high and low carbon Chrom X products are on the market.

Metallurgical ores should contain not less than 48 to 50 per cent Cr_2O_3 and as little iron as possible. The Cr-Fe metal ratio should be at least three to one, for when the ratio is less the melt will not yield a 60 to 70 per cent chromium ferro, even from a 50 per cent ore. Sulphur must not exceed 0.50 per cent; and phosphorus 0.20 per cent. In most manufacturing operations, lump ore is most desirable and ordinarily, only a small amount of fines or concentrate is used. Some of the large manufacturers, however, now use concentrates. One chromite producer in the United States has overcome this difficulty by making a synthetic lump or briquette of the concentrate. For some types of high carbon steels, ores as low as 42 to 45 per cent Cr_2O_3 are employed, but the iron content must be low.

An appreciable quantity of chromite with certain physical and chemical properties is used for refractories. Specifications for ore suitable for bricks vary somewhat, and depend to some extent upon the kind of brick to be made. A Canadian manufacturer indicates maxima allowances of 20 per cent Fe_2O_3; 18 per cent Al_2O_3; and 4 per cent SiO_2. The silica should be as low as possible and it usually occurs in the ore, not as free silica, but as serpentine, a hydrated magnesium silicate, which has a comparatively low melting point. It is highly important that the silica be evenly and very finely distributed throughout the ore and not as visible lumps or particles of the silicate. The ore should also be hard and lumpy, and the lumps should be plus 10 mesh. Provided these impurities are within the above specifications, the chromium content may vary within certain limits, but it is generally between 40 per cent and 45 per cent Cr_2O_3.

Ground chromite is used for chromite cements and for plastics that are used in building and patching furnaces; in laying sub-hearths; and for furnace tap holes.

Chromite is used in the manufacture of chromic acid for electroplating, and also in the making of sodium bichromate, chromic oxide, and other chemicals. The former is used largely in the tanning of leather, and the latter as a pigment.

Except for those suitable for refractories, there is little sale at present in Canada for ores under 40 per cent Cr_2O_3, so that for metallurgical purposes, ores below this grade would have to be concentrated. Most Canadian chromites are relatively free from heavy sulphides and can be concentrated by ordinary gravity methods. High iron or magnetite-chrome ores undergo a preliminary roasting or straight magnetic separation. During the last war, the 67,000 tons of ore milled from the chromite deposits in Quebec averaged about 11.5 per cent Cr_2O_3 from which 11,000 tons of 49 to 50 per cent Cr_2O_3 concentrate made by the gravity process was shipped. At present prices, it is questionable if an ore under 10 per cent could be treated profitably. The possibility of using the "sink and float" method of raising the grade of an ore from as low as 5 per cent up to 25 or 30 per cent Cr_2O_3 as a preliminary to gravity treatment is being investigated. This method costs less than 15 cents a ton, and is based upon the use of a "heavy" solution of suspended fine galena (lead sulphide) in which the light gangue or rock floats, and the heavy materials, such as chromite, sink.

Owing to war demands, prices are constantly changing. United States quotations in December 1939, for 48 to 50 per cent Cr_2O_3 ore were $26 to $28 a long ton c.i.f. North Atlantic ports. Early in 1941, quotations were $36 to $38; and for lower grades $32 to $33. For refractory ores of 41 to 45 per cent Cr_2O_3 they were $23 to $25. The price of Canadian 40 per cent ore, f.o.b. cars at mine is about $26.

High carbon ferrochrome, 66 to 70 per cent chromium and 4 to 5 per cent carbon is now about 11 cents a pound and low carbon ferro, 16 to 20 cents a pound of contained chromium.

The present large Canadian consumption of imported chromite is likely to increase appreciably during the war and the situation is becoming acute. All the large producers, except Cuba, lie in the eastern hemisphere and heavy shipping losses and ever-increasing ocean freight rates are being experienced. Even the Cuban output will be wholly absorbed by the United States. In the autumn of 1940, some action was taken by the Government at Ottawa in the way of surveying and mapping properties. Apart from the activities of H.B. Fletcher, and Chromite Limited, very little effort appears yet to have been given to developing home production by private corporations or individuals. Early in 1941, however, a Government investigation was started as a means of stimulating activity. Although an eventual large output of high grade lump ore is not expected, it is believed that the known low grade deposits could yield a substantial output of metallurgical grade concentrate such as was produced in 1917 when the output amounted to 24,000 tons.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

COBALT IN 1940

Most of the cobalt produced in Canada has come from the silver-cobalt mining camps at Cobalt, Gowganda, and South Lorrain in northern Ontario. It is obtained mainly as a by-product of silver mining, and thus the output varies largely in accordance with the extent of such operations. Some ore, however, is mined chiefly or solely for its cobalt content. Apart from the silver-cobalt camps of Ontario there are no known occurrences of cobalt in Canada that give promise of commercial importance. Production has been maintained in recent years by lessees working over old surface dumps and mining narrow surface veins and old underground workings.

Cobalt Products Limited, of Cobalt, Ontario, has been operating a concentrating plant since 1938 and is now the main producer of cobalt in Canada. The ore is obtained from various surface dumps and from underground workings at one or two properties. Flotation concentrate carrying 10 to 18 per cent cobalt is either sold direct or is treated in a cupola to produce a silver-cobalt matte.

The only plant in Canada treating ores for the recovery of cobalt is that of Deloro Smelting and Refining Company, Limited, at Deloro, Ontario, which produces cobalt metal, oxides, and salts, chiefly for the British market. A considerable portion of the Canadian cobalt ore is sold for treatment abroad.

Small amounts of by-product cobalt are reported to be recovered in Europe from the refining of Canadian nickel-copper matte, but the quantities are not recorded in Canadian statistics.

Canadian production and trade figures are not available for publication owing to the war.

The total annual world output is estimated to approximate 6,000 metric tons. The greater part of the world's 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, so far of lesser importance, are Australia, Japan, Germany, and Russia.

About 75 per cent of the world production of cobalt is used in the metallurgical industry and most of the remainder 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 the alloy stellite continues to spread throughout the world, and has been found of great value in the manufacture of valves for aeroplane 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. A large amount of cobalt is now used as a catalyst. Cobalt oxide is used mainly in the ceramic industry owing to its fine colouring properties. Other compounds of cobalt are used as driers in paint and varnish.

Mainly owing to the agreement reached in 1935 by the principal producers, the price of cobalt has remained fairly constant in recent years. The nominal New York price (as quoted by Metal and Mineral Markets) for cobalt metal imported from Belgium, remained at $1.92 per pound throughout the year. The nominal price for cobalt ore, 13 per cent grade, f.o.b. cars, Ontario, remained at 70 cents per pound of cobalt from January to December when it was increased to $1.00 per pound.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

COPPER IN 1940

Canada's output of copper is obtained from the copper-nickel ores of Sudbury, Ontario; the copper-gold ore of the Horne mine at Noranda, the copper-zinc ores of Waite-Amulet and Normetal mines, and the copper-pyrites ores of the Aldermac mine, in Quebec; the copper-zinc ores of the Flin Flon and Sherritt-Gordon mines in northern Manitoba; the copper-zinc pyrites ores of the Britannia mine, and the copper ore of Copper Mountain mine in British Columbia.

In British Columbia, Britannia Mining and Smelting Company operated its mines and concentrator at Britannia Beach. The copper concentrate, as in past years was shipped to the Tacoma smelter in Washington State. Most of the pyrites concentrate was added to the stock pile to await more favourable market conditions and part of it was shipped to the acid plant of Nichols Chemical Company at Barnet, B. C. Development work was started below the 4,100-foot, or bottom level. Very little change was made in the metallurgical treatment.

Granby Consolidated Mining Smelting and Power Company, Limited, operated its Copper Mountain mine and its concentrator at Allenby, near Princeton. The copper concentrate was shipped to the Tacoma smelter. The power plant and the concentrator were both enlarged during 1940.

At Flin Flon, Manitoba, Hudson Bay Mining and Smelting Company, Limited, operated its mine, concentrator, copper smelter, and zinc plant at capacity. The new South main shaft was completed to the 2,500-foot level, with ore pockets and crusher stations immediately below the 2,210-foot level. The surface plant was completed with the installation of the new ore hoist. Changes in the flow sheet and additional thickening equipment permitted the treatment of a higher daily tonnage in the concentrator in 1940. The copper smelter treated a larger tonnage of pay materials. A holding furnace, pelletizing plant, and more adequate equipment for handling flux were being installed at the end of the year.

In Ontario, International Nickel Company of Canada, Limited, operated its Frood, Frood Open Pit, Creighton, Levack, and Garson mines. Ore shipments from the Frood Open Pit which were commenced in January, 1939, were continued at an increased rate in 1940. The concentrator at Copper Cliff was enlarged; and the mines and smelters were operated at a rate sufficient to meet the increased demands for war requirements.

Underground development at Falconbridge Nickel Mines, Limited, was adequate to maintain substantially the ore reserves in regard both to tonnage and grade. About sixty per cent of the ore hoisted for treatment was milled and the resulting concentrate was sintered. The rest of the crude ore was smelted, together with the sinter, to produce matte, of which about thirty-one per cent was refined at the company's plant in Norway up to the time of its occupation by the German forces in April, 1940. Under subsequent arrangement with the International Nickel Company, the rest was handled at that company's plants at Port Colborne and Copper Cliff.

Nickel Offsets, Limited, with a property in Foy and Bowell townships, west of Capreol, Sudbury district, continued the extensive surface exploration and diamond drilling that was started in 1939. Denison Nickel Mines, Limited did not operate its property in Denison township, northwest of Sudbury. Ontario Nickel Company did no work on its holdings in the Sudbury district and in other parts of Ontario.

In Quebec, Noranda Mines, Limited, operated its Horne mine, its concentrator, and its smelter at capacity. Exploration and diamond drilling were continued on the levels from 3,500 to 4,000 feet and the sinking of an interior shaft from the 3,000-foot level was completed to a depth of 4,900 feet, the intention being to continue it to 6,000 feet before lateral work is undertaken. Back-filling of stopes which was begun in May, 1939, was continued at the rate of about 8,000 tons per day. A mixture of reverberatory furnace slag reclaimed from old dumps, granulated current slag, and pyrrhotite tailings from the concentrator is being used as filling. The pyrites concentrate, a by-product of the milling process, was being marketed for acid manufacture.

Waite-Amulet Mines, Limited, continued the exploration and development of its large high-grade orebody discovered in 1938. Its new concentrator, completed and put in operation in October, 1939, was enlarged during 1940.

Aldermac Copper Corporation, Limited, with mine and concentrator, situated twelve miles west of Noranda, Quebec, operated throughout 1940. The products consist of a copper concentrate which is shipped for treatment to the Noranda smelter, and a high grade iron pyrites concentrate which is exported to chemical plants in the United States. The main shaft of the mine was extended by 125 feet to a depth of 1,375 feet; the tenth, or bottom level was opened up; and exploratory crosscutting and diamond drilling was undertaken. On the surface, the east end of the property was explored by diamond drilling, and geophysical work was also carried out.

Normetal Mining Corporation, north of Dupuy Station on the Canadian National Railway, increased the capacity of its concentrator. The copper concentrate was shipped to the Noranda smelter, and the zinc concentrate was exported to the United States. Production was curtailed during the first quarter owing to a shortage of hydro-electric power, but for the rest of the year the concentrator operated at capacity and shipments of copper and zinc concentrates were made regularly. About 80 per cent of the copper produced is being sold under contract to the British Ministry of Supply, and the remainder is used in Canada. A new shaft (No. 3.) was sunk to connect with a raise from the 800-foot and intermediate levels, which in turn connects with the winze from the 800-foot to 1,400-foot level. It was then extended from the 1,400-foot level and had reached a depth of 1,868 feet at the end of 1940. It will be carried to a depth of 2,000 feet. Upon completion of the shaft and the ore pockets and ore passes, four new levels will be developed at 150-foot intervals below the 1,400-foot horizon.

International Nickel Company's copper refinery at Copper Cliff, Ontario, was operated at capacity. It treats the output of blister copper which is produced at the nearby smelter and which goes in molten form to the refinery's anode furnace. Refined copper is produced from reverberatory furnaces and from electric furnaces of the arc type. A second unit of the electric furnace was put in operation in 1939. A feature of the special shapes department is the production of machine-pointed vertically-cast wire bars.

The copper refinery of Canadian Copper Refiners, Limited, at Montreal East, Quebec, was also operated at capacity. This plant was enlarged during the year. It treats the anode copper from Noranda smelter and the blister copper from the Flin Flon smelter.

Canadian production and trade figures are not available for publication owing to the war.

Prior to the war, most of the Canadian refined copper went to Great Britain, where the consumption of new copper in peacetime was at the rate of about 250,000 tons annually. By agreements reached in

the early weeks of the war, Canadian producers are supplying about 70 per cent of their output of electrolytic copper to the United Kingdom at prices prevailing immediately prior to the outbreak of the war. Producers on the Pacific coast are continuing to export their product for treatment in the United States.

Owing to the special revenue tariff of 4 cents a pound, sales of Canadian refined copper in the United States had ceased in 1933, but were resumed in 1937 and are continuing. Concentrate shipped to the United States, chiefly from British Columbia, but also from Quebec, was treated in bond, all of the metal recovered being offered for sale abroad. Owing to its excellent quality, Canadian refined copper is much in demand. Most Canadian producers have the advantage of producing copper largely as a by-product in the recovery of gold, silver, nickel, or zinc.

The world production of copper in 1939 (figures for 1940 not yet available), as reported by the American Bureau of Metal Statistics, was 2,382,600 tons, compared with 2,187,000 tons in 1938. World consumption in 1938 (1939 and 1940 not yet available), as given by the American Bureau of Metal Statistics, was 2,174,000 short tons, compared with 2,407,700 short tons in 1937.

The United States is by far the greatest consumer of copper, the principal industries using the metal in that country being, in order of importance: the electrical manufacturing, automobile, building, electric refrigerator, and air conditioning. The last named industry is expected to consume large quantities of copper. Domestic consumption in the United States in 1940 rose from a low of 50,000 tons a month in April to about 90,000 tons in December. The total consumption in 1938 (1939 not yet available) approximated 522,000 tons compared with 878,200 tons in 1937. Ordinarily, the building industry is as large a consumer of copper and its alloys as is the automobile industry. Copper is one of the principal strategic metals in wartime.

A recent development of interest is the inclusion of small amounts of copper in steels and irons to improve their resistance to corrosion and their mechanical properties. Beryllium-copper is a new alloy, the use of which although increasing, is curtailed to some extent owing to the fact that the alloy requires special treatment and proper understanding. (London Metal Bul. January 26, 1940.)

The price of electrolytic domestic copper (London price in Canadian funds) averaged 10,086 cents per pound in 1940 compared with 10,092 cents in 1939. The New York price of domestic electrolytic copper averaged 11.296 cents a pound in 1940, compared with 10.965 cents in 1939. Owing to the 4 cent a pound duty, the foreign and domestic prices do not correspond.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

GOLD IN 1940

The chief source of gold in Canada in 1940 was, as for many years past, the gold-quartz mines which contributed about 85 per cent of the total. The contribution of the base metals mines is 12 per cent, and the balance of about 3 per cent is obtained from alluvial glacer operations.

Ontario is by far the most important producing province, contributing over three million ounces, or three-fifths of the total Canadian production. With the exception of the gold obtained as a by-product in the refining of nickel and copper (about 85,000 ounces), virtually all Ontario's gold comes from gold-quartz mines, Porcupine and Kirkland Lake being the principal producing areas. Important contributions (about 719,000 ounces) have been made in recent years from Little Long Lac and adjoining areas in Thunder Bay district; from Red Lake, Crow River, Sachigo River and Lake of the Woods areas in Kenora district; Larder Lake and Matachewan areas in Temiskaming district; and from Goudreau and Michipicoten area in Algoma district.

Quebec's chief producer is still the Noranda gold-copper mine, but the relative amount contributed by gold-quartz mines in the northwestern part of the province is increasing rapidly. Important contributions are being made by the mines in the Bourlamaque, Siscoe, Malartic and Cadillac areas in Abitibi county, and the Arntfield, Duparquet, Rouyn and Mud Lake areas in Temiscamingue county.

The chief source of gold in British Columbia is the gold-quartz mines of the Bridge River area, in Lillooet division, of the Salmon River area, in Portland Canal division; of Wells camp, in the Cariboo division; of Hedley camp, in Osoyoos division; of the Sheep Creek, Ymir and other adjoining areas in the Nelson division; and of Zeballos river, on the west coast of Vancouver Island. Next come auriferous base metal ores, notably those of the Britiannia and Copper Mountain mines. A relatively small amount is obtained from placer operations.

Manitoba's gold is derived partly from the copper-zinc-gold ores of the Flin Flon mine supplemented to a small extent by the Sherritt-Gordon mine, and to a greater extent (about 55%) from the gold-quartz mines of Rice Lake district in eastern Manitoba, of God's Lake district, and of The Pas district.

In Saskatchewan, the production is mainly from that portion of the Flin Flon mine lying west of the inter-provincial boundary, and to a small extent from the new mines near Goldfields, Lake Athabaska district.

In the Northwest Territories, production was started in 1938, this being obtained from the Yellowknife River area, on the north shore of Great Slave lake.

Yukon's gold output is virtually all from placers, and is won chiefly in large-scale dredging operations, mainly in the vicinity of Dawson City.

Nova Scotia's output is from the gold-quartz mines of Caribou, Goldenville, Seal Harbour, and a few other areas.

In Alberta, a small amount of place gold is reported annually.

Plants for the production of fine gold are operated by:

The Royal Canadian Mint, Ottawa, Ont.
Hollinger Consolidated Gold Mines, Ltd., Timmins, Ont.
International Nickel Company of Canada, Ltd., Copper Cliff, Ont.
Canadian Copper Refiners, Ltd., Montreal Que.
Consolidated Mining and Smelting Company, Ltd, Trail, B.C.

The Copper Cliff refinery provides a service for several of Canada's gold mines by working up their accumulation of slags, mattes, and other gold-bearing materials.

During 1940, great activity was manifest in the development of new mines, especially in the old Porcupine and Kirkland Lake (Larder Lake section) areas, in the Patricia section of Kenora district, and near Opeepeesway Lake, Sudbury district, Ontario; in the Cadillac-Malartic and adjoining areas, in western Quebec; in new areas of Yellowknife River, in the Northwest Territories; near Lake Athabaska in Saskatchewan; and in the Zebellos river area, on the west coast of Vancouver Island in British Columbia.

In 1940, 143 gold mills were in operation, with a combined daily capacity of 62,400 tons. Of this total 11 small plants were in operation only intermittently, and 8 plants ceased operation in the course of the year. New mills completed and put in operation numbered 12 with a combined daily capacity of 1,605 tons. In addition, there were 5 mills, with a combined daily capacity of 1,085 tons, under construction and scheduled to come into production in 1941.

In 1939 the total number of mills was 161 with a combined daily capacity of 57,815 tons. Fifteen small mills operated intermittently and 14 plants ceased operation in the course of the year. New mills put in operation numbered 26, with a combined daily capacity of 4,855 tons. In addition, 5 mills were under construction.

Increases to plant capacity in 1940 took place at 60 plants and totalled 5,690 tons, compared with 33 plants and a total of 3,085 tons in 1939.

(b) Operating Milling Plants

Year	New Mills		Total Mills		Increases	
	No.	Capacity Tons	No.	Capacity Tons	No.	Capacity Tons
1940	12	1,605	143	62,400	60	5,690
1939	26	4,855	161	57,815	33	3,085
1938	37	6,265	157	50,925	32	2,985

In Nova Scotia, several old properties were again put in operation in a small way. The two largest plants in Nova Scotia, the Seal Harbour (250-ton) and the Guysborough (100-ton) were operated continuously and to capacity.

In Quebec, the only new mill was the Powell-Rouyn with a capacity of 450 tons a day. There were 23 mills in continuous operation with a total daily capacity of 12,950 ton a day.

In Ontario, the new mills were: Aunor and Broulan, each with a capacity of 300 tons a day; Faymar, with a capacity of 200 tons; Devon, with a capacity of 100 tons; Mineral Milling Company, with a capacity of 150 tons (to treat old tailings); Orelia and Upper Seine, each with a capacity of 50 tons a day. There were 72 mills in continuous operation with a total daily capacity of 37,235 tons a day.

In Manitoba and Saskatchewan there were no new mills during the year. There were 6 mills in operation with a total capacity of 5,750 tons a day.

In British Columbia the new mills were: Consolidated Nicola, with a capacity of 100 tons a day (renovated plant); Alpine, a 50-ton mill; Homeward, a 35-ton mill; Piedmont, a 25-ton mill; Stewart Canal and Winslow, each with a 15-ton mill. There were 31 mills in operation with a total daily capacity of 5,655 tons; nine of these mills were operated only intermittently.

There were no new mills during the year in the Northwest Territories. There were two mills in continuous operation, the Con with a capacity of 175 tons a day, and the Negus with 65 tons a day.

New mills under construction which will be operating early in 1941 are: in Quebec, Rochette, a 300-ton mill; in Ontario, Hoyle and Jerome, each with a 500-ton mill; in Manitoba, Century, a 125-ton mill; in the Northwest Territories, Thompson-Lundmark and Ptarmigan, each with a 150-ton mill, and Giant Yellowknife, a 25-ton mill.

The gold production of the Dominion in 1940 was 5,322,857 fine ounces, valued at $204,929,995, compared with 5,094,379 fine ounces, valued at $184,115,951 in 1939, a gain of 228,478 fine ounces and of $20,814,000. The 1940 output was an all-time high record.

By provinces the production was as follows:

	1939		1940	
	Fine Ounces	$	Fine Ounces	$
Nova Scotia	29,943	1,082,170	22,219	855,432
Quebec.....	953,377	34,455,998	1,019,413	39,247,400
Ontario				
Porcupine.....1	,312,702			
Kirkland Lake.	941,371			
Others.....	832,003			
Total Ontario....3	,086,076	111,533,872	3,260,536	125,530,636
Manitoba.....	180,875	6,537,003	152,295	5,863,358
Saskatchewan....	77,120	2,787,194	102,925	3,962,618
Alberta.....	359	12,975	215	8,278
British Columbia	626,970	22,659,323	629,623	24,240,486
Yukon.....	87,745	3,171,192	80,531	3,100,443
N. W. T.....	51,914	1,876,224	55,100	2,121,350
CANADA	5,094,379	184,115,951	5,322,857	204,929,995

The value of Canada's gold production in 1940 was about 53 per cent of the total value of all metals and 38 per cent of the total value of the entire output of the Canadian mineral industry.

The world production of gold in 1940 is estimated at 41,936,000 fine ounces (as given by the Engineering and Mining Journal), compared with 39,462,600 fine ounces in 1939 (as given by the American Bureau of Metal Statistics). Canada ranks third after South Africa and Russia as a world producer, and contributes about 12 per cent of the total output. In the past 15 years the gold production of the world has more than doubled. The United States Treasury continued to add to its gold reserves, now valued at 22 billion dollars, said to be equal to ove. two-thirds of the world's monetary gold.

After war was declared the price of gold rose in September, 1939, to an average of $37.21 as a result of the adverse exchange with the United States; in the latter part of 1939, in view of the premium of 10 per cent on United States funds, the price averaged about $38.50. The average at which Canada's gold production as computed for the year 1940 was $38.50 per fine ounce.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

IRON ORE IN 1940

Deposits of iron ore in Canada are many and widespread and include hematite, siderite, magnetite, bog iron, and magnetic sand. Because of the availability at low cost of higher grade ores in the Lake Superior iron ranges of the United States and in Newfoundland, no iron ore from domestic sources was produced in Canada from 1923 until 1939. In July of that year, as a result of a bounty of two cents a unit provided by the Ontario Government, Algoma Ore Properties, Limited, a subsidiary of Algoma Steel Corporation, commenced the production of sinter at its New Helen mine in the Michipicoten area, Ontario.

The New Helen deposit is estimated to contain at least 100,000,000 tons of carbonate ore, averaging about 35 per cent iron. To fit it for use in blast furnaces a sintering plant capable of treating 3,000 tons of ore a day was built, the analyses of the sinter being as follows:

Iron	53.40%	Alumina	2.06%
Phosphorus	0.03	Lime	3.95
Silica	7.00	Magnesia	7.50
Manganese	3.00	Sulphur	0.035

The beneficiated ore is shipped to the company's blast furnaces at Sault Ste. Marie, Ontario, and to United States ports on the lower lakes for use in American blast furnaces.

Steep Rock Lake Iron Mines, Limited, continued its program of exploratory and development work on its hematite property near Atikokan, about 135 miles west of Port Arthur, in preparation for production. This work indicates that the deposits, which were discovered in the winter of 1937-38 by diamond drilling through the ice, are large and contain a high percentage of iron. A shaft was sunk to a depth of over 800 feet, from which a crosscut was driven at the 800-foot horizon toward the orebody. One of the diamond drill holes drilled from this crosscut intersected the ore. Water trouble was encountered, however, and it will thus be necessary to pump out part of Steeprock lake. The development program of the company includes the diversion of the Seine river and the drainage of Steeprock lake for open pit mining of the large orebodies already indicated. This deposit is one of the most important discoveries made in Canada for some time.

Dominion Steel and Coal Corporation with plants at Sydney, Nova Scotia, obtains its iron ore from its own mines at Wabana, Newfoundland. Steel Company of Canada at Hamilton, Ontario, and Canadian Furnace Limited, at Port Colborne, Ontario, obtain their iron ore from the Lake Superior region of the United States. Algoma Steel Corporation supplements its requirements with imports from the same source.

Bounties on the production of iron ore are offered by the provinces of Ontario and British Columbia.

Canadian production and trade figures are not available for publication owing to the war.

The demand for primary iron and steel was supported in 1940 by the heavy demand for war purposes.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

LEAD IN 1940

Most of the lead produced in Canada comes from Consolidated Mining and Smelting Company's great Sullivan silver-lead-zinc mine at Kimberley, British Columbia. Other important sources of production have been the Monarch silver-lead-zinc mine near Field, and numerous silver-lead and silver-lead-zinc mines in the Kootenay and other districts in British Columbia; the high-grade silver-lead mines of the Mayo area, Yukon; various lead mines in Ontario, from which there has been no production for a number of years; the lead-zinc mine in Portneuf county, Quebec; and the lead-zinc-copper mine at Stirling, Cape Breton, Nova Scotia.

In British Columbia, the lead and zinc concentrates produced in the concentrator at the Sullivan mine are shipped by rail 185 miles to the company's smelter and refinery at Tadanac, near Trail. The Monarch mine of Base Metals Mining Corporation, Limited, was reopened in the latter part of 1939, but production did not commence until January, 1940. Western Exploration Company increased the capacity of its concentrator at Silverton to re-treat the old tailings accumulated during previous operations, mainly for the purpose of recovering the zinc. The company's Mammoth mine was also being prepared for production. The Lucky Jim mine, at Zincton, was taken over by Zincton Mines, Limited, a new company owned by Sheep Creek Gold Mines, Limited. The mine and concentrator were prepared for production early in 1941. Operations were resumed at the old Cork Province mine in the fall of 1940. The New True Fissure mine and concentrator were also in operation. Several small lead-zinc properties, mainly in the Ainsworth-Slocan district were shipping crude ore to the Trail smelter. The lead smelter and the electrolytic lead refinery at Trail, the only such plants in Canada, were in continuous operation.

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

The Tetreault property near Notre-Dame-des-Anges, Portneuf county, Quebec, and the Stirling property, Cape Breton, Nova Scotia, remained idle in 1941. When produced, the lead and zinc concentrates are exported.

Canadian production and trade figures are not available for publication owing to the war.

World production in 1939, (figures for 1940 not available) as published by the American Bureau of Metal Statistics, was 1,899,000 short tons, compared with 1,878,500 tons in 1938, and a peak production of 1,933,000 short tons in 1929. The principal producing countries are, in order of importance: United States, Mexico, Australia, Canada, Germany, Belgium, India (Burma), and Russia.

The world consumption in 1938 (1939 and 1940 not yet available), as given by the American Bureau of Metal Statistics, was 1,638,100 metric tons, compared with 1,731,400 metric tons in 1937. The Canadian peace-time consumption of lead is probably between 35,000 and 40,000 short tons a year. In the United States lead continues to be used chiefly in the storage battery, lead pigment, cable covering, building, and ammunition industries. Lead is used in so many industries that business improvement in any direction is reflected in the demand for the metal. Consumption of lead in the United Kingdom has been increasing in recent years and prior to the war it amounted to about 450,000 short tons a year, a figure much higher than that for 1929. The demand is now governed largely by the use being made of the metal in the manufacture of armaments.

Much interest has been shown recently in combinations of lead with iron, particularly leaded steel. A lead coating is being used as a lubricant for successive withdrawing operations on alloy steel, the coating being removed finally with the use of solvents. Lead-base bearings are still used extensively in low speed applications.

Radio-active lead chloride and radio-active lead oxide is now being produced as a by-product at the radium refinery at Port Hope, Ontario.

The average price of pig lead (quotations on the London market, converted to Canadian funds) in 1940 was 3.362 cents a pound, compared with 3.169 cents in 1939. The average price at New York was 5.18 cents, compared with 5.05 cents in 1939.

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DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

MANGANESE IN 1940

The manganese ores that have been mined in Canada are pyrolusite (MnO_2), psilomelane (H_4MnO_5), manganite ($Mn_2O_3H_2O$) and braunite (Mn_2O_3), all of which are black or grey-black and comparatively hard, and bog manganese, a soft earthy black oxide. Pyrolusite is the most common and most important and when pure contains 63 per cent manganese. It is much softer than the other hard rock ores and can be distinguished in the field by the ease with which it blackens the fingers. Most of the hard rock deposits are replacements in limestone, but they also occur in the form of accumulated nodules and cementing material in siliceous sediments, and as veins in metamorphosed pre-carboniferous rocks.

In Canada, manganese is a strategic metal in the sense that the production from domestic sources of supply is small and is far short of the wartime requirements. It has come mainly from the limestone replacement type of deposits, but vein deposits have contributed much of the recent output. There is little demand for bog manganese and then only if it is of the highest grade manganese dioxide. All of the manganese ore (mainly pyrolusite) produced in Canada in 1940 came from Atlantic Manganese Corporation's property eight miles north of New Ross, Lunenburg county, Nova Scotia, and in 1939 the output came from the Turtle Creek mine in New Brunswick.

Production and trade figures for 1940 are not available for publication, however, owing to the war.

The production of manganese ferro-alloys in Canada in 1939 was more than double that of 1938 and consisted of ferromanganese, spiegeleisen, and silico-manganese. Less spiegeleisen was produced in 1940 than in 1939 and most of it was exported to the United States. In contrast, the output of silico-manganese was several times that of 1939, and there was a twofold increase in the output of ferromanganese. Most of the exports of these two alloys in 1940 went to England. Imports into the United States are subject to a duty of about two cents a pound of metallic manganese on grades of 30 per cent or over, but this duty does not apply to spiegeleisen, which is less than 28 per cent manganese.

Canada has been importing most of its requirements of manganese ore from the Gold Coast, West Africa, but owing to the risks involved in shipments from that country, and to the fact that the United States has been producing only a small part of its ferro grade requirements from domestic sources and consumes all of the output from Cuba, it is probable that the Dominion may be required to obtain most of its requirements from Brazil and Chile.

Close to 200 deposits of manganese are known in Canada and most of them are in the Maritime Provinces. For the most part they are low grade replacement, or bog deposits, and there are only a few localities from which high quality ore has been mined. Since 1886, when records were first kept, about 16,500 short tons of manganese ore has been produced, close to half of it in the succeeding four years. More than 20,000 tons is known to have been produced, however, between 1862, when manganese mining first started, and 1886. During the war period, 1915-1918, about 1,784 tons was shipped, the largest output in this period being 957 tons in 1916. Production since 1918 has been small and intermittent.

Since the outbreak of the present war, much interest has been shown in the development of known deposits and in the search for new sources of supply, and in 1940, active attention was given to the exploration of several old properties. Prospecting to date, however, indicates that little high grade ore remains in these old properties, most of which were operated about 50 years ago, though the presence of a fair tonnage of medium grade ore is likely. Such ore would be suitable for the manufacture of ferro-manganese but only if some economic process of beneficiation could be applied. The deposits on the Magdalen

Islands, referred to elsewhere, appear to show promise of commercial development. Several of the islands have yet to be prospected.

In Nova Scotia, East Mountain Mining Company extracted and stock piled some high grade ore from a property near Truro, and in January 1941, the company started to erect a reduction plant at Truro to produce metallic manganese by the Electro-thermite process. Some recently discovered large bog ore deposits in Cape Breton were prospected and the deposit and dumps of the old Tenecape mines at Minas Basin, Hants county, were sampled and surveyed by the Nova Scotia Department of Mines.

In New Brunswick, activity was more widespread than in Nova Scotia. The Markhamville area, eight miles south of Sussex in Kings county, was in the past, one of the principal producing districts, and from it close to 25,000 tons of ore is estimated to have been mined between 1862 and 1895. The ore occurred as nodules in residual clay and as lenses in limestone. The old workings, which extend for 3000 feet in the Windsor limestone, were surveyed by the New Brunswick Department of Mines in 1940. More than 70 claims were staked along the limestone outcrop for a distance of 12,000 feet by companies and syndicates formed during 1940. Nothing of importance appears as yet to have been accomplished. At the end of 1940, Kirwin and Boyle of Boston, Massachusetts, was granted a large reserve in the Markhamville area covering many of these claims. This syndicate intends to prospect its holdings in 1941. The old Jordan Mountain mine, seven miles north of Sussex, Kings county, which was last worked in 1887, has been reopened by Sussex Manngganese Mining Company. By the end of 1940 the company had uncovered the extension of a 6-foot vein of manganese ore in breccia and later it sent a bulk sample to the Bureau of Mines at Ottawa for testing. This company is also examining the old Glebe mine, eight miles southeast of Sussex.

In Albert county, N. Vincent of Toronto is investigating the old Shepody Mountain property, three miles from Hopewell; and the old Memel mine, about a mile from Hopewell Hill station, was investigated by Allison Peck of Hillsborough, who later transferred the mineral rights to Pilot Molybdenite Mines, Limited, of Toronto. The recent workings of the mine, which are scattered over an area of about 2,000 square feet, were surveyed by the New Brunswick Department of Mines in 1940. A sample of several hundred pounds of the ore, which is a manganese conglomerate, was sent to Ottawa in the fall of the year, but was much too low in grade (2.5 per cent Mn) to test. Ore of higher grade is said to have been since discovered. From the Turtle Creek mine near Berryton, in Hillsborough parish, I.G.O. Fenton of St. John, shipped 392 tons of ore in 1939, this being the only manganese ore produced in Canada in that year. Diamond drilling of the property by the New Brunswick Department of Mines failed to disclose any large orebodies and apparently, little work was done at the mine in 1940.

The Gowland Mountain property, four miles east of Elgin station, is one of the most promising of the recently prospected manganese deposits in New Brunswick. When worked between 1885 and 1890, little ore was shipped, but in 1934, when it was reopened by I.G.O. Fenton of Manganese Limited, a fissure vein containing a good grade of manganese ore was discovered. The vein is in fine grained granite and was opened for a distance of 250 feet by a series of pits. From it about 100 tons of high grade ore was shipped in 1936. Nabco Manganese Mining Company of Toronto purchased the claims in 1940 and intends to tap the vein by means of a low level adit. About half a mile east of the Gowland Mountain area, M. Harrison recently prospected a fractured granite containing small manganese veins. The Gowland Mountain property, as well as the bog manganese deposits at North Renous and Grainfield in Northumberland county, owned by C.W. Singleton, were

surveyed and sampled in 1940 by the New Brunswick Department of Mines. Many of the manganese deposits in the Maritime Provinces were examined in 1940 by L.J. Weeks of the Department of Mines and Resources, Ottawa.

In Quebec, interesting deposits of manganese ore occur in the Magdalen Islands, which lie in the Gulf of St. Lawrence, about half way between New Brunswick and Newfoundland. The ore is known to occur on some of the islands, but the principal deposits worked are on Grindstone Island, the centre of the group, and on Amherst Island. Late in 1939, claims were staked by J.W. Storer of Toronto, representing British American Oil Company and by W.G. Porter, representing R. F. Hardy of Toronto. Early in 1941, the Storer holdings were incorporated under Magdalen Manganese Mines, Limited. Some of the deposits on the Magdalen Islands were examined and reported upon in the fall of 1940 by F.J. Alcock of the Department of Mines and Resources, Ottawa. About three-quarters of the surface of all the islands is covered by a recent capping of red sandstone, under which, in many places, the manganese-bearing rocks occur. The ore occurs as high grade nodules in limestone that contain 47 to 48 per cent manganese, this variety being characteristic of Grindstone Island, and as silicified and disseminated nodules up to two feet across as a replacement in sandstone. The latter nodules contain from 25 to 30 per cent manganese and from 45 to 50 per cent silica and are characteristic of Amherst Island. Nodules of the ore in both islands occur in several places mixed with the soil.

Various bulk samples of both varieties of ore weighing from 100 pounds to two tons were tested in Ottawa in 1940 and early in 1941. From the Grindstone Island nodules in limestone, a concentrate of over 53 per cent manganese and 4.0 per cent iron was obtained by ordinary wet gravity methods. Even from the low grade ore (5.0 per cent Mn) comprising the rest of the rock a 43 to 46 per cent manganese concentrate was obtained. The silicified material from Amherst Island, however, was not successfully concentrated. Prospecting and diamond drilling is being carried out. It is possible that a large tonnage of high grade ore occurs in the limestone underlying the red sandstones of some of the islands of the Magdalen group.

In Manitoba, several bog manganese deposits were prospected, mainly in the vicinity of Riding Mountain, near Rossburn and Birtle, about 200 miles west of Winnipeg. Many of the deposits, which are in the form of small shallow basins, were examined and tested in 1940 by the Department of Mines and Natural Resources, Winnipeg.

In British Columbia, A.J. Curle worked his bog manganese deposits seven miles northwest of Kaslo on the west side of Kootenay lake and also his claims seven miles farther west, where a belt of manganiferous siderite runs along the bank of Kaslo creek. Samples from both localities were sent to Ottawa for testing. Dan McIntosh of Revelstoke prospected a deposit of rhodochrosite (manganese carbonate) on Sproat Mountain, four miles north of Arrowhead. F.B. Bass of Wells did some prospecting on a pyrolusite deposit at Chimney Creek bridge near Williams lake in the southern part of Cariboo area. A small sample of the crude ore ran 25.52 per cent manganese and 1.06 per cent iron. Samples of manganese ore of varying grade were received from other localities in British Columbia.

Since the outbreak of the war, figures of production for many countries are unobtainable, but there have been marked changes in the flow of supplies. Estimates of world production are in the neighbourhood of 6,000,000 tons annually, the chief producing countries in order of output being Russia, British India, Union of South Africa, Gold Coast (West Africa), Brazil, and Cuba. Russia produces close to 3,000,000 tons annually, the output being mainly from the Chiaturi

deposits in Georgia and from the Noikopol deposits in the Ukraine. Russia was long the principal source of supply of high grade manganese ore for the United States, but in December, 1940, the shipments were discontinued. India produces close to a million tons of metallurgical grade ore a year. Most of exports of manganese in 1940 from India were taken by Great Britain and it was also the second greatest source of supply for the United States, its exports to that country amounting to 215,000 long tons of 50 per cent manganese.

The production from South Africa in 1940 was about 406,000 long tons, a slight decrease as compared with 1939. Most of the output comes from Griqualand West, Cape province. The ore was shipped in five grades of 35 to 52 per cent manganese. Exports through the port of Durban were mainly to the United States. One of the largest known single manganese deposits occurs on the Gold Coast at Nsuta, Wasaw district, and is operated by African Manganese Mines Company, Limited. The ore is of excellent metallurgical grade (48 to 52 per cent manganese). Exports from the district in 1939 were 336,000 long tons. Much of the output in 1940 was taken by England, but the district was also the main source of supply for the United States, shipments to which country amounted to 217,927 long tons of 51 per cent ore.

The output from Brazil reached more than 500,000 tons in 1917, but declined to 7,000 tons in 1934, after which there was a marked increase as a result of large exports to the United States, which in 1940, took the total output of 222,551 long tons of ore averaging 42 per cent manganese. In Cuba, the Cuban-American Manganese Corporation is the principal producer, its deposits being in Orient province. The plant was recently expanded to produce 130,000 tons annually, most of which is in the form of nodulized concentrate containing 51 per cent manganese. Exports to the United States in 1940 were 130,621 long tons.

The United States produced 40,000 long tons of high grade (35 per cent and over) manganese ore in 1940, a 30 per cent increase over 1939. About 50 per cent of the output came from Montana and a total of 30 per cent from Tennessee, Georgia, Arkansas and Virginia, the remainder being from nine other states. A total of about 1,300,000 long tons of ferruginous manganese, containing 10 to 35 per cent manganese, and manganiferous iron ore containing 5 to 10 per cent manganese were also produced, the amount being double that for 1939. Minnesota contributed 95 per cent of the output of the lower grade ores. In 1940, the United States imported 1,268,153 long tons of metallurgical ore grading 48 per cent manganese and over and 601,887 long tons of battery grade ore (80 to 85 per cent MnO_2), the total manganese content of both these grades being about 616,000 long tons, an increase of 82 per cent as compared with imports in 1939. In order of importance the imports in 1940 were obtained from Gold Coast, India, British South Africa, Brazil, Russia, and the Philippines. In each case the imports from the first three countries were in excess of 100,000 long tons of contained manganese. Brazil contributed 93,000 tons; Russia, 86,000 tons; Cuba, 64,163 tons; and the Philippines, 21,824 tons. Shipments from the Gold Coast were decreasing to a marked extent early in 1941, but those from India and South Africa were being maintained.

For many years the United States has been producing only seven per cent or less of its requirements of ferro grade manganese ore from domestic sources and has obtained about two-thirds of its high grade ore requirements from countries of the eastern hemisphere. Owing to the scarcity of ships, greatly increased ocean freight rates, and to the possibility of overseas supplies being cut off, the United States Government has taken various steps to prepare for future supplies and to increase domestic production. By the end of 1940, the Metals Reserve Company, which is associated with the Procurement Division of

the Treasury Department, had contracted for more than 2,000,000 tons of ore from all sources, about half of which is said to be already delivered.

The U.S. Bureau of Mines and the Geological Survey are mapping and diamond drilling deposits of merit and are also studying processes of recovering manganese from low grade ores that occur in large quantities in Minnesota, Arizona, and South Dakota, in the hope of supplementing production on a large scale. A leaching and electrical process, devised by the Bureau of Mines, is being used with success at Knoxville, Tennessee. The increase in government and private stocks; the close cooperation between government and industry, which has helped to solve metallurgical difficulties and to stabilize prices; the increase in production from domestic mines and from Cuba; and changes in furnace practice which permit, among other things, the use of lower grade ores, all tend to alleviate the present situation in respect to manganese in the United States.

It is estimated that about 90 per cent of the world consumption of manganese ore is used in the manufacture of iron and steel, and the ore so used is termed "Metallurgical". The remainder, termed "Chemical", is used for several purposes. Metallurgical ore is used for making ferro-manganese, spiegeleisen, and silico manganese, in which forms it is added to the steel bath. Manganese is beneficial mainly in improving the workability of the steel, and in improving the product by acting as a deoxidizer, a desulphurizer, and a re-carbonizer. On the American continent, an average of about 14 pounds of manganese is used in each ton of steel. Ferro manganese, containing 75 to 82 per cent manganese, is by far the most important addition agent, and to make it, the highest, or "ferro grade" ore is used.

Ferro grade ore must contain at least 48 per cent of manganese, the maximum allowance of iron being 7.0 per cent; of silica, 8.0 per cent; of phosphorus, 0.15 per cent; of alumina, 6.0 per cent; and of zinc, 1.0 per cent. It must be low in copper, lead, and barium, and the ratio of manganese to iron should not be less than seven to one. The ore should be hard and in lumps of less than four inches, and not more than 12 per cent of it should pass a 20 mesh screen. Soft ores, such as bog manganese, are objectionable. Specifications of ore required for silico manganese, used for high silicon alloys and steels, are much the same as for ferro, except that slightly less manganese and considerably more silica is allowed. Ores in which the manganese-iron ratio is too low for making "ferro" can in some instances be used for making spiegeleisen, which contains 19 to 28 per cent manganese, but there is little demand for spiegeleisen in Canada and the price of the ores is too low to encourage the mining of such deposits.

The Canadian market for metallurgical ore is confined mainly to two manufacturers of manganese ferro alloys, one at Welland and the other at Port Colborne, Ontario.

Chemical grade ores are used mainly in the manufacture of dry batteries. Specifications call for high grade pyrolusite because of its high available oxygen that acts as depolarizer. The ore should contain not less than 80 per cent, and preferably 85 per cent manganese dioxide (MnO_2) and not more than 1,5 per cent iron; 1.0 per cent alumina; 6.0 per cent silica; 0.07 per cent copper; less than 0.05 per cent of any other metal; and 1.0 per cent moisture. It should also be finely ground (85 to 90 per cent through 200 mesh). Canadian requirements of chemical ore range from 3,000 tons to 4,000 tons a year and practically all of it is used by three manufacturers of dry batteries in Toronto and another in Niagara Falls, Ontario. Chemical ore is used also in the glass and ceramic industries; as paint and varnish dryers;

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as pigments and dyeing materials; and as salts for fertilizers. Prices of chemical ore showed a gradual increase throughout the year. Quotations in the United States are based on a long ton unit (22.14 pounds) of metallic manganese in a 48 per cent or over manganese ore c.i.f. Atlantic ports, exclusive of duty of one-half cent per pound of the metal. Early in 1941, the United States quotations were 60 to 70 cents a long unit, or about $26 to $32 a short ton of ore of 48 to 52 per cent manganese for imported ores exclusive of duty, except Cuban ore which was 75 to 80 cents a unit, duty free. United States prices for imported chemical grade ore, minimum of 80 per cent MnO_2, are $55 to $60 and for minimum of 85 per cent, $70 to $75 a long ton in carlots; domestic 72 per cent, $45 to $50 in carlots, f.o.b. mines.

Little commercial success has been achieved in the treating of ores containing less than 15 per cent manganese, but the Technologic Committee on Manganese was organized in the United States recently to study and develop processes for the recovery of manganese from low grade ores.

In its beneficiation, much depends on the physical occurrence of the manganese mineral in the ore. Success has been achieved on Cuban ores averaging 18 per cent manganese by means of careful crushing, flotation, and then sintering the concentrate into hard nodules which contain over 50 per cent manganese. The low grade ores of Knoxville, Tennessee, are being successfully treated by the chemical and electrolytic Shelton process. Excellent results were obtained by the Bureau of Mines, Ottawa, on ore from Grindstone Island, Quebec. The nature of the ore was such that by ordinary gravity methods a jig concentrate of 52 to 54 per cent manganese and a table concentrate of 48 per cent manganese was obtained. The coarse mesh product assaying 28 per cent manganese, was tested by the "Sink and Float" process and the grade was raised to 52 per cent. In this process, separation is obtained by means of a dense solution containing fine galena in suspension, in which the gangue floats and the heavy minerals sink. The ore from Amherst, the neighbouring island, did not respond to these methods of concentration because of a difference in its physical properties.

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MERCURY IN 1940

Cinnabar (HgS), the principal ore of mercury, is a very heavy mineral (G = 8.1) with a deep cochineal-red colour and scarlet streak, and contains 86 per cent mercury. In Canada, the ore occurs in porous rocks such as altered limestones (ankerite), volcanic breccias or greenstones, and green and purple andesitic lavas. The cinnabar often occurs in veins and stringers of calcite or dolomite within these rocks, and may be associated with stibnite (antimony sulphide) and accompanied by globules of metallic mercury. The presence of mercury can be readily detected by heating a small piece of rock to about 300°C and placing it between an ultra-violet-ray lamp with purple filter and a screen coated with powdered willemite (zinc silicate). If mercury is present, a fume shadow will be cast on the screen. As little as 0.02 per cent mercury can be detected in this manner, but better results are achieved with a powdered sample.

The only known deposits of cinnabar in Canada are in British Columbia, by far the most important development being that on the northwest side of Pinchi lake, Omineca Mining Division, about 40 miles north of Vanderhoof station on the Canadian National Railway. The deposit was discovered in the summer of 1937 by J.G. Gray of the Geological Survey, Ottawa, and claims were staked in May, 1938, by A.J. Ostram and others. Late in that year they were optioned to Consolidated Mining and Smelting Company. Prospecting disclosed large cinnabar-bearing areas in veins and impregnations mainly in dolomitized and brecciated limestone along zones of fracturing and shearing. A roasting and condensing plant was erected, and production was started in June, 1940. The grade of ore treated is between 0.5 and 0.75 per cent mercury. Prior to the discovery of the Pinchi lake deposits, little mercury was produced in Canada and their successful operation has brought about a complete change in the Canadian situation in respect to the metal. The output is now far in excess of the domestic requirements and the ore reserves are estimated to be sufficient to assure continuous output at the present rate for several years.

At the property of Empire Mercury Mines Limited, 16 miles north of Minto City in the Bridge River area, cinnabar and native mercury occur mainly in shear zones in purple andesitic lava and sometimes in calcite veins. A 10-ton Gould furnace and condenser system was erected in 1938 and production was started in September of that year, but ceased in February, 1939 when a total of 16 flasks had been produced. In cleaning up in 1940, less than four flasks were recovered. Although small pockets of high grade ore were found, the average grade of the ore treated was about 0.35 per cent mercury, and the tonnage in sight in the several tunnels and surface strippings was considered too small to warrant recovering. In 1940, a few tons of cinnabar ore mixed with stibnite was put through a small retort erected in 1937 on the Tunkwa Lake property 15 miles south of Savona, which is at the southwest end of Kamloops lake. The property was prospected by D.B. Sterret, G.F. Dickson, and T.W. Hardie. Little more than a flask was produced owing to the antimony fusing through the walls of the retort. Prospecting and development work was carried out in a number of other places in British Columbia.

Eight deposits are known to occur at the west end of Kamloops lake. The original discovery at Copper creek on the north shore of the lake was worked in 1894, and during the next three years, about 138 flasks were produced and five more were produced between 1924 and 1927. From then until 1940, when it was prospected successively by Kamloops Mercury Mines Limited, (Neville Brothers) F.L. Gorse of Kelowna, and by Tranquille Mercury Mines, the property was idle. The operators of the Tunkwa property prospected the Hardie Mountain deposits two miles north of Copper creek station. Mercury Mining Syndicate (A. McDonald) prospected the Criss creek deposits eight miles northwest of Hardie Mountain deposits. These and several other properties in the vicinity of Kamloops lake are still being prospected, but no deposits of commercial importance

have been found. For the most part, the cinnabar in the area occurs in dolomite veins in brown weathering porphyry dykes, which cut green and purple volcanic breccias.

A number of cinnabar claims have been staked on both sides of Yallakom river, above the mouth of Shulaps creek, 30 miles northwest of Lillooet. The Golden Eagle group on the east side, is owned by C. Moberg and P.J. Wilson of Lillooet. In the four open-cuts in the treeless and steep mountain-side cinnabar is exposed in dolomite veins which cut brown-weathering ankerite zones, and along tongues of breccia. Across the river, a few patches of cinnabar are exposed in two short adits and in about 20 small open-cuts of the Red Eagle group, staked in 1937 by C.J. Parker and owned by G.L. MacInnes and associates of Vancouver. The ore and rocks are similar to those on the Golden Eagle, but most of the work has been done in a band of massive dolomite. No commercial deposit has yet been found in this region. In 1940, Consolidated Mining and Smelting Company prospected a recent cinnabar discovery at Indata lake, about 80 miles northwest of its Pinchi lake property. Many of the mercury deposits in British Columbia were examined and reported upon in 1940 by H.M.A. Rice of the Geological Survey, Ottawa. Details are given of all known occurrences of mercury by J.S. Stevenson of the Department of Mines, Victoria, in "Mercury Deposits of British Columbia" (Bulletin No. 5, 1940).

Canadian figures of production and trade are not available for publication owing to the war.

World production in recent years is estimated to be slightly in excess of 5,000 metric tons a year. For many years Italy and Spain have shared honours as the leading producer and prior to the war they accounted jointly for 70 per cent of world output, while the United States contributed about 15 per cent. Mexico, Russia, and Czechoslovakia are also producers of mercury.

During the period of the recent civil war in Spain, Italy maintained the lead with an annual output of over 2,000 metric tons. About 55 per cent of its output comes from the Monte Amiata mines in the province of Sienna and 40 per cent from the Idria mines in the Julian Alps. The average grade of the Italian ore is 0.75 per cent mercury. Since March, 1940, exports of mercury from Italy have been taxed and prohibited, except under licence. In Spain, output from the famous Almaden mine was greatly increased in 1939, and reached a record of 12,000 flasks (413 metric tons) in December of that year. The Almaden is one of the oldent known mines and is said to have been first worked in 400 B.C. A continuous record of its production has been kept since 1500 A.D. The grade of the ore is over 5 per cent. Until the present war, Spanish and Italian mercury were both sold in London. In July, 1939, a cartel "Mercurio Europeo" was formed with an agent in London, but early in 1940 a commercial agreement was reached between the Spanish and French Governments. All former marketing arrangements have since become disorganized.

The 7,376 flasks (254 metric tons) produced in Mexico in 1939 came mainly from mercury-antimony concentrate produced at the Huitzuco mine and treated in Los Angeles, California.

The United States in 1940 produced about 36,300 flasks (1,250 metric tons), a record for many years and double the output of 1939. This large increase was the result of the difficulty of obtaining mercury from Europe and of the high price. More than a hundred mines were producing, and California, followed by Oregon, and Nevada continued to be the leading producers. H.W. Gould and Company of San francisco,

the principal producer in the United States, operates six mines in California and Nevada, and contributes about one-third of the total output. During 1940 this company's New Idria mine in San Benito county, California, was the largest producer in the Western Hemisphere, and from it is recovered an average of 550 flasks monthly from 450 tons of ore roasted daily. Most of the increase in output in the United States in 1940 came from new disclosures of ore in old mines, the average grade being slightly under 0.5 per cent mercury. Exports in 1940, which were placed under Government control in July, were about 9,615 flasks, of which England took 5,285 flasks and Canada, 667 flasks. Imports, which were discontinued at the end of March, amounted to only 171 flasks compared with 3,499 flasks in 1939. Consumption was estimated at about 26,600 flasks, but early in 1941 it increased to 4,000 flasks monthly, owing possibly to the increase in the manufacture of mercuric oxide to fill Navy purchases. Stocks at the end of 1940 were 14,707 flasks. There is an import duty into the United States of 25 cents a pound of mercury.

As a result of the entry of Italy into the war, England is now dependent upon imports from the United States, Mexico, and Canada for a large part of its requirements, and the improvement in the Canadian situation is accordingly of timely importance. In 1938 England imported 44,317 flasks, but re-exported 15,535 flasks and had 18,000 flasks in stock at end of that year, an apparent consumption of 11,000 flasks. Stocks at the end of 1939 were much lower.

Mercury enters into the manufacture of acetic acid and anhydride, acetone, chlorine, and caustic soda, which are required for manufacturing military supplies. In the past, an appreciable amount of the metal was consumed as fulminate of mercury, a powerful detonator, but it has since been replaced by other compounds such as lead azide, and at present only a small quantity of mercury is used for a special type of detonator.

Mercury is also used in the manufacture of mercury salts, thermometers, medical supplies, mirrors, mercury vapour lamps; in the extraction of gold from ores by amalgamation; in the manufacture of electrical and chemical apparatus; for automatic electrical contacts; in catalysts; in electric rectifiers; in pharmacy; as cathodes in electrolytic chemical processes; in felt manufacture; in boiler compounds; in specially designed mercury boilers to replace steam in power production; and in cosmetics. Many of these uses are for military as well as for civilian purposes.

In Canada, about 75 per cent of the mercury consumed is used in the medicinal, pharmaceutical, and in heavy chemical industries, particularly in the form of mercury sulphate as a catalyst. The consumption of mercury in Canadian gold mines has decreased owing to wider use of cyanidation and improvements in the recovery of the mercury after amalgamation. Gold mining now absorbs about 7 per cent of the total mercury consumed.

In the United States, 45 per cent of the consumption of mercury is used in the preparation of mercurial salts, one of the largest single uses at present being as mercuric oxide for anti-fouling paint for ship bottoms. Other chemical uses such as fulminate, pigments, and dye stuffs, take 15 per cent; mechanical adaptations, 13 per cent; the preparation of hatters' felt, 10 per cent; the electrical field, 8 per cent; gold amalgamation, 2 per cent; and dental amalgams, 2.5 per cent.

The New York prices for the flask of 76 pounds averaged $75.00 in 1938, and $104.00 in 1939. By January, 1940, the price had increased to $142.00 and following the entry of Italy into the war it reached $202.00. It declined gradually to between $164.00 and $169.00 in December, but early in 1941 it had increased to $176.00.

Canadian prices in bulk in the third quarter of 1940 were about $220.00 the re-sale price to small consumers being as high as $260. Imports of mercury into Canada from the United States are not subject to duty, but have a sales and war tax amounting to 18 per cent of the value in Canadian funds, so that the present price is slightly less than that of New York, plus the exchange, and sales and war tax. The average price of Canadian exports of mercury was $213.50 a flask.

Canadian and United States cinnabar ores seldom average over 1.0 per cent mercury and are, as a rule, treated by roasting the coarsely crushed ore in furnaces, usually rotary kilns through which air is circulated. The sulphur is oxidized to sulphur dioxide, which escapes into the outside air, and the mercury is driven off as vapour and is condensed in cooling chambers. Occasionally ores are roasted in circular, or D-shaped horizontal cast-iron retorts one foot in diameter and 15 feet long. The interior of the retort is not in contact with the flame or air so that very little oxidation takes place, but lime is usually added to convert the sulphur into calcium sulphide, and is necessary when pyrite is present to take care of the excess of sulphur. The mercury vapour is caught in condensing chambers. This process is used in very small operations at the earliest stages, a small water-cooled pipe being used for a condenser. Retorts are also used on a large scale for very high-grade ores and for concentrates. Several attempts have been made to concentrate mercury ores by gravity and flotation methods, but the results have not been as satisfactory as by direct roasting of the crude ore.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

MOLYBDENUM IN 1940

Molybdenite, the chief ore of molybdenum is a soft and shiny steel blue-grey sulphide containing 60 per cent of the metal. In Eastern Canada it is usually found in pegmatite dykes or along the contacts of limestone and gneiss, commonly associated with greenish-grey pyroxenites in which other metallic minerals such as pyrite and pyrrhotite often occur. In northern and western Ontario and in British Columbia, molybdenite is usually associated with quartz veins, intruding granites, or diorites.

During the first half of 1940 active prospecting or development was underway on close to one hundred molybdenite properties throughout the Dominion. As a result of the market collapse in May, however, less than twenty of these properties, nine of them in Ontario and Quebec, were active at the end of the year. Most of the present activity is in the nature of assessment work and the claims are being held in the hope that a market will develop.

Quyon Molybdenite Company, at Quyon, Quebec, was the only producer in 1940. The new mill was completed by May and a small tonnage of concentrate, averaging 78 per cent MoS_2, was produced. The ore treated was obtained mainly from the main No. 1 pit. Late in the year a small furnace was erected on the property in which some of the better grade concentrate was converted to molybdic oxide, part of which, averaging 55.5 per cent molybdenum, was sold. Early in 1941 operations ceased and the whole property, including the mine, mill, and furnace plant was sold to J. Poulin of St. Lambert, Quebec, who proposes to resume operations.

In Ontario, Regnery Metals closed its property near Hawk in the Algoma district in January, 1941, as the ore was found to be much too low in grade for profitable operation.

In British Columbia prospecting was being maintained on a small scale on six properties during January, 1941.

World production of metallic molybdenum amounted to about 16,500 tons in 1939, of which the United States contributed about 15,160 tons. Aside from those of the American Continent, little is known of molybdenum activities in 1940. The United States produced about ~~16,750~~ 14,850 short tons of the metal, of which, Climax Molybdenum Company, the world's largest producer, at Climax, Colorada, contributed about 11,400 tons (10,000 tons in 1939). Most of the remainder was obtained as a by-product in the treatment of copper ores. Consumption of the metal in the United States showed a 50 per cent increase over that of 1939 and it is expected that the increase will be greater in 1941.

Production from Cananea, Mexico is estimated at the equivalent of 1,000 tons of the metal; and molybdenite concentrate is being recovered as a by-product from the Braden Copper mine at Sewell, Chile. Prior to the war, the Knaben mine in Norway was the largest producer outside the American Continent, its output in 1938 being 750 tons of concentrate. Other producing countries were Peru, French Morroco, Korea, Greece, Turkey, and Australia.

Molybdenum is being used to an increasing extent in many fields, but it is used chiefly in steel to intensify the effects of other alloying metals, particularly nickel, chromium, and vanadium, the molybdenum content of these steels being only from 0.15 to 0.4 per cent.

Molybdenum alloys are widely used for the hard-wearing and other important parts of aeroplanes such as in seamless steel tubing, and in the hollow steel propeller blades. They are used also in the

manufacture of shell steels; in armour plating; and in high grade structural steels, etc. Molybdenum-vanadium high-speed tool-steels are in some instances, replacing high tungsten high-speed steels with a resulting greater efficiency, and in other cases molybdenum is being used successfully in combination with the tungsten. The use of molybdenum in cast iron has increased considerably in recent years. A magnetic alloy for permanent magnets contains 30 per cent of molybdenum combined with cobalt and iron. Much molybdenum wire and sheet is used in the radio industry, and new alloys suitable for electrical contacts and for heating elements contain molybdenum. The chemical applications of the metal continue to increase.

Molybdenum was formerly introduced into steel either as calcium molybdate or as ferro-molybdenum, but during the past three years molybdic oxide briquettes, a compound of molybdenum oxide, lime and flux-forming oxides, have largely replaced the older forms of addition agents on the American Continent. About 70 per cent of the Canadian consumption of molybdenum in 1940 was in the form of the oxide briquettes, [redacted] which contain [redacted] 50 per cent of molybdenum.

The price at New York of 90 per cent molybdenite concentrate is nominally 45 cents (49 cents in Canadian funds) a pound of contained molybdenum sulphide, but the duty on ore or concentrate into the United States is 35 cents a pound on the metallic molybdenum contained therein (about 20 cents a pound for a 90 per cent concentrate). The price of molybdenite in England is nominally 48 cents a pound (50 shillings a long ton unit) f.o.b. English port.

The price per pound of contained molybdenum, f.o.b. Toronto, in Canadian funds, for the following compounds is: Calcium molybdate (40% Mo), 98 cents; ferro-molybdenum (58 to 64% Mo), $1.23; and molybdic oxide (50% Mo), 98 cents. The calcium molybdate is sold in 12½-pound bags containing 5 pounds of molybdenum and the molybdic oxide briquettes weigh five pounds each and contain 2½ pounds of molybdenum.

In May, 1940, the British Government stopped issuing import licences for Canadian molybdenite concentrate or compounds. The action was taken as the result of an arrangement with United States producers whereby Great Britain agreed to take their surplus so as to obviate the danger of supplies reaching the Axis countries or to countries friendly thereto. As this surplus is more than sufficient to meet British needs, the action also applies to all other countries. The United States tariff of 35 cents prohibits the entry of Canadian molybdenum products into that country.

With the exception of the small plant at Quyon, Quebec, there are no plants in Canada for the conversion of molybdenite concentrate into suitable addition agents. Consequently, all of the Canadian requirements of these agents are imported and there is no market for concentrates from Canadian sources. It is possible that the steadily increasing consumption of molybdenum in Canada, will lead to the erection of a conversion plant.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

NICKEL IN 1940

Canada produces by far the greater part of the world output of nickel, the source of all but a small percentage of the Canadian production being the nickel-copper ores of the Sudbury district in Ontario. Some nickel is also recovered as a by-product from the treatment of the silver-cobalt ores of Cobalt and other areas in northern Ontario.

International Nickel Company of Canada, Limited, which is much the larger of the two Canadian producers, operated its Frood, Frood Open Pit, Creighton, Levack, and Garson mines. Ore shipments from the Frood Open Pit which were started in January, 1939, were continued at an increased rate in 1940. The concentrator at Copper Cliff was enlarged during the year. The mines and smelters were operated at a rate sufficient to meet the increased demands arising from the war effort.

Falconbridge Nickel Mines, Limited, obtains its ore from the Falconbridge mine in the Sudbury area. Some sixty per cent of the ore hoisted by the Company for treatment was milled and the resulting concentrate was sintered. The rest of the crude ore was smelted, together with the sinter, to produce matte, of which about thirty-one per cent was refined at the Company's plant in Norway prior to the occupation of that country by the German forces in April, 1940. Under subsequent arrangement with International Nickel, the rest was handled at that company's plants at Port Colborne and Copper Cliff. Underground development work at the Falconbridge mine was sufficient to replace most of the ore treated, in respect to both tonnage and grade.

Nickel Offsets, Limited, continued the extensive surface exploration and diamond drilling that was commenced in 1939 on its property in Foy and Bowell townships, west of Capreol.

Denison Nickel Mines, Limited, did not operate its property in Denison township, northwest of Sudbury, nor did Ontario Nickel Corporation operate its properties in the Sudbury district and other parts of Ontario. The property of the Pacific Nickel Mines, Limited, at Choate, British Columbia, was also idle.

Canadian production and trade figures are not available for publication owing to the war.

The world production in 1939 (figures for 1940 not available) is estimated at 133,300 short tons, most of which was produced in Canada, the other producing countries being New Caledonia, Greece, India Norway, and Russia.

International Nickel Company estimated world consumption of nickel in 1939 at 128,000 short tons, compared with 102,000 tons in 1938 and 120,000 tons in 1937. This record comsumption is attributed to the great improvement in the heavy industries in the United States and Canada, and to the general speeding up of industry in order to augment the production of necessary war supplies.

New applications of nickel developed during recent years have accelerated the consumption of nickel steels and alloys in a great diversity of form and composition. The approximate distribution of the use of nickel in 1939, as given by International Nickel Company, was as follows:

	Percentage
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	10
Nickel-brass, bronze and aluminium alloy castings	2
Heat resistant and electrical resistance alloys	3
"Monel", malleable nickel, nickel clad, "Iconel"	10
Electrodeposition	8
Non-metallic materials for the chemical industry. Nickel salts, ceramic materials, storage battery materials and catalysts.	1
Miscellaneous and unclassified	2

The base spot price of nickel in the United States in 1940 was 35 cents per pound. The same price has ruled for the past 15 years.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

PLATINUM GROUP METALS IN 1940

Except for a few ounces of platinum recovered from the black sands of British Columbia, and a small production obtained as an impure residue in the refining of gold at Trail in that province, all of the Canadian output of platinum and allied metals are obtained in the form of residue from the treatment of the Sudbury nickel-copper matte. As a result of the successful development of the copper-nickel mines near Sudbury, Canada has become the leading producer of the platinum metals.

The precious metals residue produced at the Canadian plants of International Nickel Company is shipped to the company's refinery at Acton in England, which is operated by Mond Nickel Company, a subsidiary enterprise. The refinery has an annual capacity of 300,000 ounces of refined platinum metals. They are sold by Mond Nickel Company and by its regular distributors throughout the world.

Falconbridge Nickel Company, prior to the German invasion, exported its nickel-copper matte to its copper-nickel refinery at Christiansand, Norway, which is equipped to produce refined gold, silver, platinum, and palladium, in addition to the refined nickel and copper. About two-thirds of the Falconbridge matte is now being treated at the plants of the International Nickel Company.

Canadian production and trade figures are not available for publication owing to the war.

The world production of platinum and allied metals in 1939, as estimated by Baker and Company Incorporated, approximated 500,000 ounces, compared with 460,000 ounces in 1938. Canada has been the leading producer of platinum since 1934 when it displaced Russia, the other principal producers by order of importance being; Russia, Colombia, and South Africa. Canada also leads as a producer of palladium, as a result of the great increase in recent years in the Canadian output of nickel. Owing to the disorganized state of the world markets and government restrictions on publication of statistics, estimates on world production and consumption for 1940 are not available. The world consumption of platinum metals in 1939 was about equal to production, a notable gain over the 1935 figure of consumption of 275,000 ounces.

Industrial uses of the platinum metals continued to expand in 1940. Palladium ranks second in consumption and iridium third. Osmium, rhodium, and ruthenium, are as yet consumed in relatively small quantities.

The market situation is explained by Charles Engelhard, President of Baker and Company, Incorporated, in the following words:

> "In airplanes, platinum-iridium and platinum-ruthenium continue to be used for magneto points. Experiments with both of these alloys for production of spark plugs in airplane engines continues. Spark plugs for semi-diesel engine operation are included in the experimental work.
>
> The jewelry trade was more active in 1940 than in several years past and platinum has received a share of this increased business. Progress was made in production of platinum-clad optical frames.
>
> In dentistry, the demand for platinum metals registered further gains, particularly palladium.

> The chemical industry contributed in a broader use of platinum metals. A new platinum catalyst for the production of sulphuric acid has been developed. Greater interest is being shown in palladium as a catalyst. With the expansion in the United States of the facilities for the production of nitric acid, there has been a large demand for platinum-rhodium for gauze for ammonia oxidation. Spinnerettes of platinum-rhodium gained in the production of rayon."
>
> (Mineral and Metal Markets, January 23, 1941)

The average price in New York of refined platinum in 1940 was $37.92 per ounce, compared with $36.75 in 1939. Palladium was unchanged at $24 per ounce; rhodium was $125; and ruthenium $35 to $40 per ounce. Iridium advanced to $275 and upwards as a result of what the price stabilization division of the National Defence Advisory Commission of the United States has described as speculation.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

RADIUM AND URANIUM IN 1940

Eldorado Gold Mines, Limited, continued to be the only producer of radium and uranium in 1940, both of which are recovered in the company's refinery at Port Hope, Ontario, from the pitchblende concentrates obtained from its property at Great Bear Lake, in the Northwest Territories. As the demand for its products had shown a marked decrease owing to the war, the company closed down its mine at the end of June, and also considerably reduced the scale of its refinery operations. Stocks of mill concentrates at the rail-head at Waterways, Alberta, and at Port Hope are estimated to be sufficient to meet refinery requirements at the present rate of consumption for the next three years. For several years prior to the war, Canada was one of the two important producers of radium in the world, the other, which had a larger annual output, being the Belgian Societe Generale Metallurgique de Hoboken, a subsidiary of Union Miniere du Haut Katanga, which obtainedits ores from the Belgian Congo in Africa.

During the six months of mine operation in 1940, the company reported a total of approximately 700 feet of drifting, cross-cutting and raising, and 875 feet of underground diamond drilling. The 15,500 tons of ore milled yielded 419 tons of concentrates valued at $832,140, compared with 33,373 tons milled, and production of 1,057 tons of concentrates, in 1939. The latter figure included 100 tons of silver-copper concentrate which was shipped to a smelter in Tacoma, Washington. Retreatment of concentrates by flotation before shipping was reported to have effected substantail savings during the few months this procedure was followed. Ore reserves were estimated to have a value of $9,066,700.

The refinery operated throughout the year, with a staff of 50 employees, and at the end of 1940 stocks of finished products, mainly radium bromide and sulphate, sodium uranate, black uranium oxide, and other uranium compounds, as well as of concentrates, were reported to be sufficient to take care of all anticipated demands. The refinery also recovers radio-lead which is sold for use in sparkplugs as a source of polonium; silver sulphide, which is shipped to Irvington Smelter, Irvington, New Jersey; and a cobalt-nickel-copper concentrate.

In 1940, as a result of the curtailment of overseas markets, Eldorado disposed of 60 per cent of its output of radium and 50 per cent of its uranium output in the United States. Early in 1941 the company announced the gift of 3 grams of radium to the British Government for use in the luminous dials of airplanes. In March of that year it announed the formation of a subsidiary, Canadian Radium and Uranium Corporation, with headquarters at 630 Fifth Avenue, New York, to act as exclusive sales representative for its products in the United States. It also initiated a long-term deferred payment plan for purchases of radium in any form and in any desired type of container.

Following the initial development of Eldorado's deposits at LaBine Point, Great Bear Lake, in 1931, several other deposits in the same general area received attention. Consolidated Mining and Smelting Company did considerable work on an adjacent group of claims at Common lake, in 1934-1935, but suspended operations in 1936. Bear Exploration and Radium (B.E.A.R.) opened a deposit at Contact lake, 10 miles south of LaBine Point, containing mainly silver, cobalt, and nickel, from which a few tons of pitchblende concentrates were shipped to Eldorado's refinery in 1938. Owing to the low price of silver, work was discontinued in 1939. In 1934, several tons of high-grade crude pitchblende were taken from a pitchblende-hematite occurrence on the Arden claims at Beaverlodge lake, about 100 miles south of the Eldorado mine, but this operation was short-lived. Pitchblende has also been found associated with narrow cobalt veins near Goldfields, on Lake Athabaska, Saskatchewan, but this occurrence is probably of little economic interest. In Ontario and Quebec, many of the

pegmatites worked for feldspar, mica, etc., contain small traces of radioactive minerals, but such occurrences are of mineralogic interest only. About 10 years ago Ontario Radium Corporation did some work on an occurrence of uraninite in a pegmatite formation near Wilberforce, Ontario.

No detailed statistics of refinery products made and sold are released by Eldorado, but the total value of radium and uranium products in 1939 was reported at $1,121,533. By the middle of 1939, total radium recovery had passed the 100-gram mark.

Small amounts of radium have been produced at Joachimathal, in Czechoslovakia, and by two American enterprises, which treat high-grade carnotite ore from Colorado and Utah. It was reported in 1940 that one of the larger American producers of vanadium had installed a plant for the recovery of uranium from large tonnages of low-grade tailing residues from its carnotite-vanadium operations. A small production of radium has also been credited to France, where autunite from Portugal is processed, and to Russia, where attempts have been made to utilize low-grade ore (tyuyamunite, calcium-uranium vanadate) from Turkestan. No world statistics of radium and uranium production or trade are published.

Canadian exports and imports of uranium compounds are not shown separately in trade statistics. Radium imported for medical or scientific use in 1940 was valued at $22,360, compared with $15,929 in 1939.

Radium continues to be used chiefly in the treatment of cancer. It is recovered in the form of the bromide salt of 90 per cent purity, and it is usually converted into sulphate for hospital use, the salt being loaded into fine gold or platinum needles containing only a few milligrams of radium. Larger dosages are given by means of so-called radium "bombs" containing up to 5 grams. Radium is also employed at certain clinical centres for the production of radon or radium emanation, a heavy gas of short-lived radioactivity, which is used for hospital treatment. Radium may be used in place of X-rays in engineering, to detect flaws in heavy castings etc., but its use in this field is as yet of minor importance. Some radium is used in luminous paints for clock, watch, and compass dials, instrument boards, gun-sights, etc. Because of its high cost, much of the radium used in hospitals, research, and for other purposes, is hired or loaned from the producers or from enterprises engaged in such business. The current rate for such leased radium is stated to be about 40 cents a milligram a month.

Intensive research on applications of radioactivity in the fields of biology, radiology, chemistry, geology, and industrial physics, has followed the discovery a few years ago of the possibility of creating "artificial" radioactive substance by means of the cyclotron and other devices. The products made by such means, have proved of great value for research purposes, particularly as "tracers" in a variety of fields, but they are mostly evanescent, with a very short life, and they have not as yet superseded natural radium for therapeutic and other uses to any appreciable extent. Marked headway has been made, however, in X-ray cancer therapy, with the result that radium has been displaced to some extent, but it is still regarded as being indispensable in certain types of treatment. This applies also to industrial radiography, where radium and X-rays each have advantages in particular fields of use.

Of especial scientific interest was the discovery in 1939 that the uranium atom could be split by neutron bombardment, which resulted in "nuclear fission" and the production of radioactive isotopes of a long series of unexpected lighter-weight elements. The phenomenon is accompanied

by the liberation of a tremendous amount of atomic energy, suggesting the possibility of employing uranium as a source of power. Although widespread publicity has been given to the discovery, any practical utilization of the reaction remains to be demonstrated.

Uranium, the heaviest known element, is used chiefly in the form of various salts, mainly the oxide, and sodium uranate, which are employed as colouring agents in the ceramic industry. These compounds impart a greenish-yellow colour to glass, and give rich reddish-orange shades in pottery glazes. Uranium glasses, like many uranium salts, are strongly fluorescent and it is possible that the latter may find use in fluorescent paints and lighting applicances. Certain of the salts have a limited use in the analytical laboratory, in photography and medicine, and in textile dyeing. A new use for the oxide is in the starting resistors of motors. The metal, as ferrouranium, imparts desirable properties to steel and other ferro-alloys, but the limited supply, the high cost, and the difficulty in preparing it in the pure form have tended to retard its use for this purpose.

Chemically pure uranium is difficult to prepare, but recently metal of 98 per cent purity has been made in the form of powder by the hydride process. Production of a binary alloy of uranium and nickel, with 66 per cent of uranium, has been reported as being 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, with up to 20 per cent uranium, is reported as being resistant to corrosion and of high conductivity.

Before Canada had become an important producer of the substance, radium sold at about $60 per milligram in lots of one gram and upwards, but by 1938 the price had dropped to between $20 and $25. There is no open market for radium and sales are usually based on individual tender and contract. An agreement was reached between Eldorado Gold Mines, Limited and the Belgian companies in 1939 whereby they were to share world sales on a basis of 40 per cent by the former and 60 per cent by the latter, the agreement to run for five years. The price was not divulged, but in 1940 sales were being made in the United States at about $30 a milligram for orders from one to 99 milligrams; $27.50 for orders of 100 to 999 milligrams; and $25 for one gram lots or over. The price of sodium uranate in 1940 averaged about $1.65 a pound; of the black oxide $2.55 a pound; and of uranium nitrate $2.36 a pound. All of the above quotations were in U.S. dollars. Radium for Canadian sale was quoted in 1940 at $33 a milligram.

World demand prior to the war for radium and uranium salts had shown a steady increase, radium commitments having been materially raised by large-scale programs for hospital use undertaken by both the British and American Governments. Radium imports into the United States reached a new high of 78 grams in 1939, this being double the figure for 1938.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

SELENIUM IN 1940

Selenium, although fairly widely distributed, is not abundant in nature. It occurs in association with sulphur, and frequently accompanies the sulphides of heavy metals in the form of selenides. In no case does it occur in quantities large enough to be mined for itself alone.

Commercial selenium is recovered in association with tellurium 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, and was first produced in the Dominion in 1931 in Ontario Refining Company's copper refinery at Copper Cliff, Ontario. The only other producer in Canada is Canadian Copper Refiners, Limited, with refinery at Montreal East, Quebec, where production was commenced in November, 1934. Considerable quantities are now being produced annually by both companies. The Copper Cliff product is derived from the treatment of the copper-nickel ore of the Sudbury district, and that at Montreal East is obtained from the treatment of the gold-copper ore of Noranda, Quebec, and the gold-copper-zinc ore of the Flin Flon mines situated on the boundary line between Manitoba and Saskatchewan.

Canadian production and trade figures are not available for publication owing to the war.

World production of selenium is believed to approximate 300 to 500 short tons a year, the United States and Canada being the principal sources of supply. Small quantities are produced by several countries including Russia, Japan, Rhodesia, and Mexico. It is reported that selenium is now being recovered from the copper-gold-arsenical ores of the Boliden mine, Sweden.

Selenium is at present used chiefly in the glass and pottery industries, both as a colouring agent - as in ruby glass - and to neutralize the effect of objectionable oxides. To a minor extent it is used in the photo-electric cell, or electric eye, which is finding many industrial applications, and in alloying stainless steel for screw and bolt stock, where it develops improved cutting and threading qualities. It has a large potential market in certain rubber compounding industries and is now being used for the vulcanizing and fireproofing of switchboard cables and to increase the resistance of rubber to abrasion, these applications being still subjects of research. Selenium is used in the manufacture of certain kinds of paintand of certain dyes. As selenium oxychloride, it is a powerful solvent of many substances. The use of the metal in the production of improved cutting-tool steels and in the vulcanizing of rubber appears to offer the best opportunities for the expansion of the market. Rapid progress is also being made in the production of high-quality, selenium rectifiers.

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

A nominal price for selenium, black powdered, 99.5 per cent pure, of $2 per pound at New York prevailed for a few years prior to August, 1938, when the price dropped to $1.75, at which level it remained to the end of 1940.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1940.

SILVER IN 1940

The silver production of Canada is obtained mainly as a by-product from the treatment of base metal ores. Important contributions are also made from the silver ores of Ontario and British Columbia, from the gold-quartz ores, and to a small extent from gold alluvial deposits.

The rapid expansion of mining in western Quebec during the last few years, has resulted in a noticeable increase in the production of silver from the copper-gold ores of Noranda, the copper-zinc ores of Waite-Amulet, the copper-pyrites ores of Aldermac and Eustis, and the numerous gold-quartz mines of western Quebec. Contributions have also come in past years from the lead-zinc mines of Portneuf county.

In Ontario, for several years the silver-cobalt mines of Cobalt and adjoining areas have shown a gradual falling-off in production, accentuated by the low price of silver. The demand for cobalt, however, is helping to keep numerous small concerns in operation in these areas. The increased production from Sudbury nickel-copper mines in the last few years has partly made up for the decline from the Cobalt area. Important contributions are also made from the gold-quartz mines of Porcupine, Kirkland Lake, and other areas in Ontario.

In Manitoba, the production is from the copper-zinc ores of Flin Flon and Sherritt-Gordon and to a less degree from the San Antonia, Gunnar Gold, God's Lake and other gold-quartz mines of the province.

In Saskatchewan, the output is credited to that part of the Flin Flon orebody that overlaps the provincial boundary of Manitoba and to the gold-quartz ores of the "Box" property at Goldfields.

In British Columbia, the Sullivan silver-lead-zinc mine is by far the largest silver producer of the whole Dominion. Important contributions are also made by Silbak-Premier, Bralorne, Pioneer and several other gold-quartz mines, by the silver mines of Beaverdell camp, and by various relatively small silver-lead-zinc mines.

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

In the Northwest Territories, production is obtained from the silver-radium ores of Eldorado mine in the vicinity of Echo Bay, Great Bear Lake district, and from the gold-quartz ore of the "Con" and the Negus properties at Yellowknife River.

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

The Canadian production of silver in 1940 was 23,815,715 fine ounces, valued at $9,109,273, compared with 23,163,629 fine ounces, valued at $9,378,490 in 1939.

The exports in 1940 were: 5,633,106 fine ounces of silver in ore and concentrate valued at $2,052,298, and 13,612,952 fine ounces of silver bullion valued at $5,113,206. In addition, manufactures of silver valued at $8,121 were exported.

The imports in 1940 included unmanufactured bullion to the value of $519,247 and manufactures of silver to the value of $332,047.

The world production of silver in 1940, as estimated by Messrs. Handy and Harman, was 278,000,000 fine ounces, compared with 264,200,000 fine ounces in 1939. The production in 1940 sets a new high.

The world consumption of silver in 1939 (1940 figures not yet available) is estimated by Handy and Harman at 441,300,000 ounces compared with 510,300,000 ounces in 1938. Of the total consumption of 441,300,000 ounces in 1939, 341,400,000 ounces was purchased by the United States Government, 26,000,000 represents Indian consumption, 8,900,000 was used for coinage, and 65,000,000 was consumed in the arts and industries.

The United States Congress passed the Act of July 6, 1939, which increased the domestic subsidy from 64.65 cents to 71.11 cents an ounce and made it permanent. The silver provisions of this act leave the Administration no discretionary power over domestic silver, but opened the U.S. mints permanently to all newly mined silver of domestic origin, (Eng. Min. Jnl., Feb. 1940).

The ratio of silver to gold and silver in the monetary stock of the United States is set down in the Silver Purchase Act of 1934 at 25 per cent. Treasury acquisition of silver has resulted in an increase of the ratio from 10.3 per cent in June, 1934, to 18.7 per cent at the end of 1938, the ratio declining from 18 per cent in 1939 to 15½ per cent in 1940. The Monthly Bulletin of the U.S. Treasury Department reports that from January, 1934, when the silver purchase programme began, to December 31, 1939, the American Treasury bought 314 million ounces of domestic silver. The purchase of domestic silver (U.S.) for the calendar year 1940 totalled 67 million ounces. The estimated holding by the United States Treasury, to the end of 1940, amounts to 3,135 million ounces.

Under the American Silver Producers Research Project investigations are being carried on to find new uses for silver. The consumption of silver in the arts and industries of the United States and Canada showed an increase of more than 20 per cent over 1939, a new high record.

The average price of silver in 1940 was 38.249 cents per fine ounce compared with 40.563 cents in 1939. (New York prices transposed to Canadian funds.)

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

TELLURIUM IN 1940

Tellurium occurs native and as an essential constituent of several minerals, none of which has been found in commercial quantitites. Tellurium-bearing minerals also occur in minute quantities in association with other metallic ores, and the element may be recovered from residues in the refining of copper or lead, and also when sulphuric acid is manufactured from certain forms of pyrites. The potential recovery and production of tellurium are great, but the demand remains small so that the quantity of refined metal produced is small. Ores containing tellurium occur in British Columbia, Saskatchewan, Manitoba, Ontario, and Quebec.

Two electrolytic copper refineries are operating in Canada, both having plants for the recovery of tellurium from their refinery sludges, and for the production of the refined metal. One of them, Ontario Refining Company at Copper Cliff, Ontario, started production in 1934, and the other, Canadian Copper Refiners, Limited, at Montreal East, Quebec, commenced production in 1935. The former plant treats the slime from the refining of the blister copper produced by International Nickel Company at Copper Cliff; and the latter, the slime from the refining of the anode copper of Noranda Mines, Limited, at Noranda, Quebec, and the blister copper of Hudson Bay Mining and Smelting Company, whose smelter is at the Flin Flon mine on the boundary line between Manitoba and Saskatchewan. There has been no recovery as yet in Canada from the sludge of sulphuric acid chambers.

Canadian production and trade figures are not available for publication owing to the war.

The world production is estimated at 40 to 70 short tons a year and Canada and the United States appear to be the main sources of supply.

Metallic tellurium, until quite recently, was of little industrial importance. Formerly it was used to a small extent in some radio work and it was used also in the photographic arts and for blackening art-silverware. Small quantities are used as a colouring agent in the ceramic industry. More recently industrial research has shown that when alloyed with lead, the tensile strength and toughness of the lead is increased greatly. The use of small quantities of tellurium as a substitute for tin in the lead used for sheathing electric wire cables is reported to improve the resistance of the cables to heat and corrosion. It has also been used for improving the machining qualities of certain steels. Very finely powdered tellurium may be used as rubber-compounding material. Its presence is stated to shorten the time of curing, and to greatly improve the resisting qualities of the product. Tellurium is also used in the steel industry, but so far mainly in an experimental way.

A nominal price for tellurium of $1.75 per pound at New York prevailed throughout 1940.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

TITANIUM IN 1940

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

Ilmenite or titanic iron ($FeTiO_3$) in commercial quantities and carrying from 18 to 25 per cent of titanium is found at St. Urbain in Charlevoix county, and at Ivry in Terrebonne county, Quebec. Rutile (TiO_2), which usually contains 54 to 59 per cent titanium, is found mixed with the ilmenite in parts of one of the St. Urbain occurrences and in sufficient quantities to make it of possible importance for the rutile alone, this being the only known workable deposit of rutile in Canada. Titaniferous magnetite deposits (magnetite carrying 3 to 15 per cent titanium) occur on the Saguenay river, near Lake St. John, and at Bay of Seven Islands, both in Quebec, and on the shores of Seine Bay and Bad Vermillion Lake in western Ontario.

A few thousand tons of ilmenite is shipped annually from the St. Urbain deposits, part of it to Niagara Falls, New York, presumably for use in the manufacture of ferro-titanium, and part of it to plants of the General Electric Company in the United States. No shipments from the Ivry deposits have been reported for several years.

In 1937, Canadian Titanium Pigments, Limited, was formed to manufacture titanium oxide in Canada. Although the Canadian market for titanium pigments is not believed to be large enough to justify the immediate establishment of a plant in Canada, preliminary preparations are being made, looking to the future possibility of such a market.

Canadian production and trade figures are not available for publication owing to the war.

The world production of titanium ore is estimated at about 260,000 tons of ilmenite, which would yield 115,000 tons of titanium pigment, and 3,000 tons of rutile. India is the principal producer of ilmenite, the other producers being Norway, Malaya, Portugal, and Canada. Brazil is the principal producer of rutile, and Norway is second in importance.

The use of titanium pigments developed slowly during 1940, but an acceleration in the replacement of lithopone occurred during the year due to the greatly increased selling prices of the latter product. It is expected that this trend will continue and become even more noticeable, as the large quantity of lithopone imported during 1940 is believed to have resulted in an accumulation of a considerable reserve supply.

Commercial uses for titanium in recent years have continued to increase independently of the trend of general business. Ilmenite continues to be used chiefly in the manufacture of white pigment, and it is used to a smaller extent for making ferro-alloys. In metallurgy, titanium is not only an effective dioxidizer and cleansing agent, but also an alloying element. By 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 better structure. A variety of carbon-titanium alloys are now available.

A new tungsten-titanium carbide, known as "Kennametal" is an ultra-hard carbide used in cutting tools and various wearing surfaces.

Titanium treated rails are said to be superior to those treated with silicon. In other industries titanium compounds have many different uses. Rutile is used chiefly in welding-rod coatings and in the ceramic industry.

The New York quotations for ilmenite 50 to 60 per cent TiO_2, f.o.b. Atlantic seaboard were $16 to $18 from March to August, and $18 to $20 from September to December. The price for rutile 94 per cent TiO_2 was 10 cents per pound of concentrate. The price of ferrocarbontitanium f.o.b. plant remained at $142.50 per ton in 1940.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

TUNGSTEN IN 1940

Wolframite, $(Fe_2Mn)WO_4$, is the principal ore of tungsten, the next in importance being scheelite ($CaWO_4$) a calcium tungstate. The former is a dark brown to black heavy mineral, which contains 76.4 per cent WO_3 (tungstic oxide) when pure. It is not common in Canada. Scheelite, the usual ore of tungsten found in Canada, is a heavy, usually buff, but sometimes white mineral with a dull lustre, which contains 80.6 per WO_3 when pure. It is commonly associated with quartz and frequently occurs in gold-bearing veins. It can be detected readily by its brilliant pale bluish fluorescence under ultra-violet light and purple filter.

Canadian production of tungsten is small and in 1940 was confined to two properties in Nova Scotia, one in Ontario, and one in British Columbia. The total output was shipped as concentrate to Atlas Steel Company, Welland, Ontario.

In Nova Scotia, the production came from the Indian Path mine near Lunenburg and from the Goff property near Enfield, Halifax county. The former mine was first worked in 1926 and was drilled and bulk sampled in the spring of 1940 by Siscoe Gold Mines, Limited, and was later developed by W.M. Goodwin for Scheelite Prospectors, Limited. A 25-ton sample was sent to the Bureau of Mines at Ottawa for testing and about 350 tons, mainly from the stopes on the 65-foot level, was crushed, screened, and sluiced. The rough concentrate thus obtained was sent to the Nova Scotia Technical College, Halifax, to bring it up to commercial grade. This resulted in a shipment of concentrate with a WO_3 content of 71.4 per cent. Operations ceased in September, but the property has since been re-opened by one of the large mining companies. The Goff property was surveyed in detail by the Nova Scotia Government in 1939 and was later worked by W.M. Goodwin for Kirkpatrick Tungsten Syndicate. Several tons of high grade picked ore was concentrated by crushing and sluicing and a concentrate containing 71.2 per cent WO_3 was shipped. The option on the property was dropped, however, and it reverted to R.E. Kirkpatrick of Debert, Nova Scotia.

Elsewhere in Nova Scotia, activities were confined to prospecting and development work and other than a few bulk samples for testing; no shipments were made. A 300-pound sample assaying 4.6 per cent WO_3 was sent from the Lake Charlotte gold property of Guysborough Mines, Limited, to the Bureau of Mines at Ottawa for concentration tests. The company, a subsidiary of Ventures, Limited, is at present prospecting and diamond drilling the deposit. Lake Thomas Syndicate prospected a deposit northeast of Halifax and also did some development work on the Hyland property farther east, both properties being on the Waverly anticline.

Burnt Hill Brook property in York county, New Brunswick, is one of the few known deposits of wolframite in Canada. It was operated by Acadia Tungsten Mines, Limited, during the last war and in 1918, thirteen tons of concentrate was shipped from the property. It remained idle until the autumn of 1939, when it was mapped and surveyed by the New Brunswick Department of Mines. A large mining corporation planned to sample and drill the deposit in the spring of 1941.

In Ontario, the production came from the Hollinger mine of Hollinger Consolidated Gold Mines, Limited, Timmins, which hand-picks and stock piles the tungsten ore. From a small trial shipment containing 33 per cent WO_3 sent by the company to Ottawa, a concentrate with a WO_3 content of 75 per cent was produced and shipped.

Scheelite also occurs in association with the gold at the properties of Preston East Dome Mines, Limited, South Porcupine; Leitch Gold Mines, Limited, in the Thunder Bay District; Matachewan Consolidated Mines (Ventures, Limited) in the Temiskaming District; and McKenzie Red Lake Gold Mines, Limited, about 100 miles north of Kenora; and in each case the ore containing the tungsten is hand-sorted and stock-piled. A 100-pound sample assaying 2.5 per cent WO_3 was sent to Ottawa from the McKenzie Red Lake property for testing. [redacted] the grade of the scheelite in [redacted] the Matachewan Consolidated property may be too erratic and the quantity available too small to be worth recovering.

In British Columbia, the production came from a group of claims 15 miles northeast of Minto City in the Bridge River area, on which scheelite was discovered by Ed Phillips, the owner, in 1939. Shipments of picked ore from the property that were sent to Ottawa assayed from 42 to 59 per cent WO_3 and from them a concentrate with a WO_3 content of 72.4 per cent was produced and shipped. The scheelite is white instead of the usual buff colour and occurs in gash veins in dolomitized serpentine, varying in width from threads to 18 inches. At the end of the year the property was being investigated by a western mining corporation. Elsewhere in the province, activity was reported from nine properties. Columbia Tungstens on Hardscrabble Creek near Wells in Cariboo District has the only tungsten mill in Canada. No ore was milled, however, in 1940 and operations were largely confined to development work on the 350-foot level. In 1939 the company shipped a few tons of high grade scheelite concentrate. It is continuing the search for ore at depth.

A small underground mill erected in 1938 by Regal Silver Mines, Limited north of Albert Canyon in the Revelstoke Mining Division for the treatment of silver, lead, and zinc ores, was later enlarged and remodelled to treat both scheelite and tin ore (Stannite). The scheelite ore is very complex in nature, however, and although an appreciable tonnage of it is believed to occur scattered through the workings opened up on eight levels, the problem of its commercial recovery is not as yet satisfactorily solved. Early in 1941, the company was reorganized and is now known as Consolidated Tungsten Tin Mines, Limited, the head office being at Victoria. The property is being re-sampled by a large Canadian mining enterprise

Prospecting was continued by A.W. Davis of Nelson on the Red Rose property on Rocher de Boule mountain, about 15 miles west of Hazelton, the owner of the property being Mrs. B.S. Sargent of New Hazelton. On it is an outcrop of quartz-scheelite containing a fairly high percentage of WO_3 which has been opened up by pits and trenches for a distance of about 500 feet. Consolidated Mining and Smelting Company, which had an option on the property, did some diamond drilling on the outcrop during the summer of 1940, but did not exercise its option. Its high elevation makes transportation difficult, and the development of the property is accordingly handicapped, but in the belief that a small production could be maintained, prospecting is being continued.

Showings of scheelite were discovered by E. Taylor and A. Paxton in 1940 on two claims in the Snowshoe Plateau about 30 miles south of Wells in the Cariboo area. In the Taylor claim, the scheelite occurs in blobs of small crystals in a four-inch quartz vein which was traced for 25 feet. A few hundred pounds of ore obtained from a small shaft in the vein was sent to Columbia Tungsten Company's mill at Wells for treatment. Following the discovery of scheelite in the gold quartz veins of the Euphrates

mine south of Nelson, Gold-Silver Tungsten Mining and Milling Company of Spokane, Washington, started the erection of a mill on the property late in 1940 and the production of scheelite as a by-product is likely to begin in 1941. Many of the tungsten deposits in British Columbia were investigated by H.M.A. Rice of the Department of Mines and Resources, Ottawa, during 1940, and recently the Department of Mines, Victoria, published a report by J.S. Stevenson that covers about 35 tungsten properties in the province.

All the developments of interest, however, were not confined to the three provinces that contributed to the output in 1940. Much interest has been aroused in recent discoveries of scheelite in quartz-diorite stringers near Gilmour Lake, about 50 miles east of Yellowknife settlement in the Northwest Territories. A total of 17 scheelite-bearing veins have so far been discovered in the area and other veins have been discovered about 8 miles southwest of Gilmour Lake and occurrences of the mineral in the region are believed to be widespread. A. Mitchell of the A. and M. Syndicate, and others have been actively engaged in the prospecting of the finds and the area is being investigated by A.W. Jolliffe, a Dominion Government geologist. A 200-pound sample sent to Ottawa early in 1941 assayed 8.9 per cent WO_3. Tungsten in the form of ferberite, an iron tungstate similar in appearance to wolframite, occurs in the gold-copper deposit of Slave Lake Gold Mines on Outpost Island in Great Slave Lake. The ore of the deposit is very complex, containing gold, copper, molybdenum, tungsten, and tin in shear zones. The vein system has been opened up on five levels to a depth of 450 feet and channel samples taken on different levels are reported to average from 0.5 to 1 per cent WO_3 and 0.2 per cent tin in the form of cassiterite. A 100-pound sample sent to Ottawa for testing in July, 1940, assayed 2 per cent WO_3 and 2 ounces of gold per ton. Several other minerals were also present. In the preliminary tests, a good recovery was made of the gold and copper, but only about 50 per cent of the tungsten was recovered in the concentrate, which assayed 52 per cent WO_3. The company recently erected a small concentrator.

In Quebec, Manley Gold Mines prospected some scheelite-bearing quartz veins in La Reine township near the Ontario boundary. Lamaque Mining Company has found small quantities of scheelite in its gold ore deposits at Val d'Or in the Abitibi district. Tungsten occurs also in the ores of the Sullivan and Sigma mines in the same area. In Dalquier township north of Amos, Nortrac Mining Company found scheelite while engaged in the exploration of gold-bearing deposits. The property was recently taken over by Kayrand Mining and Development Company of Montreal and prospecting is now under way.

Both scheelite and wolframite occur in some of the placer gold gravels in the Yukon, particularly in Canadian creek about 50 miles southwest of Fort Selkirk, also at Dublin gulch and at Johnson creek in the Mayo district. The tungsten ore recovered from gold sluicing operations is being set aside for future shipment. The occurrences were recently investigated by Dr. H.S. Bostock of the Department of Mines and Resources, Ottawa.

Canadian production and trade figures are not available for publication owing to the war.

World production of tungsten ore and concentrate in 1939 on a basis of 60 per cent WO_3, was about 34,000 tons (1940 not yet available), the principal producing countries being Burma, China, United States, Bolivia, Portugal, Korea, and Japanese controlled areas

in South China.

China had dominated the tungsten industry for more than 20 years prior to 1939, but the Sino-Japanese conflict has very seriously interrupted the flow of ore. Exports of wolframite from China amounted to about 11,000 metric tons in 1939 and to 18,000 tons in 1937. As a result of Japanese control, the centres of transportation have shifted from Shanghai and Canton to Hong Kong. The Chungshan and other south China deposits are in the control of Japan, but the more important tungsten areas of northern Kwangtung and Kwangsi are still under Chinese control. Sales rights of Chinese wolframite were granted to Pekin Syndicate, Limited, a British enterprise by the Chinese government in 1939. Uncertainty and disruption of trade caused such a serious check on exports that only 827 tons were shipped from Hong Kong in the first nine months of 1940, as against a total of 7,741 tons from that port in 1939.

Burma, the largest world producer of tungsten ore, is the principal British source of supply. The Ministry of Supply, London, is taking all the tungsten ore that can be produced and has fixed a price of 55 shillings a long unit at Rangoon. Exports from Burma in 1940 were 12,000 long tons of wolframite and mixed tin-wolframite concentrates, nearly all of which went to England. Portugal is the leading European producer of tungsten and operations are financed by British capital. The principal mines are in the district of Castello Bianco. Tungsten exports from Portugal, which are now under licence, are increasing annually and in 1939 amounted to 3,100 metric tons. Bolivia was the principal South American producer during the last war, after which the production became negligible, but the mineral is again being produced in appreciable quantities, the output of wolframite being estimated at about 4,000 tons in 1940. Exports of wolframite from Bolivia amounted to 2,400 metric tons in 1939. When transportation difficulties are overcome, shipments from that country are likely to show a considerable increase. Argentina is also an important producer, the output in 1940 being 1415 long tons, 80 per cent of which went to the United States and the remainder to Japan. Tungsten production from Australasia is becoming of importance, the output in 1939 being 1,200 tons, about 80 per cent of which was wolframite and the remainder scheelite.

In Cuba, the Pan-American Tungsten Corporation (Pan-American Steel and Alloy Company of Montreal) expects to start the production of wolframite early in 1941 from a large deposit near Siguanea bay on the west coast of the Isle of Pines, where a plant was recently completed. About two tons of concentrate with a WO_3 content of 72 per cent was shipped to the United States late in 1940 for analysis and trial.

The United States imported 9,915 tons of tungsten ore in 1940, close to half of it from China. The shipments were made through Indo-China until this route was cut off by Japan after which, and following the opening of the Burma road, they were made via Rangoon. Most of the remaining imports came from South America. The United States produced 5,319 short tons of 60 per cent WO_3 as compared with 4,287 tons in 1939. Its estimated consumption in 1940 was about 12,000 tons of average grade concentrate, or the equivalent of 6,000 tons of tungsten metal, which is more than double the peacetime requirements. Although the United States is third in the production of tungsten ore, its output is less than half of its present consumption. Arrangements have accordingly been made under the Strategic Minerals Act for Government stock piling of foreign and domestic ores. A large loan was made to the Chinese Government late in 1940 which is to be

repaid partly by tungsten deliveries throughout the next five years.

The United States Bureau of Mines and the Geological Survey are encouraging production by the carrying out of development work and diamond drilling on properties of merit and by searching for new deposits. Considerable success has been achieved already, of particular interest being the discovery by Government engineers of a high grade tungsten deposit in Valley county, Idaho. Detailed reports were issued recently by the Geological Survey on the tungsten deposits in Kern, Inyo, and Mono counties, California; in Boulder county, Colorado; and on other deposits. Several promising developments near Bishop, Inyo county, California, are also likely to alleviate present conditions. United States Vanadium Corporation is building a 1,000 ton a day mill at Pine Creek, California, and Nevada-Massachusett Company, which operates at Mill City, Nevada, hopes to produce 150 tons of concentrate a month by the summer of 1941. The State of Nevada has been the leading American producer of tungsten for several years.

Close to 95 per cent of the world output of tungsten is used in the steel industry, mainly for the production of high speed steels for cutting tools in which the tungsten content is from 15 to 20 per cent, and partly for use in different alloy steels in combination with other alloying metals. Some of these latter steels are being used to an increasing extent in the making of armour plates, armour piercing projectiles, and other military equipment. Stellite, the best known non-ferrous alloy, contains from 4 to 15 per cent of tungsten and higher percentages of chromium and cobalt. The use of tungsten carbide as a super hard cutting tool is an outstanding development, a more recent development being the placing on the market of a compound with titanium, known as "Kinnmetal" ($W_2Ti_2C_4$), which is said to be harder than the hardest known tool steel. Pure tungsten is used in lamp filaments (about 1.5 per cent of total tungsten consumption), in radio tubes, contact points, etc. Small amounts of tungsten in the form of sodium tungstate and tungstic oxide are used in the preparation of chemicals and as salts in the pigment and tanning industries.

Owing to its abundance in that country, molybdenum is partly replacing tungsten in high-speed steels in the United States. In some instances the combined molybdenum-tungsten steel is better than the straight tungsten product.

Under authority of the United States Strategic Minerals Act of June, 1939, for the acquiring of an emergency stock pile, specifications for tungsten ore were drawn up as follows: WO_3, a minimum content of 60 per cent, the maxima of the following harmful impurities being: copper and antimony each 0.05 per cent; arsenic and sulphur each 0.05 per cent; bismuth, 0.12 per cent; tin, 1.0 per cent; molybdenum, 0.40 per cent; and phosphorous, 0.035 per cent.

In Canada, the only market at present is for scheelite and the specifications of the single consumer call for a minimum of 70 per cent WO_3, with impurity maxima somewhat similar to those for the United States. Scheelite is added direct to the steel and, accordingly, it must contain at least 70 per cent WO_3. In the case of wolframite, which is converted into ferro-tungsten before being added, the minimum allowance is 60 per cent.

The United States prices of imported 60 per cent WO_3 ore at the close of 1940 were $24 to $26 per short unit (20 pounds) of contained WO_3, duty paid in car lots, c.i.f., United States ports. Domestic, $23.50, delivered. The duty into the United States is $7.93 a short unit of contained WO_3. The United States price of 75 to 80 per cent ferro tungsten is $1.90 to $2.00 per pound of contained tungsten metal. The price of tungsten metal of 99 per cent purity is $2.50 a pound; of 99.5 per cent purity, $3.25 a pound; and of 99.9 per cent purity, $6.00 a pound.

The price in Canada of scheelite concentrate containing 70 per cent WO_3 (within specifications), is $17 to $17.50 a short unit of WO_3, delivered at Welland, Ontario.

Owing to their heavy weight, tungsten minerals can be concentrated by gravity methods without difficulty provided the ores are relatively free of metallic sulphides; otherwise, combined gravity and flotation methods must be employed. As the ore, especially scheelite, tends to slime, care must be taken in the grinding so as to avoid excess loss in sliming.

Tungsten is one of the most important of the war metals, but its production in Canada is insignificant as compared with the steadily increasing amounts required in the manufacture of war products in the Dominion. This, together with hazards involved in shipments from Asia, the principal source of supply, give emphasis to the need for a greater domestic production. It is probable that many gold deposits other than those mentioned above contain some scheelite and it is a mineral that can be readily detected by means of the ultraviolet lamp. If all or most of this ore could be recovered, the total tonnage would probably be sufficient to alleviate the present situation materially. The Dominion Government has already purchased some ferrotungsten for stock piling and is likely to purchase more as none of it is being made in Canada at present.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

ZINC IN 1940

Close to 75 per cent of the zinc produced in Canada comes from Consolidated Mining and Smelting Company's Sullivan silver-lead-zinc mine near Kimberley, British Columbia. The remainder is from Hudson Bay Mining and Smelting Company's copper-zinc deposits at Flin Flon, which straddle the boundary line between Manitoba and Saskatchewan; the Sherritt-Gordon copper-zinc mine in northern Manitoba; several small lead-zinc properties in West Kootenay district, British Columbia; and the Normetal and Waite-Amulet copper-zinc mines in northwestern Quebec.

In British Columbia, the Sullivan mine and concentrator at Kimberley were operated at capacity. The capacity of the Company's zinc plant at Trail has been increased in recent years and in 1940 the plant was operating close to capacity. Base Metals Mining Corporation's lead-zinc mine and concentrator near Field were re-opened late in 1939 and production was commenced in January, 1940. The Britannia mine produced no zinc concentrate during 1940.

Western Exploration Company increased the capacity of its concentrator at Silverton, B.C., to re-treat the old tailings accumulated during previous operations, mainly for the purpose of recovering the zinc. The Company's Mammoth mine was also being prepared for production. The Lucky Jim mine, at Zincton, was taken over during the year by Zincton Mines, Limited, a new company owned by Sheep Creek Gold Mines, Limited. The mine and concentrator were prepared for production early in 1941. Operations were resumed at the old Cork Province mine [redacted] in the fall of 1940. The New True Fissure mine and concentrator were also in operation. Several small lead-zinc properties, mainly in the Ainsworth-Slocan district were shipping crude ore to the Trail smelter.

In Manitoba, the rate of output at the Flin Flon mine of Hudson Bay Mining and Smelting Company was appreciably higher than in 1939. The new south main shaft was completed to the 2,500-foot level, and ore pockets and an underground crusher were built below that level. Alterations and additions were made to the concentrator and zinc plant, the improvements to the latter including two new roasters, additional thickeners and purification equipment, solution storage tanks, and a fifth electrolytic tank circuit. The zinc plant operated at capacity, treating a slightly greater tonnage of zinc concentrate and producing more slab zinc than in 1939. The Sherritt-Gordon copper-zinc mine and concentrator, about 50 miles northeast of Flin Flon, were operated throughout the year.

In Ontario, the copper-zinc-lead property of Sudbury Basin Mines, Limited, in the Sudbury basin, remained idle.

In Quebec, Normetal Mining Corporation, Limited, near Dupuy, increased the capacity of its concentrator. The copper concentrate produced is shipped to the Noranda smelter and the zinc concentrate is exported to the United States. Production was curtailed during the first quarter owing to a shortage of hydro-electric power, but for the rest of the year the concentrator operated at capacity and shipments of copper and zinc concentrates were made regularly. About 80 per cent of the copper produced is being sold under contract to the British Ministry of Supply and the remainder is used in Canada. A new shaft (No. 3) was completed to the 1400-foot level. It was later extended and had reached a depth of 1,868 feet at the end of 1940. It will be carried to a depth of 2,000 feet. Upon completion of the shaft, ore pockets and ore passes, four new levels will be developed at 150-foot intervals, below the 1400-foot horizon. Waite-Amulet Mines, Limited, did not produce any zinc concentrate in 1940.

In Nova Scotia, the Stirling copper-lead-zinc property in Cape Breton has been idle since late in 1937.

Canadian production and trade figures are not available for publication owing to the war.

The world production of zinc in 1939 (1940 not available), as reported by the American Bureau of Metal Statistics, was 1,849,700 short tons, compared with 1,752,300 short tons in 1938. The principal producing countries, according to the origin of ore, are: United States, Canada, Australia, Germany, Poland, Mexico, and Russia.

Canada holds fourth position as a producer of slab zinc, being headed by the United States, Belgium, and Germany. The last two countries, in addition to domestic ore, treat large quantities of imported ore.

World consumption in 1938 (1939 and 1940 not available), as given by the American Bureau of Metal Statistics, was 1,641,800 short tons, compared with 1,802,700 short tons in 1937.

The making of munitions has resulted in a marked increase in the consumption of zinc. In peacetime the galvanizing industry uses most of the primary and secondary output of zinc. Large quantities of the metal are used also in the brass and castings industry; as paint pigments; in radio and flashlight batteries; and in the making of zinc oxides.

The average price of zinc for 1940 in Canadian funds based on London quotations, was 3.411 cents per pound, compared with 3.069 cents in 1939. The St. Louis price was 6.335 cents, compared with 5.110 cents in 1939.

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DEPARTMENT OF MINES AND RESOURCES,
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ARSENIOUS OXIDE IN 1940

The world output of arsenic is practically all obtained as a by-product from the treatment of gold, silver, copper, lead, zinc, cobalt, tungsten, and tin ores. In Canada, arsenic is obtained as a by-product from 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 O'Brien mines in Quebec and the Little Long Lac mine in Ontario. At these three properties baghouses to extract arsenic from the fumes of roasting plants used in the recovery of gold from arsenical concentrate have been installed. The Bralorne and Hedley and other mines in British Columbia export arsenical gold concentrates to the United States, but no payment is made for the arsenic.

Deposits containing arsenopyrite in association with gold occur in various parts of Canada, and some of these deposits in Ontario, Quebec, and Nova Scotia, are being operated for the recovery of gold. If the arsenic could be recovered at a profit such properties could supply considerable amounts of concentrate suitable for the production of the mineral.

All the refined white arsenic (As_2O_3) and arsenical insecticides made in Canada are produced by Deloro Smelting and Refining Company, Limited, Deloro, Ontario, which obtains its raw material from the silver-cobalt-arsenic mines of northern Ontario.

Canadian production and trade figures are not available for publication owing to the war.

The world production in 1939 (1940 not yet available) is estimated by the U. S. Bureau of Mines at 58,000 metric tons compared with 55,000 metric tons in 1937. Accurate production data are not available as some countries fail to record arsenic statistics and others give only sales or exports.

Although the world consumption of white arsenic has varied greatly during the past ten years, the quoted price remains at 3½ cents a pound. As most of it is a by-product of metal recovery, through necessity rather than choice, and as the potential supply is far in excess of any probable demand, there seems to be little likelihood of any sustained increase in price. The present world consumption is estimated at 55,000 metric tons a year.

Arsenic is used chiefly in insecticides, weed killers, sheep and cattle dip, wood preservatives, and in the manufacture of glass, minor uses being in pigments, tannery supplies, and pharmaceutical preparations. Experiments are being made to determine whether arsenic salts can be used to replace creosoting in the preservation of wood.

The nominal price of arsenious oxide in New York remained at 3 cents a pound in the first half of 1940 and at about 3½ cents during the last half of the year.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

ASBESTOS IN 1940

The asbestos production of Canada is all of the chrysotile variety and comes entirely from areas of serpentinized rock in the Eastern Townships of Quebec where the producing centres are Thetford Mines, Black Lake, East Broughton, Vimy Ridge, and Asbestos. The Canadian deposits are the largest known in the world. Production has been continuous from the Thetford area 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. Most of the output consits 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 the East Broughton area. The average yield of fibre from the Quebec deposits is 5 per cent of the rock mined and 7.7 per cent of the rock milled.

In 1940 there were five producing companies. Asbestos Corporation, Limited, worked two properties at Thetford Mines and one each at Black Lake and Vimy Ridge. Johnson's Company operated at Thetford Mines and at Black Lake. Bell Asbestos Mines, Limited, operated at Thetford Mines; Quebec Asbestos Corporation, Limited, at East Broughton; and Canadian Johns-Manville Company, Limited, at Asbestos.

Rahn Lake Mines Corporation discontinued operations in Bannockburn township, Matachewan area, Ontario.

The asbestos-bearing rock is mined both in open pits and underground. The method of block-caving instituted at the King mine of Asbestos Corporation in 1934, has resulted in a remarkable reduction in cost of mining and improvement in grade of mill feed. This development coming at a time when many of the open pits had been worked almost to the economic depth and operators were faced with rising costs and with the prospect of being unable to recover much valuable rock in the walls of the pits, is of the utmost importance to the industry.

Small deposits of chrysotile asbestos are known in other parts of Quebec and also in Ontario and British Columbia. Several of these have been worked from time to time but there is no production from any of them at present. Certain of these small deposits would yield asbestos having a very low iron content and entirely free from magnetite which should render the product of interest in connection with its use as insulation in electrical machinery.

Numerous deposits of other varieties of asbestos occur in Canada including anthophyllite, fibrous tremolite, and fibrous actinolite, all referred to commercially as amphibole asbestos. The fibres are harsher and weaker than those of chrysotile and are in little present demand. None of these deposits is being worked, although formerly fibrous actinolite was quarried near the village of Actinolite, Hastings county, Ontario, for use in the making of roofing materials. Asbestos deposits reported as having been found in recent years in Manitoba, east of Lake Winnipeg, and in Ontario, in the Lake of the Woods district and 260 miles north of North Bay, are of the amphibole varieties. There is a possibility that material from some of these deposits may be suitable for use in special products such as acid filters, and where long, harsh fibres are required.

Canadian production and trade figures are not available for publication owing to the war.

There was a slight decrease in production in 1940. This was due to European markets being closed on account of the war. However, the world's largest market is in the United States and a greatly increased demand for asbestos from that country is expected during 1941.

Complete data on world production in 1940 are not available, but it is known that Canada maintained her position as the principal asbestos-producing country. Other countries producing relatively large quantities of asbestos are Russia, Rhodesia, Union of South Africa, Swaziland, Africa, the United States, and Cyprus. It is reported that a new deposit of blue asbestos (crocidolite) is being developed in Australia and that small shipments of an excellent grade of chrysotile has been made from India.

Asbestos is marketed by the producer in the crude condition (long-fibred material only); in a partly open state; and in a condition ready for use, i.e., completely fluffed out and freed as much as possible from impurities.

Most of the Canadian production of asbestos is exported in the unmanufactured state - chiefly to the United States. Large exports are also made to the United Kingdom and Australia. Since September 20, 1939, the Dominion Government has controlled the exports of asbestos.

Asbestos is essential for the manufacture of brake linings and clutch facings and is used for many other purposes such as insulation materials, packing, and for building materials such as roofing shingles, corrugated sheeting, tile and piping. This last use has been greatly developed with the past two years.

Prices throughout 1940 remained the same as in 1939, and were as follows: No. 1 crude, $700 to $750 per ton; No. 2 crude, $150 to $350; spinning fibre, $110 to $200; shingle fibre, $57 to $78; paper fibre, $40 to $45; cement stock, $21 to $25; floats, $18 to $20; shorts, $12 to $16.50 per ton.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

BARITE IN 1940

Barite is fairly widely distributed in Canada, the most important occurrences being in Nova Scotia, Ontario, and British Columbia. In the early days of the industry, attention was centred mainly on the Nova Scotia deposits, and most of the total recorded output (about 42,000 tons since 1885) has come from that Province. Small tonnages have also been reported at intervals from Ontario and Quebec. Although some of the British Columbia occurrences are understood to be important, little interest has as yet been directed to them owing to their remoteness from markets and to the probability that the ore would require concentration for the removal of sulphides and other minerals.

There has been no important production of barite since 1917, when 3,500 tons was shipped; this material came from mines in the Lake Ainslie district, Nova Scotia. Some attention has been directed in recent years to the possibility of renewed operations on the Lake Ainslie deposits owing to their favourable situation for the export to Trinidad of material for use in oil well drilling, but nothing has as yet materialized.

Most of the productive activity in 1940 was directed to deposits in northern Ontario, from several of which small shipments of crude ore were made to grinding plants at Montreal or Toronto. Properties worked included the Eby mine, in Lawson township, near Elk Lake, and the Cryderman mine, in Penhorwood township, near Tionaga. The Premier Langmuir property on Night Hawk river, Langmuir township, which had been re-opened in 1938-39 by Canada Baryte Mines, Ltd., suspended operations after making some small shipments of crude ore. In addition a few tons of crude ore are reported to have been shipped from the Palmer property, Bathurst township, in the southern part of the Province, as well as from one of the Lake Ainslie mines, in Nova Scotia, and from a deposit near Quyon, Quebec, in the Ottawa Valley.

The outstanding development of 1940 was the discovery in the latter part of the year of what appears to be a deposit of exceptional size near Walton, in Hants county, Nova Scotia. This occurrence lies in a district hitherto unsuspected of containing barite, and from present indications appears to be of a bedded, sedimentary nature in a sandstone formation. A deposit of such character would be novel for Canada, and for that matter, for this continent. The important barite deposit at Meggen, in Germany, however, which has long been one of the chief sources of ore for the lithopone and barium chemicals trade, as well as for use in oil well drilling, has bedded character, and this suggests the possibility of similar conditions for the Walton occurrence. Surface trenching has proved up apparently continuous barite over an area 200 x 300 feet, and drilling has yielded cores of substantially massive, pure material, to vertical depths ranging from 58 to 200 feet. Thus far, the indicated tonnage is given as 1½ million tons. From the chemical standpoint, the barite is exceptionally pure, a sample from a composite 3,000 pound shipment made to the Bureau of Mines laboratories having given 98.44 per cent $BaSO_4$, with a specific gravity of 4.53; it would thus be well adapted for use in oil well drilling, the specifications for which call for 92-95 per cent $BaSO_4$ and a gravity of 4.20-4.25. Although the deposit contains zones or bands of lighter-coloured material, the bulk of it appears to be a deep reddish shade, due to the presence of finely-disseminated iron oxide, and would thus not be suitable for the ground barite trade without bleaching. Tests made in the Bureau of Mines Laboratories have shown that substantially complete removal of the contained iron can be accomplished by treatment with either sulphuric or hydrochloric acid, but this may not be practicable commercially on account of cost. The deposit is now under development by the discoverers,

Springer Sturgeon Gold Mines Ltd., of Toronto, who are proceeding with the erection of a 100-ton per day grinding plant on the property, with the intention of producing initially for the Trinidad trade. Being situated close to an existing wharf on tidewater, favourable loading and shipping facilities are available for export. In view of the apparent large tonnage available, the exceptionally high $BaSO_4$ content of the ore, and probable low production costs, this deposit may also prove an important source of supply of crude ore for the American lithopone and barium chemicals trade, most of the plants for which are situated along the Atlantic seaboard.

Total Canadian production of barite in 1940 was 330 tons, valued at $4,739. Value of the 1939 production was $3,639, with no tonnage figures available. All of the material was ground in custom mills at Toronto or Montreal, for domestic consumption.

In 1938, the latest year for which fairly complete statistics are available, total world production of barite was given as 960,738 tons. Germany has long been the leading producer, supplying 50 per cent of the total world supply in 1938, followed by the United States, with about 30 per cent. The remainder has been obtained chiefly from the United Kingdom, Italy, Greece, France and India. Developments currently under way in Cuba are expected to make that country of increasing importance as a producer.

Canada has had no barite exports for many years, outside of small trial shipments. Imports in 1940 totalled 2,622 tons, valued at $64,922, all ground material. Most of the supply came from the United States.

The main industrial uses of ground barite are as an in inert filler or loader in rubber, paper, oilcloth, textiles, leather, and plastics. In paints, it serves as a pigment and as an extender. A more recent use is as a loading medium in oil well drilling muds, to overcome gas pressures, and in 1939 the amount used for this purpose in the United States was 73 per cent of total sales. Coarse, granular barite is finding increasing use as a batch ingredient for moulded flint glass.

A very large proportion of the barite used by industry goes to the lithopone and barium chemicals trade, the amount so used in the United States in 1939 being about half of the total consumption, or 200,000 tons.

Domestic requirements for powdered barite have been running about 2,500 tons per annum, most of which has come from the United States and Germany. This relatively small tonnage has given little encouragement towards the establishment of a domestic industry, particularly as many of the most favourably situated deposits have been found to carry material that either requires beneficiation to meet trade specifications or is off-colour. Transportation obstacles and high freight rates to consuming centres have proved difficulties in the case of certain other deposits carrying better-grade material.

Recovery of barite occurring as gangue with other minerals such as sulphide ores, fluorspar, etc., from mill tailings of plants treating such ores is not regarded as commercially practicable and is not known to have met with any success.

Some activity was registered in 1940 in a search for domestic deposits in eastern Canada that might be drawn on for a supply of ore for custom grinding in Montreal and Toronto mills in order to meet the

situation created by the war, which has cut off German material and raised the price of American, and to conserve exchange. These efforts drew small tonnages from a few scattered properties, but have not resulted in establishing any important sustained operations. A ready market exists with certain custom mills for a limited tonnage of prime white crude ore for grinding to supply the domestic trade.

Barite is a relatively low priced commodity. Using the American trade as an index of recent price trends, market quotations in December 1940 were as follows: crude ore, $6 - $7 per ton, according to grade, f.o.b. mines; prime white, floated Missouri, $22 - $25 per ton, f.o.b., and off-colour grades, $12 - $16. Canadian trade journal quotations were $47 per ton for prime white, and $40 - $44 for off-colour grade.

Witherite (barium carbonate), the only other commercial barium mineral, sold in the United States in 1940 for $43 per ton for 90 per cent, 300 mesh material. The chief use for witherite is as an addition to heavy clay products, as well as to mortar, in which it combines with soluble sulphates and inhibits the formation of the objectionable efflorescence known as "scumming". It is also used as a carburizing agent in the case-hardening of steel, as a water softener, and in certain types of glass. No commercial deposits of witherite are known in Canada.

Barite enters Canada free under the British preferential tariff; imports from other countries pay 25 per cent ad valorem. The United States imposes a duty of $4 per ton on crude barite and $7.50 per ton on ground or otherwise manufactured material.

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DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

BENTONITE IN 1940

Bentonite, mainly of the highly-colloidal, "swelling" type, is widely distributed over large areas of the Prairie Provinces, where it occurs at several horizons in the upper Cretaceous sediments. The more important known deposits are exposed mainly in areas dissected by drainage channels where they show as beds in the slopes bordering valleys, and in the sides or on top of small buttes in typical "bad-land" topography. Thus, many of the chief exposures are found in the Red Deer Valley section of Alberta; over a wide area in southern Saskatchewan; and in the district around Morden, in southern Manitoba. One lower-lying bed is met with as a persistent parting in the No. 1 or main coal seam mined at a number of points in the Drumheller district, Alberta, as well as near Cluny, further to the east. Other exposures exist in the Edmonton region, Alberta, and further west, on the McLeod river, near Edson.

In British Columbia, a deposit of unusual thickness occurs in Tertiary beds near Merritt and at Princeton.

Until a few years ago, comparatively little interest had been shown in Canadian bentonite and most of the small production had come from the Princeton occurrence in British Columbia, from which a few cars are shipped annually to Vancouver for grinding and local consumption, mainly in gasoline refining. Some six years ago, attention became directed to the Morden deposits and there have since been occasional small shipments, most of which went to the local foundry trade at Winnipeg. In 1940, Pembina Mountain Clays, Limited, was incorporated by Winnipeg interests to undertake more active development, and a small drying and grinding plant was erected at Winnipeg to supply foundry clay. The bentonite of this district has been reported to possess high bleaching power in its natural state, without activation, and the company plans to engage also in the production of clay for the packing house and oil refining industries.

The largest tonnage of bentonite produced in Canada has come from the Drumheller district, in the Red Deer valley, Alberta, where, since 1937, several concerns have been engaged in shipping clay for use in oil well drilling in the Turner Valley field. The larger part of such output has come from the Gordon L. Kidd property at Drumheller, being shipped to a drying and grinding plant at Calgary operated by the Calgary Mud Company, who market their product under the trade name "Altamud". The remainder has been obtained mainly from coal mines operated by the Aetna Coal Company, at East Coulee, and Wayne Coal Producers Association, at Wayne, the material being shipped to a small plant at Longview, in Turner Valley, for processing and sale under the trade name "Viscolite". Shipments from the above concerns in 1940 totalled about 750 tons: total production to date from the area has been about 3,000 tons.

There has as yet been little attempt to exploit occurrences in Saskatchewan, but a small trial shipment was made some years ago from a deposit near Eastend.

Production of bentonite in Canada in 1940 was 1,469 tons, valued at $4,488, compared with 988 tons, valued at $3,441 in 1939, and 1,179 tons, valued at $3,659 in 1938.

There are no world statistics of bentonite production. The United States supplies the great bulk of the material used and exports large quantities. Such exports include both ground natural clay for foundry and other industrial uses and activated clay for bleaching purposes. American sales in 1939 rose to the record figure of almost 220,000 short tons, valued at $1,702,393. About one half of the output was mined from an important field in adjoining sections of Wyoming and South Dakota, which furnishes a highly colloidal type of clay used largely for foundry use, oil-well drilling, water-sealing, etc. Other

important producing states are California, Mississippi, Texas and Utah. Of the 1939 sales, about 43 per cent was reported as used for oil bleaching, mostly after acid activation; 16 per cent in drilling muds; and 25 per cent in foundry work. A large part of the clay used in the activated form is obtained from Mississippi.

Canada exports little or no bentonite. Substantial quantities of activated clay of the Filtrol type are imported from the United States for bleaching purposes in oil refineries and for packing-house products, as well as, possibly, some ground natural bentonite for similar use. There are also considerable imports of American ground bentonite for foundry use and for other minor industrial purposes. Imports of activated clay, for oil refining, in 1940 were valued at $196,467 with no record of quantity.

Outside of the three main ~~listed~~ listed above uses, viz., for bleaching, oil-well drilling, and foundry work, bentonite finds a variety of minor industrial applications, most of which call for the colloidal, or "swelling", type. It is employed as an emulsifying agent in asphaltic and resinous compounds; in soaps and detergents, as well as in a variety of cosmetic and pharmaceutical preparations; as a suspending, spreading, and adhesive agent in horticultural sprays and insecticides; as a plasticizing ingredient in ceramic bodies, slips, and glazes, and in plasters; to improve the flow and workability of concrete; and in the clarifying of wines, vinegar, etc. Increasing amounts are being used for water-sealing, in order to stop seepage through or around dam abutments, reservoir walls, the sides of irrigation ditches, and structural foundations. A further growing use is as a coagulant in clarifying the water used in paper mills and sewage disposal plants, as well as to remove turbidity in domestic and industrial water supplies. Research directed to producing a mica substitute from bentonite films has been actively pursued during the last couple of years, but at latest report the product ("Alsifilm") was still in the development stage. Some very fine (micron-size) material is used in paper coatings.

War demands greatly stimulated bentonite sales in the United States for general foundry work in 1939-1940, both for domestic use and export, and producing plants were working at full capacity. Canada probably possesses ample reserves of bentonite of foundry quality to supply domestic requirements, but freight costs to the main consuming centres have proved an obstacle to development in the face of low-priced material from the United States. Wyoming dried and ground 200-mesh clay currently sells for $8 per ton, f.o.b., in bulk, and $10 bagged, whereas similar material from Alberta has been quoted at $38. Selected, air-floated Wyoming clay is priced at $25 per ton, f.o.b. Chicago. Freight rates from Wyoming points to Montreal are about $13.50 per ton. Activated bentonite has sold for $65 to $75 per ton, in carload lots, delivered eastern Canadian points.

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DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

BERYL IN 1940

Beryl, a silicate of aluminium and beryllium, and commonly containing from 10 to 12 per cent of beryllium oxide (4 to 4.5 per cent of metallic beryllium), is the only commercial beryllium mineral. Its occurrence is confined to pegmatite dykes, usually in the form of disseminated crystals, and most of the beryl sold represents by-product material from the mining of such dykes for their feldspar, lithium minerals, or mica. Occurrences are known in many countries, but most of the supply has been derived from the United States (South Dakota, Colorado, and New England), India, Argentina, and South Africa. The total amount produced and sold annually is only a few hundred tons, but the known world reserves are believed to be capable of meeting considerably increased demand.

Known occurrences of beryl in Canada include a deposit in Lyndoch township, Renfrew county, Ontario, and several scattered showings in the Pointe du Bois district, southeastern Manitoba.

The Lyndoch deposit has been worked intermittently on a small scale since 1926 by various operators, and for several years past has been under development by Canadian Beryllium Mines and Alloys Limited, 901 Royal Bank Building, Toronto: this company has opened up two surface pits, and has stock-piled about 50 tons of cobbed beryl crystals. Another 50 tons of beryl is estimated to be contained in stocks of uncobbed rock awaiting a practical milling method of separation. The pegmatite carries minor amounts of columbite and certain other minerals of rare-elements. Some small shipments of feldspar have been made from the property. The mine was inactive during most of 1940.

The Manitoba beryl is found mainly as scattered crystals in certain pegmatite bodies that have been worked for either feldspar or lithium minerals in the Winnipeg river and Bird river areas. There has been no production outside of a small amount of clear, glassy material used for cutting into gem stones, for the local Winnipeg jewellery trade. In 1940, a company - Mobirk Beryllium Mining, Limited, of Toronto, - was incorporated to take over and develop five groups of claims in the Shatford, Bernic, and Cat lake areas, upon which beryl showings are reported: plans call for building up a stock of beryl, to be later processed for the production of beryllium oxide in a plant to be located at Winnipeg.

Field parties of the Geological Survey working in the Yellowknife region, Northwest Territories, have recently reported the occurrence of beryl-bearing pegmatites, carrying also lithium minerals, in an area lying about 20 miles northeast of the Yellowknife camp. Occurrences of beryl are also known in Rainy River and Patricia districts, Ontario, and in northern Quebec. None of the above are considered as of particular present economic interest.

The United States is the chief consumer of beryl on an important scale for the production of beryllium metal and alloys, as well as of beryllium oxide and other salts. Germany, France, and Italy have also been prominent countries engaged in making beryllium products: Japan is stated to have recently come into the picture with a production plant built in 1939.

American supplies of beryl, other than domestic, have been drawn largely from India, Argentina, Union of South Africa, and Brazil. There are no figures of world trade in beryl, and no statistics of either production or consumption in the United States. Present American consumption, however, is estimated to be under 500 tons per year, probably equal to about half the total world demand. Imports into the United States rose sharply in 1939, to 459 short tons, valued at $14,574, compared with about 150 tons annually in the three preceding years. Consumers, as for some years past, continue to report adequate supplies available, with offerings larger than the market can absorb. Argentina appears to be the most

important present world source of the mineral: mines in Cordoba and San Luis provinces in 1938 shipped 430 tons, and in 1939, 753 tons.

There has been a recent marked increase in the commercial interest in beryllium in the United States and in 1940 sales of the metal, alloys, and other compounds are estimated to have approached a value of $500,000. In the alloy field, beryllium-copper still leads, but increased interest is also now developing in the possibilities of light alloys of beryllium aluminium for aircraft use. A variety of beryllium salts are on the market, the chief of which is the oxide, used as a super-refractory in crucibles and in insulators. Ground beryl finds employment as a batch ingredient in sparkplugs and other ceramic specialties, to which it imparts high electrical and impact resistance and transverse strength. The current consumption for such uses is estimated at about 100 tons per year. Beryllium compounds give chrome-green glazes at cone 12.

The main use for heavy beryllium-copper alloys continues to be in the general industrial field, for small springs in business machines, pressure gauges, valves, electrical contacts, etc., and in precision control instruments of various kinds. For such purposes, the value of the alloy lies in its exceptional resistance to fatigue and stability, coupled with resistance to corrosion, wear, and change of volume under load. Beryllium-copper tools, which reduce fire hazard from sparking, also consume a considerable amount of the alloy. A recent development is the use of beryllium-copper as the metal for cast-set bits and reaming shells for diamond drilling: the alloy used has a low melting point and carries the trade name "Vankolite".

Two main classes of such alloys are now offered, chiefly those containing 1.75 to 2.25 per cent of beryllium ~~and they~~ which are employed for strong, heat-treated castings having tensile strengths up to 180,000 pounds per square inch, and a second class with only 0.05 per cent of beryllium but with the addition of nickel, cobalt, or chromium. These last, of which one with 2.5 per cent of cobalt is reported to have shown promising properties, have been developed in an effort to lower base prices and so encourage wider use of beryllium. Although not as strong or corrosion resistant as the first class, these low-beryllium alloys have higher electrical conductivity and more uniform physical properties: one important use for them is in flash-welding.

The potential importance of beryllium alloys for defence purposes has latterly aroused considerable interest. To off-set the corrosive effect of high-lead gasoline, beryllium-copper is reported to be replacing steel in the valve-guides of high powered aeroplane-engines, and is also now being specified for a growing number of military uses. It is reported that certain parts of the new American Garand rifle may be made of beryllium-copper, cast in special moulds, so as to obviate expensive machining and finishing, and a further potential field is seen in the making of castings for aeroplane-engines.

The price level for beryllium-copper master alloy in 1940 remained at $15 per pound, with the base price of bar, strip, and sheet for fabrication at $1 per pound for metal with around 2 per cent of beryllium. One ton of beryl, selling for about $50 per ton, delivered, is estimated to yield enough beryllium metal to make some 3,000 pounds of such alloy, and with the current trend towards reducing the content of beryllium, this yield may increase to 5,000 pounds, or more.

Recent tests on pure beryllium have shown it to possess remarkable conductance of sound - 2½ times that of steel. Its good reflectivity for white light, permanent surface, low density (1.84), and fair electrical and thermal conductivity, suggest its value for instrument mirrors.

A reported new use for the salt beryllium acetate is as a coagulating, hardening bath for a new form of textile fibre (sodium alginate) made from seaweed.

Nominal quotations for standard beryl in 1940 remained substantially unchanged, at around $30 to $35 per short ton, f.o.b. mine, or $40 to $45 at consuming plant, for 10 - 12 per cent BeO material. The war blockade of Germany and Italy, however, has diverted South American supplies that normally went to those countries to the United States, with resulting surplus offerings and sales at as low as $30 - $35 per ton ex dock Atlantic ports. Special, glassy, crystalline beryl, that commonly runs higher in beryllium oxide than normal standard grade and is preferred for ceramic use, commands a premium and may sell as high as $50 per ton f.o.b. shipping point.

Since the loss of the main European market (Germany and Italy), the two American users - Beryllium Corporation of Pennsylvania, Reading, Pennsylvania, and Brush Beryllium Company, 3714 Chester Avenue, Cleveland, Ohio, - remain the most important world consumers. Cooper-Wilford Beryllium Limitd, of Newton Falls, Ohio, and 33rd and Arch Streets, Philadelphia, a company recently formed to engage in the development and production of light beryllium-aluminium alloys for aircraft use, advised the Bureau of Mines early in 1941 that they might be in the market for supplies of beryl, and also that they were conducting research on flotation methods of concentrating low-grade beryl ores. A recent report of the United States Bureau of Mines (Mineral Trade Notes, January 20th, 1941) states that a company has recently been organized in Argentina to produce mixed beryllium oxide-carbonate as a base material for the extraction of beryllium metal from domestic ores. This product, which is made by a newly-developed process, is stated to be of high purity and to contain 80 per cent of beryllium oxide, the difference being carbon dioxide: production was scheduled to commence in November 1940, at an initial daily output of 300 pounds, rising eventually to 2,000 pounds. Selling price of the product has been estimated at $3.50 per pound.

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DEPARTMENT OF MINES AND RESOURCES,
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BITUMINOUS SAND IN 1940

Deposits of bituminous sand occur along the Athabaska River between the twenty-third and twenty-sixth base lines, in the northern part of the province of Alberta, and extensive exposures may be seen along both sides of the river and certain of its tributaries. Detailed field investigations since 1913 by the Bureau of Mines have made it clear that these deposits constitute a vast reserve of bituminous material available for use as asphalt or for conversion by modern refining methods to more valuable petroleum products. Nothing commensurate with the immensity of this resource has yet been attempted in the way of production, but demonstration pavements have testified to the excellence of the sand as a paving material and much work has been done on the problem of the separation of the bitumen from the sand and on the production of higher grade products.

Since the provision of railway facilities to McMurray, serious efforts have been made for several years past to work the sand in the vicinity of McMurray where the more accessible and conveniently excavated sites are to be found.

Between 1927 and 1930, a total of 2,000 tons was shipped for laboratory investigations, and a further 3,000 tons was used in the construction of demonstration pavements and road surfaces. During 1931 to 1938, International Bitumen Company processed small amounts of bituminous sand at its plant at Bitumont, Alberta, producing asphalt for paving and roofing and 37,500 gallons of fuel oil. Fuel oil was disposed of to mining companies at Lake Athabaska. Roofing asphalt was shipped to Crown Point, Indiana; and Calgary, Alberta; paving asphalt to Edmonton and Banff, Alberta. The International Bitumen Company did not operate its plant during 1939 and 1940.

During 1940, Abasand Oils, Limited, contined the building of its separation plant and refinery on Horse River near McMurray and the development of a system of quarrying the bituminous sand. The separation plant is designed to treat 400 tons of sand, and the refinery to treat 600 barrels of charging stock per twenty-four hours. It is expected that initial production will include white products, fuels, road oil, asphalt and coke. The construction and installation of the mining, separation and refining equipment was nearing completion in January, 1941, and the company anticipates starting production on a commercial scale in 1941.

Prior to 1934, the Bureau of Mines, Ottawa, conducted a comprehensive investigation of these asphaltic deposits. 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.

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DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

CELESTITE IN 1940

Several occurrences of celestite of possible economic interest are known in Canada, but there has been very little attempt at development; the last was in 1920-21, when some ground material was produced from a deposit in Bagot township, Ontario, and sold to the paint trade. The Bagot ore has coarsely-fibrous character and is not very pure, containing about 18 per cent of barium sulphate. On this account, it would not be favoured for chemical use, but is regarded as suitable for paints and general filler or loader use. Renewed interest in the deposit developed in 1940 and plans were reported for placing the property in production, but these have not yet materialized. Celestite similar in character and analysis occurs at some of the old fluorspar mines of the Madoc area, in Ontario, and some might be recoverable from the waste dumps.

A very pure celestite, analysing 98-99 per cent strontium sulphate, occurs as a small vein of coarse platey crystals in Lansdowne township, Ontario. Some was mined many yers ago, but its disposition is not on record. Calcite appears to be the only associated mineral, and recovery of a concentrate of high purity should be easily made by jigging and tabling. In the event of a war shortage of imported strontium compounds, this deposit probably offers the best possibility for supplying the deficiency, though the indicated tonnage is not great.

Celestite of similar type to the above occurs also in Fitzroy township, Ontario, where it was disclosed in a small prospect shaft made for galena about 30 years ago. Analysis of selected material showed 93 per cent strontium sulphate. A moderate supply might be obtainable from this source, but the ore would probably need to be concentrated.

No important deposits of strontianite are known in Canada, though several occurrences of the mineral are on record: these are probably only of mineralogic interest.

Celestite (strontium sulphate) is the principal commercial source of strontium for the manufacture of the various strontium salts used in industry. Strontianite (the carbonate) is a less common mineral, used for the same purpose. Most of the world's supply of celestite is obtained from England, and some strontianite is mined in Germany. Important deposits are reported to occur in India and Newfoundland, but there has been no production from these sources as yet. There are no very complete figures on the world trade in these minerals, but in recent years total production would appear to have been around 5,000 - 7,000 tons.

As stated above, the chief use for both celestite and strontianite is for the manufacture of various strontium salts and chemicals used in industry and medicine. Of such compounds, the nitrate, carbonate, and hydrate are the most important. Strontium nitrate is employed mainly in pyrotechnics, for fireworks, signal flares, tracer bullets, etc., to which it imports the characteristic strong red flame colour of the element. The hydrate is chiefly used in the refining of beet sugar by the Scheibler process, but this is little practised on this continent, where the Steffens, or lime, process is mainly used. The carbonate is said to be used to some extent as a batch ingredient in the manufacture of certain types of glass, and as a fluxing and desulphurizing and dephosphorizing agent in iron and steel.

Strontium metal, made from either the natural sulphate or carbonate, finds limited application in certain alloys, mainly of copper, tin, lead, zinc, and cadmium.

According to American trade journals, ground celestite of 92 per cent grade currently sells at $45 per ton.

A review of the strontium situation in the United States, published early in 1941, furnished the following information: A new, and possibly the principal, outlet for strontium ores is now offered by the employment of powdered celestite for purifying caustic soda solutions used in the manufacture of rayon. Domestic reserves of celestite are held to be abundant, though American requirements have been supplied almost entirely by imported material for many years. In 1940, several deposits were reported to be under development in California, and celestite-bearing limestones in Ohio are regarded as of possible commercial interest. An occurrence of strontianite has been reported in New Mexico, and impure celestite has been mined in Texas to replace barite in oil-well drilling muds. American importers of celestite are stated to have stocked up heavily in 1939 at a delivered price of about $14 per ton for crude ore, and though quotations on certain strontium salts have shown a slight rise, no shortage is feared.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

CEMENT IN 1940

Portland cement, the principal raw materials for which are limestone and clay, is manufactured in five provinces of Canada. In addition to the standard or ordinary variety of Portland cement several other varieties including high-early-strength, alkali-resistant and white cement are now made in this country, the last named variety, however, being made from imported clinker.

The Canada Cement Company, Limited, operates plants at Hull and Montreal East in Quebec; at Port Colborne and Belleville in Ontario; at Fort Whyte, Manitoba; and at Exshaw, Alberta. The 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, making white cement, cement paints, etc., from imported clinker. The British Columbia Cement Company, operates at Bamberton, British Columbia. The total rated daily-capacity of all plants is about 35,000 barrels. (A barrel of cement weighs 350 pounds net.)

The dry process of cement manufacture is used at all but one of the eight plants making cement from domestic raw materials, and remarkable uniformity in the standard variety of cement is now achieved throughout the country as the result of close technical control and improvements in plant equipment. The rotary kilns used in the cement industry are the largest units of moving machinery in existence.

Froth flotation is now used in a number of plants in the United States and other countries to remove certain materials, principally excess silica and mica, from limestone. The successful adaptation of this process to the beneficiation of cement raw materials has permitted the utilization of limestone deposits, which though advantageously situated, are too impure in their natural state for cement manufacture.

Production of cement in 1940 was 7,559,648 barrels valued at $11,775,345, compared with 5,731,264 barrels valued at $8,511,211 in 1939. This marked gain in production was due mainly to the large increase in industrial construction in connection with war activities. Most of the cement produced is used within the Dominion but there is a small import and export trade as well.

Exports of cement during 1940 amounted to 300,000 barrels valued at $414,442, compared with 156,556 barrels, valued at $159,579 in 1939.

Imports of cement totalled 13,214 barrels valued at $69,821 compared with 16,622 barrels valued at $58,316 in 1939.

Cement is one of the most important of our structural materials and finds use in all construction work such as bridges, dams, highways, foundations or buildings. In addition, an industry known as the cement products industry making building blocks, bricks, pipe, artificial stone, garden furniture, etc., 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, 1938 and 1939 were as follows:

	1937	1938	1939	1940
Quebec	$1.37	$1.35	$1.33	$1.41
Ontario	1.38	1.40	1.43	1.49
Manitoba	2.27	2.28	2.25	2.25
Alberta	1.99	2.01	1.97	2.01
British Columbia	1.81	1.87	1.91	1.94

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OTTAWA, MARCH, 1941.

CLAYS AND CLAY PRODUCTS IN 1940

The industrial clays of Canada may be classified as common clays, stoneware clays, fireclays, and china clays. Statistically, the ceramic industry of Canada is conveniently classified into two divisions: (1) Production from domestic clays, which includes the production of building brick, structural tile, drain tile, roofing tile, stoneware, sewer pipe, pottery and refractories, and (2) production from imported clays, which includes the manufacture of electrical porcelain, sanitary ware, sewer pipe, table ware, pottery, ceramic floor and wall tile, and various kinds of fireclay refractories. The gross value of all ceramic products manufactured from Canadian clays (including sales of domestic clays) was $6,341,220 in 1940, compared with $5,151,236 in 1939.

Common Clays

Common clays suitable for the production of building brick and tile are to be found in all the provinces of Canada. The value of structural clay products made from domestic clays (building brick, hollow building tile, drain tile, roofing tile, etc.), was $4,359,505 in 1940, compared with $3,771,184 in 1939.

Stoneware Clays

The largest producing area in Canada of stoneware clay or semi-fireclays lies in the vicinity of Eastend and Willows, Saskatchewan, where large quantities of the clays are selectively mined and shipped to Medicine Hat, Alberta, to be extensively utilized (owing to the availability of cheap gas fuel) in the manufacture of stoneware, sewer pipe and pottery.

Stoneware clays and moderately refractory fireclays occur near Shubenacadie and Musquodoboit, Nova Scotia. A small amount of the Musquodoiboit 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 known to occur near Williams Lake, and Chimney Creek Bridge in British Columbia; in the Cypress Hills of Alberta, and near Swan River, Manitoba, but as yet there has been little or no development, owing to their comparative inaccessibility.

The value of stoneware articles (sewer pipe, pottery, etc.) produced in Canada from domestic clays in 1940 is reported to have been $1,623,728, compared with $1,095,920 in 1939.

Fireclays

Two large plants and a few small plants in Canada manufacture fireclay refractories from domestic clay. One, about 50 miles south of Vancouver, B. C., extracts a high grade, moderately plastic fireclay (by underground mining) from the clay beds in the Sumas Mountain, and manufactures firebrick and other refractory materials. Another plant at Claybank, Saskatchewan, by solective mining, utilizes the highly plastic refractory clays from the "White Mud" beds of southern Saskatchewan.

A small amount of the most refractory clays in the deposits near Shubenacadie is mined and used by the steel plant at Sydney for refractory purposes and the Musquodoiboit clay is utilized to some extent for stove linings. Except for a few small concerns manufacturing refractory specialties, and companies producing firebrick, blocks, etc., for their own use, all manufactures of fireclay refractories in Canada utilize imported clay.

The value (sales) of the refractories produced in Canada from domestic clays in 1940 was $250,652 as compared with $214,602 in 1939; the value of refractories produced from imported clays is reported to have been $754,565 in 1940, compared with $523,268 in 1939.

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, where a group of open pits was operated for several years prior to 1923. In 1937 a reorganized company was formed to extract the kaolinized material by underground mining and to refine it into high grade china clay, washed silica sand forming a by-product. A shaft has been sunk to a depth of 365 feet, and a mill erected to carry out the washing process in accordance with the most modern methods. 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 in 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 aroused much interest in recent years, but have not as yet been commercially developed, owing to their remoteness from industrial centres, and the 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 that compares favourably with the best china clays found on this continent. Transport by barge to railway has been considered but as yet little development has taken place.

In the manufacture of such products as porcelain, sanitary ware, dinner ware, ceramic floor and wall tile, etc., china clay imported from England is used almost entirely. In addition to clay for ceramic use, large annual importations of china clay are made into Canada for use in the production of fine paper, in the rubber industry, and for other industrial purposes. The imports of china clay in 1940 were valued at $483,399, compared with $376,750 for the previous year.

Ball clays of high bond strength occur in the white mud beds of southern Saskatchewan but as yet these have not been developed to any extent.

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 ceramic products imported into Canada was $9,677,723 in 1940, compared with $6,992,382 in 1939.

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DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

DIATOMITE IN 1940

Diatomite is the microscopically small remains of siliceous shells of diatoms, a form of algae that at one time lived under water. The material of recent origin, which is the most common in Canada, usually occurs as a grey or brown mud or peat, whereas the Tertiary diatomite is in more or less dry and compact beds, very light in weight and white to cream in colour.

The International Diatomite Industries Limited, Tatamagouche, Nova Scotia, continued to be by far the largest Canadian producer, but its output was twenty-five per cent less than in 1939. The crude diatomite from Rhudes and Lockerby ponds, near New Annan, is calcined and treated in a small mill at Tatamagouche Station, 12 miles to the north. About 85 per cent of the sales was exported, mainly to England, while of the remaining 15 per cent sold in Canada, nearly all was used for filtration. G. Wightman, Smith's Cove, produced about 40 tons of calcined diatomite in a small kiln erected on the Digby Neck deposit, Nova Scotia, and shipped a few tons for insulation purposes. Production is expected to increase in 1941.

There was some activity by W. M. Campbell of Saint John, New Brunswick, on a number of properties in the Pocologan area near Saint John, New Brunswick. The deposits are extensive and the diatomite of good quality. About 1½ tons of the crude from this area was shipped to Ottawa in 1939 by J. A. Morton of Montreal for experimental tests.

In Ontario, G. Rusznyak of Toronto shipped about a ton of crude diatomite to Ottawa for testing from the Silver Lake deposits at Indian Station west of Pembroke. Although the material is considerably better than in the average deposits, only a small proportion can be made into an efficient filter-aid. From the Muskoka region a very small amount of diatomite was sent for testing by the Muskoka Diatomite Limited, Gravenhurst, but no shipments were made and the plant is no longer in operation.

In British Columbia, the operations started in 1939 by West Coast Silica Products, Gabriola Island, ceased in December of that year, mainly owing to the lack of markets. There is a small treatment plant near the deposit. About seven tons of the diatomite stocked in Vancouver by Fairey and Company, Vancouver, and mined several years ago from Quesnel was consumed by that company in the manufacture of insulation bricks.

The Canadian production in 1940 was 176 tons and sales 248 tons, valued at $7,947 compared with 301 tons valued at $10,397 in 1939.

Exports records are not available, but from private information it is known that 70 per cent of the total sales was for England and about 3 per cent for United States; sales within Canada in 1940 amounted to 74 tons compared with 56 tons in 1939.

In 1940, imports were about 4,900 tons, almost all from California, United States, compared with 4,550 tons valued at $128,808 in 1939.

Very little change occurred in the consumption of diatomite used in the home industries during the year. About 80 per cent of the diatomite now being consumed in Canada is in the form of filter-aids, 14 per cent is used for insulation, a 9 per cent increase over 1939, and the remainder is absorbed as a filler, concrete admixture, silver

polish base, and in chemicals. Two companies are manufacturing diatomite insulating bricks. Amongst the recent applications, the use of diatomite in the paint and varnish industry, has demonstrated its advantages as a flattening agent and as an extender.

Deposits containing medium quality diatomite are very common in some parts of Canada. Owing, however, to United States competition and to the, at present, comparatively small Canadian demand, only properly prepared diatomite of the highest quality can be successfully marketed on a scale sufficiently large to warrant the operation of a property and the erection of a plant.

Indications are that not more than 25 per cent of the calcined material produced from the best quality Canadian deposit so far discovered, can be made into an efficient filter-aid that can compete with the imported product. Therefore, unless the remaining 75 per cent or more of the non-filter grades automatically produced can be sold, the cost of producing the filter-aid alone would be too high to be commercial. At present, the Canadian consumption of all non-filter grades is less than 600 tons annually, mainly in the form of made-up diatomite insulation bricks, the greatly increased production of which by Canadian firms is necessary before the Canadian diatomite industry can be profitable.

Prior to the war, England consumed about 50,000 tons of diatomite annually, which included a substantial tonnage of Danish "Moler" for insulation purposes. Since May, 1940, exports to England from Canada of all non-filter grades have been stopped owing to the lack of shipping space for this very bulky and non-critical material. England is, however, now importing from the United States at the rate of about 4,000 tons annually of the highest quality filter-aid only.

The United States, which contributed about 50 per cent of the world's output, had 15 producers in 1940. The total sales were estimated at 125,000 short tons, about the same as in 1939. The largest of the 25 other world producers are, Denmark, Germany, Japan, Algeria, and Northern Ireland, in order of their importance, each producing over 5,000 tons annually.

The present price in Canada varies from $30.00 to $75.00 per ton for insulation and filtration; up to $200.00 in small lots for material suitable for polishes; imported insulation bricks vary from $85.00 to $140.00 per 1,000, according to grade and density.

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FELDSPAR IN 1940

Feldspar has been mined in Canada since 1890, the total recorded production to date being over three-quarters of a million tons, valued at nearly 6½ million dollars. Most of the production has been of high-potash grade, and "No. 1 Canadian" has long been a standard in the ceramic industry as denoting prime quality for porcelain products. Some soda spar also is mined, and is sold for blending, as well as for use in scouring preparations and soaps of the "Bon Ami" type.

The main centre of production has been adjacent sections of western Quebec and eastern Ontario, in the general Ottawa region, with lesser amounts obtained also from Ontario mines distributed as far west as the Parry Sound and Sudbury districts. Although formerly a considerable part of the supply was derived from a number of small, scattered, and often intermittent operations, in recent years the great bulk of the output has been obtained from a few larger established mines. The chief Ontario source is currently the Bathurst district, in Lanark county, some also coming from the Madawaska region, west of Ottawa. At year-end, it was reported that the old Richardson mine, near Verona, Ontario, formerly a large producer, was in process of being re-conditioned for production by Toronto interests. Most of the Quebec production comes from an area along the Lievre river, north of Buckingham, in Papineau county. Total output has, for some time past, been about equally divided between Ontario and Quebec.

Some feldspar has also been mined from deposits in the Pointe du Bois region, in southeastern Manitoba, to supply a mill at Warroad, Minnesota, but there have been no important shipments from this source since 1936.

Feldspar production (sales) in 1940 totalled 21,185 tons, valued at $185,442. This was an increase in quantity of 69.5 per cent over 1939, when sales were only 12,500 tons, valued at $112,309. The threat to the industry from nepheline syenite, production of which commenced in 1936 and which it was thought might seriously affect feldspar sales, has thus far not proved as serious as expected, though the material has greatly lowered feldspar consumption by the domestic glass industry.

Canadian spar production is divided between export and domestic channels, export sales being usually somewhat higher than domestic consumption. Material for Canadian use is ground in mills operated by the following concerns:

Canadian Flint and Spar Company, Buckingham. Quebec.
Frontenac Floor and Wall Tile Company, Kingston, Ontario.
Bon Ami Company, Montreal East, Quebec.

The first two companies grind ceramic material, whereas the Bon Ami product (mainly soda spar) goes into scouring compounds.

The greater part of the exports ~~are~~ is consigned to mills of the following two American grinders:

Consolidated Feldspar Corporation, Rochester, New York.
Genesee Feldspar Company, Rochester, New York.

In 1940, consequent on the cessation of Scandinavian supplies, a demand for Canadian feldspar developed for export to Great Britain, and the year saw the first bulk shipments of both crude and ground material to the British market. Towards year-end, such shipments became restricted owing to lack of cargo space, but the demand still continued active.

Exports of feldspar in 1940 totalled 14,255 tons, valued at $95,846, compared with 7,661 tons, valued at $49,957, in 1939. Imports of ground spar, all from the United States, were 740 tons, valued at $13,661, compared with 607 tons, valued at $10,379, in 1939. Imports of crude feldspar (used for blending and for the manufacture of cleaners) were 50 tons, valued at $673, compared with 257 tons, valued at $1,302, in 1939.

Latest complete statistical records (1937) show the world production of feldspar (including "china stone", a variety of granite used in place of pure feldspar) as nearly half a million tons. Canada ranks sixth in point of output, with about 4 per cent of the total tonnage.

The feldspar used in industry is all crushed or finely-ground material, usually prepared either in mills operated by producers of the crude mineral or in merchant mills supplied from independent mines. A few manufacturers of ceramic products both mine and grind spar for their own use. Specially selected "dental spar", used in the production of artificial teeth, is also similarly prepared by the manufacturers.

The great bulk of the feldspar production goes to the ceramic industries, of which the glass trade is the largest consumer, followed by pottery, enamel, and sanitary ware. In the United States, in 1939, these industries accounted for 98 per cent of total sales. Minor uses include soaps and cleansers, abrasive wheels, and artificial teeth.

Domestic feldspar prices in 1940 showed little change from the levels of 1939. Crude No. 1 grade was quoted at $5.50 - $6.00, f.o.b. rail, for domestic mills and export. Ground spar, 200-mesh, sold at $16 - $18, and granular glass spar at $12, both f.o.b. mill.

Crude feldspar entering the United States pays a duty of 25 cents per long ton; ground feldspar is assessed at 15 per cent ad valorem.

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DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

FLUORSPAR IN 1940

Production of fluorspar in Canada is relatively small and the operations are somewhat intermittent, the chief source of output at present being the Madoc area in Hastings county, Ontario. Elsewhere in Eastern Canada no deposits of commercial importance have been found although there are scattered occurrences in Ontario and Quebec, and in the Lake Ainslie district, Nova Scotia, the mineral is found in association with veins of barite. In the West, the Rock Candy deposit near Grand Forks, British Columbia is the largest known occurrence of fluorspar in the Dominion.

Some fluorspar was mined in the Madoc district in the early years of the present century, but the deposits first received serious attention during and immediately following the Great War period, when a number of mines were opened and from which shipments totalling about 20,000 tons were made. The interest then waned, and until 1939-1940 the output seldom exceeded 100 tons in any one year. Most of the material was won by pick-and-shovel methods at surface or by working over old waste dumps. During the past two years, several companies have been formed to re-open certain of the old mines in this field. In 1939, operations were started by Moira Fluorspar Mining Syndicate on the Noyes property and a mill was built to beneficiate the ore, which, as in most of the other Madoc deposits, carries considerable calcite and barite. Some fluorspar was produced, but the venture was not a success and in 1940 the company transferred its operations to the near-by Perry mine. Work was suspended, however, before the mine came into production. In 1940, the Wallbridge mine was taken over by the Dominion Fluorspar Company, which built a fair-sized plant and which made shipments during the last half of the year mostly to steel plants in Ontario. No concentration was practised, aside from hand-picking to remove waste, and the grade is reported to have averaged about 63 per cent.

The possibilities of various other properties in the Madoc area were investigated by interested concerns in 1940 without results of importance. At the end of the year Reliance Fluorspar Company, a new enterprise, is reported to have commenced operations on the old Howard, or Hill, mine. An article entitled "Fluorspar Ores of Madoc, Ontario", appeared in the Canadian Mining Journal of October, 1940.

Small bodies of fluorspar occur in a pegmatite formation in Cardiff township, north of Madoc, from one of which W. E. Clark of Toronto shipped a carload of fluorspar in 1940. The material is of a deep purple colour and exceptionally pure, and the shipment is reported to have assayed over 98 per cent.

A discovery of fluorspar associated with metallic sulphides was made in Montbeillard township, in the Rouyn-Noranda district, Quebec, and Cook Copper and Fluorite Corporation, Limited, was formed to develop the property. A sample shipment of the ore made to the Bureau of Mines at Ottawa for testing assayed 53 per cent CaF_2.

The Rock Candy mine in British Columbia was operated by Consolidated Mining and Smelting Company between 1919 and 1929, but it has since been idle. Output from the mine reached an estimated total of 70,000 tons of ore, from which 30,000 tons of concentrate was recovered. Most of the production was used by the company to make hydrofluosilicic acid, for use in the electrolytic purification of lead at its Trail smelter. Sufficient by-product fluorine for this purpose is now recovered from the treatment of phosphate rock in the company's fertilizer plant at Trail.

Considerable test work was done in the Bureau of Mines laboratories at Ottawa during 1940 on means of beneficiating Canadian fluorspar, chiefly on ores of the Madoc, and Lake Ainslie areas. It was found difficult to make high grade concentrates and at the same time to obtain a high recovery from these ores owing to the trouble encountered in removing the associated barite and calcite. Encouraging results were obtained, however, with the use of the sink-and-float method for the removal of limestone gangue in the coarse sizes.

Canadian production and trade figures are not available for publication owing to war conditions.

World production of fluorspar in recent years has averaged about 500,000 short tons annually, of which the United States and Germany together have supplied about 75 per cent. The remainder has come mainly from France, the United Kingdom, Korea, Italy, Newfoundland, and the Union of South Africa. As a result of the war demands for the steel trade, production in the United States has shown a large increase, and developments have been undertaken to raise the Newfoundland output considerably. Fluorspar has been classed by the American Government as an essential war mineral.

Fluorspar is a widely used mineral, but the steel industry is by far the largest consumer. Using sales in the United States as an index of consumption, close to 70 per cent of output in 1939 was used in the steel industry; 15 per cent in the manufacture of hydrofluoric acid, and 12 per cent in the enamel and glass trades. Fluorspar is used also in foundry work; in the making of cement, carbon electrodes, calcium carbide and cyanamid; in the reduction of aluminium, the refining of lead, and the treatment of various rare-metal ores; in the production of ferro-alloys; and as a binder in abrasives. Most of the hydrofluoric acid made is used in the manufacture of artificial cryolite, and of a wide range of organic and inorganic fluorine compounds. Its use in the making of organic refrigerants of the "Freon" (dichloro-difluoro-methane) type is increasing.

Clear, glassy, crystal fluorspar which is exceedingly rare and sells at about $1.00 an ounce, is used in various types of optical instruments. Recently the tendency has been to supplant this material by artificial lithium fluoride, grown from a furnace melt, and now obtainable in crystals up to 8 pounds in weight.

Recent interest in Canadian fluorspar has been prompted largely by war demand for the domestic steel trade, the requirements of which have been running at about 10,000 tons a year. Fluxing gravel or lump grade for metallurgical use is usually sold on a specification of 85 per cent CaF_2, with not over 5 per cent silica. It should contain not over 15 per cent of fines. Much lower grade material is, however, usable, provided it contains no excess of objectionable impurities that might contaminate the metal, though the price commanded would be below the regular market level for standard spar.

Regular metallurgical-grade fluorspar (imported) sold in 1940 at about $21 per long ton, delivered, while domestic 65 per cent grade was quoted at about $18 per short ton. United States prices at the end of the year were $20 per short ton f.o.b. Kentucky and Illinois mines, and $25.50 per ton for imported material, duty paid, delivered at Atlantic ports. Ceramic (glass and enamel) grades call for not less than 95 per cent CaF_2, with a maximum of 3 per cent silica and 0.12 per cent

iron (Fe_2O_3). The material f[redacted] requires to be offered in ground form in various mesh sizes, from coarse to extra fine. American quotations for this grade at the end of 1940 were $32.60 per ton, in bags, f.o.b. Illinois mines. Acid-grade spar, lump, gravel, and ground, carries the strictest specification, minimum 98 per cent CaF_2, and not over 1 per cent silica. It sells at approximately the same price as the ceramic grade.

Fluorspar entering the United States pays a duty under the general tariff of $5.60 per long ton if it contains more than 97 per cent CaF_2; $8.40 per ton if it contains less than 97 per cent. Imports from Canada and the United Kingdom pay $4.20 per long ton ($3.75 per short ton) for above 97 per cent grade material. No duty is levied on fluorspar imported into Canada.

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GARNET IN 1940

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 as an abrasive. Garnet is a rather common mineral constituent of certain rocks distributed throughout the Dominion and it usually occurs as a garnetiferous-gneiss, large areas of which are known in parts of Ontario and Quebec. At present, however, little garnet is produced in the Dominion, the only company in operation in 1940 being Canada Garnet, Limited, at Labelle, Quebec. Some prospecting was also done on a deposit about 40 miles northwest of North Bay, in Ontario.

Garnet, crushed and suitably graded as to size, is used for making abrasive-coated papers and cloth, which in turn are used mainly in the wood working (hard woods) and to a lesser extent in the shoe leather industry. As artificial abrasives rather than those made from garnet are used in the surfacing of metals, the marked increase in this work arising from the war effort has not affected activities in the garnet industry to any appreciable extent.

The specifications for garnet for use in the making of high quality abrasives are somewhat exacting. The individual crystals should be clear and free from embedded impurities and from minute factures. They should be of a deep wine-red colour, and not smaller than pea size, walnut size or larger being preferable. The garnet should be tough, but should yield sharp and angular grains when crushed. The deposit should be extensive and the garnet content should not be less than 25 per cent. It should also be close to rail transportation and industrial centres. Few, if any, of the hundred or more garnet deposits so far examined in Canada fulfil all of these requirements.

Canada Garnet, Limited, completed the mill on its property at Labelle, but made no shipments of abrasive garnet, other than a few hundred pounds for trial. The company, however, sold about 88 tons of mixed garnet and rock valued at $629 for use in sand-blasting.

Between 90 and 95 per cent of the world output of garnet comes from the United States, Barton Mines Corporation, North Creek, New York, being by far the largest producer. Its product is regarded as the world standard abrasive garnet and its deposits are large. Total sales of the three active companies in the United States in 1940 amounted to 3,600 tons as compared with 4,056 tons, valued at $278,536 in 1939.

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. Consumption in Canada has never been more than 150 tons of graded grain a year, about half of which is supplied by the United States.

Aside from the United States, England is by far the leading consumer of garnet, but the amount used prior to the war was less than 800 tons a year. Coated abrasive manufacturers in England would be glad to take Canadian garnet, provided it is up to the American standard and that a regular supply of this standard could be guaranteed over a long period, but they are not prepared to do so otherwise. Chalk flint, which is used to a large extent in England, is mined locally and, although it is not as good as garnet, it is much cheaper and could be substituted almost entirely, if necessary. As abrasives made from garnet are not used for war purposes, the British demand is not likely to increase as a result of the war. Competition from the artificial abrasives--silicon carbide, and oxide of alumina--is another

serious factor in the marketing of garnet, the more so as the use of these abrasives has been extended recently to the wood working and leather industries, the two industries in which the use of garnet abrasives has long held sway.

The price in the United States of the best quality concentrate from which grain is prepared for abrasive papers and cloths ranges from $75 to $80 a ton f.o.b. mines and of graded grain, $90 a ton. Some sales of garnet fines for use in the surfacing of plate glass were made at about $26.00 a ton delivered, and garnet for use in sand-blasting sold at $30.00 a ton.

Crude garnet ore or ungraded mixed concentrate enters the United States duty free, the duty on grain graded into separate sizes and specially prepared garnet being one cent a pound.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

GRANITE IN 1940

(Building, Ornamental, and Crushed)

The stone quarried in this industry consists of granite and related crystalline igneous rocks used for building, decorative, ornamental, or constructional purposes. Producing properties are situated in Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba, and British Columbia. Large areas in Canada are underlain by granite, and the prospects of finding stone suitable for its various uses are good.

Much of the granite produced in Canada is used for foundations for highways; for the permanent ballasting of railway roadbeds; for heavy aggregate in large concrete structures; for the filling of breakwaters; and for bridge piers. The marked curtailment of such operations during the past several years has seriously affected production. Production is still far below the record years.

The industry in the Maritime Provinces was comparatively quiet. Few new deposits were opened and production came from the well-established firms.

Quebec furnishes most of the granite for building, the Stanstead, St. Samuel, Lake St. John, and Riviere-a-Pierre districts being the leading producers. The low ebb of building construction during the past few years has seriously affected this branch of the industry.

The Silver Granite Company extended their operations in the Lake St. John district.

Material from quarries in Quebec was made use of in the past few years in a number of Canada's public buildings including the Supreme Court Building, Ottawa, the Ottawa Post Office, and several structures in British Columbia. It was used also in the construction of the T. Eaton Company's stores in Port Arthur and Edmonton. A red granite of medium to coarse texture and of a uniform mixture has recently been developed near Coe Hill, Ontario, by the Upper Canada Granite Quarries Limited and this deposit is being exploited with a view to supplying both the domestic and export markets for monumental and building stock.

Prospecting for granite deposits, suitable for both building and monumental use, has been active in Manitoba, and several deposits of red granite of various shades have been located, but so far little development has taken place.

Granite for monumental use is produced in the Maritime Provinces and in Quebec, Ontario, Manitoba, and British Columbia, and is finding a small but steadily increasing market. Early in 1939 an appreciable amount of foreign stone, principally of the black and red varieties, was imported, mainly from Finland and Sweden, but this source of supply is now cut off. Black granite has been quarried in Canada, notably in the vicinity of lake St. John, Quebec, and from quarries along the north shore of lake Superior, and stone from these areas should find a ready market for monumental use. Other deposits of 'black granite' in the Maritime Provinces, Quebec, Ontario, and Manitoba show promise of yielding stone of good quality.

Granite is used for building purposes mainly in large buildings, such as public and semi-public structures and institutions.

The Canadian production of granite in 1940 was 1,147,667 tons valued at $1,884,410, compared with 1,102,395 tons valued at $2,119,501 in 1939.

Exports were 1,075 tons, valued at $10,954 (granite and marble unwrought), compared with 925 tons, valued at $10,235 in 1939. Imports of granite were valued at $61,935 in 1940, compared with imports valued at $94,738 in 1939.

Some granite was imported during the year from the United States for monumental use, but these imports are likely in time to be replaced by Canadian material. The demand for stone for monumental use varies, and a variety which has enjoyed a steady market for a number of years may later be completely superseded by another variety. At present, the so-called 'black granite' and the 'grey' varieties seem to be in most demand for monuments, although the various shades of reds are still popular in many districts.

Now that shipments from the Scandinavian countries to the United States and to Canada have been discontinued, Canadian producers would be well advised to give careful study to the market possibilities of a monumental stock, especially for the black and red varieties.

In the building trade, coloured granites are being used to an increasing extent in the form of thin polished slabs for trim for buildings in which the main colour scheme calls for contrast.

Canadian granites are suitable for all the purposes for which granite is used, and with persistent advertising there is no reason why this industry should not have a flourishing future.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

GRAPHITE IN 1940

Graphite is widely distributed in the Archaean rocks of western Quebec and eastern Ontario, in which regions there was formerly a somewhat extensive graphite industry. With the exception of the Black Donald mine, all of these operations have long been idle and the plants for the most part have been dismantled. The Canadian deposits include bands or lenses of graphitic gneiss; belts of crystalline Grenville limestone carrying disseminated flake; and smaller, but often rich, pockety bodies or veins of coarsely crystalline graphite of plumbago character, usually also in limestone. Near St. John, in New Brunswick, bodies of amorphous graphite were worked many years ago on a small scale.

No new developments were reported in 1940. Black Donald Graphite Company was the only operator, its mine and mill being located at Whitefish lake, 13 miles west of Calabogie, Renfrew county, Ontario. The company has been in continuous operation for more than 30 years, mining a deposit of exceptional size and richness. The ore carries a grade of flake too small for crucible use, but well adapted for foundry facings and lubricants, for which purpose most of the output is sold.

Artificial graphite is made in Canada by Electro-Metallurgical Company of Canada, at Welland, Ontario, and by the Exolon Company at Thorold, Ontario. These concerns supply the American market with ~~most~~ part of its requirements of this class of graphite.

Canadian production and trade figures are not available for publication owing to the war.

Most of the material treated in the Black Donald mill in recent years has been old, rich mill tailings made in the early days of operation and discharged into Whitefish lake, from which they are now being recovered by pumping. At the end of 1940 the company started to diamond-drill in a search for new orebodies, as the ore in the old mine workings has been mostly removed. Most of the production goes to the domestic and American foundry trade, but in 1940, shipments were also reported to have been made to Great Britain.

World production of natural graphite of all grades, and including flake, crystalline (Plumbago), and amorphous, during the past decade has averaged about 140,000 short tons a year. Madagascar, Germany, Austria, and Czechoslovakia are the principal sources of flake graphite; Ceylon of crystalline; and Mexico and Korea of the amorphous variety.

Graphite has a variety of uses in industry, but it is employed principally in foundry facings, lubricants, crucibles, pencils and crayons, paints, and stove polish. Using the United States as an index of the trend of consumption, the above industries took 63 per cent of the total graphite sales in 1938, the remainder going into minor, unspecified trades. Dry batteries, electrodes, and commutator brushes use important quantities, mostly amorphous or artificial.

By the end of 1940, the war had not occasioned any serious shortage of graphite shipments to the American continent, and dealers' stocks were then estimated at about twelve months' supply. American importers, however, early in 1941 commenced to show concern over a threatened curtailment of shipments from Madagascar for the crucible trade, which consumes about 90 per cent of such imports. This involved the possibility that American crucible makers might be forced to revert to earlier practice and use Ceylon graphite, now largely discarded in favour of Madagascar flake.

Graphite for United States consumption is mainly handled through large importing houses who supply the trade. Prices at the close of 1940, as reported by one such importer were: Madagascar flake, 6½ - 8 cents per pound; Ceylon lump, 7 - 15 cents per pound; Ceylon chip, 5 - 10 cents per pound; Ceylon dust, 3½ - 8 cents per pound, all ex-dock, duty paid, New York.

United States imports of graphite from Madagascar in the period 1931-1939 averaged about 2,000 tons a year, but as a result of the defence programme requirements are now much higher. Ceylon's production and exports remained steady in 1940, with no important change in prices. Exports from Ceylon were chiefly to Japan which was followed by the United States and the United Kingdom. Mexican amorphous graphite sales suffered a temporary set-back during the latter part of 1939, but recovered early in 1940. The material recently sold at $10 (U.S.), f.o.b. mines, for 80 to 82 per cent grade. Exports of amorphous graphite from Korea have been increasing rapidly, and in 1939 shipments from that country reached a total of close to 87,000 tons, a gain of 31,000 tons over 1938, Japan being the chief importer.

Graphite entering the United States, under the general tariff, pays 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. Imports from Canada and the United Kingdom pay one-half of the above rates. The Canadian tariff provides as follows: graphite, not ground or otherwise manufactured, British, free; intermediate (including the United States), 7½ per cent ad valorem; general, 10 per cent: on ground and manufactures of, including foundry facings, but not crucibles, British, 15 per cent; intermediate, 22½ per cent, general, 25 per cent.

Graphite has been classed as an essential or "strategic" mineral by the United States Government, and exports of graphite and graphite products have been subject to special export license since July 5th, 1940.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

GRINDSTONES, PULPSTONES, AND SCYTHESTONES IN 1940

Grindstones - The Read Stone Company, Sackville, New Brunswick, produced about 9,200 stones with a total weight of 237 tons from near Stonehaven, on the Bay of Chaleur, New Brunswick. The Stanley Works Company, New Britain, Connecticut, United States, operated the Mic Mac quarry at Woodburn in Merigomish Harbour, Nova Scotia, and shipped approximately 62 tons of grindstones. The total grindstone sales amounted to 299 tons valued at $11,723, as against 283 tons valued at $12,188 in 1939.

The large-size Canadian grindstones are used mainly for sharpening pulp-mill and tobacco knives, and in the United States in the file, machine-knife, granite tool, and shear manufacturing industries. The small stones are used for scythe and axe grinding. Substantial competition from the artificial grinding wheel, and to some extent from foreign natural stones, are causes of the dwindling of this business.

Pulpstones - There has been no output of pulpstones since the J. A. and C. H. McDonald Company ceased production three years ago from the sandstone beds on the northwest end of Gabriola Island, near Nanaimo, Vancouver Island, British Columbia, but the company expects to resume production in 1941.

Good pulpstones are in demand, particularly for use in the large magazine grinders, but as known Canadian deposits containing thick beds of sandstone of the proper quality appear to have been worked out, production for the present has ceased. Added to this there is substantial and increasing competition from Canadian made artificial segmental pulpstones mainly of silicon carbide grit, there being at present nearly 500 of these stones in operation in the various Canadian pulp mills. The imported natural pulpstones come mainly from West Virginia, United States.

Scythestones - Over 42,000 of these small hand operated stones, with a total weight of 18 tons and valued at $2,520 were sold by the Read Stone Company. These stones have for many years been obtained from the same Stonehaven, New Brunswick, quarry from which the grindstones are produced, but from finer textured beds of the sandstone. Sales in 1939 were 20 tons valued at $3,088.

The production of all grades of stone in 1940 was 317 tons valued at $14,243; in the previous year the production was 403 tons valued at $15,276.

The exports of these stones in 1940 were valued at $4,149 as against a valuation of $6,312 in the previous year. The imports which consisted chiefly of pulpstones, were valued at $192,493 as against $133,273 in the previous year. Most of these come from the United States.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

GYPSUM IN 1940

The materials produced 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. 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 portion of the calcined material enters into the manufacture of wall-board, gypsum blocks, insulating material, acoustic plaster, etc. Anhydrite is used mainly as a fertilizer for the peanut crop in the Atlantic seaboard states of the southern United States.

Nova Scotia is the largest producer of gypsum in Canada, and is followed by Ontario, New Brunswick, Manitoba and British Columbia.

In Nova Scotia, the National Gypsum (Canada) Company did not operate their Cheticamp quarry throughout the year although a small shipment was made from storage. The largest operation of this company is at Dingwall in northeastern Cape Breton where operations were carried on continuously night and day, furnishing shipments for the United States.

The Gypsum, Lime and Alabastine (Canada) Limited continued operations during the summer months from their deposit at the head of Baddeck bay. This deposit was formerly owned by the North American Gypsum Company, Rutland, Vermont. Already a face 20 feet high and over 100 feet long has been developed and shipments were made by boat to the company's manufacturing plant at Montreal.

The Windsor Plaster Company obtained its requirements of gypsum from the old Mosher quarry on the property of the Windsor Gypsum Company. This quarry is situated a few miles east of Windsor, Nova Scotia.

The deposits in the vicinity of Windsor, Hants county, were actively worked throughout the year, most of the material being shipped crude to the United States.

The gypsum quarries and plant at Hillsborough, New Brunswick, operated steadily and shipments of crude gypsum were made to the United States and all grades of plaster and wallboards were produced for the market in eastern Canada.

Extensive deposits of gypsum are known to occur in northern Ontario, but, so far, these have not been developed. In southern Ontario, the gypsum industry was active in the district south of Hamilton, and supplied all grades of plaster and plaster products to the markets in Ontario and Quebec.

The markets in the Prairie Provinces were supplied by the four operating plants, two of which are in Winnipeg, Manitoba, and two in Alberta.

Deposits in northern Alberta, although distant from markets and railway, are of good grade.

In British Columbia, production from the deposits at Falkland were maintained to supply the plant at New Westminster. Several other deposits are known to occur in British Columbia. A large tonnage of by-product gypsum is obtained from the production of phosphate fertilizers at the plant of the Consolidated Mining and Smelting Company at Tadanac, and efforts to find an outlet for this material are being continued.

IRON OXIDES (MINERAL PIGMENTS) IN 1940

Ochreous iron oxide, sold uncalcined and used chiefly in the purification of illuminating gas, constitutes the bulk of the minerals produced under this category. The calcined form of ochreous iron oxide is used in the manufacture of paints; a smaller quantity of natural iron oxides associated with clay-like materials in the form of umbers and siennas is produced in both the raw and calcined state, for use as pigments in paint manufacture.

Most of the production for many years has come from deposits in the vicinity of Trois Rivières, Quebec. In Quebec the operations were as follows: at Red Mill, near Trois Rivières by Sherwin-Williams Company of Canada, at Rang St-Pierre, Champlain Seigniory, and at St. Adelphe, all in Champlain county; at Almaville, Laviolette county, and at Les Forges, St. Maurice county.

The Sherwin-Williams Company was the only producer of calcined iron oxides; all the other producers marketed only air-dried products.

A small ochre deposit at Cheneville, Hartwell township, Papineau county, was under development in 1940 by J. E. Chapman of Hawkesbury, Ontario, and a small tonnage of air-dried products was shipped for experimental purposes. The mine and plant of Eugene McNicoll, at Lacoste, Labelle county, were idle throughout the year.

Other deposits worked in the past in Quebec are: near Ste. Anne de Beaupré, Montmorency county; at Les Forges, near Trois Rivières; in Lynch township, Labelle county; and at St. Raymond, in Portneuf county.

The erection of the proposed sulphur plant at the Aldermac mine, from which iron oxide was to be produced as a by-product, has been deferred owing to the war.

A small production of iron oxide from British Columbia has been reported since 1923; the oxide is used chiefly for gas purification.

The iron oxide industry is comparatively small, and the quantity produced varies but little from year to year. The present producing localities have met the requirements of the domestic pigment trade for the cheaper grades for many years. Other deposits could be worked in Quebec and Ontario, if the demand warranted their development. In Nova Scotia, beds of ochre and umber have been worked in the past to a small extent. In Alberta and Saskatchewan several deposits of ochre are known, some having commercial possibilities, but, owing to their present inaccessibility and to the limited market, they have had little development, and large deposits near Grand Rapids and Cedar Lake in northern Manitoba remain undeveloped for similar reasons.

The records of Canadian production of ochres include in a single item all grades of material from the low priced raw material to the high priced calcined products; sales of ochreous iron oxide in Canada in 1940 totalled 9,979 tons valued at $111,875, compared with 6,015 tons valued at $88,418 in 1939. The production during the previous ten years has averaged 6,000 tons per year.

Our exports of mineral pigments in 1940 were 4,913 tons, valued at $342,988, compared with 2,622 tons valued at $178,320 in 1939.

Imports of all kinds of ochres, siennas, and umbers totalled 1,817 tons, valued at $70,339, compared with 1,547 tons valued at $56,873 in 1939. In addition there were imported prepared oxides, fillers, and related products, some of which were probably not ochres, valued at $1,037,951, compared with $954,927 in 1939.

The demand within the country for these products is fair. Most of the higher grade oxides, ochres, and umbers used in the paint trade were formerly 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. During the last two years the above-mentioned imports have been mainly from the United States.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

LIME IN 1940

Lime is manufactured in every province except Prince Edward Island, though the Saskatchewan production is intermittent and very small. Fifty-nine plants were in operation during 1940. 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. Ontario is the leading lime-producing province and supplies over one-half of the total output, and Quebec comes next with slightly more than one-quarter of the total production. The production in 1940 created an all-time high record for the industry.

In addition to the recently developed new use for white high-calcium lime in the making of calcium carbonate filler for newsprint and magazine paper, a number of other new uses for Canadian lime have been developed lately, several of them in connection with the manufacture of war materials. Recent research in the United States on stabilization of clay-soil roads with hydrated lime has shown that on certain clays better results are obtained with lime than with other stabilizing materials.

During 1940, Gypsum, Lime and Alabastine Canada Limited, further increased the capacity of its chemical lime plant at Beachville, Ontario, by the addition of a new, vertical, gas-fired kiln, and the three large kilns of this type are now being supplied with producer gas instead of natural gas. The new kilns are regarded as being among the most modern shaft kilns on this continent and they represent a notable advance in the technology of manufacturing lime in vertical kilns.

Aged lime putty and lime morter for use in building construction are now available in a number of Canadian cities. Lime morter is coming back into favour as a binder in masonary, and sales of lime for this purpose have increased very considerably within the past two years and, with the present high degree of activity in the construction industry, are expected to increase further in the coming year.

There are many prospective lime-producing localities in Canada because of the abundance of suitable limestone throughout the country. With the northward development of the mining industry, considerable interest is being manifested in making lime from limestone deposits in the far north.

Lime production in 1940 amounted to 623,803 tons of quicklime, valued at $4,421,758 and 92,927 tons of hydrated lime valued at $772,797, compared with the production in 1939 of 474,753 tons of quicklime valued at $3,326,647 and 77,456 tons of hydrated lime valued at $676,867.

Very little trade in lime exists between Canada and other countries, because lime is made in nearly all countries. Exports of lime in 1940 amounted to 9,209 tons valued at $121,340 compared with 4,866 tons valued at $40,573 exported in 1939. The greater part of these exports go to the United States but small shipments are made to South America and the West Indies.

Imports, which are all from the United States, amounted in 1940 to 5,057 tons valued at $29,886, compared with 8,714 tons valued at $74,261 in 1939, according to data supplied from the United States Bureau of Foreign and Domestic Commerce

Lime is marketed in the form of quicklime and in the hydrated state, the latter being specially prepared slaked lime in the form of fine powder that is marketed in 50-pound, multi-wall paper

bags. Quicklime is marketed in the lump, pebble, crushed, and pulverized forms; lump lime and pebble lime are sold either in bulk or 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 construction, agriculture, and other industries. Lime is one of the great basic raw materials for the chemical industry, and of the current production about 85 per cent is used in chemical processes, thus the old conception of lime as being primarily a structural material is no longer true.

Prices of the various lime products vary over a wide range depending on the geographical position of the plants and on differences in quality of the lime. No significant change occurred in prices of lime during 1940.

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DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

LIMESTONE (GENERAL) IN 1940

Limestone, because of the great variety and importance of its industrial uses, is the most useful of all rocks. It is quarried in all provinces of Canada except Prince Edward Island and Saskatchewan but by far the greater part of the production comes from Ontario and Quebec. The 1939 production of limestone for all purposes, including the manufacture of lime and cement, constituted about 86 per cent of the total production of Canadian stone.

Limestone is available in great bedded formations and in massive highly metamorphosed deposits--the former being much more common and yielding most of the production. At present, almost all Canadian limestone is won by open pit methods, though underground mining of the rock has been adopted by several companies producing limestone for chemical and metallurgical uses and for making lime. Underground mining will undoubtedly become more common, particularly for the production of high-grade stone for chemical use, as the readily accessible parts of deposits become worked out.

Of significance in connection with future production of pure limestone 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.

The 1940 production of limestone for general use, exclusive of that used for building stone, lime, and cement is estimated at 6,221,357 tons valued at $4,954,644, compared with a production of 4,117,472 tons valued at $3,378,813 in 1939. The production for all purposes in 1940 was 9,296,626 tons, compared with 6,429,447 in the previous year.

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

For domestic use 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. Some few of the products are processed but little if at all from the condition in which the rock is obtained from the quarry, as for example limestone used in the wood pulp industry, but the bulk 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, and various chemical products. Argillaceous dolomite is used in the manufacture of rock wool. This industry is steadily expanding in Canada and in 1940 its output was valued at over $1,000,000.

New uses for limestone are continually being developed. 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 claimed to be comparable in refractoriness with materials that are several times as expensive. Dolomite is assuming a position of importance in Europe as a raw material for making metallic magnesium, where after being calcined it is used to precipitate magnesia from sea-water. Processes are also being developed to extract magnesium directly from calcined dolomite. Canada possesses ample deposits of high-grade dolomite and developments are being watched with interest in this country. A present use for limestone, capable of enormous development, is in agriculture. 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.

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DEPARTMENT OF MINES AND RESOURCES,
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LIMESTONE (STRUCTURAL) IN 1940

Limestone in blocks of large dimensions for sawing into building stone is quarried in Quebec, Ontario, and Manitoba. In Quebec, quarries at St. Marc des Carrieres, Portneuf county, produce grey limestone and several in and near Montreal yield 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 as building stone is available. The Manitoba quarries are near Tyndall and yield mottled buff, mottled grey, and mottled variegated limestone. Besides these large 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 the province of Quebec; and at Ottawa, Kingston, Erin, and Wiarton in Ontario. Rubble is their chief product.

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

During 1940 no noteworthy new developments occurred in connection with the production of limestone for building. Data on production for 1940 are not yet complete but the production is approximately the same as 1939 when 32,515 tons valued at $442,071 was marketed. The production was largely from quarries in Ontario and Quebec. The value of production given 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.

Very little trade in building stone exists between Canada and other countries. Exports of building limestone are very small and are not separately recorded, but exports of all kinds of building stone except granite and marble had a value of only $1,016 in 1940. Imports of all varieties of building stone excepting marble and granite, during 1940 were valued at $29,749, compared with imports valued at $37,456 in 1939. This 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 on the size of block and grade of stone.

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.

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DEPARTMENT OF MINES AND RESOURCES,
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LITHIUM MINERALS IN 1940

The known Canadian occurrences of lithium minerals of present economic interest are confined to Manitoba. Since the original discovery in 1925 on the Silver Leaf property near Point de Bois, in the Winnipeg river section, in the southeastern part of the Province, a number of other lithium-bearing pegmatites have been found in the same general area. Exploratory work on certain of these deposits has disclosed moderate tonnages of spodumene, amblygonite, and lepidolite, and intermittent mining has resulted in the shipment of a few hundred tons of these minerals, most of which has come from the Silver Leaf mine and from the Buck claims at Bernic lake, between Winnipeg and Bird rivers. The bulk of these shipments was consigned to the United States. Lithium Corporation of Canada, 403 Avenue Building, Winnipeg, has been the most active recent operator, but has done little since 1937, when the last shipment was made. The company has confined its work principally to the Bernic lake occurrences, but also controls important spodumene showings at Cat lake, north of Bird river; in 1940 it was reported to have arranged financing of further work through Perseverance Mining and Development Company, of Toronto, and to have hand-picked some ore, and to be erecting buildings preliminary to engaging in further work.

In addition to the above Manitoba deposits, other spodumene occurrences are known near Falcon lake, 85 miles east of Winnipeg, and on the Kobar claims, Wekusko lake, near Mile 81 on the Hudson's Bay railway, in the northern part of the Province: no mining has yet been undertaken on these properties.

In the Northwest Territories, field parties of the Geological Survey working in the new Yellowknife gold area, north of Great Slave lake, have recently reported spodumene-bearing pegmatites carrying beryl, tantalite, and other minerals typical of lithium mineralization within a section lying about twenty miles northeast of the camp.

In Quebec, platey books of lepidolite occur in small amount in a pegmatite in Wakefield township, Hull county, and spodumene has been reported from Lacorne township, Abitibi county, about ten miles from Barraute station on the Canadian National railway.

No production of lithium minerals was reported in 1940, the last shipment having been made in 1937, when the value was $1,694: this came from the Bernic lake deposit, Manitoba.

Figures of world production of lithium minerals, exports, and trade, are not published. Most of the supply comes from deposits in the United States, Southwest Africa, and Argentina.

American production of lithium minerals in 1940 more than doubled in quantity and value over the figures for 1939, 1990 tons, valued at $97,000, as compared with 892 tons, valued at $47,088. These totals covered, in addition to the straight minerals spodumene, amblygonite, and lepidolite, by-product lithium-sodium phosphate recovered from the brine of Searle's lake, California, production of which began in 1938. The Black Hills region, South Dakota, is the principal source of lithium minerals, but in past years considerable lepidolite has been mined also in California and New Mexico. Important reserves of spodumene have recently been discovered in the King's Mountain district of North Caroline, where it occurs intimately mixed with feldspar, and also as a very finely-crystallized inter-growth with quartz near Tinton, South Dakota, in the northern part of the Black Hills. Pilot plants have been erected at both these points to work out details of beneficiating the spodumene rock by flotation, and reports indicate that a commercial product can be made in both cases. Flotation would seem to offer a better means of concentrating such low-grade spodumene rock than the decrepitation process suggested some years ago.

Southwest African shipments have become important in recent years, with exports of 611 long tons of lepidolite and 179 tons of amblygonite in the first nine months of 1940. In the same period of 1939, exports of lepidolite totalled 531 long tons, and of amblygonite, 673 tons. In addition, a production of 40 tons of petalite, a lithium-aluminium silicate of lower lithia content than spodumene, was reported in 1940. The whole of the above exports went to Great Britain.

Production of spodumene in Argentina also is increasing, with reported exports of 204 metric tons in the two-year period 1937-1938. Production in 1938 was 169 tons, all of which went to the United States at an f.o.b. price of $9 per ton.

It was reported in 1940 that Sweden would shortly commence production of lithium minerals and salts for domestic use, the projected enterprise to be undertaken by the Boliden Mining Company, employing an improved leaching method in a fused sodium sulphate bath.

The principal outlet for the high-lithia minerals amblygonite and spodumene has been for the production of lithium chemicals and metal, whereas lepidolite has gone chiefly to the glass industry as a batch constituent in opal and heat-resistant ("Pyrex") glass. The treatment of lithium ores for the production of salts and metal has long been confined to a few important companies, with plants in the United States, England, Germany, and France. The world trade in lithium chemicals is comparatively small, and consumption has remained fairly steady. Lithium chloride, one of the most hygroscopic inorganic compounds known, has been growing in importance as a drying agent in air-conditioning: it, as well as the fluoride, also finds employment as a flux in aluminium welding. A method of making single lithium fluoride crystals up to 8 pounds in weight from a molten bath has now been perfected; the material has valuable optical properties and is replacing fluorspar for general instrument use. Exclusive of the chloride used in air-conditioning, the consumption of lithium chemicals in the United States is estimated at about 500,000 pounds annually. The treatment of lithium minerals for the production of the carbonate, the base salt used in making other lithium salts, is confined to the Maywood Chemical Company, Maywood, New Jersey, which also takes the entire output of the by-product sodium-lithium phosphate recovered from Searle's lake brine. The company also makes metallic lithium and lithium-calcium.

Considerable research has been proceeding in the United States on applications for lithium metal in the form of master alloys. A wide range of such alloys, with calcium, silicon, brass, copper, manganese, zinc, lead, tin, magnesium, and aluminium, has been developed and is now offered by Lithaloys Corporation, 444 Madison Avenue, New York, on a tonnage basis. The lithium content of the alloys ranges from 0.5 to 10.0 per cent in the base metal varieties, rising to as high as 50 per cent in the light, calcium and silicon series. All the component metals are produced by electrolysis, and the alloys themselves are made in an electric vacuum furnace. Prices range from 50 cents to $8 per pound, in ton lots. Straight lithium metal is quoted at $15 per pound, in sticks, cubes, or plates.

The alloys are furnished, variously, in lumps, slabs, cubes, or plates. They are finding increasing use as de-oxidizing, de-gasifying, and de-sulphurizing agents in copper, brasses, bronzes, etc., and for hardening lead and aluminium.

Lithium is the lightest of all the metals, having a specific gravity of only 0.53. It is reported that lithium-beryllium alloys possessing the desirable properties of extreme lightness, permanence, and hardness have been developed in Germany: such materials would

presumably be designed for use in aircraft, but no definite information on their actual utilization for such purpose is available. The same applies to lithium-aluminium alloys, also developed in Germany, and used to some extent as a substitute for brass. A recent article covers the use of lithium as a neutralizing medium for furnace atmospheres in the heat-treating of steel and non-ferrous alloys: the desired effect is achieved by a lithium cartridge placed in an evaporation chamber through which the spent gases pass to the muffle where the work is being treated. It is claimed that this method dispenses with any carburizing, decarburizing, or scaling of the finished work, and also that it is applicable in the melting of non-ferrous alloys in crucibles, in which it prevents drossing, and in the heating prior to forging or pressing.

The use of lithium hydride as a convenient means of transporting hydrogen gas by air to remote localities has been suggested, and the nitride offers similar possibilities for ammonia.

Ths use of the natural minerals amblygonite, spodumene, and lepidolite, in the ceramic industry is based on the powerful fluxing effect of the lithia they contain, as compared with the soda or potash of feldspar. In addition to its use in opal and heat-resistant glass, lepidolite, with around 4 per cent of lithia, has proved highly effective as a fluxing addition in high-talc bodies. Amblygonite, the commercial lithium mineral with the highest lithia content (around 8 per cent) and containing also fluorine, is valuable for opaque glazes. The greatest recent attention from the ceramic point of view has been directed to spodumene, the most abundant lithium mineral, with around 6 per cent of lithia. Spodumene itself is relatively refractory, but spodumene-feldspar mixtures have lower melting points than straight feldspar. The objectionable high thermal expansion of spodumene may be overcome for ceramic use by calcining and conversion to the stable beta form, as is done in the so-called "decrepitation" process for recovering spodumene in the form of fine powder from rock consisting of intimately mixed spodumene and quartz or spodumene and feldspar. The mineral is held to offer considerable possibilities in pottery bodies, glazes, and enamels, to replace more costly prepared lithium carbonate, provided that it can be offered in standard grade of the requisite purity.

Potential world reserves of lithium minerals are large and widely distributed, and production could be greatly increased if demand warranted it. At the present time, however, world requirements appear to be satisfied with a few thousand tons per year. The price of amblygonite, the mineral most preferred for the manufacture of lithium chemicals, showed little change in 1940, and it continued to sell at about $40 per ton f.o.b. American mines for 8 to 9 per cent Li_2O content. Lepidolite, crude lump, held at the 1939 figure of $24 to $25 per ton, f.o.b., and spodumene, 6 per cent grade, at $30 per ton.

NOTE: A new edition of the treatise "Lithium; Theoretical Studies and Practical Applications", by Hans Osborg, was published during the year by the Electrochemical Society, Incorporated, New York.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

MAGNESITE IN 1940

Magnesitic dolomite consisting of an intimate mixture of magnesite and dolomite is quarried at Kilmar and at Harrington East, in Argenteuil county, Quebec, and is processed for use as refractory materials. Products at present marketed include caustic-calcined magnesitic dolomite, dead-burned or grain material, bricks and shapes (both burned and unburned), finely ground refractory cements, and, in combination with chrome, the dead-burned material is used as an ingredient in certain other types of refractory. Magnesia products made in Canada from imported magnesite and magnesia include fused magnesia (artificial periclase), optical periclase, and "85 per cent magnesia" pipe covering.

The recent discovery by the Bureau of Mines of deposits of a magnesium mineral known as brucite, at Rutherglen, Ontario, and at Bryson and Wakefield, Quebec, is considered a matter of importance. The brucite occurs as granules thickly disseminated through a matrix of crystalline limestone, and by a process developed in the Bureau of Mines laboratories, and described in a report recently issued by the Bureau, it is possible to recover these brucite granules in the form of magnesia of a high degree of purity, apparently at a cost that will enable it to compete with imported magnesia in eastern Canada. The magnesia so obtained is suitable for the manufacture of high-grade basic refractories, magnesium metal, and various chemical compounds. Hitherto, magnesia of equal purity has not been available from any Canadian source, but has had to be imported from Asia, Europe, or the United States. Being an essential war commodity, supplies of magnesia are difficult to obtain during wartime, and a domestic source is of prime importance. At present the deposits are being investigated by several companies in cooperation with the Bureau of Mines, and early production of magnesia from them is expected.

Large deposits of magnesite containing considerable silica and alumina occur in British Columbia near Marysville, between Cranbrook and Kimberley. They are owned by Consolidated Mining and Smelting Company of Canada Limited and experimental work to remove the silica and alumina by flotation has been done but there has been no commercial production to date. A number of other deposits of magnesite are known in British Columbia and the Yukon, but either because of their limited extent or remoteness from transportation, they are not now of commercial importance.

Deposits of earthy hydromagnesite occur in British Columbia near Atlin and Clinton, and at various times some have been worked on a small scale, but there has been no production in recent years.

Canadian production and trade figures are not available for publication owing to the war.

Magnesite is available in many countries. Russia is probably the world's greatest producer of magnesite, but almost all is for domestic use. For export, the magnesite is generally shipped in either the calcined or the dead-burned state.

Magnesite is usually calcined before shipment and the resultant magnesia is used for the making of refractory products to withstand extremely high temperatures, for making oxychloride cement, and for magnesium metal. It is also the basis of a number of magnesium salts and has many minor uses. The world-wide demand for magnesium metal has greatly stimulated interest in deposits of magnesite. Although until three years ago almost all the world's magnesium was made from magnesium chloride brine and from waste water used in treating potash minerals, magnesite is now an important

source of this light metal in Europe. Sea-water and magnesium chloride brine are the sources of all magnesium at present produced in the United States.

Competing with magnesite as sources of magnesia products are dolomite, brucite, and sea-water. Dolomite, in addition to its newly discovered possibilities for the making of refractories, has long been the principal source of basic magnesium carbonate and pure magnesium oxide, and processes have been worked out 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 in England, the material so obtained being now marketed in various forms for industrial and pharmaceutical purposes, and for use in refractory products.

Prices of calcined magnesite f.o.b. Montreal or Toronto, as quoted by Canadian Chemistry and Process Industries for March, 1941, were $70 to $90 per ton. This price has obtained since November, 1939, when the price rose from the $48 to $60 range that had prevailed for more than a year previously.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

MAGNESIUM SULPHATE IN 1940

Natural hydrous magnesium sulphate (Epson Salts or Epsomite) occurs in deposits in lake bottoms or in solution in brine lakes in British Columbia. In Saskatchewan it is found associated with sodium sulphate. Attemps have been made to produce refined salts, and a number of years ago there was considerable production from several of the "lakes" in British Columbia, and experimental shipments were made from one of the lakes in Saskatchewan.

The largest production has come from the deposits at Basque, British Columbia, the material from which is refined at Ashcroft, 15 miles south of the deposit. The refinery, now owned by Ashcroft Epsom Salts Company, has a capacity of 10 tons of salt a day. It was operated until the early summer of 1939, when it closed down pending improved marketing conditions. The material produced was of high grade, four samples, representative of the different crystal sizes prepared, all ran over 99.5 per cent $MgSO_4.7H_2O$.

There are a number of other occurrences in British Columbia, near Clinton, north of Kamloops, and in Kruger's Pass, south of Penticton.

In Saskatchewan, two lakes south of Wiseton contain brines high in magnesium sulphate, and Muskiki lake, just north of Dana, contains brine high in magnesium and sodium sulphate, which at certain times of the year, crystallizes into a bedded deposit with layers of both salts.

The Canadian production of magnesium sulphate in 1939 was 550 tons valued at $9,900, there being no production in the present year.

The imports in 1940 were 2,211 tons valued at $86,090, compared with 1,950 tons valued at $56,648 in 1939.

As magnesium sulphate is not at present being manufactured in Canada, imports are dutiable at the rate of 17½ per cent, otherwise the duty would be 20 per cent. The tariff on the material entering the United States is 3/4 of a cent per pound, or $15.00 per ton.

Prices for Epsom salts remained steady for the greater part of the year, but with the discontinuance of supplies from European countries, hitherto the main source of supply, prices increased rapidly. Quotations at the end of the year for the technical grade, as given by Canadian Chemistry and Process Industries for Toronto or Montreal delivery, ranged from $65.00 to $70.00 per short ton in bags, whereas the B.P. material in barrels was quoted at from 3-1/2 to 3-3/4 cents per pound.

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DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

MARBLE IN 1940

Marble quarries are operated in the provinces of Quebec, Ontario, Manitoba, and British Columbia. The products include squared blocks for sawing into slabs and for making monuments, and broken marble for rubble and for making terrazzo, stucco dash, whiting substitute, marble flour and artificial stone. Waste from some of the quarries is sold for chemical uses and for road metal.

In Quebec, several varieties of clouded grey marble and also a black marble are quarried at Phillipsburg by Missisquoi Stone and Marble Company, Limited. Some brown marble used for counters and wainscoting is obtained from the building stone quarries in the Trenton limestones at St. Marc des Carrieres, Portneuf county. Dolomitic white 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 the chemical and ceramic uses. A small quantity of dark red marble is quarried at Cap St. Martin near Montreal, chiefly for making tombstones.

In Ontario, black marble is quarried at St. Albert, near Ottawa, by Silvertone Black Marble Quarries, Limited, Recently a 40-inch bed of marble was uncovered in this quarry which, because of its soundness and uniformity, is suitable for making large monolithic pillars. White marble is quarried at Marmora by Bonter Marble and Calcium Company, Limited, and at Haliburton by Bolender Brothers for making terrazzo chips, poultry grit, stucco dash, and artificial stone. Bonter Marble and Calcium Company also produces white marble in block form. Buff, red, white, green and black marbles are quarried, near Eldorado, Hastings county, by Karl Stocklosar of Madoc, for use as terrazzo.

In Manitoba, a number of highly coloured marbles are available but there is only a small production to supply terrazzo chips and building rubble.

In Alberta, a deposit of calcareous tufa near Radnor station on the Canadian Pacific railway has been quarried for terrazzo and a small quantity has also been marketed in block form.

In British Columbia are many deposits of marble but there is only a small production of white marble near Victoria and on Texada island for the production of terrazzo, poultry grit, marble sand, and whiting substitute.

Many known deposits of beautifully coloured marbles 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 production of marble during 1940 amounted to 13,739 tons valued at $75,409, compared with 14,124 tons valued at $200,054 in 1939. The market for Canadian marbles is almost wholly domestic and production in normal times depends on the extent of building in the Dominion. At present, supplies of foreign marbles except from the United States, are entirely cut off owing to war conditions and the country is dependent on domestic marble, but although construction activity is again at a high level, most of the buildings erected are the industrial type in which little or no marble is being used.

Exports of marble are recorded with exports of granite, and the exports of the two during 1940 amounted to 1,075 tons valued at $10,954, compared with 925 tons valued at $10,235 in 1939.

Imports of marble during 1940 had a value of $84,005 compared with $97,797 in 1939. Current imports of marble are largely in the form of unpolished slabs and in the form 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.

The Canadian market calls for interior decorative marble almost entirely, and very little is used for exteriors of buildings. A considerable quantity is, however, used for tombstones. In recent years there has been an increasing demand for marble in the form of terrazzo for flooring, and many inquiries have reached the Bureau of Mines as to where marbles of various colours could be obtained.

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DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

MICA IN 1940

Canada, for the past fifty years, has been one of the two chief sources of phlogopite, or "amber" mica. Prior to 1920, practically the entire supply of this type of mica was drawn from Canada, and production records dating back to 1886 show continuous annual outputs ranging in value from about $30,000 in the earlier years to ~~as high as close to one million dollars~~ in 1920. The advent of Madagascar as an important producer about twenty years ago resulted in severe competition, which gradually brought about a serious decline in the Canadian production, and in the past decade the annual value of sales has seldom exceeded $100,000. Such sales have always included a considerable portion of waste grinding scrap, the value of which in some years has represented over 50 per cent of the total, the average for the entire period being about 20 per cent.

The production has been derived almost entirely from a comparatively restricted area in adjacent parts of Ontario and Quebec, in the general Ottawa region, and extending roughly from Kingston, on Lake Ontario, northeastward into Gatineau and Papineau counties, Quebec. In Quebec, the mica-bearing series extends for some distance west and east of the main productive district, into Pontiac and Argenteuil counties, respectively, and there are also several scattered occurrences as far east as Quebec City. In Ontario, similar outlying deposits extend westwardly into Hastings and Haliburton counties. In recent years, most of the productive activity has been centred on deposits in Quebec, shipments from Ontario comprising mainly scrap.

In 1940, as a result of a threatened curtailment of mica exports from Madagascar, a strong export market developed for Canadian phlogopite--both knife-trimmed block and splittings--and dealers reported a heavier volume of sales than for some years past, with supplies at the end of 1940 lagging considerably behind orders. Despite this, little new mining was undertaken and there was little change in the number of operators as compared with other recent years. Most of the exports went to the United States, Great Britain, and Japan. The demand was particularly strong for hard, heat-resistant grades of block, suitable for heavy-duty aviation sparkplugs, the production of which grades is limited to a few mines. Efforts to stimulate output of this type of mica were made under the joint cooperation of the Bureau of Mines and the Metals Controller.

Leading producers of amber mica in 1940 were Messrs. Blackburn Brothers, who operate the old Nellis mine, in Hull township, Quebec; St. Lawrence Mica Corporation, with a mine at Petit Pré, near Quebec City; and Kingston Mica Mining Company, which operates the Thirty Island Lake mine in Bedford township, near Godfrey, Ontario. These properties accounted for the most of the output, the remainder being derived from about twelve small and mostly intermittent operations, most of them in Quebec. Scrap mica continued to be recovered from old waste dumps, from which some merchantable sheet was also salvaged. The scrap is mostly exported to a grinding plant of United States Mica Manufacturing Company, at East Rutherford, New Jersey.

The larger Canadian producers operate their own mica shops, but there are 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 smaller rural communities, much of the work, particularly splitting, is farmed out, the labour being performed mostly by girls on piecework.

Black mica (biotite or lepidomelane) occurs in considerable quantity in Faraday township, near Bancroft, in Hastings county, Ontario, and the deposits were worked some years ago to supply a grinding mill,

now inactive, at Bancroft. This mica occurs in very large sheets, but is mostly of poor splitting quality and too high in iron to serve for electrical purposes.

Although muscovite, or "white" mica, is widely distributed in the Precambrian rocks of eastern Canada and in certain areas of western Ontario, Manitoba, and British Columbia, production has been negligible. In general, it has been found that the proportion of sound, merchantable sheet in the pegmatites is too low for the profitable mining of this mineral alone. During the past two years, there has been considerable prospecting and some mining activity on scattered muscovite occurrences in Quebec, mainly in the Lake St. John-Saguenay region. Only a limited production, mostly of very small punch sizes, resulted from most of this work, and some of the output was shipped to a punching plant at St. Césaire, near Granby.

An outstanding development was the discovery in Bergeronnes township, east of the Saguenay river, of a deposit of high-grade "ruby" muscovite, comparable in quality to the best Indian or Brazilian mica. This property which is owned by Eugene Simard, of Grandes Bergeronnes, came into production on a small scale in 1940. Some muscovite was also taken from the old Maisonneuve mine, in Berthier county, north of Joliette. Samples of large sheets of a good grade of stained muscovite, said to have come from a remote locality on the Peribonka river, 100 miles north of Lake St. John, were received by the Bureau of Mines at Ottawa, and similar samples were also furnished from a deposit near Wabowden, on the Hudson Bay railway in Manitoba. No developments have been reported, however, in either instance. There were reports of plans to further develop certain of the muscovite occurrences in the Tête Jaune, Big Bend region, in British Columbia, but there is no record of any production. Fine flake muscovite, or sericite, continued to be produced from the Ray deposit, at Baker Inlet, near Prince Rupert, British Columbia, 80 tons ~~of which were~~ being shipped to Vancouver for grinding. The property is owned and operated by P. M. Ray, 23 Besner Block, Prince Rupert. The ground material is stated to sell for $32.50 per ton, f.o.b. Vancouver, and is consumed mainly in the local roofing trade. Ground muscovite, made from imported Indian scrap, is also produced by G. W. Richmond, 2635 West 15th Street, Vancouver, for local roofing use and for export.

The mica grinding plant at the Blackburn mine, in Templeton township, Quebec, continued to produce various mesh-sizes of ground amber mica from mine and shop scrap, the sales ~~of which were~~ with higher than in 1939.

Canadian production and trade figures are not available for publication owing to the war.

Canada's exports of mica to the United States are dutiable under the following classification:

Untrimmed small sheet, phlogopite, yielding rectangular pieces not over 1 x 2 inches, 10 per cent ad valorem.

Mica unmanufactured, valued at not over 15 cents per pound, 4 cents per pound; valued at over 15 cents per pound, 4 cents per pound plus 25 per cent ad valorem.

Mica, cut or stamped to dimensions, shape, or form, 40 per cent ad valorem.

Mica films and splittings, not cut or stamped to dimensions, not over twelve ten-thousandths of an inch in thickness, 25 per cent ad valorem; over twelve ten-thousandths of an inch in thickness, 40 per cent ad valorem.

Mica films and splittings cut or stamped to dimensions, 45 per cent ad valorem.

Mica plate and built-up mica, and manufactures of, 40 per cent ad valorem.

Phlogopite waste or scrap, valued at not over 5 cents per pound, 15 per cent ad valorem. Mica waste and scrap valued at over 5 cents and not over 15 cents per pound, 4 cents per pound; valued at over 15 cents per pound, 4 cents per pound plus 25 per cent.

Mica, ground or pulverized, 15 per cent ad valorem.

Imports of mica and manufactures of, into Canada, are dutiable at 15 per cent ad valorem under the British Preferential tariff; under the Intermediate tariff, at 25 per cent; and under the General tariff, at 27½ per cent. Such importations from the United States, however, are dutiable at 20 per cent, under the 1938 Trade Agreement.

Latest available statistics indicate that in 1938 total recorded world production of mica of all classes and grades was about 31,000 long tons, but of this total, over 22,000 tons was low-priced grinding scrap. The remainder comprised both sheet or block mica in various styles of trimming and splittings. Most of this was muscovite, as only Canada and Madagascar, which together produced a little more than 1,000 tons, are producers of phlogopite. India has for many years been the world's chief source of mica, both block and splittings, and in 1938 exported almost 9,000 tons. Brazil recently has been making rapid headway as a second important source of high-grade muscovite; exports from that country in the first eleven months of 1940 having totalled 1,058 metric tons, or double the 1938 figure. Canada's share of the world production, though relatively small, is important, as for certain uses, notably for heater plate, commutator insulation, and heavy-duty aviation sparkplugs, amber mica has definite superiority over muscovite.

Sheet mica is marketed in various classes, depending upon the amount of preparation the mine-run material receives. Much of the Canadian output was sold formerly in the semi-rough form, termed "thumb-trimmed", but the trade now calls for knife-trimmed sheet, a much higher grade of product. Price is governed largely by dimensions of sheet, and rises rapidly for the larger sizes. Quality, which is gauged by colour, softness, ability to split readily, and by freedom from cracks, creases, pin-holes, and inclusions of foreign mineral substance, is also highly important. Good dielectric strength is a prime consideration, but most amber mica, except perhaps the very dark, high-iron varieties, possesses this in the required degree. For heater use, the mica must be able to withstand temperature up to red heat without puffing or swelling, in which respect phlogopite tends to be variable, particularly in cases where it has undergone some degree of natural alteration (hydration).

Of all industrial minerals, mica, in the sheet form, through the various stages of its mining, preparation for market, grading, etc., involves the greatest expenditure of labour and time per unit of quantity production, and it is by far the most costly of these minerals. From mining to preparation in the form of trimmed or split sheets, each piece entails an individual hand operation. Mechanical preparation has made little progress, and most of the production is still handled by primitive hand-and-knife methods. The making of splittings by hand in particular, is a slow and costly operation as an expert worker can split only about one pound an hour, at a labour cost of about 15 cents. As a result, comparatively little mica is made into splittings on the

American continent, most of this class of product coming from India, Madagascar, and other countries having an abundant supply of cheap labour.

Sheet mica is used almost entirely for electrical insulation. 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 that can be sawn, bored, and machined into any desired article. Some clear mica, mostly muscovite, is used as stove windows, and in lighting equipment. Muscovite and phlogopite are essential in the manufacture of aviation sparkplugs, the latter for the nose-washers at the base of the plug, which are required to possess high heat-resistance. Recent research has been directed toward the perfecting of a ceramic type of plug, some of which are already in use and in time this type of plug may replace the mica plug. It is claimed that their cost is only one quarter that of mica plugs; that they absorb no moisture, and thus prevent condensation in the combustion chamber, in the event of which there is the risk of shorting in cold weather; and that they are not subject to penetration and corrosion by the lead oxide derived from high-rating aviation fuel.

Much has been heard in the past two years of a new synthetic material, "Alsifilm", made from a colloidal dispersion of bentonite clay, and designed to replace mica for use in electrical insulation. It is claimed that this product possesses most of the desirable properties of mica, and that it can be made in sheets of any desired size and thickness by a process similar to that followed in the making of paper, and at very low cost. Considerable research has been proceeding on the development of the product, which, if perfected, would vitally affect the mica industry, but so far it has not attained commercial significance.

Mica is a comparatively unimportant mineral from the view point of tonnage produced. Sheet mica is, however, a vital mineral in industry, particularly in all forms of electrical equipment. It is one of the few industrial minerals that are listed by the United States government as strategic minerals. Although already drawn on extensively, Canadian reserves of amber mica are still adequate to furnish important supplies, and any appreciable advance in price would probably result in a general revival of mining and increased production. The depression in the Canadian industry in recent years is largely attributable to the competition of more cheaply produced Madagascar mica, this being especially severe in the case of splittings.

Fine flake or powdered mica has become an important industrial product, particularly in the United States, where a number of plants are engaged in its manufacture both by wet and dry systems of grinding. Most of the production goes to the roofing and rubber trades. New uses include its combination with resin varnishes as a coating for foodstuff cans, and as a base in cleanser compounds. Increased interest is being shown in its possibilities as a protective inert pigment in paints, to which it is claimed to impart resistance to weathering and to corrosion by fumes and liquids. A new use that promises large outlets for coarser grades is as an addition to oil-well drilling muds, to prevent circulation loss of water into uncased and porous formations. Large amounts of wet-ground muscovite mica are used in the manufacture of wall-paper, and some is used in the ceramic type of insulating material termed "Mycalex". Progress is reported in the development of resin-bonded ground mica for insulation purposes; and a new product, ("Watsonite"), using dehydrated, heat-treated, powdered mica, similarly bonded, is announced as a flexible insulating material.

A method of separating flake mica from crushed rock or sand by means of the frictional electricity induced in the flakes during their passage down inclined glass plates has been made known by the United States Bureau of Mines. The Bureau has also investigated a method of breaking down coarse flake mica to powder by means of a device termed an "attrition scrubber". Designed originally to clean mineral particles prior to flotation the device pulverizes mica, a particularly difficult mineral to grind, as readily as does ball-milling, and it may provide a cheaper means of producing ground mica than the machines now used. It has also proved successful in promoting the recovery of vermiculite by agglomerate tabling.

Mica prices are difficult to determine owing to the lack of reliable market quotations and to the prevailing system of trade discounts. Quality has such a bearing on value that the only satisfactory method of getting information is to submit samples to an accredited dealer for a quotation. The mica market is subject to pronounced periodic fluctuations in demand owing to prevailing trade conditions, and to the practice by consumers of laying in stocks well ahead of current requirements. According to dealers' reports, general retail price averages for phlogopite in 1940 advanced slightly from those of 1939, quotations being approximately as given below. These prices are not an index of what producers may expect to receive from dealers for small parcels, as they include the dealers' overhead, culling, grading, and marketing costs, profit, etc.

Knife-trimmed Sheet		Splittings	
Size	Per Pound	Size	Per Pound
1 x 1 inches	$0.30	1 x 1 inches	$0.55
1 x 2 "	0.40	1 x 2 "	0.60
1 x 3 "	0.60	1 x 3 "	0.70
2 x 3 "	0.85		
2 x 4 "	1.25		
3 x 5 "	2.00		
4 x 6 "	2.50		
5 x 8 "	3.50		

Ground mica (phlogopite) continued to sell as follows, according to fineness: 20 mesh, $25 per ton; 60 mesh, $30; 120 mesh, $65; all prices f.o.b. Ottawa, in ton lots.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

MOULDING SAND (NATURAL BONDED) IN 1940

Every province except New Brunswick and Prince Edward Island produces natural bonded moulding sand. A small production came formerly from New Brunswick, one deposit being operated in 1918 and another in 1921 and 1922. A small production also came from Prince Edward Island of a grade suitable only for light weight castings. By far the greater part of the production has always been in Ontario in the Niagara peninsula, from Niagara to and around Hamilton. Occasionally new deposits have been opened up, mostly in Ontario and the western provinces.

A general investigation regarding such sands in Canada was made a few years ago and the results were published in 1936 by the Mines Branch (now Bureau of Mines), Ottawa, as report No. 767, "Natural Bonded Moulding Sands of Canada". This report draws attention to the large number of deposits from which supplies have been obtained for local foundries and the probability of replacing imported material with Canadian sands.

The Canadian production in 1940 was 30,320 tons valued at $31,767, compared with 17,618 tons valued at $18,652 in 1939, and 18,845 tons valued at $19,698 in 1938.

It is estimated that 50 to 60 per cent of our consumption of natural bonded moulding sand is imported, mostly from the United States. Moulding sands as well as other sands and gravels enter Canada duty free.

Small quantities of moulding sands not tabulated in official records are produced in nearly all the provinces by foundrymen for their own use from nearby deposits; or by small part-time operators such as farmers for local foundries.

Silica sands without clay bond, which are used in steel foundries, are not included in the above production figures.

The industry gives only seasonal occupation to producers, as foundrymen usually obtain their supplies in the summer and autumn.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

NEPHELINE SYENITE IN 1940

Nepheline syenite is a quartz-free rock consisting essentially of the mineral nephelite (a silicate of alumina, potash and soda) and albite and microcline feldspars. It often carries also a variable amount of iron-bearing minerals in the form chiefly of black mica and magnetite, together with such accessory minerals as zircon, corundum, calcite, scapolite, etc. On account of its freedom from free quartz and its high alumina content (20 to 30 per cent in average commercial rock) as compared with straight feldspar, it has found high favour with the ceramic industries, particularly in the glass trade. For ceramic use, the crude rock requires to be cleaned of its iron-bearing constituents, removal of which can often be readily effected by a relatively cheap process of magnetic separation at around 20-mesh size.

Attention has become increasingly directed in recent years to the possibility of using various forms of rock as substitutes for straight feldspar in the ceramic industries, and growing use is now made of semi-kaolinized granite (Cornwall or Carolina stone), aplite, pinite, alaskite, etc.

Most of the known important occurrences of nepheline syenite in Canada lie in Ontario, the most extensive developments of commercial rock being in Peterborough, Hastings, and Haliburton counties, Central Ontario. Production of the material began in 1936, with the opening of a quarry by the Canadian Nepheline Limited at the west end of Blue Mountain, in Methuen township, Peterborough county: at the same time, this company erected a small plant at Lakefield, 27 miles distant and the nearest rail-point, for crushing and cleaning the rock. Production for supplying the domestic glass trade has been continuous and in 1937-38 production of crude rock was greatly expanded by the formation of a subsidiary, American Nepheline Corporation, which erected a large crushing and processing plant at Rochester, New York, to take care of United States requirements. Capacity of the Lakefield mill is 45 tons of finished product per day, and the Rochester plant is designed for about 200 tons of feed per day. The product made in both plants is a granular, minus 20-mesh material, containing about 24 per cent of alumina, and only 0.07 per cent of ferric oxide (Fe_2O_3). The Lakefield mill supplies cleaned material to the mill of Frontenac Floor and Wall Tile Company, Kingston, Ontario, for fine grinding for general ceramic use, and similar fine syenite is now produced at the Rochester plant. In 1940, Canadian Nepheline Limited became merged with American Nepheline Corporation, as its Canadian branch.

Canadian Flint and Spar Company which also has holdings at the east end of the Blue Mountain deposit, where it has done work preliminary to starting mining operations, reported no further work in 1940.

A second important nepheline syenite area lies in the Bancroft-Gooderham district, Hastings and Haliburton counties, to the northeast of the Methuen deposit. Production began in this district in 1937 and has since been continued intermittently by several operators, the total output to date being about 20,000 tons. The principal operators have been Gooderham-Nepheline, with quarry at Gooderham, in Glamorgan township; New England Nepheline Company, an affiliate of the Golding-Keene Company, Keene, New Hampshire; Temagami Development Company, 38 King Street, West, Toronto; and Canadian Flint and Spar Company, 207 Victoria Building, Ottawa. Operations of the three last-named have all been in Dungannon township, to the east of Bancroft. Output of the Gooderham-Nepheline and Temagami Development Company quarries has gone chiefly to the grinding plant of United Feldspar Corporation, at West Paris, Maine; that of the New England Nepheline Company to the Golding-Keene mill at Keene, New Hampshire; and that of Canadian Flint and Spar Company to the mill of Consolidated Feldspar Corporation, at Rochester, New York. In 1940, Temagami Development Company was re-incorporated under the name of Superior Nepheline Mines Limited, and plans were announced for the building of a crushing plant at its quarry and of a cleaning mill at Bancroft.

In contrast to the rock produced in Methuen township, which is a medium-grained and uniform-textured syenite, most of the output from the Gooderham-Bancroft district has consisted of coarse pegmatitic material; it has been used, after processing at destination for removal of iron-bearing constituents (chiefly black mica) for blending with feldspar, to raise the alumina content. The Gooderham quarry has been inactive since 1938, and during 1940 most of the Bancroft properties were also idle . Shipments, consisting mainly of stockpiled rock, were, however, made during the year from Bancroft, and totalled about 2,000 tons.

Nepheline syenite production in 1940 was valued at $113,245, compared with $140,737 in 1939. Most of these values represented crude rock consigned to American mills, but included also finished products made in Canada for domestic consumption and export.

Exports in 1940 (all to the United States) totalled 23,812 tons, valued at $111,357, compared with 24,701 tons, valued at $87,487 in 1939. Crude nepheline syenite enters the United States free of duty, provided that total imports of both crude and ground material do not exceed 50,000 long tons in any calendar year. Ground material pays 15 per cent ad valoren. During 1940, the United States Customs Court ruled that ground syenite was entitled to free entry under the classification of "manufactured sand", but this ruling was later contested by the United States Treasury Department and the 15 per cent figure restored pending new record trial. In addition to 22,000 tons of crude rock consigned to its Rochester, New York mill, American Nepheline Corporation reported 600 tons of processed glass-grade product shipped to Great Britain.

Outside of Russia, whose production is not known, Canada is the only present producer of nepheline syenite. Russia recovers important tonnages of apatite (phosphate) from apatite-nepheline rock, large bodies of which occur in the Kola Peninsula, and considerable research has been done looking to the commercial utilization of the by-product nephelite. It is believed, however, that this material is not comparable in quality to the Canadian product, though probably suitable for dark glass. It has also been investigated as a possible raw material for the manufacture of aluminium. Despite active search for commercial-grade nepheline in the United States, most of the recorded occurrences have proved to contain too much finely-divided and inseparable iron to be suitable for white glass manufacture. Experimental work in the Bureau of Mines laboratories at Ottawa in 1940 has shown good results in the cleaning of nepheline syenite from coarse iron-bearing impurities by flotation, followed by magnetic separation to remove remaining traces of finely-divided magnetite.

The chief market for nepheline syenite continues to be with the glass trade, where it is preferred to straight feldspar on account of its higher content of alumina (about 24 per cent as compared with 17-20 per cent in an average feldspar). Most Canadian glass plants now use the material, 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 higher content of alkalis reduces the temperature of melting, with resulting saving of fuel and longer tank life. Research has been proceeding steadily on applications for the material in other branches of ceramics, and it has been found of advantage, on account of its higher fluxing action, as a body ingredient in a variety of products, including pottery, semivitreous ware, sanitary porcelain, floor and wall tile, and structural clay products, as well as in enamels. Increased vitrification, translucency, and mechanical strength, improved glaze fit and reduced absorption, warpage, thermal expansion, and crazing, are among the desirable properties claimed for various types of ware made with it. As stated above, finely ground syenite for general ceramic use is now being offered in commercial quantities both in Canada and the United States by American Nepheline Corporation, and the company reported sales

in 1940 to domestic sanitary ware and enamel plants.

Glass-grade nepheline syenite for the domestic trade was quoted at $11.75 per ton, in carload lots, f.o.b. Lakefield, in 1940, and ground, 200-mesh ceramic grade at $17, f.o.b. Kingston. American quotations were $12 and $15.50 per ton, respectively, for the same grades, f.o.b. Rochester, New York.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

PHOSPHATE IN 1940

As in past years, phosphate production consisted of apatite obtained from the mica-apatite deposits of the Precambrian area north of Ottawa, in western Quebec, where a little was taken out by about a dozen small-scale producers in the Gatineau-Lièvre rivers-Templeton district. Most of the output was in less than individual car-load lots, and the bulk of it was sold to the Electric Reduction Company, Buckingham, Quebec, for the production of phosphorus or its products. This company has for years been practically the sole customer for domestic apatite: purchases in 1940 are reported as 332 tons, at a base price of $11 for 80 per cent grade, plus or minus 14 cents per unit above or below this figure. Early in 1941, Canadian Refractories Limited, Kilmar, Quebec, reported that they would be in the market for about 100 tons annually.

The only other known occurrence of phosphate in Canada is a belt of rather low-grade sedimentary rock extending northward along the continental divide from the Crowsnest area, just west of the Alberta-British Columbia boundary; it has been traced as far north as Jasper, Alberta. Operations some ten years ago in the Crowsnest-Michel area by the Consolidated Mining and Smelting Company resulted in the shipment of 5,000 tons of this rock to Trail, British Columbia, for the manufacture of fertilizer, but attempts to concentrate it proved unsuccessful and the company discontinued mining and has since drawn its supplies from Garrison, Montana. Eastern Canadian plants using phosphate for fertilizer or other purposes employ mainly Florida rock: in 1940, this cost about $15 per ton, delivered, for 75 per cent grade.

Reported production (sales) of apatite in 1940 were 358 tons, valued at $4,039, compared with 157 tons, valued at $1,712, in 1939.

Total world production of phosphate is of the order of about 11 million long tons annually. The great bulk consists of sedimentary rock, but the Russian output of apatite, produced as concentrate from nepheline-apatite rock, amounts to about one million tons. Outside of Russia, Sweden and Canada are the only other producers of apatite for which figures are available. Sweden produced 6,192 tons in 1938, and, as a war measure, was reported in 1940 to be undertaking the recovery of apatite from iron-ore tailing under government subsidy. Japan is reported to be negotiating for developing extensive apatite deposits in French Indo-China, and it is announced that the Brazilian government has begun the production of superphosphate from domestic apatite. In the United States, apatite is recovered as a concentrate from the treatment of nelsonite in Virginia, and some by-product mineral has also been produced from magnetite-apatite ore in New York State, but no figures are available. The leading world producer of sedimentary phosphate is the United States, with nearly 4 million tons in 1939, of which nearly one million tons went to export. In 1938, shipments from Tunisia and Morocco, totalled nearly 3½ million tons; from Egypt and Algeria, about half a million tons each; and from the Pacific islands of Nauru, Ocean, and Christmas, an aggregate of over 1¼ million tons. Except for Russia, Europe is lacking in phosphate deposits, and is vitally dependent on imports from overseas to supply its needs.

Imports of phosphate rock into Canada in 1940 totalled 165,858 tons, valued at $663,554, compared with 124,900 tons, valued at $477,317, in 1939, practically all of which came from the United States. Canada also imported 99,686 tons of superphosphate, valued at $982,337, compared with 104,126 tons, valued at $979,052, in 1939. Phosphate rock enters Canada duty free. Superphosphate, for use as fertilizer in the condition imported, is free under the British preferential tariff, but under the intermediate tariff pays 7½ per cent ad valorem, and under the general tariff, 10 per cent. Under the United States-Canada Trade Agreement of 1938, superphosphate imports from the United

States are dutiable at 5 per cent, provided that no restrictions are placed by the latter country on exports of either crude phosphate rock or superphosphate; however, superphosphate intended for blending with other fertilizer ingredients enters Canada free under all tariffs.

The Quebec-Ontario apatite deposits, mined actively many years ago as a source of fertilizer phosphate, are estimated to have produced a total of about 350,000 tons. Owing to the generally pockety and erratic nature of the ore-bodies, they are much more expensive to mine than sedimentary phosphate, which can be worked by sluicing or steam-shovel methods, and there is little prospect that they could be operated profitably today. Most of the apatite sold in recent years has been by-product material from mica mines, or has been taken out by small intermittent operators working near-surface showings or turning old waste dumps for mica. A moderate tonnage could probably be recovered from such waste dumps by milling and flotation of discarded low-grade rock, but apatite has little superiority over sedimentary phosphate for most industrial uses and the cost of such treatment would probably prove prohibitive under present conditions.

Growing interest has been shown in recent years in improved methods of treatment of crude phosphate rock for the extraction of its phosphoric acid and for the production of more concentrated acid and compounds. In the United States, much research both by government and private agencies has been devoted to the problems involved, as well as to the development of new fields of utilization of elemental phosphorous, and this work is expected to bring about a large expansion in the industry in phosphorus chemicals. Higher-strength superphosphates are now being made by acidulation of rock with phosphoric acid in place of sulphuric acid, and by improved removal of contaminating calcium sulphate from the product, with resultant large saving in the cost of shipping. Production of concentrated phosphoric acids, containing up to 84 per cent of phosphorus pentoxide, by volatilization from phosphate rock in the electric furnace or blast furnace in place of acid treatment, is now established commercial practice; elemental phosphorus is produced and later oxidized to acid for the production of calcium metaphosphate and superphosphate. Investigation of methods of handling phosphorus have also shown that this dangerous product can, with proper care, be shipped in steel drums or tank cars without risk, thus permitting it to be distributed from centres of production to other points for the manufacture of acid and other derivatives at a material saving in freight costs. Research has also been proceeding on methods of rendering raw phosphate available as plant food by volatilizing the combined fluorine from fused rock, it having been determined that it is the latter compound that inhibits solubility in the soil. Removal of contained fluorine is required from acid phosphate to be used in stock feeds and food products generally, and defluorination of fertilizer superphosphate is also desirable in order to prevent reversion to the citrate-insoluble form during curing and storage, particularly of processed fertilizers diluted with calcareous materials. At the fertilizer plant of Consolidated Mining and Smelting Company, Trail, British Columbia, the fluorine so removed is now recovered for use in the manufacture of hydrofluosilicic acid, used in the electrolytic refining of lead, thus dispensing with the employment of fluorspar as a source of fluorine.

Although fertilizers will always continue to consume the great bulk of the world's phosphate produced, a growing future for phosphorus and its compounds seems to be assured. One of such chemicals that is rapidly coming into extensive use is trisodium phosphate, employed as a detergent in laundry work and as a general cleanser, as well as for preventing scale or scum in boiler-feed and washing waters, and in the tanning, photographic, sugar and other industries. The removal of injurious fluorine, the cause of "mottled" teeth, from potable waters is

now accomplished by filtering through a bed of tricalcium phosphate. Sodium pyrophosphate and tetraphosphate are proving of value for deflocculating and lowering the viscosity of the muds used in oil-well drilling. Sodium metaphosphate is a strong "wetting" agent, and is highly efficient in the flotation of certain non-metallic minerals, and also in laundry practice. Alkaline-earth phosphate binders are proving of value for refractory materials. Research is proceeding on the use of phosphate in glass batches. Non-fertilizer uses for phosphate in the United States have been showing a steady expansion and now total about half a million tons annually.

The use of electric-furnace and blast-furnace smelting for the treatment of phosphate rock has made available large tonnages of low-grade slime made in the washing of sedimentary phosphate, material that it would not be economic to treat by the acid method of superphosphate manufacture, thus materially stepping up total recovery: the slime is sintered before smelting.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

PYRITES IN 1940

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

Aldermac Copper Corporation's mine and concentrator, twelve miles west of Noranda, Quebec, were in continuous operation in 1940. The copper concentrate is shipped for treatment to the Noranda smelter, while the high grade iron pyrites concentrate is shipped partly to chemical plants in the United States and partly to Three Rivers, Quebec, for use by St. Lawrence Paper Mills Company. The main shaft of the mine was extended 125 feet to a depth of 1,375 feet, and the tenth, or bottom level, was opened up. The east end of the property was explored on the surface by diamond drilling and geophysical work, and underground by crosscutting and diamond drilling.

At the Noranda mine, a small tonnage of pyrites concentrate - a by-product of the milling process - was marketed for the manufacture of acid.

At Three Rivers, all of the pyrites used in the Freeman flash-roasting plant in the mill of St. Lawrence Paper Mills Company is now being obtained from the Aldermac mine. Formerly the plant burned pyrites obtained from the old Eustis mine which was closed down in June, 1939. The Freeman plant supplies all of the sulphur dioxide and part of the steam required for the operation of the company's sulphite plant.

In British Columbia, part of the large output of pyrites from the Britannia mine was consigned to the acid plant of Nichols Chemical Company at Barnet, British Columbia. As in previous years, however, much of the output was stored, awaiting more favourable market conditions. Some of this stock was exported in 1939.

Northern Pyrites, Limited last year completed a program of development work that has been in progress for the past four years on its Ecstall pyrites property, located on Ecstall river about sixty miles south of Prince Rupert. A large plant as well as a railway to tidewater is required before active production can commence, but in the meantime, the company is awaiting more favourable market conditions. The Granby Company did considerable exploratory diamond drilling on the Ecstall property several years ago. According to reports, the orebodies contain 5,000,000 tons of ore averaging 49 per cent sulphur, 42 per cent iron, 2.3 per cent zinc, less than one per cent copper, and about $1.00 a ton in gold and silver.

Although the Freeman process of flash roasting, designed for by-product flotation fines that are obtained from the treatment of copper ore, has opened a prospective market for this class of ore, it is not to be assumed that the mining of pyrites will be stimulated. Ample supplies of pyrites fines are already available at strategic points to meet any demand that may arise in the immediate future.

Canadian production and trade figures are not available for publication owing to the war.

There is apparently no standard price in Canada for sulphur in pyrites. 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.

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OTTAWA, MARCH, 1941.

SALT IN 1940

Common salt (sodium chloride) is obtained in two forms, in solution in a brine from which the salt is extracted by evaporation, and in lump or solid form by direct mining. During 1940 salt was produced in southern Ontario; at Malagash, Nova Scotia; at Neepawa, Manitoba; and at Waterways, Alberta. Ontario salt is obtained from brine wells, as is also that produced in Manitoba and Alberta. The Malagash salt is recovered by mining rock salt and by evaporation from brine produced by leaching the waste material in the mine.

In Ontario, production was steady throughout the year, and all of the well established plants were in operation. The caustic soda-chlorine plants of Canadian Industries Limited, at Cornwall, Ontario, and Shawinigan Falls, Quebec, obtained their salt from Sandwich, Ontario.

In Nova Scotia, Malagash Salt Company produced slightly less than in the previous year, owing to a fire which completely destroyed its power plant early in December, in consequence of which a complete shut down of underground development was necessary. Temporary power arrangements have been made until such time as a new and permanent plant can be erected. Definite zones in which indications of potash salts occur have been correlated from the second to the twenty-sixth level and there seems to be an increase in the potash content with depth. The study of these zones is being continued.

At Neepawa, Manitoba, the plant of Canadian Industries Limited operated continuously, and the company has installed a new plant utilizing vacuum evaporation with modern equipment to produce all grades of salt.

At Waterways, Alberta, Industrial Minerals, Limited, controlled and operated by Dominion Tar and Chemical Company of Montreal, remodelled its whole plant. The direct-fired pans of the original plant have been discarded and replaced by one set of quadruple effect vacuum pans, complete with all modern accessories. Two grainers have been added so that the coarser grades of salt can be produced. Other new equipment includes an Oliver filter with the necessary heaters and exhauster; one block press; weighing and bagging equipment for 100-pound bags, down to 3-1/2 pound packets; as well as packaging and wrapping machinery for the 2-pound cartons of table salt. With this new plant the company is in a position to place all grades of salt on the market. To provide for contingencies, a second production well has been drilled and was made ready for production when needed.

In New Brunswick, a salt basin was discovered in 1921, as a result of drilling in the vicinity of Goutreau, south of Moncton, on the east side of the Petitcodiac river. The extent of the basin was further determined when New Brunswick Gas and Oilfields, Limited, in drilling at Weldon on the west side of the Petitcodiac river, penetrated over 1,500 feet of salt formation. This was the second drill hole to strike salt on this side of the river. The top of the rock salt was 1,473 feet below the surface. During 1939 still another drill hole passed through the same salt formation, the thickness, however, being only about 100 feet, indicating that the northern edge of the basin is being approached. Altogether, six drill holes have penetrated the salt so that a deposit of salt over 1-1/2 miles wide and four or more miles long is already indicated, the greatest thickness so far encountered being 1,500 feet. There are, therefore, many millions of tons of salt in this basin, available for future development. The possibility of developing this deposit for the production of salt is being seriously considered.

Near Amherst, Cumberland county, Nova Scotia, a well drilled a number of years ago by Imperial Oil, Limited, in a search for oil and gas, penetrated 3,200 feet of alternating beds of salt, anhydrite,

dolomite, limestone and shale, the salt constituting 45 per cent of the whole. Salt was first met at a depth of 920 feet; and one bed more than 480 feet in thickness contained over 90 per cent sodium chloride. The apparent great thickness of the salt may be due to the steep dip of the beds.

The production of salt in 1940 was 464,714 tons, valued at $2,823,269, compared with 424,500 tons, valued at $2,486,632 in 1939.

Exports of salt from Canada in 1940 were 6,349 tons, valued at $61,922, compared with 10,656 tons, valued at $76,287 in 1939. Imports of salt were 112,511 tons, valued at $557,768, compared with 117,628 tons, valued at $507,368 in 1938. The greater part of this salt comes into Canada free of duty for use in the fisheries on the Atlantic and Pacific coasts.

The world production of salt is steadily increasing and in 1937, the last year for which fairly complete figures are available, it amounted to well over 37,000,000 short tons. Canada in that year stood thirteenth on the world list and was the third largest producer in the British Empire; being exceeded only by Great Britain and India. Canada produces only slightly over one per cent of the world production and over 7 per cent of that of the British Empire.

The market for salt in Canada is steadily increasing, and the industry is in a sound condition. Domestic production, except for small exports, is sold principally to the dairy, meat curing, and canning industries; to fisheries; to highway and transport departments for soil stabilization; to the chemical industries, and as table salt for household use.

Soil stabilization with salt and clay for the foundations of highways and for a surface veneer for gravel roads is now firmly established and this use of salt showed a decided increase in the past few years. The development of soil stabilized bases for runways at Canadian air fields continued, and several air fields have been so prepared. The use of salt for mixing with sand, piled each fall at regular intervals along main highways, has increased greatly during the past few years, as it has been found that even in the coldest of weather the sand in piles which have been so treated remains loose and free flowing, thus allowing easy distribution on the icy roadway.

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

According to the Canadian Chemistry and Process Industries (Toronto), prices for the several grades of salt remained stationary throughout the year. Quotations for specially purified (99.9 per cent NaCl) salt in 280-pound barrels f.o.b. plant was $3.10 per barrel, while industrial fine in bulk car lots f.o.b. plant per ton was $6.32, and industrial coarse per ton was $10.00.

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DEPARTMENT OF MINES AND RESOURCES,
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SAND AND GRAVEL IN 1940

Deposits of gravel and sand are numerous 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 value, local needs for these materials are usually supplied from the nearest deposits, as their cost to the consumer is governed largely by the length of haul. Hence the large number of small pits and the small number of large plants. Some grades of sand particularly suitable for certain industries command a much higher price than does ordinary sand.

The total production of sand and gravel for 1940, amounted to 30,758,961 tons valued at $11,664,614, compared with 28,172,384 tons valued at $10,820,631 for 1939. Following are the output and value by provinces for these two years:

	1939		1940	
	Tons	Value	Tons	Value
Nova Scotia.....	2,072,405	$1,213,918	1,607,761	$950,165
New Brunswick.....	3,131,844	1,277,438	1,090,294	460,978
Quebec.....	10,114,941	2,628,397	9,973,000	2,545,500
Ontario.....	7,884,925	3,048,973	9,599,462	3,989,038
Manitoba.....	1,163,508	642,835	2,334,558	979,601
Saskatchewan.....	1,038,231	658,331	2,280,390	810,210
Alberta.....	853,680	611,666	1,638,068	1,046,867
British Columbia.....	1,912,850	739,073	2,235,428	882,255
	28,172,384	$10,820,631	30,758,961	$11,664,614

Road improvement, concrete works and railway ballast absorb by far the greater part of the gravel and sand used. Gravel in particular has proved a good material for building all-weather roads at low cost and its use has steadily increased with the growth of motor traffic.

A considerable tonnage of sand and gravel is also used in the mines for re-filling underground workings. Some mines use several thousand tons a day.

Most of the gravel used for road work comes from pits worked for that purpose. Usually a portable or semi-portable plant is used to extract enough gravel to supply the immediate need and then a sufficient reserve is built up, in the form of stock piles, for two years' requirements. Road pits may remain idle for two years or more. The amount of gravel produced from year to year thus fluctuates, depending on the program of road construction and improvement. Intermittent operation also applies to railway pits, which may remain idle for several years.

Part of the gravel used is crushed, screened and in some cases even washed and the proportion thus processed is increasing steadily. Some Provincial Highway Departments have used crushed instead of pit-run gravel on their main highways for a number of years. Most of the large commercial plants are equipped for producing crushed gravel, a product that can compete with crushed stone.

The amount of sand consumed follows the trend of building activity, as most of it is used in the building industry for concrete work, cement and lime mortar, or wall plaster. The sand must be clean, that is, free from dust, loam, organic matter or clay, and contain but little silt, and is usually obtainable from local deposits.

Other important uses of sand are for moulding in foundries, filtering of water supply, and glass making, all of which require special grades of sand.

War conditions did not materially affect the total consumption of sand and gravel, as the extra amount absorbed by war services is partly if not wholly offset by a decreased activity in ordinary industry due to the war. The increased consumption in Ontario, however, is attributable to war conditions.

Prices of sand, gravel and crushed stone in the four largest cities in Canada were as follows, at the end of 1939 and 1940. Prices are per ton, carlots, f.o.b. cars:

	Montreal		Toronto		Winnipeg		Vancouver	
	1939	1940	1939	1940	1939	1940	1939	1940
	$	$	$	$	$	$	$	$
Sand	1.15	1.15	.85	.93	.70	1.00	.70	1.00
Pit run gravel	1.10	1.10	1.60	1.43	.70	1.00	.70	1.00
Crushed stone 3/4 inch & over	.75	.75	1.55	1.35	---	---	.75	1.13

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

SILICA IN 1940

The materials produced are quartz for smelter flux and ferro-silicon; quartzite for ferro-silicon and silica brick; silica sand for the manufacture of glass, carborundum, sodium silicate, etc., also for sand blasting, roofing and for use in steel foundries; and silex, the finely pulverized silica used in the ceramic and paint industries.

Quartz, quartzite, or sandstone in sizes from ½ inch to 6 inches is used in the manufacture of ferro-silicon and pure silicon, and quartz and quartzite are used also as a smelter flux. For silica brick, quartzite is crushed to about 8 mesh. Some quartz is also crushed to make silica sand.

Silica sand is generally prepared from a friable sandstone by crushing, washing, drying, and screening to recover different grades of material according to the use for which it is required. In the manufacture of glass, for instance, the material should range between 20 and 100 mesh. Silica sand may also be obtained from naturally occurring sands, the required grade being recovered by screening. It may in special cases be prepared from a friable quartz and from vein quartz.

Silex is the washed sand or pure quartz, crushed and ground in some form of mill, and then either air- or water-floated to recover the fine flour. The ceramic industry requires that it be 150 mesh or finer, whereas in the paint industry, air-floated material 250 mesh or finer is required.

Quartz is produced in Quebec and Ontario, and quartzite is quarried in Nova Scotia, Quebec, Ontario, Manitoba and British Columbia. Silica sand is obtained from Nova Scotia, Quebec and Manitoba, and silex is prepared in Quebec.

The deposit of silica sand near River Denys, Inverness county, Nova Scotia, was not operated during the past year. The sand is of good quality and is suitable for a number of uses. It should find a ready market in the Maritime Provinces, especially in the steel foundries.

In Quebec, the plant of the Ottawa Silica and Sandstone Company, was idle most of the year. When operating it produces sand of different grades for steel foundries, the glass industry, and for sand blasting, etc. This company has also a plant for the production of rock wool. Canadian Kaolin Silica Products, Limited, made regular shipments of silica sand during the first part of the year to the glass companies and others in the Montreal district, from its property at Lac Remi. Although most of the output was shipped to glass manufacturers, a part of it was used for sand blasting and as an abrasive. In April a disastrous fire destroyed this company's plant and to date no move has been made to rebuild. As this company was supplying a large part of the Canadian production of silica sand, much hardship has been placed on the consumers, who in consequence have to obtain their requirements from the United States.

Canadian China Clay Company, at St. Remi d'Amherst, Quebec, has sunk a shaft to a depth of over 500 feet and has carried out extensive development on its 250 foot level. Two large mill buildings have been erected, one for clay preparation and the other for housing equipment for the production of silica sand, and it is planned that operations will be started during 1941. China clay and

high grade silica sand will be produced. Canadian Flint and Spar Company, operating a crushing plant at Buckingham, produced a small tonnage of high grade quartz sand, which was used as an abrasive.

Canadian Carborundum Company, at St. Canute, Quebec, produced silica sand almost entirely for the manufacture of carborundum at its plant at Shawinigan Falls. St. Lawrence Alloys, Limited, produced ferro-silicon of several grades as well as metallic silicon running 97 per cent or better in electric furnaces at Beauharnois, and used sandstone from Melochville, Quebec, as well as high grade quartz from localities in Ontario. The sandstone from Melochville is trucked the 2 miles from the quarry to the plant, where it is crushed to pass a 3 inch screen and be retained on a 5/8 inch screen. The silicon is marketed mainly in Canada, and the ferro-silicon finds a market both in Canada and abroad.

An appreciable amount of ferro-silicon of low silicon content is produced in Canada from the silica in the bauxite used in the manufacture of aluminous abrasive. Five companies, two at Niagara Falls, one at Chippawa, one at Thorold, Ontario, and one at Arvida, Quebec, produce this grade.

In the use of silica as a flux, smelter operators endeavour to obtain their material from the nearest possible source, and in many cases use a siliceous ore containing small amounts of the precious metals. The silica requirements for the manufacture of ferro-silicon and silica brick depend upon the market for the finished products.

The demand for high grade silica sand was steady and large quantities are still imported. Canadian producers have a good chance to enter this market at the present time provided they can guarantee the grade of the material and regularity of shipments. Silica sand for the manufacture of glass and silicate of soda has to be of a high degree of purity and uniformity, and Canadian producers must adhere rigidly to specifications and must guarantee regularity of shipments, if they hope to gain control of these markets. The use of Canadian sand for sand blasting is increasing.

Interest is active throughout Canada in the search for deposits of high grade silica strategically situated for supplying the increasing demand, especially that in central Ontario and in western Canada. West of Winnipeg the needs for silica are met almost entirely by imported material.

The production of quartz and silica sand in 1940 was 1,858,259 tons valued at $1,203,532, compared with 1,582,935 tons valued at $1,100,214 in 1939. The 3,437 M silica brick produced in 1940 were valued at $182,786, compared with 2,493 M valued at $124,807 in 1939.

Exports of silica and silica products in 1940 amounted to 106,203 tons valued at $195,163, compared with 108,397 tons valued at $196,418 in 1939. The total of the various grades of silica, (ganister, flint, silex and silica sand) imported in 1940 amounted to 283,850 tons with a value of $630,679, compared with 171,372 tons valued at $424,372 in 1939. Imports of silica brick in 1940 were valued at $472,215, compared with $312,413 in 1939.

The price per ton of the several grades of silica varies greatly depending on its purity and on the purpose for which it is to be used. Silica generally is a low-priced commodity, and therefore

the situation of a deposit with respect to markets is of great importance. The largest markets for silica are in the provinces of Quebec and Ontario, and new deposits to be of interest to these markets should be within economic reach of either Toronto or Montreal. In western Canada the main markets are in Alberta and Manitoba.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

SODIUM CARBONATE (NATURAL) IN 1940

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" throughout the central part of British Columbia, chiefly in the Clinton Mining Division, near 70-mile House, about 20 miles northeast of Clinton, and in the neighbourhood of Kamloops. Since 1921 there has been a small intermittent production from several of these deposits, the product being marketed in Vancouver for use in the manufacture of soap. During 1940 the only shipments made were from the Clinton area.

Production in 1940 was 220 tons valued at $1,760 compared with 300 tons valued at $2,400 in 1939.

Imports of soda ash or barilla totalled 1,573 tons valued at $45,377, compared with 1,454 tons valued at $41,831 in 1938.

Sodium carbonate, or soda ash, has many industrial uses, such as in the manufacture of glass and soap, and in the purification of oils. As the present known Canadian deposits are far from the main markets, the output is restricted to the requirements of consumers within economic rail haul from the deposits. Eastern consumers of soda ash obtain their supplies from the chemically prepared material made from salt by the Solvay or ammonia process in Ontario.

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OTTAWA, MARCH, 1941.

SODIUM SULPHATE (NATURAL) IN 1940
(Glauber's Salt and Salt Cake)

The material produced in Canada is either hydrated sodium sulphate, known as Glauber's Salt, or anhydrous sodium sulphate, known to the trade as "salt cake". It occurs as crystals (Glauber's Salt) or in the form of partly saturated or saturated brine in many lakes throughout Western Canada.

Production in 1940 was mainly from Saskatchewan, but a small tonnage of the crude salts was harvested in Alberta for local consumption for cattle licks. The principal producers were: Natural Sodium Products, Limited, Bishopric; Horseshoe Lake Mining Company, Ormiston; and the Midwest Chemicals, Palo; all of which are in Saskatchewan. Small tonnages were also produced from several other properties.

Natural Sodium Products, Limited, at Bishopric, operated throughout the year and now has a capacity of about 500 tons daily. Horseshoe Lake Mining Company, at Ormiston, operated throughout the year 1940. Midwest Chemicals, Limited, at the central portion of Whiteshore Lake, completed the erection of its new plant, and commenced production early in the year 1939, operating one rotary kiln. By the end of 1939 a start was made installing a second kiln which was put in operation early in 1940.

At Sybouts lake, 9 miles south of Gladmar, Saskatchewan, a start was made on the erection of a dehydrating plant by a company known as Sybouts Sodium Sulphate Company, Limited with head office at Gladmar, Saskatchewan. This plant is expected to be in operation during the summer of 1941. In anticipation of the completion of the plant some 10,000 tons of crystals were harvested and stockpiled on the shore adjacent to the new plant site.

No production is reported from British Columbia. Sodium sulphate is the predominant salt in a number of deposits and, during the past year, several of these deposits were prospected to prove their extent.

A discovery made in New Brunswick during 1937, may yet prove to be of importance as a source of sodium sulphate. New Brunswick Gas and Oilfields, Limited, in drilling for gas at Weldon, has proved large thicknesses of rock salt (sodium chloride). Two holes drilled 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 thick, mostly overlying the rock salt, the sodium sulphate content of which ranges from 25 to 30 per cent. Both glauberite and sodium chloride were proved by drilling in 1939, thus further extending the salts basin. Many millions of tons of sodium sulphate would seem to be indicated in this deposit. The Bureau of Mines, Ottawa, has done much research work on the material recovered in these cores, and has been able to indicate a probable method of recovery of the sodium sulphate, but further detailed work must be done to determine the full commercial possibilities of the deposit.

The industry in Western Canada seems now to be well established, and steady progress is being made. The investigation of sodium sulphate deposits in this section of the Dominion was started by the Bureau of Mines in 1921, and over 120,000,000 tons of hydrous salts was proved in the few deposits examined in detail. In 1921 none of this material was used commercially, but by 1939 the revenue derived by Canadian railways from this industry in incoming and outgoing freight exceeded $1,500,000.

At present the operating plants in Western Canada are capable of producing over 900 tons of dried salts a day, and, if necessary, the tonnage could be greatly increased .

The production of natural sodium sulphate in 1940 amounted to 94,260 tons valued at $629,589, as against 71,485 tons valued at $628,151 in 1939.

The production from the deposits of Western Canada increased over 30 per cent compared with that of 1939, and some 18 per cent over the previous record of almost 80,000 tons in 1937. The increase in 1940 can be traced to the increased activity in the nickel and the pulp and paper industries and to the increased demand for the material in the north central United States during the last four months of the year.

Complete figures for the world production of salt cake are not available, and it is difficult to compare the returns from different countries, owing to the fact that the production comes both from chemidal plants and from natural deposits. Germany in the past was probably the largest producer of total salt cake production, and Canada was among the first ten world producers. Canada is, however, one of the largest producers of salt cake from natural deposits.

Shipments from the deposits in Western Canada to the United States continued during 1940, but export figures, however, are not available. Imports of sodium sulphate during 1940, including Glauber's salt, salt cake, and the acid sodium sulphate (nitre cake), amounted to 9,498 tons valued at $132,480, compared with 8,449 tons valued at $110,577 in 1939.

The price for natural anhydrous sodium sulphate from the deposits in Western Canada during 1940 ranged from $6.50 to $8.50 per ton f.o.b. plant. The delivered price is considerably higher than this, owing to the high freight rates to the consuming plants, which are mostly in eastern Canada.

Producers in Western Canada have endeavoured to improve the quality of their product as the consumers demand a product of high purity, and the results have been gratifying. Since the start of the war in September, 1939, shipments of salt cake from European countries to the United States have shown a marked decline and, in consequence, the prices have firmed materially and the demand for material from other sources has increased. Canadian producers now have an opportunity to increase their export shipments, especially to the north central states. Western producers, however, will have to be on the watch to find new markets for their material, as there is always the possibility of the present consumers of their product finding new sources of supply nearer to their plants, or of making use of substitute material. Thus, by-product salt cake and nitre cake may be available in large tonnages in Eastern Canada if extensive manufacture of munitions is undertaken. In the southern States, some of the pulp mills are employing a synthetic material made from soda ash and sulphur as a substitute for salt cake in the manufacture of Kraft pulp.

The products from these deposits in Western Canada should find a rapidly extending market, as the by-product material from the manufacture of hydrochloric acid is each year decreasing in volume owing to the manufacture of hydrochloric acid synthetically.

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OTTAWA, MARCH, 1941.

SULPHUR IN 1940

Deposits of elemental sulphur of commercial grade have not been found in Canada, but sulphur occurs in combination with copper, lead, zinc, nickel, or iron in many base metal sulphide orebodies in various parts of the country. In the smelting of these ores sulphur dioxide gas is produced, but until recent years this gas was a total waste as no facilities were available for the recovery from it of sulphur, or sulphur ~~containing chemicals~~ compounds.

In practice, this gas can be used directly for the manufacture of sulphuric acid; the production of liquid sulphur dioxide; or for the production of elemental sulphur. A few years ago, International Nickel Company of Canada erected a plant at Copper Cliff, Ontario for the recovery of portions of its smelter gases for use in the manufacture of sulphuric acid. Later a similar plant was erected at Tadanac (Trail), British Columbia by Consolidated Mining and Smelting Company. At the former plant high grade sulphuric acid is produced and is marketed in several industries, while at the latter, the acid made is used chiefly for the manufacture of fertilizers. Part of it is used elsewhere in the plant and some of it is marketed. Since the summer of 1936, the plant at Tadanac has also been producing elemental sulphur from the smelter gases. No plant in Canada is producing liquid sulphur dioxide from smelter gases, although this has been done experimentally.

In Quebec, Aldermac Copper Corporation, with a mine and concentrator 12 miles west of Noranda, produces a copper concentrate and a high-grade pyrites concentrate from massive sulphide ores. The former is shipped to the Noranda smelter for treatment, while part of the latter is exported to chemical plants in the United States and part of it is shipped to Three Rivers, Quebec, for use by St. Lawrence Paper Mills Company for use in its Freeman flash-roasting plant. Construction by Aldermac Copper Corporation of a plant to produce sulphur and iron oxide has been suspended owing to the existing favourable market for its pyrites concentrates in the United States.

At the Noranda mine a small tonnage of pyrites concentrate, a by-product of the milling process, was marketed for the manufacture of acid.

Canadian production and trade figures are not available for publication owing to the war.

Sulphur is used chiefly in Canada in the production of sulphide pulp and for use in the making of artificial silk and newsprint. It is used to a large extent also in the manufacture of sulphuric acid, explosives, and rubber, and in the production of fertilizers.

According to Metal and Mineral Markets, New York, sulphur was quoted at $16 per long ton, f.o.b. cars at the mines in 1940. The prices at consumers' plants in Canada vary according to location, the difference being due to transportation costs.

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TALC AND SOAPSTONE IN 1940

Talc mining in Canada dates back about 50 years. The earlier production, previous to 1906, consisted mainly of low-grade roofing and foundry talc obtained chiefly from deposits associated with the serpentine belt in the Eastern Townships, Quebec, with a little also from Nova Scotia and Ontario. With active development of a large deposit of high-grade, white talc at Madoc, Ontario, in 1906, output started to rise, and this district has since been the principal source of supply. Canada Talc, Limited, is now the major Madoc operator, having taken over the holdings of the G. H. Gillespie Company, the pioneer producer in the district, in 1937. There have been various other small talc operations in the area, but these have been of small proportions. In 1940, a small output was reported by Moira Talc and Silica Mining Syndicate and Trent Mining Syndicate, both of Trenton, Ontario, the material being milled in a local slate plant. Small amounts of talc have been produced in recent years in British Columbia, mainly from deposits near McGillivray, on the P. G. E. railway, and from Kapoor, near Victoria, Vancouver Island, but these properties have been idle since 1935: the crude was shipped to a grinding plant at Vancouver, for local roofing use. Some ground soapstone is currently prepared in a small mill in Vancouver by G. W. Richmond, 2635 West Fifteenth Avenue, from crude imported from the State of Washington; this mill also grinds mica, slag, etc., mainly for local roofing concerns, but also for export to Tacoma, Washington.

Quebec has had a small but active cut soapstone industry since 1922, supplying mainly blocks and bricks for alkali recovery furnaces of domestic kraft mills. Some such stone has also gone to export, and latterly the sawing of crayons has been undertaken. The principal operator is the Broughton Soapstone and Quarry Company, which has opened a large quarry near Leeds station on the Quebec Central railway, in Broughton township: this company in addition to cut furnace stone, also produces crayons, and has recently installed a grinding mill, pulverizing both quarry and sawing waste, as well as more highly talcose stone found in a band cutting its main soapstone body. Other recent producers of sawn furnace stone in the same area have been Charles Fortin, of Robertson; L. C. Pharo, of Thetford Mines; and Louis Cyr, of St. Pierre de Broughton: the two first-named have operated in Thetford township, and the last in Leeds township. The Cyr holdings were taken over in 1940 by the Broughton Soapstone and Quarry Company. L. C. Pharo installed a small grinding unit on his property in 1938. Sawing dust from these operations is disposed of to some extent to domestic roofing firms, and a considerable tonnage of quarry and sawing waste is shipped to the grinding plant of Messrs. Pulverized Products, Limited, 4820 Fourth Avenue, Rosemount, Montreal. Outside of the above producers, all of whose operations lie close to Thetford Mines, the only other operator in the province is Baker Mining and Milling Company, 4010 St. Catherine Street, West, Montreal, with mine and mill near Highwater, in Potton township, Brome county, close to the Vermont boundary. This company's mill was completed in 1938, and it has since been proceeding with underground development of its deposit: most of the output has found a market with the roofing trade.

The talc market was exceedingly active during the year, consequent on heavy demand from Great Britain for rubber grades, to fill the deficiency caused by the cutting off of Italian, French, and Norwegian supplies. Operators found difficulty in keeping up with this demand, and even larger sales could have been made had adequate cargo space been available. British importers reported general grade of shipments well up to trade specification, and the Canadian material should now be well established in the British market.

Production of ground talc in 1940 was 15,166 tons, valued at $154,735, compared with 13,114 tons, valued at $128,595, in 1939. The output of soapstone was valued at $74,905, compared with $41,471 in 1939;

these figures cover both sawn furnace stone, crayons, and quarry and sawing waste sold for grinding, as well as, possibly, some sawdust from the cutting plants. Total value of production of all classes of talc and soapstone products was $229,640, compared with $170,066 in 1939, an increase of nearly $60,000, or 35 per cent.

Exports of talc products, mainly ground material but including also crayons, totalled 10,232 tons, valued at $142,577, compared with 7,185 tons, valued at $74,560, in 1939. Most of the shipments went to the United States and Great Britain.

Imports totalled 3,719 tons, valued at $66,238, compared with 3,193 tons, valued at $51,380, in 1939. Practically all of the material came from the United States.

Canadian ground talc or soapstone exported to the United States is dutiable at 17½ per cent ad valorem on material valued at not over $14 per long ton. On material valued at over $14 per ton, the duty is 35 per cent. Crude material pays one-quarter cent per pound, while cut soapstone or talc, in the form of bricks, crayons, blanks, etc., is dutiable at 1 cent per pound. Talc, ground or unground, enters Canada under the British Preferential tariff at 15 per cent ad valorem, and under the Intermediate and General tariff at 25 per cent: imports from the United States, however, are dutiable at 20 per cent.

Total world production of talc, including cut soapstone, steatite, and pyrophyllite (a mineral closely resembling talc and used for many similar industrial purposes), is on the order of half a million tons per annum. The leading producer is the United States, with 230,000 tons in 1939, a record high, followed by Manchuria, with over 100,000 tons. France and Italy both produce around 50,000 tons, Norway about 25,000 tons, and British India, 20,000 tons. Canada, in 1937, the latest year for which complete statistics are available, ranked eighth in production, but her output was less than 3 per cent of the total. Illustrating the leading position of the United States in the world talc industry, sales in 1939 totalled nearly 2-3/4 million dollars, with 35 producers distributed over 9 States, and a production nearly 2-1/2 times that of the second leading country, Manchuria. World talc consumption has shown a steady increase of over 40 per cent in the last decade.

Using United States consumption figures as an index of industrial uses for ground talc (including soapstone and pyrophyllite), the principal consuming trade in 1939 was the paint industry, with 27 per cent of the total. The ceramic industry followed, with 15 per cent, and the rubber, roofing, and paper trades each took 12 per cent. Toilet preparations accounted for 4 per cent, and foundry facings, 2 per cent. The remainder went into a variety of unspecified uses, including textile bleaching, insecticides, plasters, etc. Both talc and its alumina analogue pyrophyllite (see below), have been finding rapidly increasing ceramic uses, notably to eliminate crazing in wall and floor-tile, in electrical and other porcelain, in porcelain enamels, in dinnerware bodies, and in refractories.

Many grades of ground talc are on the market, and prices range between very wide limits. Value is dependent on purity (governing freedom from grit, slip, and colour), particle shape, and fineness of grinding, the specifications for which vary in the different consuming industries. Roofing and rubber talcs are the cheapest grades, these trades being satisfied with grey, off-colour material, often soapstone, such as produced in the Eastern Townships, Quebec, and selling at from $5 to $9 per ton, f.o.b. mills, according to fineness, which commonly ranges from 35 mesh to 150 mesh. Quotations on white, foliated, Madoc talc range from $30 to $21 per ton for the two best grades, to $17 for standard, and $8 for lowest-grade roofing grit. Imported superfine

Italian talc, cosmetic grade, has sold as high as $80 - $100 per ton, delivered eastern points. The average selling price of American talcs in recent years has been about $11 per ton, f.o.b. mines; the high-grade Californian talcs lead the market at $17 to $20, followed by New York, $11 to $19, with the off-colour Vermont, Georgia, and Virginia products ranging from $4.50 to $10. Lava steatite and crayon talc bring high prices, from $100 to $150 per ton, while at the other end of the scale are the coarser roofing granules, often largely talc-coated, gritty, air-separator rejects, which may sell as low as $4.

According to a report of the Dominion Bureau of Statistics, domestic ground talc consumption runs about 7,500 tons per annum. The roofing and paint trades each take about 2,500 tons, the pulp and paper trade about 1,000 tons, rubber and toilet preparations, each about 500 tons, while about 250 tons goes into soaps and cleansers.

PYROPHYLLITE. Pyrophyllite (hydrous silicate of alumina) is a mineral closely resembling talc in appearance and physical characteristics. It is difficult to distinguish from talc, even by microscopic means, and often requires chemical analysis for its identification. In the ground state, it can be employed for many of the industrial uses served by talc, and in United States mineral production returns is included under that mineral. It is, however, far less common, and commercial deposits are relatively scarce. Most of the recorded world production is derived from occurrences in North Carolina, where there is a growing pyrophyllite industry. A large part of the American output goes to the ceramic trade, the remainder being sold for filler purposes in various products. When fired, pyrophyllite does not flux, as does talc, and it has been found of value in a wide range of high-grade ceramic products, including refractories. A furnace-patching product made with pyrophyllite has recently been introduced under the name "Pyroplastic".

In addition to the North Carolina occurrences, important deposits are known in Newfoundland, from which some shipments have recently been made to the grinding mill of Clinchfield Sand and Feldspar Corporation, at Baltimore, Maryland. In Canada, some rather low-grade, sericitic pyrophyllite occurs at Kyuquot Sound, on the west coast of Vancouver Island: some 30 years ago a small quantity was shipped from these deposits for use in refractories and cleanser products, and recently some interest has been reported in the material as a possible substitute for china clay by Coast paper mills. Several occurrences of pyrophyllite in Quebec are recorded in early reports of the Geological Survey, but no development of them has ever been undertaken and little is known about their extent or economic possibilities.

Pyrophyllite in 1940 was quoted, unchanged, at $7.50 to $12 per ton, f.o.b. North Carolina mills, for 200-mesh and 325-mesh material, respectively.

(Note: A report "Talc, Steatite, and Soapstone: Pyrophyllite", publication No. 803, was published by the Bureau of Mines during the year, and copies may be obtained by application to the Director, Mines and Geology Branch, Department of Mines and Resources.)

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VERMICULITE IN 1940

There are five plants in Canada for the expanding by heat-processing of the hydrated variety of mica known as vermiculite, three of which are owned by Gypsum, Lime and Alabastine, Canada, Limited, and are located at Calgary, Alberta; Winnipeg, Manitoba; and Caledonia, Ontario. Duplate Safety Glass Company operates a plant at Oshawa, Ontario; and a fifth was installed in 1940 by F. Hyde and Company, Limited, at 5350 Connaught Avenue, Montreal West, Quebec. All of the plants draw their supply of crude vermiculite from a deposit at Libby, Montana. Vermiculite expands tremendously when heated, yielding an extremely light-weight product which is used widely in heat and sound-insulation and to some extent for decorative purposes.

Vermiculite, or rather the heat-expanded product, first came on the market about 15 years ago, when the Montana deposits were first developed, the material being given the trade-name "Zonolite". Commercial interest in the commodity was greatly stimulated as a result of the growing demand for house and acoustical insulation, and in recent years marked gains have been made in the output of crude vermiculite in the United States. In the four-year period, 1936-1939, sales averaged over 20,000 short tons a year, with an average value of about $200,000, aand in 1940 are reported to have reached a new high. Although the Montana deposits are the principal American source of higher-grade material, accounting for over 90 per cent of the production, deposits are now being worked in Colorado, Wyoming, and North Carolina. The crude cleaned and screened material is shipped to strategically-located expanding plants across the continent, which serve as centres for local distribution. This avoids excessive freight charges on the finished product due to its bulky nature, and degradation caused by break-down and packing in transit.

Vermiculite is essentially an American product, though occurrences have been reported in the Transvaal and Tanganyika, in Africa; in Western Australia; and in Russia. No important development of any of these deposits is known to have taken place as yet, but methods of processing the Transvaal material have been investigated in the laboratories of Witwatersrand University. Some American crude is exported for expanding to Great Britain and possibly to other countries. Improved demand for finer sizes, coupled with closer attention to preparation of crude, has recently resulted in an increased mine-yield from the Montana deposits, so that one ton of shipping products is now obtained from 2 tons of mine-run material.

No important occurrences of the mineral are known in Canada, though there have been unconfirmed reports of discoveries in the Albreda district, British Columbia. The occurrence of vermiculite seems to be restricted to areas of pyroxenite, in which the pyroxenite has been serpentinized and the phlogopite altered to vermiculite by acid intrusives. It is possible that vermiculite may be present in some of the similarly intruded mica-bearing pryoxenites of Ontario and Quebec.

The grade of crude vermiculite, based on its exfoliating properties, is distinctly variable in material from different sources, with resulting differences in the specific gravity, coherence, strength, and consequently in the insulating efficiency of the expanded product. The size of crude flakes is also important, the preference for house insulation being for plates about one-half an inch in diameter as they yield a product giving the maximum loose-fill packing quality. About 60 per cent of the total sales is estimated to be used for this purpose.

Increasing use is being made, however, of the formerly discarded finer sizes in different types of insulation; for fire-resistant and acoustical purposes; in light-weight plasters; in tile, cements, concrete, slabs, and coatings; and for decorative purposes in stucco and textural finishes. They are also being used in special refractories, such as those placed in the combustion chamber of oil-burning equipment.

A number of patented vermiculite products, compounded with gypsum, bentonite, asphalt, tar, wood-fibre, etc., are now on the market. Very fine vermiculite powder ("Mikolite") is being used as an extender in aluminium paints, and as a cooling and lubricating agent in automobile engines and transmission: its use has also been proposed as a substitute for graphite in oil-less bearings. Freshly-expanded vermiculite is stated to be a most powerful desiccant and an excellent source of adsorptive silica.

Crude, cleaned and screened Montana vermiculite sold in 1940 at $12 per ton, f.o.b. mine. The delivered cost, including freight and duty, laid down at eastern Canadian points is about $30 per ton. North Carolina crude was quoted at $9.50 per ton f.o.b. The retail price of expanded house-fill material on the American market has recently ranged from 90 cents to $1.35 per 24 pound bag of 4 cubic feet. Crude vermiculite weighs 60 pounds per cubic foot, or ten times the weight of the expanded product.

Crude vermiculite imports from the United States are subject to a duty of 10 per cent ad valorem, equivalent to $1.35 per ton.

ISSUED BY THE BUREAU OF MINES,
DEPARTMENT OF MINES AND RESOURCES,
OTTAWA, MARCH, 1941.

VOLCANIC DUST IN 1940

Deposits of volcanic dust (pumice dust) are found in Saskatchewan, Alberta, and British Columbia. The material is used mainly as the abrasive base in scouring and cleaning compounds, and a very small amount in acoustic plaster and concrete admixture. There has been intermittent production from Waldeck, near Swift Current, Saskatchewan, and from near Williams lake in British Columbia, but none since 1934, when 31 tons valued at $310 was produced from Waldeck.

Other deposits are known in Saskatchewan, namely, 5 miles north of Braddock; west of Beverley; near St. Victor, all of which are grey to buff in colour. Some stripping and prospecting was done during the year on a deposit of white volcanic dust overlain by bentonite 5 miles west of Rockglen. Laboratory experiments are being carried out by the University of Saskatchewan at Saskatoon, on the Rockglen and several of the other deposits of volcanic dust, and it is believed that as a result of such experiments, one or more of them may be put into production shortly. Several deposits occur in British Columbia, of which the purest known is a snow-white, fine-grained volcanic dust from the Deadman river, north of Kamloops lake; extensive beds of compact dust also occur in the vicinity north of Quesnel lake in the Cariboo, but there has been no production.

Imports are not separately recorded, but are grouped with a number of similar products -- pumice, pumice stone, lava, and calcareous tufa. Imports of these products in 1940 were valued at $35,631 compared with $29,314 in 1939.

In the United States, shipments of volcanic dust and pumice in 1939 (figures for 1940 not available) were 89,159 tons, valued at $424,780, about twenty companies being engaged in production. About 60 per cent of this output is used for cleansing and scouring compounds; 23 per cent for light weight concrete and aggregate; 6 per cent for acoustic plaster and the remainder for asphalt filler, road grading, chicken litter, filtering and insulating media, paint filler, floor sweep, dusting inside tires, and in abrasive uses such as glass bevelling, or polishing aluminium. During 1939 some of the United States volcanic dust was used in the manufacture of fireproff walls, building tiles and slabs, and in the refining of petroleum. The use of volcanic dust as a ceramic raw material has not been extensive in the United States, although its practicability has been indicated both by laboratory and industrial applications. In this connection it has been used successfully in some glazes, replacing feldspar.

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WHITING SUBSTITUTE IN 1940

Whiting substitute, as the name implies, is a material that may be used in place of chalk whiting, all of which originates in England or in Europe. Until 1940 all whiting substitute made in Canada was made from white limestone or white marble. In 1940 production of whiting substitute from white marl began by White Valley Chemicals, Limited, at Bobcaygeon, Ontario. Whiting substitute is used mostly in the manufacture of oilcloth, linoleum, in certain kinds of rubber products, in putty, and in explosives. In lesser quantities it is used in the manufacture of moulded articles, cleaning compounds and polishes, as a ceramic glaze, and for a number of other purposes.

The products made from white marble or white limestone are pulverized to various degrees of fineness ranging from 200 to 400 mesh, and the raw material used contains very little magnesium carbonate, though in the past a whiting substitute made from white dolomite was produced in eastern Canada for making putty.

The principal differences between whiting and whiting substitute made from marble or limestone are that the latter is usually whiter, has a low capacity for absorbing oil, and the individual particles are sub-angular rather than rounded.

Marl suitable for making whiting substitute should be white or nearly so, be nearly free from grit and clayey material, and have a very low content of organic matter. This last-named constitutent, which is present to some extent in all deposits of marl, renders the product unsuitable for use as a filler in products such as putty and paint where it will come in contact with oils. The oil-absorptive capacity of whiting substitute made from marl is usually greater than that of whiting but in other respects the physical characteristics of the two products are much the same.

Whiting substitute is manufactured by Pulverized Products, Limited, Montreal; by Claxton Manufacturing Company, Toronto; by White Valley Chemicals, Limited, Toronto; by Gypsum, Lime and Alabastine, Canada, Limited, Winnipeg; and by F. J. Beale, Limited, Van Anda, Texana Island, British Columbia.

Calcium 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 several years. Itsuse up to the present has been as a filler in newsprint and book paper, and its manufacture has been undertaken by the paper companies using it. Whiting substitute made from carefully processed white marl is said to be satisfactory for this use.

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 its usefulness is restricted by the fact that it almost invariably contains a small amount of free alkali. The raw materials for the manufacture of by-product precipitated chalk are available but it is not yet being made in Canada.

No separate record is kept by the Dominion Bureau of Statistics of the production, imports, and exports of whiting substitute, but the industry has experienced a steady growth in recent years because improvements in grinding equipment and the maintenance of close technical control have enabled a product to be marketed that is very consistent in both chemical and physical properties. Many manufacturers now use the domestic

product with entire satisfaction in place of imported whiting, and in the present situation when all European sources of whiting are cut off from the Canadian market because of the war the domestic industry is largely supplying the Canadian market. Prices per ton in carload lots range from $8.00 to $15.00 per ton f.o.b. plants in Eastern Canada.

There is little or no export of whiting substitute from Canada but a considerable quantity of specially processed whiting substitute is imported from the United States. Imports of chalk whiting in 1940 amounted to 13,648 tons valued at $186,517 compared with imports of 13,195 tons valued at $152,397 in 1939. These imports of chalk whiting originated in England.

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COAL IN 1940

The Marimtime Provinces of Nova Scotia and New Brunswick produced a considerable portion of the bituminous coals used in the Eastern provinces and at points as far westward as Toronto. Coal mining operations of the Prairie and Western Provinces produced coals ranging in rank from lignites to semi-anthracites, of which Saskatchewan and Manitoba produced lignite only.

The movement of coal from Nova Scotia on the St. Lawrence route has been restricted owing to shortage of shipping facilities. This reduction in tonnage was, however, compensated by an increase in rail haulage to the markets in Ontario and Quebec.

The programme for consolidation and development of the operations of the Dominion Steel and Coal Corporation, Limited, was continued with the opening of a new mine in the Gardiner Seam during October to replace the No. 10 Reserve Colliery, at which operations have been discontinued.

Improvement in methods of mining, together with increased mechanization, has tended to reduce costs of production and to off-set the increase in cost of equipment and the upward tendencey in wages. The continued improvement in methods of preparation has aided the expansion of the market for domestic stoker fuel. The increasing production of briquetted fuel in the Western Provinces is helping to remedy the over-production of fine slack.

The briquetting of carbonized lignite continued to meet with success in Saskatchewan and negotiations are in progress for expansion.

The practice of the Brazeau Collieries Limited of briquetting fine slack-coal for disposal by addition to screened lump-coal has aroused much interest and other western collieries have installed special equipment for adopting this method of disposal of slack.

The manufacture of briquettes from a mixture of coal with 30 per cent of coke breeze was continued by the British Columbia Electric Power & Gas Company.

The production of coal in Canada amounted to 17,551,326 tons valued at $54,638,476, compared with 15,537,443 tons valued at $48,315,224 for 1939. The distribution of this tonnage in comparison with the previous year, by provinces, is as follows:

Province	1940	1939	Per cent increase
Nova Scotia.....	7,848,186	7,051,176	11.3
Alberta.....	6,202,936	5,519,208	12.4
British Columbia.....	1,867,846	1,537,905	21.4
Saskatchewan.....	1,094,236	959,595	14.0
New Brunswick.....	536,345	468,421	14.5
Manitoba.....	1,777	1,138	56.0

The imports of coal into Canada totalled 17,546,107 tons, compared with 13,884,816 tons in 1939. The anthracite imporations totalled 3,964,862 tons, of which 66.7 per cent was of United States origin and 33.3 per cent was from Great Britain.

Bituminous coal imporations consisted of 13,578,705 tons mainly from the United States. A consignment of 213,364 tons of British bituminous coal, en route to France at the time of the collapse, was diverted to Canada and disposed of by the Coal Administrator.

Coal exports from Canada amounted to 504,898 tons, compared with 376,203 tons in 1939.

Canadian coal moved under Federal Government assistance amounted in 1940 to 3,008,289 tons at a cost of $4,315,589.83 or $1.43 per ton, compared with 3,403,581 tons at a cost of $4,092,399.26 or $1.20 per ton in 1939.

Assistance to the movement of coal, generally in the form of the reduction of freight rates, is provided by the Federal Government thereby enabling Canadian coal to compete on even terms in certain markets from which it would otherwise be excluded by competition from imported coals. The toal cost to the Government in subventions, from 1928 when this as asistance came into effect up to the end of 1940, on the movement of 22,644,193 tons, amounted to $23,715,903.81 or $1.05 per ton.

The licensing under the Wartime Prices and Trade Board was continued, obliging all engaged in the production and marketing of coal or coke to obtain a licence and to keep the Board informed on the movement and disposal of these fuels.

The work undertaken in the Fuel Research Laboratories of the Bureau of Mines, Department of Mines and Resources, during the year included the continuation of the programme for the Physical and Chemical Survey of Canadian coals, carbonization investigations for the improvement of manufactured coke, and studies of available coals for the development of new coking industries.

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OTTAWA, MARCH, 1941.

COKE IN 1940

Coke was produced for domestic and metallurgical use in diversified types of carbonization equipment, which included by-product coke-ovens; vertical chamber ovens for intermittent charging; sole-heated ovens of the type constructed at Michel, Alberta; gas retorts of the continuous vertical type; horizontal "D" retorts; beehive ovens of the early non-recovery type; and a special unit for the production of a low temperature char used in the carbide industry.

The increased demand by industry for metallurgical coke, and the further development of the domestic coke market, have resulted in an increase in production of approximately 25 per cent of coke from all sources. The bringing into production of a battery of sixty ovens increased the capacity of the plant of the Dominion Steel and Coal Corporation by 50 per cent, and the operation of other large coke plants of Eastern Canada at maximum capacity was the cause of this considerable increase in tonnage.

The Dominion Steel and Coal Corporation of Nova Scotia supplies coke for its metallurgical requirements and markets domestic coke, prepared by screening the smaller sized material from its entire production of coke.

The Montreal Coke and Manufacturing Company operated for the year at maximum capacity for coke production, using 35 per cent Canadian coal in the blends of coal processed.

Increased quantities of domestic coke were produced in the larger plants of Ontario, which include the Hamilton By-Product Coke Ovens Limited, the Steel Company of Canada, and the plant at Sault Ste. Marie. The Consumers Gas Company of Toronto produced coke for domestic use and for the gas-producer units operated by the company in about equal proportion. The Curran-Knowles plant at Owen Sound produced a satisfactory domestic coke, which was readily marketed.

In Manitoba, the Winnipeg Electric Company carbonized a blend of Canadian coals for the production of domestic coke, and the Brandon plant continued operations under the Manitoba Power Commission.

The manufacture of beehive coke for metallurgical use was continued at Coleman, Alberta, by the International Coal and Coke Company, and at Michel by the Crow's Nest Pass Coal Company. The latter Company also operated ten ovens for the production of Curran-Knowles by-product coke, which was marketed for metallurgical and domestic uses. The British Columbia Electric Power and Gas Company operated its Vancouver plant and the vertical retort plant at Victoria on Vancouver Island, for the production of city gas and domestic coke from Island coals.

The total production of coke from coal was 3,015,557 tons, compared with 2,410,095 tons in 1939. The production by provinces was reported as follows:

Province	1940	1939	Per Cent Increase
Eastern Provinces (N.S., N.B., & Que.)	1,040,900	802,072	29.8
Ontario	1,732,533	1,379,942	25.5
Western Provinces (Man., Sask., Alta., & B.C.)	242,124	228,081	6.1

The coal processed for the manufacture of coke amounted to 4,198,315 tons, of which 35 per cent was of Canadian origin. In addition, a small amount of petroleum coke was produced at the oil refineries amounting to 66,820 tons, compared with 63,375 tons in 1939.

The export of coke amounted to 35,523 tons compared with 48,114 tons in 1939.

The imports of coke were: Coke from coal 717,535 tons, and petroleum coke 185,334 tons, compared with 435,870 tons from coal and 147,690 tons from petroleum coke in 1939.

The normal expansion of the coking industry in Canada has been much accelerated by wartime demands and it is expected to become still more rapid with the progress of Canada's war effort.

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OTTAWA, MARCH, 1941.

NATURAL GAS IN 1940

Natural gas has been found in most of the provinces of Canada. It is produced commercially in large quantities in Alberta and Ontario, and in smaller quantities in New Brunswick, Saskatchewan, Manitoba and Quebec.

In Alberta, most of the production comes from the Turner Valley field, which supplies the cities of Calgary and Lethbridge and the adjacent districts. The Edmonton area is supplied from the Viking field about 80 miles southeast of the city. Medicine Hat is supplied from the field of the same name, Wainwright by the Fabyan field, and the town of Brooks from the field of the same name. During 1940, large gas flows were struck in Alberta in the Brazeau and Steveville areas.

In Saskatchewan, the eastern part of the Lloydminster field supplies the town of the same name, and plans are under way to pipe gas from this field to Saskatoon. Geophysical testing was carried out in several areas in Saskatchewan during 1940, and there was drilling activity in Lloydminster, Battleford, Kamsack, Bishopric and Little Pines.

In Ontario, natural gas is produced commercially only in the southwestern part of the province. The principal fields are Tilbury, Haldimand, Dawn, De Clute, Brownsville, Dover, Norfolk, Welland, Onondaga and Malahide. Gas from these fields is supplied by a network of pipelines to the principal cities and towns of southwestern Ontario. During 1940 there was considerable exploration in Norfolk county and further development of the Malahide field in Elgin county.

In Quebec, natural gas is produced in small amounts at several wells along the St. Lawrence river and is used locally.

In New Brunswick, the Stoney Creek field supplies the city of Moncton and the town of Hillsborough with natural gas.

The total production of natural gas in Canada during 1940 was 35,954,000 M cubic feet valued at $12,877,515, compared with 35,185,146 M cubic feet valued at $12,507,307 in 1939.

Exports of natural gas from southern Alberta to the United States for the twelve months ended March 31, 1940, amounted to 5,157 M cubic feet, compared with 316,000 M cubic feet in 1939. There were no exports from the Range field in 1940.

A relatively small amount of mixed natural and manufactured gas was imported. Imports in 1940 of gas for cooking, heating and illuminating were 130,342 M cubic feet valued at $91,976, compared with 114,396 M cubic feet valued at $75,380 in 1939.

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OIL SHALE IN 1940

Large deposits of oil shale are known to exist in different parts of Canada, the la rgest 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 exploration and to laboratory investigation. 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 shale.

For many years the large-scale production of oil shale was confined to Scotland, but deposits in Manchuria and Esthonia are now being developed on a large scale. The production of these countries in 1937 was: Scotland, 1,460,700 tons; Esthonia, 1,213,700 tons; and Manchuria, approximately 3,000,000 tons. Austria, France, Germany, Italy, Spain, Russia and South Africa also produce small quantities of oil shale.

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PEAT IN 1940

Peat is a combustible substance produced by the incomplete decomposition of vegetable matter either 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 on the nature of the vegetation which has contributed to its formation. Though many species of plants are found in peat bogs, the most prominent 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 is found in every Province of the Dominion.

(a) Peat Fuel

Small amounts of peat fuel have been produced intermittently from Quebec and Ontario bogs for several years. Bogs that have recently been operated are those at St. Arsene, in Quebec; at Galt, Gad's Hill, Grand Valley, Linwood, Morewood and St. Ann's in Ontario.

At the St. Arsene and Gad's Hill bogs the peat is put through macerators before being placed on the drying racks. At the East Luther bog near Grand Valley, operated by Industrial Compounds, Limited, the peat is excavated, using a suction pump capable of handling 1,400 gallons of peat pulp per minute; the pulp is piped to a settling tank having a peat-flow regulator, and the wet solids are afterwards piped to a series of level drying beds; the products made at this plant are peat fuel and fertilizer filler.

The sales of peat during 1939 (figures for 1940 not available) amounted to 445 tons valued at $2,445. The average annual output between 1932 and 1936 was about 1,800 tons.

Imports and exports of peat fuel are not separately recorded in the Department of Trade and Commerce reports.

(b) Peat Moss

During recent years a few peat bogs have been operated more or less continuously for the production of peat moss for use as litter for bedding for animals, soil conditioner for market gardens and horticulture filler for fertilizers, insulating material in the building trade and packing material. These include the bogs at Isle Verte, Riviere Ouelle and Waterville, Quebec; Grand Valley, Vars and Clinton, Ontario; at Cowan, Manitoba; at Melfort, Saskatchewan; at Edmonton West, Alberta; and near New Westminster, British Columbia. Insulating moss has been produced at Isle Verte, Clinton, Vars, Cowan, Melfort and Edmonton West. The fabricating plants at Isle Verte, Edmonton West and New Westminster produce a material known to the trade as "Spagmoss", "Mosstex" and "Westpeco". Mosstex is also produced as boards and Westpeco as pads for shipment of vegetables, mainly asparagus.

Litter is produced at Isle Verte, Riviere Ouelle and New Westminster. Humus, used for agriculture and as fertilizer filler, is produced at Alfred, Scarboro Junction, Erie, Brampton and Grand Valley in Ontario and at St. Stephen, New Brunswick.

The cessation of European supplies, due to the war, and the absence of suitable and conveniently situated domestic supply have opened up a market in the United States for at least 62,000 tons of peat moss, her total import from Europe in 1938, and this outlet is capable of further expansion if the moss can be offered on favourable terms. This has given the Canadian producers a splendid opportunity for increased trade in this article and during 1940 several new deposits were developed for the production of baled peat moss. They are those of the Canada Peat Company, with a plant consisting of two baling presses at Riviere du Loup, Quebec; the Erie Peat Company also with two presses at Welland; Kennedy Stinson, having one press at Alfred and the Arctic

Peat Moss Corporation, Limited, at Fort Frances, all in Ontario.

A plant is under construction near Galt, Ontario, for the production of "Humar" a mixture of peat humus and marl used in agriculture as a growth stimulant and soil conditioner. The production is planned on a fairly large scale.

The Newington bog is being developed for the production of dry humus and the Victoria Road bog for peat moss and dry humus.

Imports of peat moss during 1940 were 11 tons and cleaned, sized and ground mosses and grasses amount to 770 tons, compared with 354 and 1,057 tons respectively in 1939.

Imports of peat moss into the United States from Canada in 1939 (1940 figures not yet available) were 6,922 tons valued at $147,342, compared with 3,989 tons valued at $91,167 in 1938, as given by the U. S. Bureau of Mines.

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PETROLEUM IN 1940

Petroleum is produced commercially in Alberta, Ontario, New Brunswick and the Northwest Territories. Crude oils from the different localities range in quality from volatile naphtha to semi-solid bitumen.

The Turner Valley field, southwest of Calgary, Alberta, produces about 97 per cent of the total Canadian output of petroleum. This field, which until June 1936, had produced mainly gas and naphtha, was in that year extended towards the west and began producing crude oil of high quality having an average A.P.I. gravity of 43 degrees. Extension and development of the field have continued actively up to the present and at the close of 1940, 131 wells were producing crude oil and 24 others were being drilled. Thirty-five crude oil wells were completed in 1940 in Turner Valley. Of all wells drilled since the crude-oil development began, in 1936, only ten were completed as gas wells or abandoned. The field as it is now outlined has two principal producing areas. The larger of these is in the south and has a proved length of eight miles and an average width of one mile. Seven miles farther north is a second producing area about four miles long. In this area are a number of the most productive wells in the field and during 1940 ten more were drilled. The status of the intervening section is not yet definitely established.

Small amounts of crude oil were also produced in other localities in Alberta, namely, in Red Coulee, Wainwright, Vermillion, Del Bonita, Dina, Lloydminster and Moose Dome. This group showed a slight increase in production in 1940. In the McMurray field there was no commercial production of hydrocarbons from bituminous sand in 1940.

Petroleum is produced in southwestern Ontario at Petrolia, Oil Springs, Bothwell and in the townships of Dawn, Warwick, West Dover and Mosa. In New Brunswick the production comes from the Stoney Creek field about nine miles southwest of Moncton. In the Northwest Territories it comes from near Norman, about fifty miles west of Great Bear Lake.

In July of 1940 the crude oil requirement of refineries situated in the Prairie Provinces rose to more than 31,000 barrels per day, which was about 5,000 barrels per day more than the pro-rated allowable production of the Turner Valley field. The difference had to be made up by importation. This condition is to be corrected to some extent by additional storage but it indicates the need for discovery and development of new fields. A new refinery, having a crude oil capacity of 2,000 barrels per day, was erected at St. Boniface, Manitoba. Another important development during 1940 was the greatly increased demand for aviation fuel.

Tests were completed at a number of prospective producing localities in Alberta, namely, at the Blood Indian Reserve, Brazeau, Lloydminster, Steveville and Vermillion, and drilling or preliminary operations were in progress in several other areas including Black Diamond, Clearwater, Grease Creek, Mill Creek, Moose Dome, Pincher Creek, Pouce Coupe, Sheppard Creek, Spring Coulee, Taber, Twin River, and Willow Creek. Tests were also conducted in Saskatchewan at Bishopric, Kamsack, Lloydminster and Little Pines; in British Columbia at Commotion Creek; in Ontario near Collingwood and on Manitoulin Island; and in Quebec near York River in the Gaspé Peninsula.

Production of Petroleum in Canada

(Barrels of 35 Imperial gallons --42 U.S. gallons)

	1939	1940
Alberta.....	7,576,932	8,493,000
Ontario.....	206,379	186,000
New Brunswick.....	22,799	21,161
Northwest Territories.....	20,477	17,184
TOTAL	7,826,301	8,717,345

Production of Petroleum in Alberta, 1940

Turner Valley limestone.....	8,445,000
Turner Valley shallow crude.....	7,300
Red Coulee light crude.....	12,200
Wainwright heavy crude.....	7,500
Miscellaneous.....	21,000
TOTAL	8,493,000

Imports of petroleum and its products during 1940 were valued at $66,154,927. This total included 42,623,500 bbls. of crude petroleum imported for processing in Canadian refineries, compared with 37,095,000 bbls. in 1939. Of the total crude petroleum imported, 70 per cent was obtained from the United States, 21 per cent from Colombia, and 7 per cent from Venezuela, with small amounts from Peru and Trinidad. Imports of gasoline and naphtha amounted to 105,586,170 Imperial gallons valued at $7,010,250, 84.8 per cent of which was from the United States, 10.2 per cent from Trinidad, and 5 per cent from Peru. Exports of petroleum and its products from Canada during 1940 were valued at $971,131, compared with $848,558 in 1939.

Retail sales of gasoline in Canada in 1940 amounted to approximately 883 million gallons, compared with 805 million galls, an increase of 9.7 per cent over 1939. At the end of 1940 the extremes of listed prices of regular grade gasoline, less tax, were 21 cents per Imperial gallon at Brandon and Saskatoon and 14.5 cents at Halifax and St. John.

The world production of petroleum in 1939 (1940 figures not available), was estimated at 284 million barrels compared with 278 million barrels in 1938. The principal producers in order of magnitude of output were, United States, Soviet Union, Venezuela, Iran, Netherlands, Indies, Roumania, Mexico and Iraq. Canada occupies fifteenth place in order of output.

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