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DEPARTMENT OF MINES AND RESOURCES  
BUREAU OF MINES  
OTTAWA, CANADA.

THE CANADIAN MINERAL INDUSTRY IN 1943.

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# THE CANADIAN MINERAL INDUSTRY IN 1943

(By Staff, Bureau of Mines)  
Department of Mines and Resources  
Ottawa

## Product

## Author

### I - METALS:

* Aluminium	Buisson, A.
Antimony	Buisson, A.
Arsenic	Buisson, A.
Bismuth	Buisson, A.
Cadmium	Buisson, A.
Cerium	Buisson, A.
Chromite	Eardley-Wilmot, V.L.
Cobalt	Buisson, A.
Copper	Buisson, A.
Gold	Buisson, A.
Indium	Buisson, A.
Iron Ore	Buisson, A.
Lead	Buisson, A.
Magnesium (see Magnesite)	Goudge, M.F.
Manganese	Eardley-Wilmot, V.L.
Mercury	Eardley-Wilmot, V.L.
Molybdenum	Eardley-Wilmot, V.L.
Nickel	Buisson, A.
Platinum	Buisson, A.
* Radium and Uranium	Spence, H.S.
Selenium	Buisson, A.
Silver	Buisson, A.
Tantalite - Columbite	Spence, H.S.
Tellurium	Buisson, A.
Tin	Buisson, A.
Titanium	Buisson, A.
Tungsten	Eardley-Wilmot, V.L.
Zinc	Buisson, A.

### II - INDUSTRIAL MINERALS

Asbestos	Goudge, M.F.
Barite	Spence, H.S.
Bentonite	Spence, H.S.
Beryl	Spence, H.S.
Bituminous Sand	Ells, S.C.
Brucite (see Magnesite)	Goudge, M.F.
* Celestite	Spence, H.S.
Cement	Goudge, M.F.
Clay and Clay Products	Phillips, J.G.
Diatomite	Eardley-Wilmot, V.L.
Feldspar	Spence, H.S.
Fluorspar	Spence, H.S.
Garnet	Eardley-Wilmot, V.L.
Granite	Buisson, A.
Graphite	Spence, H.S.
Grindstones	Eardley-Wilmot, V.L.
Gypsum	Buisson, A.
Iron Oxides	Buisson, A.
Kaolin (see Clays)	Phillips, J.G.
Lime	Goudge, M.F.
Limestone (General)	Goudge, M.F.
Limestone (Structural)	Goudge, M.F.
Lithium Minerals	Spence, H.S.

Product

Author

II - INDUSTRIAL MINERALS (cont'd):

Magnesite and Brucite	Goudge, M.F.
Magnesium Sulphate	Buisson, A.
Marble	Goudge, M.F.
Mica and Vermiculite	Spence, H.S.
Moulding Sands	Freeman, C.H.
Nepheline Syenite	Spence, H.S.
Phosphate	Spence, H.S.
Pyrites	Buisson, A.
Salt	Buisson, A.
Sand and Gravel	Picher, R.H.
Silica	Buisson, A.
Sodium Carbonate	Buisson, A.
Sodium Sulphate	Buisson, A.
Sulphur	Buisson, A.
Talc and Soapstone	Spence, H.S.
Vermiculite (see Mica)	Spence, H.S.
Volcanic Dust	Eardley-Wilmot, V.L.
Whiting	Goudge, M.F.

III - FUELS:

Coal	Swartzman, E.
Coke	Burrough, E.J.
Natural Gas	Madgwick, T.G.
Oil Shale	Swinerton, A.A.
Peat	Leverin, H.A.
Petroleum	Madgwick, T.G.

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.

Asterisk (\*) indicates review not issued in 1943.

O T T A W A, April, 1944.

## ANTIMONY IN 1943

### Ores Mined and Producing Localities:

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 and of 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.

In Nova Scotia, a small amount of work was carried out on the antimony property at West Gore during 1943 by Antimony Mines Ltd. It consisted of surface prospecting, and some underground exploration. An old 45-foot shaft was deepened to 80 feet and about 35 feet of drifting was carried out. No ore was raised or milled.

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 1943.

In Quebec, no operations were reported in 1943.

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 is exported to the United States for further treatment, but no payment is received for the antimony. An antimony deposit at Gates Lake, in the vicinity of Lower Manitou Lake, Kenora district, and 50 miles north of Fort Frances, Ontario, was investigated in 1942 by F. Austin of Kirkland Lake. No work was reported in 1943.

In British Columbia, a small amount of prospecting was done on the Snow group of claims at the south end of Stuart Lake, near Fort St. James.

In Yukon, little or no prospecting was done in 1943, although in 1942 Walter McAlister tested antimony showings in the Wheaton River area, about 35 miles southwest of Whitehorse. The area is described in Memoir No. 31, Wheaton District, Yukon (1912), and also in the Summary Report for 1915, of the Geological Survey.

The production of high-grade electrolytic antimony began in 1938 at Trail, British Columbia. The antimony is recovered from flue dust, a by-product of Consolidated Mining and Smelting Company's silver refinery. Operations are carried on intermittently in accordance with the demand for antimony. 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 for the production of metallic antimony. The Bunker Hill smelter, Bradley, Idaho, operates a plant for the recovery of antimony in the form of antimony oxide and electrolytic

antimony. Menardi Metals Company operates a plant for the recovery of metallic antimony at Los Angeles, California. American Smelting and Refining Company produces antimony at its Perth Amboy plant in New Jersey and the metallic antimony produced is converted into antimonial lead and other products.

#### Production and Trade:

Canadian production in 1943 was 543 short tons valued at \$184,200, compared with 1,521 short tons valued at \$517,000 in 1942. Trade figures are not available for publication owing to the war.

The world production of antimony in 1938 (1939-1942 figures not available), as published by the United States Bureau of Mines, amounted to about 38,000 tons. The production in 1937 was 42,100 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. World production at present is probably in excess of 50,000 tons a year.

Most of the production of antimony has come from China, although Bolivia and Mexico have been important producers for years. In recent years, there has been a marked increase in output from Bolivia, Mexico, Yugoslavia, and Algeria and, to a lesser extent, 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. Prior to the war, most of the refined antimony was produced in the United States, Great Britain, France, and Belgium from ores of foreign origin.

Canada's requirements are now supplied mainly from the electrolytic plant at Trail, British Columbia.

#### Market and Prices:

Antimony is an important war metal. 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 increased considerably during the past two years. The principal compound is the oxide of antimony, which is employed extensively as a pigment in sanitary enamelware and nitro cellulose enamels.

The New York price of antimony metal (ordinary brand) in 1943 remained fixed at 16 cents a pound throughout the year. The price for Chinese brand, duty paid, remained at 16.5 cents throughout the year. The price of antimony ore, c.i.f. New York in 1943, per unit of antimony contained was; for 50 to 55 per cent Sb., \$2.10 to \$2.20; for 55 to 60 per cent Sb., \$2.15 to \$2.20; and for 60 to 65 per cent Sb., \$2.20 to \$2.30.

#### Tariff:

The United States tariff on antimony is: antimony as regulus or metal, two cents per pound; needle or liquated antimony, 1/4 cent per pound.

Prepared by A. Buisson,  
In the Bureau of Mines,  
Department of Mines and Resources,  
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## ARSENIC IN 1943

### Source of Supply:

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. At these two properties, baghouses to extract arsenic from the fumes of roasting plants used in the recovery of gold from arsenical concentrate have been installed.

The gold ores of Little Long Lac, Hardrock, and MacLeod Cockshutt in Little Long Lac area, Thunder Bay district, Ontario, contain arsenic, but no attempt is being made to recover the product.

In Saskatchewan, the Douglas Lake gold arsenical mine was taken over in 1943 by Newcor Mining & Refining Company which is endeavoring to finance the operation of the mine. The Bralorne and Hedley and other mines in British Columbia export arsenical gold concentrates to the United States.

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 the Cobalt area, northern Ontario, and the crude arsenic from the Beattie and O'Brien mines in western Quebec.

### Production and Trade:

The Canadian production of arsenic in 1943 was 5,523,400 pounds valued at \$258,176, compared with 14,967,874 pounds valued at \$652,041 in 1942 and 3,538,000 pounds valued at \$153,195 in 1941. Canadian trade figures are not available for publication owing to the war.

The world production is estimated by the U.S. Bureau of Mines at in excess of 80,000 tons, compared with 64,000 tons in 1939. Accurate production data are not available as some countries fail to record arsenic statistics and others give only sales or exports. The principal producing countries are: United States, Mexico, Sweden, France, Belgium, Australia, Japan, Brazil, and Canada.

### Market and Prices:

Arsenic is used chiefly in the manufacture of insecticides. It is also used in the preparation of weed killers, sheep and cattle dip, wood preservatives, and in the manufacture of glass, minor uses being in pigments, tannery supplies, and pharmaceutical preparations. Arsenic salts are used to replace creosoting in the preservation of wood. The use of arsenic to manufacture chemical warfare materials has notably increased its consumption. Calcium arsenate and, to a much lesser extent, lead arsenate are the arsenicals ordinarily used in insecticides. Paris green, which is a copper acetoarsenite, is also used as an insecticide. Magnesium

arsenate and manganese arsenate have also been used for this purpose. A considerable tonnage of white arsenic, in the form of crude arsenic or as sodium arsenite is used in the manufacture of weed killers. High-grade white arsenic is used in glass as a decolorizer, opacifier and refining agent. Small quantities of arsenic are used in the paint industry, as realgar or arsenic disulphide ( $As_2S_2$ ) and as orpiment or arsenic trisulphide ( $As_2S_3$ ).

Although the world consumption of white arsenic has varied greatly during the past ten years, the quoted price remained steady at  $3\frac{1}{2}$  cents a pound up to the middle of 1941. 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 normal demand, there seems to be little likelihood of any sustained increase in price. The New York price remained fixed at 4 cents a pound throughout 1942 and 1943. The Canadian price of white arsenic, as given by Canadian Chemistry & Process Industries, remained at  $5\frac{1}{2}$  to 6 cents a pound throughout 1943.

Prepared by A. Buisson,  
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## BISMUTH IN 1943

### Source of Supply:

Refined bismuth is obtained mainly as a by-product from the treatment of the lead-zinc ores of British Columbia and partly 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 1928 when it was erected.

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 to the United States for refining.

### Production and Trade:

Canadian production of bismuth in 1943 was 397,600 pounds valued at \$548,688, compared with 347,556 pounds valued at \$479,627 in 1942. 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, Peru, Canada, and Mexico, supply about 90 per cent of the world output, their order of importance as producers being as given. The remainder of the output is obtained from Argentina, Australia, Belgium, Bolivia, China, France, Germany, Japan, Spain, and other countries. 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 slime from the Betts electrolytic lead process is treated for its bismuth content. Bunker Hill and Sullivan Mining and Concentrating Company has operated since 1940 a plant for the production of refined bismuth obtained from the residues produced at the company's lead refinery at Kellogg, Idaho. The American production includes metal recovered from the refining of Mexican lead bullion, and from the treatment of ores imported for smelting and refining from South America, Central America, and Australia, also a small quantity of lead-bismuth bullion imported from Canada. The Cerro de Pasco Copper Corporation imports large quantities of bismuth and bismuth-lead alloy, mainly from Peru, and is the largest supplier of bismuth alloys.

For more than half a century Bolivia was the principal source, but in recent years its production has decreased considerably.

### Market and Prices:

The demand for bismuth increased considerably during the war period owing to its greater use in metallurgical and pharmaceutical

applications. 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. 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. Alloys containing bismuth are used to a greater extent than formerly in the aircraft, machine tool, munitions, and other industries. Additions of 0.1 to 1.5 per cent bismuth to stainless steel, copper and aluminium alloys improve machinability. There are numerous alloys of bismuth containing from 33 to 56 per cent bismuth.

The price of bismuth in 1943 (London price in Canadian funds) remained at \$1.38 a pound. The price at New York remained fixed at \$1.25 a pound throughout 1943. The American product is protected by a duty of 7½ per cent ad valorem. For several years the price has been well controlled.

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## CADMIUM IN 1943

### Source of Supply:

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.

### Production and Trade:

Canadian production of cadmium in 1943 was 776,442 pounds valued at \$892,908, compared with 1,148,963 pounds valued at \$1,355,776 in 1942. Trade figures are not available for publication owing to the war.

The world production is estimated at 7,500 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.

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.

### Market and Prices:

Cadmium is used mainly in electroplating and in the manufacture of alloys and compounds. The most common use of cadmium is as a protective coating for steel, and to a much lesser extent for copper alloys. The use of cadmium alloys in automobile bearings and for solders has created a strong demand for the metal. Cadmium is used also in the arts, paints, ceramics, and dyeing etc. In the United States, the consumption of cadmium is distributed approximately as follows: electroplating 87 per cent; alloys and solders 7.5 per cent; pigments and chemicals 5.5 per cent. 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 1943 (in Canadian funds) averaged \$1.15 a pound, compared with \$1.18 in 1942. The price of metallic cadmium, f.o.b. New York, in commercial sticks remained at 90 cents a pound throughout 1942 and 1943. 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.

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## CERIUM IN 1943

### Source of Supply:

Cerium is obtained from monazite, a monoclinic phosphate of cerium metals containing about 32 per cent cerium oxide ( $\text{Ce}_2\text{O}_3$ ) and up to 18 per cent thoria ( $\text{ThO}_2$ ). Monazite is distributed widely in igneous rocks throughout the world, especially in gneisses that have been intruded by pegmatites, but usually it forms only a small fraction of one per cent of the containing rock and only the natural concentrations in stream gravels and beach sands have paid for exploration. The chief commercial sources of monazite sand are beach deposits in Brazil and India. There are a few occurrences of monazite in Nova Scotia, Quebec, and British Columbia, none of which are of commercial interest. It is usually found as small crystals in granites and pegmatites in the Canadian Shield and small quantities occur in association with the black sands of the Quesnel River, Lillooet district, British Columbia. In the United States there are commercial deposits in Carolina, Florida, and Idaho, and known occurrences in many other States.

World production of monazite is approximately 5,000 tons a year.

Cerium is usually regarded as belonging to the general group of "rare earths", as it invariably occurs in nature associated with the other 14 members of the group and is very similar to the other rare-earth elements in many of its chemical properties.

### Market Conditions, Uses, and Prices:

Thoria, which was used in gas mantles, was formerly the only commercial constituent of monazite and monazite is still marketed on the basis of its thoria content, although its content of ceria ( $\text{Ce}_2\text{O}_3$ ) and of other rare-earth oxides is of chief interest at present. Probably 50 per cent of monazite derivatives are consumed, chiefly as fluorides, in the cores of arc carbons to increase lighting intensity in searchlights, motion-picture projectors, and therapeutic lamps. About 25 per cent of the consumption of monazite derivatives is used in pyrophoric (sparking) alloys or in ferro-ceriums for use in sparking flints for lighters. The remainder is used for a variety of purposes, but principally for making optical glassware. Cerium metal is used in the evacuation of radio tubes.

Nominal prices for monazite as given by Metal and Mineral Markets, New York, remained at \$60 per short ton, 8 per cent minimum thoria, throughout 1943. No quotations are published for most of the rare-earth products, although prices for small lots may be obtained on request from mineral dealers and chemical manufacturers. The average value of cerium alloys imported from Canada into the United States in 1942 was \$5.50 a pound compared with \$4.50 in 1941.

Prior to the war the leading producers of rare-earth products for the European market were located in Berlin, London, and Paris, and those for the American market, in Chicago. In the United States the present supply of cerium products is provided by Cerium Metals Corporation, Niagara Falls, N.Y.

In Canada, Shawinigan Chemicals, Limited, Shawinigan Falls, Quebec, has been producing cerium products from cerium chloride since 1940. The output is sold to Cerium Company, Limited of Montreal, for the manufacture of sparking flints.

(Part of the information for this review was abstracted from publications of the U.S. Bureau of Mines).

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## CHROMITE IN 1943

The most notable feature of the year in reference to chromite was the marked improvement in the Allied supply situation. As a result of this improvement Canada is no longer experiencing difficulty in meeting its requirements.

### Ores Mined and Producing Localities:

Pure chromite ( $\text{FeCr}_2\text{O}_4$ ) 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 ore usually occurs in dunite bands in serpentine rocks. Fresh dunite is a fine-grained, dark grey-green olivine rock. Chromite is 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.

Shipments were made by nine producers, all in the Eastern Townships of Quebec, the largest of which are Chromite Limited near St. Cyr, 30 miles north of Sherbrooke, and Wartime Metals Project at Chromeraie, near Black Lake. Shippers of high-grade crude ore direct to consumers were Orel Pare, who worked the Montreal pit, Coleraine township, range II, lot 25, under contract for Union Carbide (U.S.A.); Chrome Association, Limited, from the old Greenshields mine, Coleraine township, Block A; and La Bonté and Metevier, from the Hall or Thetford mine, Coleraine township A, lot 16. The last three also shipped lower grade custom ore to the Chromeraie mill, other shippers to Chromeraie being: Messrs. Ward, Pharo and Labbé from Coleraine, range X, lot 7; Messrs. Harvey and Paradis (Chrome Ore Limited) from Coleraine, range X, lot 8 (adjoins Ward); Asbestos Corporation, from its B.C. mine, Thetford mines; L. Gagnier from the Gray prospect, Coleraine township, range A, lot 17. All the above shippers, except Chromite Limited, are in the Black Lake district and are from one to five miles from Chromeraie. Production was maintained from deposits that were operated prior to and during the last war.

### Important Developments and Prospective Producing Localities:

The two outstanding developments were the full scale operations of Chromite Limited, and of Wartime Metals Corporation.

Chromite Limited maintained steady production from the old Sherrett mine in Cleveland township, range X, lots 7 and 8. During the last war about 15,000 tons of crude ore and concentrate from this property were sold. The chromite occurs as fairly uniformly disseminated zones scattered through which are plums of the massive mineral. The ore zone, which has been subjected to considerable minor faulting and is cut by granite dykes, has been traced on the surface for about 1,700 feet and varies in width from 5 to 20 feet. It has been developed on four levels to a depth of 380 feet and ore was found 100 feet lower by diamond drilling. Sinking to the fifth and possibly to the sixth level is being considered. Production was started in the 100-ton mill early in 1942 and its capacity was increased to 150 tons late that year. Over 54,000 long tons of about 18.0 per cent  $\text{Cr}_2\text{O}_3$  ore were treated during 1943 and the production of 48.0 per cent  $\text{Cr}_2\text{O}_3$  concentrate was appreciably higher than the total output from the property during the last war. Most of the shipments went to the United States under contract with the Metals Reserve Company. Financial and other assistance was rendered by the Dominion Government.

Wartime Metals Corporation, a Crown company, is operating the old Reed-Belanger deposits at the west end of Caribou Lake, two miles southwest of Black Lake. About 100,000 tons of ore and concentrate was shipped from this property during the last war, which is now known as the Chromeraie project. The ore is chiefly low-grade, banded and disseminated chromite with a small amount of the massive mineral. The zone has been traced intermittently for 2,000 feet and has an average width of 30 feet and in places is 60 feet wide. The

ore is being extracted by caving methods to a present depth of 375 feet. A small amount of diamond drilling has indicated that the ore extends to a depth of at least 440 feet. Production started in May, 1943, in the new 600-ton mill and nearly 80,000 tons of about 8.0 per cent  $\text{Cr}_2\text{O}_3$  ore was treated by the end of the year from which concentrate of 47 to 48 per cent  $\text{Cr}_2\text{O}_3$  was regularly shipped to Canadian consumers. In addition, about 3,000 tons of custom ore averaging 18.0 per cent  $\text{Cr}_2\text{O}_3$  was purchased from seven local shippers. More than half the custom ore came from Union Carbide Company's 'Montreal' pit, five miles to the southeast of the Chromeraine project. The pit is operated by Orel Paré, who also made substantial shipments of higher grade crude ore direct to a Canadian consumer. The old workings were re-opened in the fall of 1941 and since then regular monthly shipments have been maintained. The deposit was first opened 50 years ago and 20,000 tons was shipped from it during the last war. From the fall of 1941 to the end of 1943 a total of about 10,000 tons of ore was shipped.

Prospecting within 12 miles of Black Lake was carried out at the old Stewart mine; on Mount Brousseau near Disraeli station; and at the Sunday Lake mine near Breeches Lake.

Work was discontinued in November, 1942, on the Webster Lake deposits in the Sherbrooke area, owned by H. Bruce Fletcher. No large bodies of chromite similar to those in the Black Lake or St. Cyr areas, have yet been discovered. Some prospecting was done in the Gaspé Peninsula by Mount Albert Mining Company in Courcellette township. The diamond drilling of small areas of high-grade chromite near the top of Mount Albert disclosed no deposits of commercial interest. Exploratory drilling near Port Daniel on the south Gaspé shore, as well as prospecting a few miles west of Lake Matapédia in Awantjish township, were likewise unsuccessful.

The chromite areas of the Eastern Townships of Quebec were investigated by C.H. Stockwell and J.W. Ambrose of the Dominion Geological Survey during 1941 and 1942. A paper by Stockwell entitled "Chromite Deposits of the Eastern Townships, Quebec", appeared in the February 1944 edition of the Canadian Mining & Metallurgical Bulletin (pages 71-86).

In Manitoba, large bodies of low-grade chromite deposits were discovered early in 1942 north of Bird River in the southeastern part of the Province. The chromite occurs in alternate narrow bands of high- and low-grade ore and various zones have been traced for lengths of several thousand feet. The run-of-mine ore ranges between 15 and 20 per cent  $\text{Cr}_2\text{O}_3$ , but it is complex and high in iron and an economical method of bringing the chrome-iron ratio to within market requirement has not yet been devised. Many claims have been staked and drilled by Hudson Bay Exploration Company, God's Lake Gold Mines, Gunnar Gold Mines, Central Manitoba Mines, Stanmore Mines, and others. Late in 1943 Hudson Bay Exploration Company formed a subsidiary, Manitoba Chromium, Limited to work the Page claims and although no development is intended in the near future, research on the treatment of the ore is being continued. Diamond drilling is being done by Stanmore Mines, Limited on some recently discovered showings near Maskwa Lake, 16 miles north of Bird River; and Gunnar Gold Mines, Limited is exploring showings at Euclid Lake to the northeast.

In British Columbia, during 1942 and 1943, a number of chromite deposits were examined by geologists of the Federal and Provincial Departments of Mines. A deposit at Rock Creek, Greenwood Mining Division, was found to be too small to warrant development. Six samples ranging from 30 to 35 per cent  $\text{Cr}_2\text{O}_3$  from different parts of the Rock Creek claims were shipped to the Bureau of Mines, Ottawa for test, but although a 48 per cent concentrate can be made, the iron content was too high. An examination of a deposit on Mitchell Mountain in the Manson Creek area in north-central British Columbia indicated fair possibilities. There was no production from the

Province during the year and prospecting for chromite appears to have ceased.

#### Production and Trade:

Canadian production in 1943 reached a record of 30,290 short tons and shipments 29,551 tons, valued at \$918,935, mainly 47 to 48 per cent  $\text{Cr}_2\text{O}_3$  concentrate. The former peak was 24,000 tons shipped in 1917. Shipments in 1942 were 11,355 tons. From 1886, when records were first kept, until the end of 1943, Canada produced 216,000 tons of chromite, all of which, except about 5,000 tons, was from the Eastern Townships of Quebec, mainly from the Coleraine district. During the last war and in the two succeeding years, the total output of high-grade ore and concentrate amounted to 93,000 tons.

Canadian consumption in 1943 was 131,276 tons, a 29 per cent increase over that of 1942.

About 48 per cent of the total imports of nearly 112,210 tons came from Africa, mainly from Rhodesia; 29 per cent from India, which included some refractory ore purchased by the Government; and 23 per cent from the United States, mainly from Montana.

Canadian production of ferrochrome and other chrome addition agents was about 47,000 short tons, an increase of 40 per cent over that of 1942.

The world annual production of chromite just prior to the present war was about 1,300,000 tons. Russia, Turkey, Southern Rhodesia, and the Union of South Africa were each producing 200,000 tons or more a year, and the Philippines, Cuba, New Caledonia, Yugoslavia, Greece, and India 50,000 tons or more each. Russian production comes mostly from the Saramov district of the Ural Mountains. In Southern Rhodesia, production is now believed to be in excess of 300,000 tons a year, the chief sources of supply being in the Selukwe district and along the Great Dyke seam stretching for 70 miles north of Darwindale. Production from the Union of South Africa in 1942 is believed to have more than doubled the 1939 output of 160,000 metric tons, but it decreased in 1943. The principal mines are in the Kaapmuiden and Rustenburg areas of Transvaal. Turkey is one of the most important sources of high-grade chromite and in recent years much of the ore has come from the Guleman mines in Eastern Anatolia. The ore is lumpy and of good metallurgical grade (49 to 52 per cent  $\text{Cr}_2\text{O}_3$ ), low in silica, and has a chrome-iron ratio of three to one. Until recently much of Germany's chrome requirements came from Turkey. In Cuba, the output in 1939 was about 60,000 metric tons but is believed to have increased about fivefold since then. The ore, which occurs along the northern coast, is mainly refractory grade averaging 31 per cent  $\text{Cr}_2\text{O}_3$  and the entire output is shipped to the United States. Deposits in New Caledonia, which is about 700 miles off the east coast of Australia, are exceptionally high grade. The Tiebaghi Dome Mine in the north of the Island is one of the largest and richest chromite mines in the world, shipments averaging over 55 per cent  $\text{Cr}_2\text{O}_3$  and production is estimated at over 75,000 tons annually. Greece, prior to the war, was producing about 50,000 tons of 37 to 40 per cent refractory grade, most of which came from Thessaly. In British India, the States of Mysore and Baluchistan are the principal sources of supply, the total annual output being about 50,000 tons. Exports to Canada of 50 per cent metallurgical ore increased considerably in 1943. India is also the principal source of refractory ore used in Canada, the grade being 47 per cent  $\text{Cr}_2\text{O}_3$  and 4 per cent silica.

In the United States, annual production is considerably in excess of the former peak of 92,300 tons in 1918. More than half the total comes from Montana, production from which State started in 1942. The principal deposits, in Stillwater county, are being operated by Anaconda Copper Company for the Government, and the second

largest chromite operation in the United States, also in Montana, is U.S. Vanadium Corporation's deposit near Red Lodge in Carbon county. Besides California, which until recently was the leading State, production is also obtained in Oregon, Idaho, and Washington States. The United States imports chromite mainly from Africa, Turkey, Cuba, and New Caledonia.

#### Uses:

Chromium is one of the principal alloying elements in a great variety of steels, chief of which in the amount of chromium used are the highly important stainless and corrosion-resistant steels. It is the vital ingredient with nickel and molybdenum in the making of armour plate, armour-piercing projectiles, and high-speed tool steels, and is used as a hard, toughening element in tank axles and frames, in aeroplane parts and in other essential war materials. Chromium is also used in some types of cast iron and in nonferrous alloys. The ore is usually converted into ferrochrome before being added to the steel bath. Large quantities of chromite, with certain specifications as to physical and chemical properties are used in the making of refractories. Chromite is the source of such chemicals as sodium and potassium chromates. It is also used in the electroplating, dyeing, tanning, and paint industries.

#### Specifications:

Until recently, metallurgical chromite had to contain a minimum of 48 per cent  $\text{Cr}_2\text{O}_3$  and a chrome-iron ratio of not less than 3 to 1. Basic ceiling prices are for ores of this grade and ratio, but ores as low as 40 per cent  $\text{Cr}_2\text{O}_3$  and 2 to 1 ratio are acceptable at lower prices. When possible, lower grade ores are mixed with those of the highest grade, the proportion depending upon whether the ferrochrome produced is to be used for low- or for high-carbon steels. The maximum allowance for sulphur is 0.5 per cent and for phosphorus 0.2 per cent. Although lump ores are preferred, fines and concentrates are used in quantity and in some instances they are briquetted before use. The low iron content of the ore or concentrate is of the utmost importance.

Specifications for refractory ore suitable for bricks depend upon the kind of brick to be made. A Canadian manufacturer indicates maxima allowances of 25 per cent  $\text{Fe}_2\text{O}_3$ , 18 per cent  $\text{Al}_2\text{O}_3$ , and 4 per cent  $\text{SiO}_2$ . The silica should be as low as possible and it usually occurs in the ore as serpentine, a hydrated magnesium silicate, having a comparatively low melting point. The chromite should be present in an evenly and finely distributed form, not as coarse grains mixed with blobs of the silicate. The ore should be hard and lumpy, and the lumps should be plus 12 mesh. Provided the impurities are within the above specifications, the  $\text{Cr}_2\text{O}_3$  content may vary within certain limits, but it is generally over 40 per cent.

Standard grades of ferrochrome contain a minimum of 60 to 70 per cent chromium and are produced in two grades, one being high (4 to 6 per cent) in carbon and the other low (less than 2 per cent).

#### Concentration:

Most Canadian chromites are relatively free from heavy sulphides and can be concentrated by ordinary gravity methods. High iron or magnetite-chrome ores must undergo a preliminary roasting or straight magnetic separation, which is often followed by leaching. Some success has been achieved by the "Sink and Float" method on low-grade ores crushed to a relatively coarse mesh. At present prices, it is doubtful if an ore with less than 8 per cent  $\text{Cr}_2\text{O}_3$  could be treated profitably.

Chromium Mining and Smelting Corporation, Sault Ste. Marie, Ontario, produces an addition agent known as Chrom-X, and exothermic alloying agent compounded with chromium and silicon. High- and low-carbon Chrom-X products are on the market.

Market Conditions and Prices:

The principal Canadian buyers of chromite for metallurgical use are: Chromium Mining and Smelting Corporation, Sault Ste. Marie, Ontario, and Electro-Metallurgical Company of Canada, Welland, Ontario. The only important purchaser of refractory ore is Canadian Refractories Limited, Canada Cement Building, Montreal, Quebec. The types and grades of ore acceptable to these buyers are indicated under "Specifications".

Canadian prices for high-grade ores are based upon the United States ceiling price, which is \$43.50 per long ton at seaboard for ore containing 48 per cent  $\text{Cr}_2\text{O}_3$  with a chromium-iron ratio of 3 to 1; plus or minus 90 cents per long ton unit of 22.4 pounds of contained  $\text{Cr}_2\text{O}_3$  above or below 48 per cent; plus or minus \$1.25 for each 0.1 chromium-iron ratio above or below 3 to 1, the limits being 3.5 to 1 and 2 to 1. The price at a Canadian mine at Black Lake in the Eastern Townships of Quebec would, for example, approximate to this basic ceiling price; plus freight of \$2.28 from seaboard to Niagara Falls (near a Canadian consuming centre); plus exchange at 11 per cent to convert into Canadian funds; less \$5.12 freight from Black Lake to Niagara Falls. For a 46 per cent  $\text{Cr}_2\text{O}_3$  ore with Cr-Fe ratio of 2.8 to 1, this price per long ton at Black Lake would thus amount to about \$43.50, less penalties of \$4.30, plus freight of \$2.28, plus \$4.56 exchange, less \$5.12 freight, or to about \$40.83 in Canadian funds; a 48 per cent ore would be about \$42 a long ton. Prices of other grade ores can be obtained from the Metals Controller, Ottawa.

United States prices of ferrochrome delivered on contracts are as follows: high-carbon ferrochrome, 66 to 70 per cent chromium and 4 to 6 per cent carbon, 13 to 14 cents a pound; and low-carbon ferrochrome, 67 to 72 per cent chromium and 2 per cent carbon, 19½ cents, and 0.1 per cent carbon, 22½ cents a pound of contained chromium.

Prepared by V. L. Eardley-Wilmot,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, March, 1944.



## COBALT IN 1943

### Ores Mined and Producing Localities:

Most of the cobalt produced in Canada has come from the mining camps at Cobalt, Gowganda, and South Lorrain, in northern Ontario. In the early years of these camps, it was obtained mainly as a by-product of silver mining, but activity in recent years has been mostly in the production of cobalt ores, with silver as a by-product. Production from the Cobalt and nearby areas has been maintained in recent years by lessees working over old surface dumps and mining narrow surface veins and old underground workings. Cobalt ore is also being produced from a property at Werner Lake about 40 miles north of Minaki, Ontario, and 15 miles east of the Ontario-Manitoba boundary. There are some cobalt occurrences in British Columbia, but there is no production as yet from that Province.

The Timiskaming Testing Laboratories, at Cobalt, are a great help to many small lessees in the Cobalt camp and adjoining areas who depend on the plant for the sampling, valuation, and frequently for the marketing of their ores.

Cobalt Products, Limited, Cobalt, has been operating a concentrating plant since 1938. In August, 1943, its holdings were taken over by Silanco Mining and Smelting Company. The ore comes from various surface dumps and also from the underground workings of a few properties. The flotation concentrate, which contains from 8 to 12 per cent of cobalt, is sold directly to Deloro Smelting and Refining Company, agent for the United States Metals Reserve Company.

The only custom mill in Cobalt is the old O'Brien 100-ton mill, now owned and operated by C. V. J. O'Shaughnessy.

Deloro Smelting and Refining Company, Limited, has the only plant in Canada that treats ores for the recovery of cobalt. The plant is located at Deloro, Ontario, and produces cobalt metal, oxides, and salts, chiefly for the British market. For the past two years, the company has been treating cobalt residues from Africa and has processed little or no Canadian ores. The Canadian production of cobalt ore in 1943 was purchased by Deloro Smelting and Refining Company as agent for the Department of Munitions and Supply, acting for Metals Reserve Company of the United States, and was stockpiled for this account.

In the United States, most of the cobalt produced is obtained from cobalt residues imported from Africa. These are converted to metal at Niagara Falls, N.Y., and to oxide at New Brighton, Wilmington, and Canonsburg, in Pennsylvania, and at Cleveland Ohio.

### Production and Trade:

Canadian production of cobalt in 1943 was 169,687 pounds valued at \$186,655, compared with 83,871 pounds valued at \$88,444 in 1942.

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 India, French Morocco, and Canada. Other producing countries are Australia, Japan, Germany, and Russia.

### Market and Prices:

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 or stellite-type alloys, which contain 45 to 50 per cent cobalt, 30 to 37 per cent chromium, and 12 to 17 per cent tungsten. There are various modifications of this composition, but all contain high percentages of cobalt. Stellite is used for cutting metals at high speed and for making permanent magnets. The use of stellite continues to spread and it is 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 certain amount of cobalt is used in electroplating and 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 paints and varnishes.

Consumption of cobalt, chiefly in the production of high-speed cutting tools and permanent magnets, increased substantially during the past two years.

The market for cobalt is uncertain at present and will remain so until the Metals Reserve Company in Washington decides on what is to be done with the surplus stocks that have been built up.

The price of cobalt has remained fairly steady in recent years. The nominal New York price for cobalt metal remained at \$1.50 a pound and for black oxide in 350-lb. lots, at \$1.85 a pound, throughout the year. The nominal price for cobalt ore, 10 per cent grade, f.o.b. cars, Ontario remained at \$1.10 a pound of cobalt.

Prepared by A. Buisson,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, March, 1944.

## COPPER IN 1943

### Ores Mined and Producing Localities:

Canada's output of copper is obtained from the copper-nickel ores of Sudbury, Ontario; the copper-gold, copper-zinc, and the copper-pyrites ores of western Quebec; the copper-zinc ores of northern Manitoba; and the copper ores of 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. Part of the pyrites concentrate was shipped to the acid plant at Nichols Chemical Company at Barnet, B.C., and the remainder was exported. Development work below the 4,100-foot or bottom level was continued. The No. 7 shaft serving the 2,200-foot down to the 4,700-foot or bottom adit level was completed and the hoist was installed and placed in operation. The No. 8 shaft, which will handle the ore from No. 8 orebody, was sunk from the 4,100-foot level to a point 35 feet below the new 5,250-foot level, the bottom being approximately 900 feet below sea level. The 4,100-foot level, which is the main haulage level, is at the elevation of the mill bin and is connected with the Victoria shaft distant 20,000 feet from the portal. Under the terms of a contract entered into in 1942 with Wartime Metals Corporation, a Crown company, Britannia Mining and Smelting Company is guaranteed against loss in the sale of its products.

The Granby Consolidated Mining Smelting & Power Company's production in 1943 approximated 72 per cent of its 1942 output. The copper concentrate was shipped to the American Smelting & Refining Company's Smelter at Tacoma, Washington. All of the 1943 production was sold to Wartime Metals Corporation. Ore reserves at December 31st, 1943, showed an increase in tonnage over the reserves at the beginning of the year, but this increase was offset by a decrease in the estimated grade of the shipping ore. The reserves are estimated at 17,341,000 tons of 1.2 per cent copper, adequate for 9½ years on the basis of operation at the rate of 5,000 tons a day.

The Tye zinc-lead-copper property near Chemainus, Vancouver Island, was taken over in 1942 by Twin "J" Mines, Limited, a subsidiary of Jason Gold Mines, Limited, and is being operated by that company under the supervision of Wartime Metals Corporation. The mine, which commenced production in July, 1943, is equipped with a 150-ton mill. The concentrates (zinc, lead, and copper) are sold under contract to Metals Reserve Company, a war purchasing agency of the United States Government.

At Flin Flon, Manitoba, Hudson Bay Mining and Smelting Company, Limited, operated its mine, concentrator, copper smelter, and zinc plant at an increased capacity. Major development and exploration work were behind schedule as a result of labour shortages and the necessity of diverting manpower to maintain maximum ore production. The South Main shaft was completed to the 3,250-foot level. Diamond drilling or "blast hole" drilling has largely replaced air machine drilling for stoping mining. Work in the open pit was confined mostly to the mining of benches and floor pillars. The concentrator treated an average of 6,140 tons a day, compared with 4,710 in 1939. The copper recovery in the form of blister copper was 46,180 tons, compared with 26,430 tons in 1939. In addition 2,200 tons of copper were obtained from the treatment of custom ores.

Emergency Metals, Limited, a subsidiary of Hudson Bay Mining and Smelting Company, was organized in 1942 as a war measure to mine the remainder of the orebody at the old Mandy mine. The new 200-ton mill was put in operation in April, 1943, and operated at capacity during the rest of the year. The shaft was unwatered to the 825-foot level. An active exploration campaign was carried on, but results so far are reported to have been disappointing.

Cuprus Mines Limited, controlled by Hudson Bay Mining and Smelting Company, organized in 1943 to acquire the Thompson copper-zinc

was

property and various adjoining claims at Schist Lake. The property was extensively drilled in 1942 and a detailed geophysical survey of one of the most favourable areas was made in 1943.

Sherritt Gordon Mines, Limited operated its mines and mill at capacity and the tonnage milled reached a new record. Sixty-five per cent of the ore mined and milled came from the West mine and 35 per cent from the East mine. In the West mine, No. 2 winze from the 8th level was completed and stations were cut at the 9th and 10th levels at vertical depths of 150 feet and 300 feet respectively below the 8th level. The winze was sunk on a 20-degree incline following the dip and rake of the bottom of the West orebody. A considerable amount of lateral development work was done on these two levels. In the East mine development was greatly curtailed from the spring to the fall of the year owing to the shortage of underground labour.

In Ontario, International Nickel Company of Canada, Limited operated its mines and plants during the first half of 1943 at capacity. During the latter half of the year it was found necessary to shut down two of the four blast furnaces at the Coniston smelter. This curtailment was due to shortage of labour at the mines, resulting in insufficient ore production. The producing mines are Creighton, Froid, Garson, and Lovack. Sinking of the Creighton mine inside shaft was completed in October. Work in connection with the shaft and underground development of Stobie and Murray mines was carried on throughout the year. A construction program started in 1941 at the mines, mill, and Copper Cliff smelter was continued. Most of the surface buildings have been completed, but considerable work remains to be done on the ore-sorting plants of the two mines under development.

Falconbridge Nickel Mines, Limited operated its mine and smelter at Falconbridge to capacity. The capacity of the smelting plant was increased following the putting into operation of a new blast furnace in March, 1943. Extensive exploration and development work was continued on several levels. Following the completion early in the year of the sinking of No. 5 shaft to a depth of 3,150 feet, a start was made to open up the 2,625-foot and 2,800-foot levels. Deepening of No. 1 shaft below the 2,100-foot level was started early in 1944. Despite the increased production, the Company's total ore reserves again showed a moderate gain, totalling 12,300,000 tons of 1.74 per cent nickel and 0.93 per cent copper.

Nickel Offsets, Limited, with a property in Foy township, west of Capreol, Sudbury district, continued the surface exploration and diamond drilling that was started in 1939. No. 1 shaft was extended from 658 feet to a depth of 1,130 feet, and stations were cut at the 800-, 950- and 1,100-foot levels. A total of 3,630 feet of diamond drilling was done underground. Shipments of ore to Copper Cliff smelter commenced in September, and to the end of 1943 a total of 5,753 tons had been shipped, with an average grade of 3.5 per cent copper, 4.3 per cent nickel, 0.14 per cent cobalt, and 0.18 ounce of platinum metals per ton. The mining of the lower grade ore, averaging 3 per cent nickel and 1.5 per cent copper, awaits the erection of a concentrator, plans for which are under consideration. The Company has decided to sink No. 2 shaft to an initial depth of 650 feet at a point 3,000 feet east of No. 1 shaft and near a lens of ore already blocked out by drilling and estimated to contain 100,000 tons of ore averaging 1.95 per cent copper and 1.75 per cent nickel. The two shafts will be connected underground.

Ontario Nickel Corporation, Limited since 1941 has been developing a nickel-bearing property in MacLennan township, south-east of Capreol, district of Sudbury, and has done considerable drifting, cross-cutting, and raising. A power line was brought in from the Falconbridge line, a distance of 7½ miles, a substation erected, and a full set of mining buildings was erected in 1942.

Early in 1943 the Company arranged to ship crude ore to one of the smelters, and a test shipment was made in June. Operations ceased shortly afterwards. A re-organization took place in September and a new company, Ontario Nickel Mines, Limited, was formed to take over the assets of the Corporation.

Denison Nickel Mines, Limited did not operate its property in Denison township, near Worthington, southwest of Sudbury.

Harlin Nickel Mines, Limited, a subsidiary of Clifton Consolidated Mines, Limited, took over the old Alexo nickel-copper property at Porquis Junction, Cochrane mining division in 1942. In 1943, the shaft was retimbered to the 120-foot level and the necessary mining buildings were erected. Production was started in June, 1943, and steady shipments to Copper Cliff smelter were maintained.

Shewan Copper Mining Corporation (371 Bay Street, Toronto) was incorporated in June, 1943, to take over from Golden Gate Mining Company its nickel-copper claims, on the north shore of Upper Shebandowan Lake, Port Arthur Mining division, and about 3 miles from Kashabowie. Some surface work was done in 1943.

Dominion Nickel Mining Corporation was organized in 1943 to take over the old Whistle nickel-copper property and the Tough Estate claims in Norman township, and several claims in Blezard township, Sudbury district. Diamond drilling to a depth of 200 feet on the Tough property disclosed an orebody containing about 600,000 tons of 3 per cent nickel. Drilling is proceeding on the Whistle property and will be followed by drilling on the claims in Blezard township.

North Range Nickel Mines, Limited was organized in 1943 to take over an area adjoining the property of Nickel Offsets, Limited, in Foy township, Sudbury district. The property is part of the holdings of the R.J. Tough Estate, and the Company plans to do extensive diamond drilling in 1944.

Kam-Kotia Porcupine Mines, Limited, a project of Wartime Metals Corporation, is operating the Jamieson copper property in Robb township, Cochrane district, 20 miles north of Timmins. This property was explored and developed by Hollinger Gold Mines, Limited, during the period 1926 to 1928. The work in 1943 included the completion of a 21-mile road from Timmins to the mine; and completion of the construction of camp and mine buildings. A 500-ton flotation mill was put into operation early in September, 1943. The copper concentrate is shipped to Noranda smelter. Mining operations are by open pit and electric shovel.

Algoma Copper Mines, Limited did some diamond drilling on its copper prospect in township IA, Mississauga Forest Reserve, Algoma district.

In Quebec, Noranda Mines, Limited operated its mine, concentrator, and smelter at capacity. Due to shortage of labour, underground exploration was greatly restricted and slow progress was made in exploring the deeper levels of the mine. The initial exploration of the mine below the 3,975-foot (33rd) level is being done on four levels 500-foot apart with the idea that exploration drifts on intermediate levels can be more efficiently located as information on the wider spaced levels becomes available. Two such intermediate levels, the 35th and 39th, were established during 1943. Exploration drifts were extended in a westerly direction from the new No. 6 shaft, on the 37th, 41st, 45th, and 49th or bottom (5,975-foot) levels. This exploration work is in what is known as No. 5 zone, a very large body of rhyolite-breccia heavily mineralized with pyrite. The entire zone contains approximately 50 per cent iron pyrites. All of the pyrite and most of the rhyolite-breccia contain small amounts of gold, copper, and zinc, but as stated in the Company's annual report, the orebody taken as a whole is below commercial grade if no account is taken of the possible value of the pyrite. Diamond drilling below the bottom level (5,975-foot) has shown a higher content of gold in what appears to be a new orebody. A total of 61,590 feet of exploratory diamond drilling was also carried out. Ore reserves are sufficient to

maintain production for about 15 years at the 1943 rate of production. The smelter produced 78,733 tons of anode copper. The estimated recovery from the Horne mine ore and concentrate was 33,082 tons and the remainder was obtained from custom ores and slags.

Waite Amulet Mines, Limited continued the exploration and development of its various orebodies, including the large "A" orebody in the Amulet-Dufault section of the mine. Its concentrator, put into operation in 1939, was enlarged by a 300-ton extension for treating zinc ores from the Waite mine; this brought the capacity to 1,800 tons a day. The year's production included 24,720 tons of copper, 40,740 tons of zinc, 41,483 ounces of gold and 702,330 ounces of silver. In the latter part of 1943, the Company entered into a contract with an American company for the sale of its production of iron pyrites, which had been previously discarded.

Aldermac Copper Corporation, Limited discontinued operation of its mine and concentrator at Arntfield, twelve miles west of Noranda, Quebec, in August, 1943, as the ore reserves were exhausted. The Company is opening up a property at Moulton Hill, Ascot township, 4 miles from Sherbrooke. This property is being developed underground and it is expected that a 250-ton concentrator will be in operation by June 15, 1944. The mill will produce copper, lead, and zinc concentrates for shipment to the United States. A pyrites concentrate may also be produced. The ore contains appreciable amounts of gold and silver.

Normetal Mining Corporation, with mine and mill north of Dupuy, Quebec, produced at a 20 per cent lower rate than in 1942, the 780-ton mill averaging 563 tons of ore a day. Development work was confined largely to lateral development on the 2,150-, 2,300-, 2,400- and 2,600-foot levels, while on the 2,700-foot level the main crosscut was driven through the ore zone. Mill heads averaged 3.25 per cent copper and 5.32 per cent zinc and the recovery was 6,224 tons of copper and 7,611 tons of zinc. Ore reserves reached a peak of 1,437,700 tons with an average grade of 3.67 per cent copper and 6.94 per cent zinc.

#### Refineries:

International Nickel Company's copper refinery at Copper Cliff, Ontario, was operated at capacity. It treats the output of blister copper produced at its nearby smelter, 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. The copper refinery of Canadian Copper Refiners, Limited, at Montreal East, Quebec, was also operated at capacity. It treats the anode copper from Noranda smelter and the blister copper from Hudson Bay Mining and Smelting Company's smelter at Flin Flon, Manitoba.

#### Production and Trade:

Canadian production of copper in 1943 was 289,491 tons valued at \$67,621,783, compared with 301,831 tons valued at \$60,417,372 in 1942.

The exports of copper were valued at \$30,816,449, compared with \$35,082,204 in 1942.

The imports were valued at \$1,300,136, compared with \$1,148,668 in 1942.

Prior to the war, most of the Canadian refined copper went to Great Britain, where the consumption of new copper 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, with certain adjustments to allow for increases in the cost of production. Producers on the Pacific coast are continuing to export their product for treatment in the United States. Concentrates shipped there, chiefly from British Columbia, were treated in bond. Refined copper sales to the United States were stopped in 1933 by the U.S. revenue tariff of four cents a pound; but they were resumed in 1937 with increased prices and demand..

Most Canadian producers have an advantage in that their ores carry important values in one or more other metals, chiefly gold, silver, ~~metal~~, or zinc.

*ickel* Figures for world production and consumption of copper in 1943 are not available.

#### Market and Prices:

Owing to its excellent quality, Canadian refined copper was much in demand for peacetime uses. Most of the output, however, has since been diverted to war uses. In the war effort, copper is used chiefly in the manufacture of brass; of generator and motor equipment; of degaussing cable used in the protection of ships from magnetic mines; of motor vehicle tubing; and of shell bands.

The United States is by far the greatest consumer of copper, the principal industries using the metal in that country in peacetime being, in order of importance; electrical manufacturing, automobile, building, electric refrigerator, and air conditioning. Ordinarily, the building industry is as large a consumer of copper and its alloys as is the automobile industry.

The wartime controlled price of electrolytic copper (London price in Canadian funds) remained at 11.75 cents a pound throughout 1943. The New York price of domestic electrolytic copper remained at 11.775 cents a pound in 1942 and 1943.

Prepared by A. Buisson,  
In the Bureau of Mines,  
Department of Mines and Resources,  
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## GOLD IN 1943

### Ores Mined and Producing Localities:

The chief sources of gold in Canada are the gold-quartz mines, which in 1943 contributed about 82 per cent of the total. The base metals mines contributed 16 per cent, and the alluvial placer operations, two per cent.

Ontario produced close to three-fifths of the total Canadian output. With the exception of the gold obtained as a by-product in the refining of nickel and copper, virtually all of Ontario's gold comes from gold-quartz mines, Porcupine and Kirkland Lake being the principal producing areas. There is a large production also from Little Long Lac and adjoining areas in Thunder Bay district; Red Lake, and Crow River areas in Kenora district; and Larder Lake and Matachewan areas in Timiskaming district.

Quebec's chief single producer is still the Noranda gold-copper mine. About 75 per cent of the output, however, comes from gold-quartz 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 sources of gold in British Columbia are the gold-quartz mines of the Bridge River area, Lillooet division; the Salmon River area, Portland Canal division; Wells camp, Cariboo division; Hedley camp, Osoyoos division; the Sheep Creek, and other adjoining areas, Nelson division; and of Zeballos River, on the west coast of Vancouver Island. Next in importance are the gold-bearing base metal ores, notably those of the Britannia Mine at Britannia Beach and Copper Mountain mine near Princeton. A relatively small amount is obtained from placer operations.

About 55 per cent of Manitoba's gold comes from the gold-quartz mines of Rice Lake district in eastern Manitoba, and of God's Lake district, the source of the remainder being the copper-zinc-gold ores of the Flin Flon and Sherritt-Gordon mines.

In Saskatchewan, the production is mainly from that portion of Hudson Bay Mining and Smelting Company's Flin Flon mine lying within the Province.

Production of gold in the Northwest Territories was started in 1938, and is obtained from the Yellowknife River and adjoining areas north 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, Klondike district.

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

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

### Treatment Plants:

Plants for the production of fine gold are operated by:

The Royal Canadian Mint, Ottawa, Ontario.

Hollinger Consolidated Gold Mines, Limited, Timmins, Ontario.

Canadian Copper Refineries, Limited, Montreal, Quebec.

Consolidated Mining and Smelting Company, Trail, B.C.

International Nickel Company of Canada, Copper Cliff, Ont.

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

### Important Developments:

Exploratory and development work was greatly curtailed owing to conditions arising from the war.

In Quebec, Rouyn Merger Gold Mines, Limited, was formed to take over a large area which extends 4½ miles along the mineral belt between Rouyn and Cadillac areas and includes the holdings of East Rouyn Gold Mines, O'Neil Thompson Gold Mines, and Cockeran and Hosking Syndicate. Towards the end of 1944 there was a noticeable increase in prospecting and exploration at a number of properties in western Quebec.

In Ontario work towards production was carried out on several properties. These include the property of Renable Mines, Limited, near Missanabie Lake, Sudbury district; the Queenston property in East Kirkland Lake area; and the Gold Island Porcupine mine, in Porcupine area. There was much activity also in the Red Lake area, Patricia district, where diamond drilling programs were under way at several properties.

Attention was given to the gold possibilities of Snow Lake area in Northwestern Manitoba. Snow Lake is west of Herb Lake, about 90 miles northeast of The Pas and 70 miles due east of Flin Flon. Diamond drilling in 1941 and 1942 by Howe Sound Exploration Company is reported to have disclosed a large tonnage of moderate grade gold ore. Northern Canada Mines, Limited and Pioneer Gold Mines, Limited jointly hold claims northwest of the Howe Sound property and found promising surface indications in 1943. Macassa Mines, Limited also holds claims west of the Howe Sound property and did some surface exploration.

In British Columbia, the Premier-Border property, adjoining the Silbak-Premier is being developed by the latter company. The Wheeler property, on which important discoveries of gold were made in 1943, was taken over by Hedley Mascot Gold Mines, Limited,

In Yukon, the placer gold production was curtailed in 1943 owing to the shortage of labour.

Data about operating gold milling plants are given in the following tabulation:

Year	New Mills		Total Mills		Increases		Ceased Operating	
	No.	Capacity Tons	No.	Capacity Tons	No.	Capacity Tons	No.	Capacity Tons
1944 (Jan.)	-	-	69	34,075	-	-	-	-
1943	-	nil	85	57,510	-	nil	16	5,845
1942	4	950	130	64,725	12	1,235	37	6,760
1941	13	2,150	142	65,635	18	2,940	15	2,825
1940	12	1,605	143	62,485	60	5,690	15	1,175
1939	25	4,830	161	57,815	33	3,085	32	2,320

In Nova Scotia, the Caribou Gold and Queen mills were in operation throughout the year. The Avon mill ceased operations in March. The three mills have a total capacity of 180 tons of ore daily.

In Quebec, 18 mills with a/daily capacity of 11,390 tons were in operation at the close of 1943, as compared with 21 mills with a total daily capacity of 13,640 tons at the close of 1942. Three mills, namely, Lapa Cadillac, Central Cadillac, and Beattie, were closed down in 1943, the Beattie as a result of a cave-in at the mine in June. Milling was resumed at the Beattie, however, early in 1944. Powell-Rouyn continued to ship its ore to the Noranda smelter.

In Ontario, 39 mills with a total daily capacity of 32,685 tons were in operation at the close of 1943, compared with 50 mills with a total capacity of 35,705 tons at the close of 1942. During 1943 milling operations were discontinued at the Uchi (800 tons daily capacity), Jerome (500 tons), Magnet (175 tons), Moneta (200 tons), Hoyle (600 tons), and Yama (75 tons) properties.

In Manitoba, only one mill treating gold-quartz ore was in operation at the end of 1943, namely that on the San Antonio property, which has a daily capacity of 550 tons. The mill on the God's Lake

property was closed down in September. The remainder of the gold output from the Province came from Hudson Bay Mining and Smelting Company's Flin Flon mine, and from the Sherritt-Gordon mine.

In Saskatchewan, no gold-quartz mills were in operation.

In British Columbia, seven mills with a total daily capacity of 1,050 tons were in operation at the end of 1943, compared with 13 mills with a total capacity of 1,895 tons at the close of 1942. The Hedley Mascot, Gold Belt, and Privateer mills were closed down during the year, but milling was resumed at the Hedley Mascot property early in 1944.

In the Northwest Territories, the Con (300 tons) and Thompson-Lundmark (115 tons) mills were closed down in August and September respectively, the only mill in operation at the end of 1943 being that on the Negus (75 tons) property.

In Yukon, Yukon Consolidated continued to operate five dredges in the Klondike area; and Clear Creek Placer Company continued to operate its now dredge on Clear Creek. Operations employing from five to ten men were closed down, but many individual miners continued their work.

Production:

The Canadian production of gold in 1943 was 3,649,671 fine ounces valued at \$140,512,334, compared with 4,841,306 fine ounces valued at \$186,390,281, in 1942.

The production by provinces was:

	1943		1942		Decrease
	Fine ounces	Value	Fine ounces	Value	
Nova Scotia	3,531	135,944	12,989	500,076	72.8
Quebec	925,120	35,617,120	1,092,388	42,056,938	15.3
Ontario	2,111,807	81,304,570	2,736,819	106,407,032	22.8
Manitoba	92,642	3,566,717	136,226	5,244,701	32.0
Saskatchewan	174,881	6,732,919	178,871	6,886,533	2.3
Alberta	21	808	34	1,309	-
Brit. Columbia	240,530	9,260,405	474,339	18,262,052	49.3
Northwest Terr.	59,136	2,276,736	99,394	3,826,669	40.5
Yukon	42,003	1,617,115	83,246	3,204,971	49.3
CANADA	3,649,671	140,512,334	4,841,306	186,390,281	23.0

In Quebec, the larger output at the base metals mines and at some of the new gold mines partly offset the decrease in production at several of the older gold mines. The base metals mines contributed 31.3 per cent of the total output. In Ontario, output from the mines in the Kirkland Lake area decreased from a total of 744,000 ounces in 1941 to 469,036 in 1943. In the Porcupine area the output decreased from 1,439,100 ounces in 1941 to 1,019,200 ounces in 1943.

The production of Manitoba and Saskatchewan showed a total decrease of 13 per cent despite enlarged operations at Flin Flon and Sherritt-Gordon base metal mines. In British Columbia the decrease was largely due to the closing of several properties.

World production of gold in 1943 is estimated at 29,813,069 fine ounces, compared with 35,614,314 fine ounces in 1942 and 40,817,707 fine ounces in 1941. Canada is surpassed only by South Africa and possibly Russia as a producer of gold and contributes about 12 per cent of the total.

The average price at which Canada's gold production was computed for 1943, was \$38.50 a fine ounce. This price has prevailed for the last three years.

Prepared by A. Buisson,  
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Department of Mines and Resources,  
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## INDIUM IN 1943

### Source of Supply:

Many zinc ores contain indium, which is frequently associated with gallium. Indium also occurs in tin and tungsten ores and in some iron and manganese ores. Indium production in Canada was reported for the first time in 1942. It is being recovered in small quantities at Trail, British Columbia, from treatment of the residues obtained at the zinc refinery of Consolidated Mining and Smelting Company.

Refined indium has a silvery-white colour somewhat resembling that of platinum. It is ductile and slightly heavier than zinc. It has a low melting point (155°C.) and a relatively high boiling point (1450°C.).

### Production:

No production of indium in Canada was reported in 1943. World production is still relatively small. Indium is being produced commercially in the United States. The production in the United States has increased considerably during the past two years.

In the United States indium is recovered as a by-product of zinc and lead operations mainly by Anaconda Copper Mining Company, and to a small extent by American Metal Company, American Smelting and Refining Company, Eagle-Picher Mining and Smelting Company, and National Zinc Company.

### Market Prices:

Indium is used for plating and as an alloy with other metals. It is deposited on and alloyed with cadmium-nickel and copper-lead on bearings for aeroplanes, automobiles, etc., and resists the corrosive action of lubricants containing organic acids. Electro deposition of indium on lead followed by heat-treatment has proved useful for bearings. Indium plate will probably be used in surfacing various other types of rubbing surfaces. Coatings of indium-alloys appear to have a diversity of uses. They are easily polished and burnished. Indium is alloyed with gold and silver and with various base metals. It is used in dental alloys and in making low melting alloys. Augmented production of engine bearings and war restrictions on ordinary plating metals have stimulated interest in indium during the past three years.

The price of metallic indium was reduced in December 1940 from \$15 to \$12.50 a troy ounce, at which price it remained throughout 1941, 1942, and 1943.

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## IRON ORE IN 1943

### Ores Mined and Producing Localities:

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.

Dominion Steel and Coal Corporation, Limited, with plants at Sydney, Nova Scotia, obtains its iron ore from its own mines at Wabana, Newfoundland. Steel Company of Canada, Limited, at Hamilton, Ontario, and Canadian Furnace, Limited, at Port Colborne, Ontario, obtain their iron ore supplies from the Lake Superior region of the United States. Algoma Steel Corporation obtains most of its requirements from the United States and the remainder from the New Helen mine, Michipicoten area.

### New Development:

In Ontario, Algoma Ore Properties, Limited, a wholly owned subsidiary of Algoma Steel Corporation, Limited, began in 1937 development work at its New Helen mine in the Michipicoten area, Ontario, and the first sinter was produced in July, 1939. Operations during the past three years consisted mainly in open-cut mining. The New Helen deposit is estimated by the company to contain at least 100,000,000 tons of siderite carbonate ore, averaging about 35 per cent iron, and, to fit it for commercial use in blast furnaces, a sintering plant capable of treating 3,000 tons of ore a day was built, the sinter produced approximating 53.4 per cent iron, 7.0 per cent silica, 0.04 per cent sulphur, and 3.0 per cent manganese. The sintered ore is shipped from Michipicoten Harbour, 8 miles from the sintering plant, partly to the company's blast furnaces at Sault Ste. Marie, Ontario, and partly to United States ports on the Lower Lakes for use in United States blast furnaces. The manganese content is of special interest to users.

Exploratory work on the hematite property of Steep Rock Iron Mines, Limited, situated near Atikokan, and about 135 miles west of Port Arthur, indicated that the deposits, which were discovered in the winter of 1937-38 under the bed of Steeprock Lake by diamond drilling through the ice, were large and high in grade. The size of the hematite bodies can be gauged from what has been reported, namely, that the probable average widths of A, B, and C bodies are 205, 135, and 200 feet respectively, with explored lengths of over 3,000 feet in the case of A, which is still open at one end, and of 5,000 and 800 feet for B and C, each of which is open at both ends. Under the A orebody the greatest depth at which the ore has been found in a borehole is 1,400 feet below the surface of Steeprock Lake, or 1,035 feet below the ledge; under the B zone ore was encountered 700 feet below lake level. High-grade ore occurs within these deposits and presumably makes up a considerable, but as yet very incompletely defined part of them. The company reports that the property has "proven ore" totalling 17,244,000 long tons and "probable ore" 14,336,000 long tons, making a total of 31,580,000 long tons, and assuring production for a number of years to come. Most of this ore is available for open pit mining. No estimate has been prepared of "possible ore".

Recent churn drilling has given continued evidence of the good quality of the ore and it is expected that the property will produce an average grade of: (dry analysis).

Iron.....	60.48%
Silica.....	3.40%
Phosphorus.....	0.023%
Sulphur.....	0.043%
Loss by ignition.....	8.5%

The moisture content is estimated at 7 per cent, so the natural iron content would, therefore, be 56.5 per cent.

The natural iron content (averaging 56.54%) is 4.54% higher than the average of ore shipped from the Lake Superior ranges, in the United States. The low silica content of 3.42% will permit the use of this ore to "sweeten" other ores and the extremely low phosphorus content of 0.017% is well below the Bessemer limit. While these qualities make Steep Rock ore a premium product, probably its most valuable quality is its physical structure, which should make it a good open-hearth lump ore producing little minus 100-mesh fines, and reducing the percentage of scrap normally required.

Work on the diversion of the Seine River was completed in 1943, and included about twenty miles of road building; the excavation of over 1,200,000 cubic yards of earth and of 500,000 cubic yards of rock; the lowering of Finlayson Lake by a tunnel; the construction of a spillway and control works in Raft Lake; the construction of coffer dams to isolate the eastern portion of Steeprock Lake; and the construction of a power line, the installation of pumps and barges, and works in preparation for pumping Steep Rock lake. This was commenced on December 10th, 1943, the pumps having a capacity at low heads of over 700 cubic feet of water per second, while at a head of one hundred feet the pumps will handle more than 400 cubic feet of water per second. It is expected that the water will be down sufficiently for the Company to commence the production of iron ore by August, 1944.

Michipicoten Iron Mines Ltd. was formed in 1943 to take over the iron properties owned jointly by Sherritt Gordon Mines Ltd. and Frobisher Exploration Co. Ltd. (a subsidiary of Ventures Limited). These properties, which consist of the Josephine, Ruth, and Lucy mines, are about 20 miles from Michipicoten Harbour, Algoma district. Construction work was started at the Josephine mine in the Fall of 1941. A transmission line was built to connect with the power line at Hawk Junction and the necessary electrically driven plant for development operations was installed. Shaft sinking was started in February, 1942 and was completed to a depth of 1,055 feet early in September. Six stations were cut, the lowest being at the 1,015-foot horizon. While shaft sinking was in progress the orebody that had been explored early in 1941 by surface diamond drilling was further explored by lateral diamond drilling at the first and second levels. The drainage of Parks Lake was then undertaken. Some experimental shipments of lump ore have been made for test purposes.

At the Josephine mine, underground development was carried on continuously throughout 1943. This work was mainly confined to the three lowest levels, the fourth, fifth, and sixth levels, the greatest amount being done on the sixth level where a length of over 1,200 feet of continuous ore was opened up, with ore still showing at one end. Surface diamond drilling indicates that this length (1,200 feet) will ultimately be doubled. As a result of this development the tonnage of ore reserves was more than doubled during the year and the grade of ore was appreciably improved. The reserves are estimated to total 2,666,000 long tons of hematite assaying (dry analysis) 53.94 per cent iron, 15.67 per cent silica, and 1.18 per cent sulphur.

The Ruth property, which is two miles from the Josephine, was drilled extensively during 1942 and during the first three months of 1943. The indicated ore reserves to a depth of 800 feet are 28,600,000 long tons of siderite averaging 31.26 per cent iron, 13.15 per cent silica, and 5.14 per cent sulphur. These reserves include 16,840,000 tons of low silica siderite averaging 34.54 per cent iron and 6.81 per cent silica. The remainder (11,760,000 tons) is high silica siderite and averages 26.57 per cent iron and 21.46 per cent silica.

Tests made in the Company's pilot mill have indicated that much of the silica material can be eliminated, so that with prior beneficiation, a good grade of sinter can be made from the high silica siderite. A pilot-plant has been in operation since the summer of 1942 for testing purposes. Consideration is being given to the erection of the necessary mining, milling, and sintering plants for the production of about 500 tons of sinter a day.

During the past year Frobisher Exploration Company, Ltd., an exploration subsidiary of Ventures Limited and associated companies, investigated in 1941 and 1942 certain magnetite deposits in Mayo township, Hastings county. Extensive underground sampling and diamond drilling were carried out at the Bessemer mine. At the Radenhurst-Caldwell magnetite property near Flower Station, in Levant township, Lanark county, a program of shallow diamond drilling was carried out in 1942. This exploration indicated a substantial tonnage of low-grade ore. Large-scale magnetic concentration tests on the Bessemer ore were continued, and small-scale testing on the Radenhurst-Caldwell ore was also done, at the Bureau of Mines Laboratory in Ottawa. The Bessemer and Childs properties in Mayo township, Hastings county, and the Radenhurst-Caldwell property near Flower Station in Levant township, Lanark county, were retained but no further work was carried out on these deposits.

Tomahawk Iron Mines Ltd. has been developing a property on Whetstone Lake, Lake township, Hastings county, eastern Ontario. The company reports estimated ore reserves of 500,000 tons of 60 per cent magnetite, above the 300-foot level. Test shipments have been made to steel plants in southern Ontario, and a truck road to the property is being built.

Hollinger Consolidated Gold Mines Ltd., under an agreement with Beverly Iron Prospecting Syndicate, did some exploration in 1943 on the Beverly iron ore holdings near Milton, Halton county, Ontario. From 1940 to 1942 the Syndicate made extensive dip-needle surveys followed by detailed magnetometer surveyings. In the spring of 1943 drilling to a depth of 3,000 feet was undertaken and an electric survey made by Hollinger. The option was afterwards surrendered.

Extensive surveys and exploration work have been carried on since 1936 by Labrador Mining and Exploration Company of Montreal, near Sawyer Lake and vicinity, along the Quebec-Labrador boundary line. Six deposits of iron ore were discovered during the short summer field seasons of 1936 to 1939 inclusive. The principal deposit located at Sawyer Lake, in the Newfoundland Labrador Concession, about 280 miles north of Seven Islands in the Gulf of St. Lawrence, is estimated by the Company to contain 2,200,000 tons of hematite ore (averaging 65% iron) per 100 feet of depth. The phosphorus content is under 0.04 per cent. Four other deposits are of good grade, and one of them is rich in manganese. ~~The total possible reserve in these four deposits is estimated by the company at 70,000,000 tons to a depth of 1,000 feet.~~ The other deposit is high in silica, and is believed to represent a large tonnage. Field work on this deposit was carried on in 1942 and 1943 under the direction of Hollinger Consolidated Gold Mines, Limited, which has acquired a controlling interest in Labrador Mining and Exploration Company. Geological and exploration work were also undertaken on the Concession in a contiguous area in Quebec, which area embraces a total of approximately ~~20,000~~ 3,900 square miles. The field work of 1942 by Hollinger confirmed the results of the work of earlier years. There was no additional drilling last year on the iron ore deposits discovered previously. Attention was focused on locating new orebodies by exploration and reconnaissance work and several bodies of iron ore of apparently good grade were found.

Labrador concession - 20,000 miles  
" " " 3,900 miles.  
Quebec

3,900

Hollinger North Shore Exploration Company, a subsidiary of Hollinger Consolidated Gold Mines, was engaged in exploring an area in Quebec, immediately north of the Labrador concession and covering an area of 3,900 square miles. Many indications of iron-ore deposits were encountered, and the area on which non-ferrous minerals might be expected was also investigated. Hollinger has completed negotiations with M.A. Hanna Company of Cleveland, Ohio, for their participation in the future exploration and developments of the iron deposits in both areas. The exploitation of these deposits would necessitate the construction of a railway line from the St. Lawrence River at Seven Islands, which port is open to navigation throughout the year.

#### Production and Trade:

Canadian production of iron ore in 1943 was 641,294 tons valued at \$2,106,334 compared with 545,306 tons valued at \$1,517,077 in 1942. Trade figures are not available for publication owing to the war.

The demand for primary iron and steel was supported in 1942 and 1943 by the large requirements for war purposes.

Bounties on the production of iron ore are offered by the provinces of Quebec, Ontario, and British Columbia. In Quebec, the premium is at the rate of four-fifths of one cent for each unit (22 lbs.) of iron metal contained in every ton of iron ore. In Ontario, the bounty is 2 cents per unit of metallic iron in the long ton of low-grade iron ore beneficiated in Ontario so as to be suitable for use in the blast furnace, or on natural ore of commercial quality smelted in Canada. In British Columbia, the bounty paid must not exceed \$3.00 a ton on the proportion of pig iron produced from ore mined in the province, and must not exceed \$1.50 a short ton on the proportion of pig iron produced from ore mined outside the province. A bounty not to exceed \$1.00 a short ton is also offered on steel shapes of commercial utility manufactured in British Columbia.

There are no official Canadian price quotations for iron ore. Prices f.o.b. Lake Erie ports, per long ton for Lake Superior, U.S.A., iron ore, 51½ per cent iron ore are: Messabi, Non-Bessemer - \$4.45, Bessemer - \$4.60, Old Range, Non-Bessemer - \$4.60; Bessemer - \$4.75. The price of Brazilian ore, f.a.s. Brazilian ports, 68 per cent iron, is 7 cents per long ton unit or \$4.76 a long ton.

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## LEAD IN 1943

### Ores Mined and Producing Localities:

Most of the lead produced in Canada comes from Consolidated Mining and Smelting Company's Sullivan silver-lead-zinc mines at Kimberley, British Columbia. Other 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; and the Lake Geneva zinc-lead mine, Sudbury district, Ontario. In Quebec the production is derived from the lead-zinc mines in Pontiac and Portneuf counties.

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 and has been in production since January, 1940. Western Exploration Company at Silverton was re-treating the tailings accumulated during previous operations, mainly for the recovery of the zinc. The company's Mammoth mine was also in production. The Lucky Jim mine, at Zincton, was taken over late in 1940 by Zincton Mines, Limited, a new company owned by Sheep Creek Gold Mines, Limited. The mine and concentrator were in production in 1943. Reco Mountain Base Metals Mines, Ltd., a subsidiary of Gold Frontier Mines, Ltd., took over the Noble Five, Surprise, and Deadman mines, near Sandon, Slocan mining division in 1942. The properties were explored by diamond drilling and underground development in 1943. The 100-ton mill of the Noble Five was rehabilitated and started to operate in September 1943, producing lead and zinc concentrates which are shipped under contract to Metals Reserve Company of the United States.

The Whitewater mines and mill were taken over in the fall of 1942 by Kootenay Belle Gold Mines Limited, and were put into shape for production. Retallack Mines, Limited, a subsidiary of Kootenay Belle Gold Mines, Limited, was formed in December, 1943, to take over the management of the property and production is expected early in 1944. An agreement has been negotiated with U.S. Commercial Company, a subsidiary of Metals Reserve Company, for the disposal of the lead and zinc concentrates. All the mill machinery and mine equipment has been transferred from the Kootenay Belle Gold Mines at Sheep Creek, and when added to the existing facilities of the Whitewater is expected to give an initial milling capacity of 300 tons a day.

The Van Roi mine on Four-Mile Creek, near Silverton, was being prepared for operation in 1943, after lying idle for many years. The old mill is being re-modelled and will have a capacity of 300 tons a day. The property is being operated by Van Roi Base Metals, Limited.

The Kootenay Florence mine at Ainsworth, on the west shore of Kootenay Lake, was taken over in 1943 by Wartime Metals Corporation and was operated as the Kootenay Florence Project. The mill equipment and machinery of the Ymir Consolidated Mines, Ltd. were installed in the old Kootenay Florence mill building. Production was started in the spring of 1943. Several small lead-zinc properties, mainly in the Ainsworth-Slocan district, shipped crude ore to the Trail smelter. The Reeves McDonald zinc-lead mine on the Pend d'Oreille River remained idle in 1943.

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 discontinued operations in October, 1941, at its several small, high-grade silver-lead properties near Mayo.

In Ontario, Lake Geneva Mining Company, Limited continued producing lead and zinc concentrates throughout the year for the Metals Reserve Company. The operation is being carried on through

Wartime Metals Corporation. An extensive exploration campaign was concluded during the year. This indicated the continuation of the veins and two new levels were opened up. The mill capacity is 100 tons of ore daily.

In Quebec, the Tetreault property near Notre Dame-des-Anges, Portneuf county, was taken over in 1942 by Siscoe Gold Mines, Ltd., and was operated under the supervision of Wartime Metals Corporation. The lead and zinc concentrates produced are contracted to the Metals Reserve Company. Production continued throughout 1943. New Calumet Mines, Ltd., operating at Calumet Island, Pontiac county, completed the erection of a 500-ton mill, which went into production in September, 1943. The property was actively explored and developed during the past two years.

Aldermac Copper Corporation is opening up a new property at Moulton Hill, Ascot township, 4 miles from Sherbrooke. The property is being developed underground and it is expected that a new 250-ton concentrator will be in operation by June 15, 1944. The sulphide ore is composed of copper, lead, and zinc sulphides with appreciable valued in gold and silver. The mill will produce copper, lead, and zinc concentrates for shipment to the United States. The proportion of metals in the sulphide is approximately 3 zinc, 1 lead and 1 copper. A pyrites concentrate may also be produced.

#### Production and Trade:

Canadian production of lead in 1943 was 222,177 tons valued at \$16,681,078, compared with 256,071 tons valued at \$17,218,233 in 1942. Trade figures are not available for publication owing to the war.

World production in 1939 (figures for 1940-1943 not available), as published by the American Bureau of Metals 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 were, in order of importance; United States, Mexico, Australia, Canada, Germany, Belgium, India (Burma), and Russia. The production in Germany and Belgium was mostly from imported ores.

#### Markets and Prices:

The world consumption in 1938 (1939-1943 not available) as given by the American Bureau of Metal Statistics, was 1,638,100 metric tons, compared with 1,741,400 metric tons in 1937. The Canadian consumption of lead prior to the war was between 25,000 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. In peacetime, lead is used in so many industries that business improvement in any direction is reflected in the demand for the metal. So far in the present war, it has been the least scarce of the metals, but as a result of direct and indirect war demands and the substitution of lead for copper and brass, consumption has been increasing. Lead is the only common metal classified in the least critical group. There are many purposes for which lead is normally used to a greater or lesser extent in competition with other materials now critical, for example, lead in plumbing, for sheet metal work on buildings, as bearing metal to replace tin, as chemical tank linings and pipes and as gaskets and washers to replace rubber, as collapsible tubes and foil to replace aluminium and tin, as die castings to replace zinc, as paint to replace zinc oxide and zinc chromate, in storage batteries to replace nickel and iron, as solder, and for various other purposes.

Tetraethyl lead, which has become an important outlet for lead, plays an indispensable role in aviation gasoline. Much interest has been shown in combinations of lead with iron, particularly leaded steel. A lead coating is being used as a lubricant for successive wire-drawing 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 are being produced as by-products at the radium refinery at Port Hope, Ontario.

The average price of pig lead (quotations on the London market, converted to Canadian funds) was 3.754 cents a pound throughout 1943. The price at New York was 6.50 cents throughout the years 1942 and 1943.

Prepared by A. Buisson,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, March, 1944.



## MANGANESE IN 1943

### Ores Mined and Producing Localities:

The manganese ores that have been mined in Canada are pyrolusite ( $MnO_2$ ), psilomelane ( $H_4MnO_5$ ), manganite ( $Mn_2O_3 \cdot H_2O$ ), and braunite ( $Mn_2O_3$ ), all of which are black or grey-black and comparatively hard; bog manganese, a soft, earthy black oxide; and a small amount of rhodochrosite ( $MnCO_3$ ), a pink, fairly soft, mineral. 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. Canadian production since 1918 has been insignificant. During the first three and a half years of the present war it was increasingly difficult for Canada to obtain supplies from abroad, but this is no longer the case.

The only activity of consequence to report for 1943 is that British Manganese Mines, Limited intermittently operated the mine and concentrator at Jordan Mountain, 7 miles north of Sussex, New Brunswick, and shipped a car lot of concentrate to Welland, Ontario. Nabco Manganese Mining Company on Gowland Mountain near Elgin, 25 miles northeast of Sussex, where a mill was erected late in 1941, and Turtle Creek Manganese Prospecting Syndicate, 10 miles northeast of the Nabco property, discontinued their operations in 1942 owing to lack of ore.

### Prospective Producing Localities and Developments:

Most of the 200 deposits of manganese known in Canada are in the Maritime Provinces. They are mostly low-grade replacement or bog deposits, and a small amount of high quality ore has been mined in only a few localities.

Since the outbreak of the war, much attention has been given to the development of known deposits, to the search for new sources of supply, and to the exploration of several old properties. Little high-grade ore remains in these old properties, though it is possible that a fair tonnage of medium-grade ore is available. No new deposits have been found, however, and attempts to operate some of the better old properties have been given up after a few months work. Manganese activities in Canada, including the aforementioned operations at Jordan Mountain have ceased and indications are that they will not be renewed. In any event, production is likely to be small and costly.

The ore at Jordan Mountain is mainly disseminated and brecciated. Underground work indicated that the ore zone is narrow and is less than 100 feet in depth. Attempts to make a commercial grade of concentrate in the remodelled mill were not successful and work was abandoned by the company in the fall of 1943. The company also cleaned out an old adit in Shepody Mountain, 40 miles east of Jordan Mountain, but no ore was found and work was abandoned.

No further work was done on the New Ross deposits, Nova Scotia, the drilling of which in 1942 by the Department of Mines, Halifax, indicated the possible existence of a fair tonnage of ore in the vein extension of the Lower (Cain) mine.

In Quebec, a program for prospecting the Madgalen Island deposits in the Gulf of St. Lawrence was outlined for 1943, but was not undertaken.

In Manitoba there was apparently no further activity on the bog and nodular manganese deposits in the vicinity of Riding and Porcupine Mountains, 200 miles west of Winnipeg.

In British Columbia, some sampling was done by D.G. Rose on the Nasko bog manganese deposit, 65 miles west of Quesnel in the Cariboo. Tests were made by British Columbia War Metals Research Board on samples of low grade manganese ore from Dome Creek, northwest of McBride on the C.N.-R. north line. Some prospecting was carried out on

the D.J. McRae deposit on Olalla Creek, 23 miles from Penticton, Osoyoos Mining Division, which was reported upon by an engineer of the Department of Mines in December, 1942.

In Newfoundland during the past four years intermittent prospecting was carried out on a siliceous manganese deposit at Brigus on Conception Bay and in the fall of both 1942 and 1943 Brigus Manganese, Limited, Montreal, shipped bulk samples of 33 and 28 per cent manganese ore to Ottawa for testing.

#### Production and Trade:

Canadian production in 1943 amounted to only 46 tons of 44.0 per cent manganese concentrate valued at \$985, compared with 435 tons valued at \$8,932 in 1942.

Approximately 50 per cent of the imports of manganese ore totalling 51,234 short tons valued at \$1,445,252 came from India, most of which was purchased by the Dominion Government; about 48 per cent from Gold Coast; and the remainder from British East Africa and Montana. Consumption was about 60,500 tons, a 41 per cent decrease below that of 1942.

From 1886 to the end of 1942, a total of about 17,500 short tons of manganese ore was produced in Canada, close to half of it between 1887 and 1890, inclusive. 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, a total of 1,784 tons was shipped, the largest output being 957 tons in 1916.

Canadian production of manganese ferro-alloys was 34,600 short tons a decrease of 34 per cent below the 1942 output. In 1943, about 70 per cent of these alloys was in the form of silico-manganese; 21 per cent in the form of ferromanganese, and 9 per cent in the form of spiegeleisen. During 1942 the Allied Governments arranged to distribute the manufacture of certain manganese ferro-alloys and for their use in part as substitutes for ores imported from distant countries.

World production is probably about 6,000,000 tons annually, the leading producing countries being Russia, British India, Gold Coast, Brazil, Union of South Africa, the United States and Cuba.

Russia in 1941 is reported to have produced close to 3,000,000 tons, the output being mainly from the Tchiaturi deposits in Georgia on the southern slope of the central part of the Caucasus. Other deposits are in the Urals and near Nikopol, north of the Crimea. India produces over a million tons of metallurgical grade ore a year, mainly from the Central Provinces, the principal district being Balaghat. Much of the exports of manganese from India are taken by Great Britain. India is also the chief source of supply for Canada and for the United States. At Nsuta, Wasaw district, Gold Coast, is one of the largest known single manganese deposits. It is operated by African Manganese Mines Company, Limited. The ore is of excellent metallurgical grade (48 to 52 per cent manganese). About 48 per cent of the Canadian manganese ore imports in 1943 were from Gold Coast. The principal deposit in Brazil is at Mato Grosso and is estimated to have reserves of 25 million tons of 45 per cent or higher of manganese ore. South Africa's production comes mostly from the Portmasburg area, Griqualand West, Cape province. In Cuba, the Cuban-American Manganese Corporation is the principal producer, its deposits being at Isabelita in Orient province. Prior to the war, Egypt was producing about 150,000 tons of 30 per cent ore annually from the Sinai Peninsula.

In the United States, nearly 70 per cent of the output of metallurgical grade ore comes from Montana, mainly from the Anaconda copper mine at Butte; about 17 per cent from Virginia, Washington, and California; and the remainder from 15 other States. The United States is also an important producer of ferruginous manganese and of manganese-iferous iron ore.

Since 1939 the United States Bureau of Mines has prospected and developed many deposits of varying grades of ore and has worked out processes of beneficiation for medium and low-grade ores. In order to offset a possible deficiency of overseas supplies, a program was evolved for the treatment of about 50 different deposits in nine states. As a result of this work, estimated reserves of usable manganese ore have been increased by several million tons. However, as it is no longer difficult to obtain supplies from abroad, this expansion program has been deferred.

#### Uses and Specifications:

It is estimated that over 90 per cent of the world consumption of manganese ore is used in the manufacture of iron and steel, the ore so used being termed "Metallurgical". The remainder is termed "Chemical". Metallurgical ore is used for making ferro-manganese, silico-manganese, and spiegeleisen, 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. Until fairly recently, about 14 pounds of manganese was used on the American Continent in each ton of steel, but in order to conserve manganese, the average has been reduced to about 12.4 pounds per short ton of steel. In the United States about 90 per cent of the metallic manganese in ore is used for making ferromanganese but in Canada, owing to an exchange agreement, the proportion in 1943 was 70 per cent for silico-manganese, 21 per cent for ferro, and 9 per cent for spiegel. Ferromanganese, containing 75 to 82 per cent manganese and 5 to 7 per cent carbon is by far the most important addition agent, and to make it, the highest, or "ferro-grade" ore is used.

Such ore should contain at least 48 per cent of manganese and not more than 7 per cent iron, 8 per cent silica, 0.15 per cent phosphorus, 6 per cent alumina, and one per cent zinc. 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 should pass a 20-mesh screen. Soft ores, such as bog manganese, are objectionable unless they are briquetted. It takes about two tons of 48 per cent ore to make one ton of standard ferro.

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.

There is little demand for spiegeleisen in Canada and the price of the ores from which it is made is at present 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: Electro-Metallurgical Company at Welland, and Canadian Furnace Limited, Port Colborne, both in 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, which acts as a depolarizer. The ore should contain not less than 75 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; 0.03 per cent copper; less than 0.10 per cent of any other metal; and 1.0 per cent moisture. Most of the ore is ground to 200 mesh, but some coarse ground ore of 8 to 12 mesh is also used. Canadian requirements of chemical ore range from 3,000 tons to 4,000 tons a year, most of it being ore from the Gold Coast. Nearly all of it is used by three manufacturers of dry batteries in Ontario:

Canadian National Carbon Company, Toronto, Burgess Battery Company, Niagara Falls, and General Dry Batteries of Canada Limited, Toronto. Chemical ore is used also as colouring agents in the glass, ceramic and paint industries; as pigments and dyeing materials; as salts in photography, fertilizers, disinfectants, bleachers, and for other minor uses.

#### Beneficiation:

Each ore or individual deposit presents a separate treatment problem. Some coarse ores can be cleaned by handpicking, screening, or washing; others can be concentrated by ordinary gravity methods. Flotation, using soap reagents, has been successful on a variety of oxide and carbonate ores. Roasting is successful in some high-rion ores or concentrate, and is followed by magnetic separation, yielding manganese and iron concentrates. <sup>and</sup> fines are objectionable for the manufacture of ferromanganese, concentrate produced by any process must be sintered or nodulized. Some success has been achieved by the "Sink and Float" process. In the case of some disseminated ores or those of large low-grade deposits, it may be necessary to use hydrometallurgical processes. Ores having as low as 10 per cent manganese have been treated, though the average is about 15 per cent. Since the start of the war research on the treatment of low-grade manganese ores has been carried out on a large scale in the United States and a considerable amount of literature on these investigations has already been published.

#### Prices:

Prices of ferro-grade ore depend upon the manganese content and the amount of harmful impurities. Imported ore is usually quoted in cents per long ton unit of 22.4 pounds of contained manganese. United States prices for metallurgical ores are based on a standard duty-free ore containing 48 per cent manganese, 6 per cent iron, 11 per cent silica and alumina combined, and 0.18 per cent phosphorus. The quotation for this grade is 85 cents per long unit of contained manganese at Gulf of Mexico ports, and 90 cents at New York and other Atlantic ports. The premiums and penalties for ores varying from the standard grade can be obtained from the Metals Controller, Ottawa. The prices paid in 1943 by the Government and Canadian consumers for approximately 48 per cent manganese ore were \$46.00 for Indian ore at Welland and \$37.00 per long ton for Gold Coast ore at Canadian ports.

Prices of chemical grade (battery grade) manganese ores throughout 1943 were \$55 per ton for Brazilian or Cuban ores (80 per cent minimum content of  $MnO_2$ ) in car lots, f.o.b. New York, exclusive of duty. The delivered price in Canadian currency for finely ground battery grade ore in bags imported into Canada from Africa or Montana, U.S.A., was \$60 to \$85 a short ton depending on mesh and origin.

Prepared by V.L. Eardley-Wilmot,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, March, 1944.

## MERCURY IN 1943

### Ores Mined and Producing Localities:

Cinnabar ( $\text{HgS}$ ), the principal ore of mercury, is a heavy mineral (s.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  $300^{\circ}\text{C}$  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 and was optioned late in 1938 to Consolidated Mining and Smelting Company and production started in June, 1940. The ore zone consists of large cinnabar-bearing areas in veins and impregnations, mainly in dolomitized and brecciated limestone along zones of fracturing and shearing. The deposit is on a steep mountain side and has been developed by adits on six levels and a shaft from the bottom adit, giving a vertical distance of about 800 feet. The grade of ore treated averages about 0.3 per cent mercury, but new zones of better than 0.5 per cent have been found recently. The plant consisting of Wedge roasters, kilns, and condensers has been enlarged periodically since 1940 and is now capable of treating about 1,200 tons of ore daily.

Prior to the discovery of the Pinchi Lake deposits little mercury was produced in Canada and the successful operation of the deposits has brought about a complete change in the Canadian situation in respect to the metal. This mine is the largest single producer of mercury on the American continent and its output is far in excess of the domestic requirements. Ore reserves are estimated to be sufficient to assure continuous output at the present rate for several years.

A number of cinnabar claims have been staked and prospected along the so-called "Pinchi fault", which runs in a northwesterly direction for at least a 100 miles from Pinchi Lake. Of chief importance is the Tackla property, east of the headwater of Silver Creek, 85 miles northwest of the Pinchi mine. It is being operated by Bralorne Mines, Limited and production from the 100-ton plant was started in November, 1943.

### Prospective Producing Localities:

Probably the most important area is along the Pinchi fault. Consolidated Mining and Smelting Company prospected, by means of tunnels and a shaft, the Snell claims, ten miles north of the Tackla mine and the Indata property, twenty miles south of the Tackla mine, but the work was discontinued temporarily early in 1943. Seven other groups of claims between the Snell and Indata groups were prospected by the Consolidated Mining and Smelting Company. Other properties along the fault were prospected by Hollinger Exploration Company and others. Farther south, Pioneer Gold Mines discovered cinnabar over a length of a mile on the Andersite group near Jumping Lake, about fifteen miles southeast of Fort St. James, but the ore is too low grade to mine at present.

In the Bridge River district, Bralorne Mines prospected a deposit on Relay Creek, 35 miles north of the Bralorne gold mine, but work ceased in the fall of 1943. A few miles to the south, Pioneer did a little prospecting on a cinnabar showing on Tyaughton Creek. A few flasks of mercury were produced in 1942 from the Red Eagle Group on the Yalakom River which is about thirty miles north-west of Lillooet, but only a little work was done in 1943.

In the Kamloops Lake area, F.L. Gorse of Kelowna late in 1942 acquired and moved the plant of old Empire Mercury in the Bridge River area to his claims on Copper Creek on the north shore of Kamloops Lake, but the plant was not erected. Some good cinnabar ore is said to have been found by recent prospecting, but the property is idle at present. Some prospecting was carried out on Hardie Mountain about four miles north of the Copper Creek deposit.

#### Production, Consumption and Trade:

Canadian production in 1943 was 22,487 flasks of seventy-six pounds each valued at \$4,609,835, as compared with 13,630 flasks valued at \$2,943,807 in 1942, and a threefold increase as compared with production in 1941. Consumption in Canada is about 3,000 flasks annually. It is used mainly by the chemical industry and to a lesser extent by the gold mining companies. About eighty-eight per cent of the exports were to the United States, through the Metals Reserve Company; about eight per cent to India; and three per cent to Australia. There were no imports. Stocks on hand at the end of 1943 were sufficient to meet domestic requirements for 18 months.

World production just prior to the war was estimated to be slightly in excess of 5,500 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 75 per cent of the world output, while the United States contributed about 11 per cent. Production from Mexico in 1943 reached a peak and is estimated to have shown a fivefold increase since 1939. The pre-war output from Russia, then the fourth largest producer, was about 300 metric tons a year, being about the same as the output from Mexico in 1939. Czechoslovakia, China, Japan, Chile and Peru are also producers of mercury. The Union of South Africa started production at Monarch Kop in 1940 and its output has increased substantially each year since.

During the 1936 to 1938 civil war in Spain, Italy maintained the lead with an annual output of over 2,000 metric tons. About fifty-five per cent of its output came from the Monte Amiata mines eighty-five miles northwest of Rome, in the province of Siena and forty per cent from the Idria mines in the Julian Alps about forty miles north of Trieste. 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 oldest 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. Stocks of Spanish mercury are said to have accumulated considerably.

The principal Russia deposits are in the Donets Basin which until recently was under German army occupation and during that period necessitated heavy imports of mercury from the United States.

Figures of production in the United States in 1943 are not officially available, but the output is reported to have been nearly 54,000 flasks and higher than in any year since 1881. About 175 mines in ten States were producing; California continued to be the largest contributor, with about sixty per cent of the total output. The New Idria mine in San Benito county, California, continued to be the largest single contributor. Increased output and imports have greatly

augmented United States Government stock piles, which at the end of 1943 were equivalent to about two years' domestic requirements. The War Production Board has recommended the cancellation of contracts and that domestic producers receive \$20 a flask, based on their capacity to produce during the last eleven months of 1944. Settlement is to be based on average monthly output during the last six months of 1943.

#### Grade and Treatment:

Canadian and United States cinnabar ores seldom average over 1.0 per cent mercury, but at 1943 prices, an 0.30 per cent ore can be produced at a profit. As a rule, the ore is treated by roasting the coarsely crushed material 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 so satisfactory as by direct roasting of the crude ore. Recent improvements include hot rotary calcine conveyors; mercurial soot flotation and dust disposal methods. Ultra violet methods are now used for analyzing stack gases and water.

#### Uses:

In Canada about seventy-five 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 uses about seven per cent of the total mercury consumed.

At present about 27 per cent of the mercury consumed in the United States is for pharmaceuticals; about twelve per cent is used in industrial and control instruments; and about ten per cent is used as a catalyst or in electrolytic preparation of chlorine; caustic soda, acetic acid and acetone. In the past an appreciable amount of the metal was consumed as fulminate of mercury, a powerful detonator, but this has been replaced by other compounds such as lead azide, and only a small quantity of mercury is now used for a special type of detonator. Mercury is also used in the manufacture of mercury salts, thermometers, medical supplies, mirrors, mercury vapour, and fluorescent lamps; and in the extraction of gold from ores by amalgamation; in the manufacture of electrical and chemical apparatus; for automatic electrical contacts; in electric rectifiers; as cathodes in electrolytic chemical processes; in felt manufacture; in boiler compounds; in especially designed mercury boilers to replace steam in power production; in cosmetics; and for anti-fouling paint. Many of these applications are for military as well as civilian uses.

#### Prices and Specifications:

The New York prices for the iron flask of seventy-six pounds of mercury averaged \$75.00 in 1938. The price during most of 1943 was about \$196 a flask, but it decreased to \$190 in December, to \$151.60

in January, 1944, and to \$130 in February. Imports of mercury into Canada from the United States are not subject to duty, but are subject to a sales and war tax amounting to eighteen per cent of the value in Canadian funds. The present price of Canadian mercury is largely governed by that of the United States. Canadian imports into the United States are subject to a tariff of twenty-five cents per pound, or \$19 a flask, in United States currency.

Specifications call for a minimum of 99.5 per cent mercury and a maxima of 0.3 per cent antimony and 0.1 per cent arsenic.

Situation:

Canada is capable of producing at least eight times the amount of mercury required to meet its present needs and stocks are considerable. Output in the United States is sufficient to supply all of its war demands and production from Mexico in 1943 was mainly exported to the United States. Consequently the Metals Reserve Company (United States) cancelled all contracts with producers for purchase of mercury, effective January 31, 1944. Canadian producers now depend upon domestic orders, orders from the British Government, and upon private sales to United States consumers.

The position of the Allied countries is now so strong that there is no longer an urgent need for a search for new deposits. Only large deposits of ore that can be mined cheaply are of interest as a reserve for the future.

Prepared by V.L. Eardley-Wilmot,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, March, 1944.

## MOLYBDENUM IN 1943

### Ores Mined and Producing Localities:

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 usually occurs in quartz veins, intruded into granites, or diorites. It generally occurs in the form of soft, pliable flakes or leaves, but is sometimes semi-amorphous, filling cracks and smearing the rock surface. It can readily be distinguished in the field by the olive grey-green smear it leaves when rubbed on glazed white porcelain or enamel. Graphite, for which it is often mistaken, leaves a grey-black smear.

Production was maintained chiefly from the LaCorne mine near Val d'Or; from Indian Molybdenum, Limited property (Dome Mines subsidiary) in the Abitibi region; from Quyon Molybdenum Company at Quyon, all in Quebec. A small amount of custom ore from Mont Cerf, Quebec, and from the Algoma district, Ontario, was treated in the LaCorne mill.

During 1941 and 1942 intensive investigation of all possible Canadian sources of molybdenum was necessitated because of the inadequate supply of the metal and the advice from Washington that there would be further curtailing of exports to Canada. As known Canadian deposits could not compete at the market price, the Metals Controller arranged to pay producers 85¢ per pound of contained sulphide in concentrate containing 80 per cent or more  $\text{MoS}_2$ . (U.S. market price is 45 cents). Since August, 1943, there has been a marked improvement in the supply as a result of the curtailment in production of certain armaments and of the large use of scrap metal containing molybdenum. Large stocks are on hand in Canada and the United States, consumption has decreased and production is abnormally high. Production from the Dome (Indian Molybdenum) and LaCorne mines in Quebec is more than sufficient to supply Canada's present requirements.

Present indications are that the Abitibi area in Quebec will continue to be the principal source of production in Canada. The area is about 100 miles from the Ontario boundary and in general extends from Rouyn to Val d'Or. It is probably one of the most favourable localities for the discovery of other workable deposits.

Owing to the greatly increased demand for molybdenum, there was much development and prospecting activity in the first half of the year on some of the 400 occurrences and deposits known throughout the Dominion, a few of which are mentioned below.

In Quebec, Wartime Metals Corporation took over the LaCorne property of the Molybdenite Corporation of Canada in July 1942, and made arrangements for Siscoe Gold Mines, Limited to operate the mine. Production at the 200-ton mill began in May, 1943, and by the end of December, nearly 50,000 tons of ore containing between 0.6 and 0.7 per cent  $\text{MoS}_2$  had been treated. The mine is the largest Canadian producer of molybdenite, which occurs as relatively small flake scattered through quartz veins in which white sericite schist is abundant in places. Two distinct types of ore occur and when development was started the east-west quartz veins were considered to be the main source of the ore, but the average grade of the ore in the north-south veins, characterized by the presence of red feldspar, and more difficult to find and to follow, was found much higher, and these veins are wider. In places the east-west veins contain bismuth minerals, but the amount of bismuth in the final concentrate is apparently not harmful, though an endeavour is being made to reduce it. The mine is being developed to a depth of about 250 feet on two levels. The present operator has expanded the old workings laterally but no exploratory work has been done below the old second level. The best ore found so far has been opened up for over 400 feet on the lower level at the northeast end of

the north-south vein system. A similar ore shoot occurs on the upper level.

In 1942 Dome Exploration Company discovered a large body of disseminated molybdenite apparently of good grade on the southern part of the old St. Maurice Mines property in Preissac township, about 20 air miles northwest of the LaCorne mine. Indian Molybdenum, Limited, the operator, is developing the property by means of a flatly inclined shaft, which extends to a vertical depth of 200 feet. Diamond drilling on the surface had indicated an ore zone about 400 feet long and nearly 40 feet wide, averaging about 0.9 per cent  $\text{MoS}_2$ , but development has shown that the grade is less than 0.5 per cent. The molybdenite is similar to the LaCorne ore; it occurs in a quartzose-sericite zone dipping about  $50^\circ$  northeast and is bounded by faults between red and grey muscovite and biotite granites. At the end of May 1944, the mill was operating near its capacity rate of 500 tons of ore daily and was producing a concentrate containing about 90 per cent  $\text{MoS}_2$ . The Company has a contract with the Dominion Government to deliver 2,000,000 pounds of contained molybdenum sulphide in concentrate by the end of 1944. Neighbouring claims have been prospected by various companies and Steeloy Mining Corporation has diamond drilled claims south of the Dome property, but to date no comparable ore-body has been found. The Company also prospected occurrences of molybdenite on claims bordering the LaCorne mine. Molybdenite of fair grade occurs at the centre of the west shore of Kewagama Lake, about 2 miles east of the Dome property. LaPause Gold Mining Corporation did some prospecting seven miles east of the Dome property and L.A. Monpas prospected the Legault property, nine miles east of Dome. The ore on both properties is low grade, disseminated and irregular. Work started by National Molybdenum Mining Syndicate in the fall of 1942 on the Zagarski property in Piermont township, northeast of the LaCorne mine, was continued for a few months in 1943 and some fair-grade molybdenite was found in a shear zone. Dumont Molybdenite Exploration Company (a subsidiary of Sullivan Consolidated Gold Mines, Limited) diamond drilled under a spectacular showing of molybdenite on the south side of Roy Lake in the northeast corner of LaCorne township, but the ore-body was shallow and operations were discontinued. Norseman Mines, Limited prospected showings of molybdenite on ground adjoining LaCorne mine and also north of the Dome (Indian Molybdenum) property.

About 35 miles northwest of Ottawa, Quyon Molybdenite Company, the second largest Canadian shipper of molybdenite, treated close to 150 tons of ore a day of an average grade of 0.25 per cent  $\text{MoS}_2$ . The concentrate produced is converted to molybdic oxide in a small roasting plant on the property, and is then briquetted and shipped to steel manufacturers in Canada. During the last war this mine was the world's largest producer of molybdenum and it contributed nearly 80 per cent of Canada's output before 1939. Extensive diamond drilling by the Dominion Government in 1942 indicated considerable reserves of low-grade ore. The company had a contract with the Dominion Government to produce a total of 100 tons of contained molybdenum in the oxide. The contract was fulfilled early in May, 1944. Vic-Ore Molybdenite Company which operates the old Bain mine in Masham township, 12 air miles northeast of the Quyon mine, increased the capacity of its pilot mill from the former rate of 10 tons a day to 50 tons a day and erected more buildings on the property. Exploratory work by the Company in an area at the east end of Indian Lake resulted in a few car lots of low-grade ore being put through the mill, but the few hundred pounds of concentrate produced was not up to standard grade. The grade of 8 tons of ore shipped by the Company to the Bureau of Mines, Ottawa, early in 1943 for concentration tests was considerably higher than that treated in its mill. The Company has a contract with the Dominion Government, which expires June 30, 1944, but by the end of May no shipments had been recorded. Work is at present being carried out on the Bain

property by Operators, Limited of Montreal for Vic-Ore Company. Norwin Molybdenite Mines Limited prospected the old Chaput-Payne property near Breckenridge on the top of the Eardley hills, in Eardley township, 20 miles northwest of Ottawa, and shipped 7 tons of ore containing 1.00 per cent  $\text{MoS}_2$  to Ottawa for sampling and assay. Occurrences on the top of the escarpment were diamond drilled by the Company in 1942 but no ore-bodies of commercial size or grade were found. The Company discovered some spectacular ore in 1943 lower down the hill on the Pink claim, from which a few hundred pounds of 3.0 per cent ore was cobbled and stockpiled. Work ceased on all the Company's claims in December, 1943. Molyca Mines, Limited, Montreal, prospected the old Moodie showings in Aldfield township, 3 miles east of Ladysmith and 20 miles north of the Quyon mine. The Company cobbled and stockpiled two tons of ore and discontinued operations on the property in July, 1943, as practically all the ore had been mined. Farley Mining Company continued work on the LaFleur deposit in Egan Township near Mont Corf, 15 miles north of Maniwaki, for a few months. It shipped 76 tons of 1.15 per cent ore to the Zenith mine near Renfrew, Ontario, in the fall of 1942 and in March, 1943, a few tons of high-grade cobbled ore to the LaCorne mill; that shipped to the Zenith mine was re-cobbled and shipped to LaCorne for treatment. Occurrences of molybdenite on the LaFleur property are spectacular but pockety, and operations ceased in May, 1943. In the Eastern Townships of Quebec, prospecting was done in the summer of 1943 by MacMillan Prospecting Syndicate near St. Sebastien on the slopes of Little Megantic mountains in Gayhurst township. The ore consists of fairly large zones of low-grade finely disseminated molybdenite in a network of quartz veins in granite and slate. The property, which has reverted to the original owners, P. Dostie and T. Doyon of Thetford Mines, would merit further attention should the demand for molybdenite increase.

In Ontario, prospecting was continued by North American Molybdenum Corporation on the property of Nakina Molybdenite Mines, Limited on the southwest side of Burrows Lake, 14 air miles northwest of Long Lac station. The molybdenite is below commercial grade, and work on the claims was abandoned in the fall of 1943. Net Lake Molybdenite Mines, Toronto, did some stripping and trenching on the old Barton property in Strathy township, 4 miles north of Timagami. Early in 1944 these and adjoining claims in Denton township were acquired by Aumo Porcupine Mines, Limited and a diamond drilling program is planned. High-grade molybdenite is reported from previous drilling and prospecting in the area. Creamar Molly Mines, Limited did considerable diamond drilling in Gaudette township, near Searchmont, Algoma District. Fairly good ore was found on the surface, but very little was found at depth by drilling. The Company shipped a car lot of ore to the LaCorne mill. About 75 miles northeast, Deep Lake Gold Mines, Limited, Akron, Ohio, prospected the Peters-Quilty showings west of Limer station. Wartime Metals Corporation discontinued its operations at the Zenith mine southwest of Renfrew, early in 1943, as the deposit proved too low grade. The Company shipped a car lot to the LaCorne mill in March 1943. Some prospecting was also done in the Tory Hill property near Wilberforce.

In Manitoba, Molybdenum Corporation, Limited, Winnipeg, prospected the Presto group near the San Antonio gold mine in the Rice Lake area. J. H. Poirier continued prospecting in the vicinity of High Lake in the southeastern part of the Province along the Ontario boundary.

In British Columbia, very little work was done on molybdenite deposits. Consolidated Mining and Smelting Company discontinued work at the Molly mine on Lost Creek in Salmo area in February 1943, as the ore-body was not continuous and as only a small tonnage could be extracted at a high cost. About 200 tons of one per cent ore are stockpiled. No work was done on the Company's deposit on Boss Mountain, Lake La Hache, in southern Cariboo. The property was drilled by the Government in 1942 and is regarded as the most promising molybdenite deposit so far found in the Province. Early in 1943 Bralorne Gold Mines

discontinued work on the Little Keen molybdenum-tungsten property in the Sheep Creek area. About 20 tons of ore containing 2 per cent  $\text{MoS}_2$  ore was stockpiled. The property has reverted to J. Sapples, the owner.

#### Production and Trade:

From the 121,700 tons of ore treated in 1943 by the three producers (LaCorne, Indian Molybdenum, and Quyon Molybdenite), about 508 tons of high-grade concentrate was produced and 361 tons of concentrate and molybdenum trioxide was shipped, the 192 tons of contained molybdenum being valued at \$583,139. In 1942 37 tons of contained molybdenum, mainly as the oxide, was shipped to consumers. The concentrate from Wartime Metals Corporation's LaCorne mill and from the Indian Molybdenum mill are shipped through the Metals Controller to Climax Molybdenum Company at Langeloth, Pa., for conversion into oxide or ferromolybdenum and an equivalent amount of these products is shipped from the United States to Railway and Power Company, Montreal, the distributor for Canada.

Prior to the war, 91 per cent of the world production, estimated at 16,500 tons of metallic molybdenum, came from the United States. Climax Molybdenum Company, at Climax, Colorado, the world's largest producer, is treating daily 18,000 tons or more of ore containing about 0.5 per cent  $\text{MoS}_2$  and probably contributes 70 per cent of United States total. The remainder is obtained as a by-product of some large copper producers in Utah, New Mexico, and Arizona. The Molybdenum Corporation of America near Questa, New Mexico, is the only Company except Climax, that produces molybdenite solely for the recovery of molybdenum. The Molybdenum Corporation is also developing the Urad mine, Colorado, for the United States Government and production is expected to start in the summer of 1944.

Production from Cananea, Mexico, is estimated at the equivalent of 850 tons of the metal a year; and a slightly smaller production is obtained 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 1940 being 500 short tons. Other producing countries were Peru, French Morocco, Korea, Greece, Turkey, Yugoslavia, Australia, and recently Manchuria.

#### Concentration Methods:

The crude ore, crushed to a certain mesh size (depending on degree of fineness of the mineral), is passed over a classifier and concentrated by ordinary flotation methods using kerosene and pine oil as reagents. The final or cleaner concentrate is then passed over a small belt screen, usually 80 mesh, known as a "Callow" screen on top of which water is sprayed. Because of the tendency for pure molybdenite to coagulate into little balls and for the iron minerals, pyrite and pyrrhotite to separate out as fines, the latter are washed through the screen leaving the clean  $\text{MoS}_2$  on top. The fines are returned to circuit so as to recover any molybdenite that may have passed through the screen. This is usually sufficient to remove the iron sulphides, but if they are in excess the concentrate can be roasted and the iron removed magnetically. As various molybdenite ores react differently, preliminary tests should always be made to determine the proper flow-sheet before erecting the concentrator. Bismuth minerals can be largely removed through the Callow screen and if necessary by tabling the final concentrate. The small amount of bismuth in the concentrates from the LaCorne and Indian Molybdenum mills is not harmful as the bismuth is not soluble in liquid iron. Tests in which ferromolybdenum was made from concentrate containing 2.0 per cent bismuth (Canadian concentrates contain less) showed that nearly all the bismuth went into the slag. In any case, high bismuth material is mixed with low bismuth material before charging into furnace. A small amount of tungsten in molybdenite

concentrate is not objectionable as it and molybdenum are interchangeable and the tungsten may be beneficial.

#### Consumption and Uses:

Molybdenite concentrate is converted into an addition agent that is introduced into steel as molybdenum trioxide, ferromolybdenum, or calcium molybdate. The oxide is moulded into briquettes and 81 per cent of the Canadian consumption of molybdenum in 1943 was in this form and 17 per cent in the form of ferromolybdenum. There are nearly 50 users of molybdenum in Canada, but 94 per cent of the total consumption is by five steel manufacturers. Consumption in 1943, exclusive of scrap, was about 600 short tons compared with 72 tons in 1939.

Molybdenum has a widening range of uses, but by far the greater part of the output is used in steel to intensify the effects of other alloying metals, particularly nickel, chromium, and vanadium. These steels usually contain from 0.15 to 0.4 per cent molybdenum but in some instances the percentage is considerably higher.

Molybdenum alloys are used widely 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, stainless steels, and to some extent in high-speed tool-steels, and in numerous other applications. The use of molybdenum in cast iron has greatly increased in recent years. A magnetic alloy for permanent magnets contain 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 resistance and contacts and for heating elements contain molybdenum. The chemical applications continue to increase, one of which is the use of ammonium molybdate enamel to dull the bright surface of certain gun parts and to prevent rust. The salts are used in pigments and for analytical work. Molybdenite is a very efficient lubricant for bearings subjected to high temperatures in which oils break down.

#### Specifications and Prices:

In Canada throughout 1943 the Metals Controller contracted to purchase all domestic molybdenum products of marketable grade at a bonus price of not less than 85 cents per pound of contained sulphide in concentrate or \$1.75 per pound of contained molybdenum in the trioxide, f.o.b. Ottawa. After December 31, 1943, owing to changed conditions, no more contracts were given. New producers will have to sell in the open market at the normal price which is about 50 cents (Canadian funds). Canadian ore and concentrate shipped to the United States is subject to a duty of 17½ cents a pound of contained molybdenum.

The price per pound of contained molybdenum, f.o.b. Toronto in Canadian funds for the following imported compounds is approximately: Calcium molybdate (42% Mo), 98 cents; ferromolybdenum (60% Mo), \$1.15; and molybdic oxide (52% Mo), 98 cents. The calcium molybdate is sold in bags of about 12½ pounds containing exactly 5 pounds of molybdenum. The molybdic oxide briquettes weigh five pounds each and contain 2½ pounds of molybdenum.

United States specifications for concentrate dried at 212°F. are: MoS<sub>2</sub>, minimum 85 per cent; copper, maximum 0.6 per cent; iron, maximum 3.0 per cent; combined phosphorus, antimony and tin, maxima 0.2 per cent.

Prepared by V.L. Eardley-Wilmot,  
In the Bureau of Mines,  
Department of Mines & Resources,  
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## NICKEL IN 1943

### Ores Mined and Producing Localities:

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 of other areas in northern Ontario.

In Ontario, International Nickel Company of Canada, Limited, operated its mines and plants during the first half of the year 1943 at capacity. During the second half of the year two of the four blast furnaces at the Coniston smelter were shut down due to shortage of labour at the mines. The Company's producing mines are Creighton, Frood, Garson, and Levack. Sinking of the inside shaft at the Creighton mine was completed in October. Work in connection with the shaft and underground development of Stobie and Murray mines was carried on throughout the year. A construction program, started in 1941 at the mines, mill, and Copper Cliff smelter was continued. Most of the surface buildings have been completed, but considerable work remains to be done on the ore-sorting plants of the two mines under development.

Falconbridge Nickel Mines, Limited operated its mine and smelter at Falconbridge at capacity. The capacity of the smelting plant was increased following the putting in operation of a new blast furnace in March, 1943. Extensive exploration and development work was continued on several levels. The sinking of No. 5 shaft to a depth of 3,150 feet was completed early in the year, following which the opening up of the 2,625-foot and 2,800-foot levels was started. Deepening of No. 1 shaft below the 2,100 foot level was started early in 1944. Despite the increased production, the total ore reserves again showed a moderate gain, totalling 12,300,000 tons of 1.74 per cent nickel and 0.93 per cent copper.

Nickel Offsets, Limited, with a property in Foy township, west of Capreol, Sudbury district, continued the extensive surface exploration and diamond drilling that was started in 1939. No. 1 shaft was extended from 658 feet to a depth of 1,130 feet, and stations were cut at the 800, 950 and 1,100 foot levels. A total of 3,630 feet of diamond drilling was done underground. Shipments of ore to the Copper Cliff smelter were commenced in September and up to the end of 1943, a total of 5,753 tons had been shipped, with an average grade of 3.5 per cent copper, 4.3 per cent nickel, 0.14 per cent cobalt, and 0.18 ounce of platinum metals per ton. Mining of the lower grade ore, averaging 3 per cent nickel and 1.5 per cent copper, must await the erection of a concentrator, a project now under consideration.

The Company has decided to sink No. 2 shaft to an initial depth of 650 feet, at a point 3,000 feet east of No. 1 shaft and near a lense of ore already blocked out by drilling. The lense is estimated to contain 100,000 tons of ore averaging 1.95 per cent copper and 1.75 per cent nickel. The two shafts will be connected underground.

Ontario Nickel Corporation, Limited has been developing a nickel-bearing property in MacLennan township, southeast of Capreol, district of Sudbury since 1941. Considerable drifting, cross-cutting, and raising were carried out. A power line was brought in from the Falconbridge line, a distance of 7½ miles, a substation erected, and a full set of mining buildings were put up. Early in 1943 the Company arranged to ship crude ore to one of the smelters, and a test shipment was made in June. Operations ceased shortly afterwards. A re-organization took place in September and a new company, Ontario Nickel Mines, Limited, was formed to take over the assets of the Corporation. So far there has been no resumption of operations.

Denison Nickel Mines Limited did not operate its property in Denison township, near Worthington, southwest of Sudbury.

Harlin Nickel Mines Limited, a subsidiary of Clifton Consolidated Mines, Limited, took over the old Alexo nickel-copper property at Porquis Junction, Cochrane mining division in 1942. In 1943, the shaft was retimbered to the 120-foot level and the necessary mining buildings were erected. Production was started in June, 1943, and steady shipments to Copper Cliff Smelter are being maintained.

Shewan Copper Mining Corporation (371 Bay Street, Toronto) was incorporated in June, 1943, to take over the nickel-copper claims of Golden Gate Mining Company, situated on the north shore of Upper Shebandowan Lake, Port Arthur mining division, and about 3 miles from Kashabowie. Some surface work was done in 1943.

Dominion Nickel Mining Corporation was organized in 1943 to take over the old Whistle property and the Tough Estate claims in Norman township, and several claims in Blezard township, Sudbury district. Diamond drilling to a depth of 200 feet on the Tough property disclosed an orebody containing approximately 600,000 tons of 3 per cent nickel. Drilling is proceeding on the Whistle property and will be followed by drilling on the claims in Blezard township.

North Range Nickel Mines, Limited was organized in 1943 to take over an area adjoining the property of Nickel Offsets, Limited, in Foy township, Sudbury district. The property is part of the holdings of the R.J. Tough Estate, and the Company plans to do extensive diamond drilling in 1944.

Prospecting by H. Johnson to the northwest of Cat Lake, about 15 miles north of Bird River in southeastern Manitoba resulted in the discovery of a low-grade copper-nickel sulphide zone of apparently large extent.

Red Cloud Mining and Smelting Company was preparing early in 1944 to carry out a program of diamond drilling and a magnetic survey in a search for copper-nickel and chromite occurrences on its claims in the Bird River area, Manitoba.

#### Production and Trade:

Canadian production of nickel in 1943 was 143,882 tons valued at \$71,626,014, compared with 142,606 tons valued at \$69,998,427 in 1942.

The world production in 1939 (figures for 1940, 1941, and 1942 not available) was 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.

#### Market and Prices:

International Nickel Company estimated world consumption of nickel in 1939 at 128,000 short tons. This has since been greatly exceeded owing to the general speeding up of industry in order to augment the production of necessary war supplies. New applications of nickel developed in recent years have accelerated the consumption of nickel steels and alloys in a great diversity of form and composition.

The base spot price of nickel in the United States in 1943 was 35 cents per pound. The same price has ruled since 1928.

Prepared by A. Buisson,  
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## PLATINUM GROUP METALS IN 1943

### Source of Supply:

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, the entire Canadian output of platinum and allied metals is 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 been for several years 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.

Falconbridge Nickel Company, prior to the German invasion, exported its nickel-copper matte to its copper-nickel refinery in Christiansand, Norway, which was 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 International Nickel Company.

### Production and Trade:

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

The world production of platinum and allied metals is estimated to exceed 600,000 ounces. 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, accurate estimates on world production and consumption of platinum and allied metals for 1943 are not possible. The world consumption of platinum metals in 1939 was about equal to production (about 540,000 ozs.), a notable gain over the 1935 figure of consumption of 275,000 ounces.

### Market and Prices:

Industrial uses of the platinum metals continued to expand in 1943. Palladium is second in consumption and iridium third. Osmium, rhodium, and ruthenium are as yet consumed in relatively small quantities.

The market situation in 1943 is explained by Charles Engelhard, President of Baker and Company, Incorporated, in the following, which is abstracted from his annual review:

"Platinum was used during the last year almost exclusively in connection with the war effort. Details of its applications in the war program are not available for publication at this time.

"Palladium experienced an active demand, principally for jewelry, dental alloys, and electrical contact. Restriction on use of platinum in non-essential uses resulted in a greater demand for palladium in the production of

white metal jewelry. The trend in jewelry continued to favour the white metals.

"Previously overshadowed by iridium as a hardener of other platinum metals, ruthenium came into its own in that field during the last year. With iridium in short supply, the properties of ruthenium were investigated by the industry, and this member of the platinum group now fills an important place as a precious-metal hardener.

"The future for platinum metals is encouraging because of growing interest in this group by science and industry. Increased knowledge of the properties of these metals points to their greater usefulness in the chemical and allied industries in the postwar era. Expanded production of fiberglass, rayon, and electronic equipment was made possible during the last year by platinum.

"The future of palladium is viewed as bright, particularly in jewelry to supplant white gold, in dentistry to replace gold, and in the chemical industry for catalytic purposes. Current supply of palladium is ample. Palladium is quoted at \$24 an ounce troy, against \$35 an ounce for gold."

The use of rhodium for electroplating jewelry, because of its importance in the war effort, has been prohibited by the United States War Production Board. This precious metal is needed to coat reflectors in anti-aircraft searchlights and as an alloy of platinum to oxidize ammonia for the production of nitric acid.

With the exception of iridium, prices for the platinum group of metals remained virtually unchanged during 1943. The average price in New York (as given by M. & M. Markets of Eng. and Min. Journal) of refined platinum remained at \$36.00 per ounce throughout 1941 and 1942. From February, 1943, to the end of the year, the price of platinum was \$35.00 per ounce. Palladium at \$24.00 per ounce has remained stable in price since 1935. Rhodium continued to be quoted at \$125 per ounce, the same quotation prevailing since 1937. Ruthenium remained at \$35.00 throughout 1943. Osmium was quoted at \$50.00 throughout the year. Iridium was quoted at \$275.00 per ounce early in 1941, then dropped to \$175.00 in February and remained at that figure until the end of May, 1942, when the price was lowered to \$165.00 at which price it remained for the remainder of the year and throughout 1943.

Prepared by A. Buisson,  
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Department of Mines and Resources,  
Ottawa, Canada, February, 1944.

## SELENIUM IN 1943

### Source of Supply:

Selenium is fairly widely distributed but 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 Refineries, Limited, with refinery at Montreal East, Quebec, where production was commenced in November, 1934. Considerable quantities are produced 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 mine on the boundary line between Manitoba and Saskatchewan.

### Production and Trade:

Canadian production of selenium in 1943 was 380,200 pounds valued at \$665,350, compared with 495,369 pounds valued at \$951,108 in 1942.

World production of selenium is believed to approximate 600 to 700 short tons a year, the United States and Canada being the principal sources of supply. Small quantities are produced by several countries including Russia, Rhodesia, and Mexico. It is reported that selenium is being recovered from the copper-gold-arsenical ores of the Boliden mine, Sweden.

Selenium is used chiefly in the glass and pottery industries as a colouring agent (as in ruby glass) and to neutralize the effect of objectionable oxides. A large amount of selenium is used for controlling the colour of glass, especially in the production of pink or ruby glass. It is used in the photo-electric cell, or electric eye, which has many industrial applications, and in alloying stainless steel for screw and bolt stock, where it develops improved cutting and threading qualities. It is employed to improve the machinability of copper and copper alloys. Selenium and tellurium are used in the free machining of copper alloys where they offer certain advantages ~~to~~ lead and sulphur. Selenium has a large potential market in certain rubber compounding industries and is being used for the vulcanizing and fireproofing of switchboard cables and to increase the resistance of rubber to abrasion, research on such uses being still under way. It is used in the manufacture of certain kinds of paint and of certain dyes. As selenium oxychloride, it is a powerful solvent of many substances. Rapid progress is also being made in the production of high-quality selenium rectifiers, which require large quantities of selenium.

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.

Since August, 1938, the nominal price for selenium, black powdered, 99.5 per cent pure at New York has been \$1.75 a pound. The Glass Industry periodical gives the following quotations for selenium salts in 1943: barium selenite, \$1.40 to \$1.60 a pound, and sodium selenite, \$1.50 to \$1.65 a pound.



## SILVER IN 1943

### Ores Mined and Producing Localities:

Silver in 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.

About half of the silver produced in Canada comes from British Columbia, by far the largest producer in the Dominion being the Sullivan lead-zinc-silver mine at Kimberley in that Province. The remainder of the output in British Columbia comes from the Silbak-Premier, Bralorne, Pioneer, and several other gold mines; the silver mines of Beaverdell camp; and from various relatively small silver-lead-zinc mines. A small production is also obtained from gold placer operations.

In Saskatchewan, the output was mainly from the portion of the Flin Flon deposits lying within that Province.

In Manitoba, the production was from the copper-zinc ores of the Flin Flon and Sherritt Gordon deposits and to a lesser extent from the San Antonio, and other gold mines.

In Ontario, production from the mines of Cobalt and adjoining areas has been decreasing for several years and it is the activities in connection with the production of cobalt ore that is helping to keep many small concerns in operation in these areas. The increased production of silver from the nickel-copper mines of the Sudbury area in the past few years has partly offset the decline from the Cobalt area. Important contributions are also made by the gold mines of Porcupine, Kirkland Lake, and other areas.

The rapid expansion of mining in western Quebec in recent years has resulted in a marked increase in the production of silver which increased from 1,665,000 ounces in 1942, to 2,259,400 ounces in 1943, and is obtained from the copper-gold ores of Noranda, the copper-zinc ores of Waite-Amulet and Normetal, the copper-pyrites ores of Aldermac, and from the many gold mines of western Quebec.

In Yukon, production has been mainly from the silver-lead ores of the Mayo district. These mines ceased operation in 1941. Gold placer mining contributes about 20,000 ounces a year.

In the Northwest Territories, production was obtained from the silver-radium ores of Eldorado mine in the vicinity of Echo Bay, Great Bear Lake district, and from the gold ores of the Con-Rycon, Negus, Thompson-Lundmark, and other properties in the Yellowknife and adjoining areas. Operations at the Con-Rycon and Thompson-Lundmark were discontinued in 1943.

Plants for the production of the fine silver are operated by the Royal Canadian Mint, Ottawa; Hollinger Consolidated Gold Mines Limited, Timmins, Ontario; International Nickel Company, Copper Cliff, Ontario; Deloro Smelting and Refining Company, Deloro, Ontario; Canadian Copper Refiners, Montreal East, Quebec; and Consolidated Mining and Smelting Company, Trail, British Columbia.

### Production and Trade

The Canadian production of silver in 1943 was 17,230,939 fine ounces valued at \$7,797,689, compared with 20,693,101 fine ounces valued at \$8,726,296 in 1942, a decrease of 16.7 per cent

compared with 1942, and 20.8 per cent compared with 1941.

World production of silver in 1941 (1942 and 1943 figures not available), as estimated by the American Bureau of Metal Statistics, was 274,300,000 fine ounces, a new high, compared with 273,295,000 fine ounces in 1940.

Figures of production for Europe, Asia, Africa, and Australia are not available. The production in 1943 for the Western Hemisphere is estimated by Messrs. Handy and Harman at 166,000,000 ounces, compared with 173,200,000 ounces in 1942.

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

#### Market and Prices:

World consumption of silver in 1939 (1940-43 figures not available) was estimated by Handy and Harman at 441,300,000 ounces.

Silver consumption in 1943 in the United States and Canada, as summarized from the "Annual Review of the Silver Markets" by Handy and Harman, was as follows:

"The arts and industries used 125 million ounces in the United States and 4 million ounces in Canada. The Canadian consumption was practically unchanged from 1942, but the figures for the United States set a new record. Of the silver consumed in the United States during 1943, approximately 65 per cent was used in war production or for purposes classified as essential by the War Production Board. In these categories the largest single use was for photographic film, followed in order of quantity by silver brazing alloys and silver-lead solder, aeroplane engine bearings, electrical contacts and parts, military insignia, silver-plated eating utensils for the Army and Navy and in considerably less volume by medical and dental products.

In the non-essential field the manufacture of silverware and jewelry was limited throughout 1943 to using domestic silver only, and the amount for these purposes has been under quota restrictions.

For the first time since the establishment of the silver purchase program in 1934, United States Government holdings of silver showed a decrease. No foreign silver at all was bought during 1943, and acquisition of newly-mined domestic silver amounted to only 5,400,000 ounces, on the other hand, substantial quantities of bullion were released for various purposes."

The average estimated price of silver in 1943 (in Canadian funds) was 45.254 cents per fine ounce, compared with 42.166 cents in 1942. The maximum domestic price of refined silver in Canada was set in January, 1943, by the Wartime Prices and Trade Board, at 40 cents per ounce. The New York official price was 44.75 cents compared with 38.333 cents in 1942. The price which manufacturers in the United States can obtain silver has increased during the past year and a half from the pre-war level of 35 cents to 45 cents an ounce, and for many purposes to 71.11 cents an ounce. The higher figure (71.11) was established in September 1942, by the Office of Price Administration in the case of domestic silver, and in July, 1943, by the Green Act in the case of treasury silver.

Prepared by A. Buisson,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, February, 1944.

## TANTALITE-COLUMBITE IN 1943

### Ores Mined and Producing Localities:

Canada produces no tantalite or columbite, and known occurrences of these minerals are scarce and of undetermined economic interest. Both minerals are of increasing importance in the war effort, however, and tantalite has been placed in the group of "strategic" minerals having the highest priority rating. Accordingly, the following summary of information on Canadian occurrences, and on the present situation in respect to supply and demand, may be of interest.

The minerals tantalite and columbite are the tantalate and columbate, respectively, of iron and manganese, with the general formula  $(\text{Fe, Mn})(\text{Ta, Cb})_2\text{O}_6$ : they grade one into the other, according as whether tantalum or columbium predominates. Analyses show a range in the content of tantalum oxide of from 0.8 to 82 per cent, and of columbium oxide of from 3.5 to 78 per cent, the total content of the two oxides usually being about 80 per cent. There is no arbitrary dividing line between tantalite and columbite, and the name applied to the particular variety under consideration is usually governed by the predominant element. In practice, it has been customary to term the mineral columbite, or an ore of columbium, if it contains 50 per cent or over of columbium oxide; and tantalite, or an ore of tantalum, if it contains 30 per cent or more of tantalum oxide. In 1943, however, the specification for tantalite was set at a minimum of 40 per cent tantalum oxide for purchases for United States Government account. Both minerals commonly contain variable amounts of tin and titanium.

The occurrence of tantalite and columbite, and of all tantalum-columbium minerals, is restricted to granite-pegmatites, or to residual or alluvial deposits derived from such rock. Both minerals are likely to be found in any type of pegmatite, but tantalite usually favours pegmatites rich in lithium minerals, such as spodumene, amblygonite, and lepidolite. A number of minerals contain tantalum and columbium, and many of these are complex compounds of these elements with uranium, titanium, etc. All are comparatively rare, and they are usually distributed in their host rocks in amounts far below the economic level of recovery. Their complex composition makes extraction of the contained tantalum and columbium difficult and costly, and, accordingly, most of them cannot be regarded as possible sources of these elements. For the most part, the small quantities produced have been obtained as a by-product from mining of feldspar, mica, beryl, lithium, gem minerals, etc., and have been used for research or deposited in mineral collections.

Numerous occurrences of complex rare-element minerals containing tantalum and columbium are recorded in Canada, most of them in Ontario, Quebec, and Manitoba, where they are found mainly in pegmatites mined for feldspar, mica, beryl, or lithium minerals. For the reasons indicated above, however, these cannot be considered as being of economic value. Tantalite and columbite, but chiefly the latter, have been found in similar association, but in amounts of only mineralogic interest.

In 1942, discoveries of tantalite that appeared to be of possible economic value were reported in Preissac and Figuery townships, Abitibi county, Quebec. The occurrences were examined and reported on by the Geological Survey, and consist of pegmatite zones containing small amounts of irregularly distributed tantalite crystals. The richest surface showing in Preissac township, range VII, lot 53, indicated by test made at Sladen-Malartic Mines, Limited, a content of 3.8 pounds tantalite per ton. A small sample shipment, consisting of rock and picked crystals, was sent in 1943 by the above company to the Bureau of Mines, Ottawa, for test, and was treated by tabling, superpanner, and high-intensity magnetic concentrator. The indicated yield from the above composite material was 13 pounds of tantalite per ton. The mineral recovered contained 54.17 per cent tantalum oxide and 26.37 per cent columbium oxide; thus, as noted elsewhere, it would be regarded as an ore of tantalum. Tests made by an American company on a sample shipment from the occurrence in Figuery township indicated a grade of 2 to 4 pounds per ton, but the mineral was reported to contain only 25 to 30 per cent of tantalum oxide and would therefore

be classed as columbite.

Field parties of the Canadian Geological Survey have reported the extensive occurrence of pegmatite dykes in the Yellowknife area, N.W.T., many of the dykes containing lithium minerals favourable for the occurrence of tantalite. In several instances, tantalite-columbite was observed on dyke surfaces. During the 1943 field season, special attention was given to appraising the possible economic importance of the region as a source of tantalite, and several mining companies had parties in the area engaged in prospecting for tantalite and other minerals of strategic interest. Several discoveries of possible economic interest were made, notably in the vicinity of Prelude, Blaisdell, Ross, Sproul, and Buckham Lakes, and near Hearne Channel. Of 35 dyke sections selected for examination, 26 were found to contain tantalite-columbite, and in about half of those the mineral was fairly abundant. Other minerals often associated with the tantalite-columbite are cassiterite, spodumene, amblygonite, and beryl. Average size of the tantalite-columbite crystals, which occur distributed irregularly through the pegmatite rock, is usually under  $\frac{1}{4}$  inch and recovery would involve milling. The Sproul Lake discovery is only about 10 miles from the Thompson-Lundmark gold mine and hydroelectric power.

Three samples of tantalite-columbite-bearing rock from the Destaffany claims on Hearne Channel were submitted to the Bureau of Mines, Ottawa, in 1943 for test, and the mineral in each case was found to be columbite rather than tantalite, with tantalum oxide content (as indicated by its specific gravity,) of about 25 to 35 per cent. Concentration tests yielded products containing cassiterite and scheelite, which could not be mechanically removed, and containing from 3.59 to 8.7 pounds of combined tantalum and columbium oxides per ton of rock. The indicated value of such rock is too low to make it of commercial interest under present conditions.

Although mineral of a higher tantalum content has been found in certain of the dykes in the Yellowknife area, the economic possibilities of the region as a source of tantalite remain to be determined. A number of claims have been staked by prominent mining interests, and further exploration is planned.

The chief sources of tantalite proper have been Western Australia, Belgian Congo, Southern Rhodesia, Uganda, United States, and Brazil. The supply of columbite has come mainly from Nigeria, Belgian Congo, Southwest Africa, Argentina, and Brazil. Most of the African production has been derived from placer or stream deposits, and the South American ores from deeply-weathered pegmatites.

Brazil has recently come into prominence as a source of tantalite, and is now supplying an important part of the requirements, largely as the result of financial and technical aid given by the United States Government. About 400 small operations were under way in the northeastern part of Brazil in 1943, and production showed an increase of 140 per cent over 1942. It is expected that the output in 1944 will show a further marked increase. The ores are very lean, and it is estimated that 3,000 tons are required to yield 1 ton of clean tantalite. A large part of the production is recovered by crude screening, sluicing, and panning methods. The entire output is purchased, under agreement, by the United States Government.

#### Production and Trade:

The annual world output of tantalite-columbite is small, and few of the known commercial deposits are capable of supplying large tonnages. The richest concentrations are the eluvial and lode deposits of Western Australia, which have furnished most of the tantalite ore, and placer deposits in Northern Nigeria, from which has come the greater part of the columbite. In the United States, there has been a small production from pegmatites of the Black Hills, in South Dakota, part of which was recovered from pegmatites operated for lithium minerals. An interesting development in 1943 was the recovery of substantial amounts of microlite, a rare calcium tantalate

( $2\text{CaO}\cdot\text{Ta}_2\text{O}_5$ ), from the waste dump and workings of the abandoned Harding lithium mine at Taos, near Petaca, New Mexico, which was formerly operated for lepidolite and spodumene.

As most of the world production of tantalite and columbite finds a market in the United States, American imports serve to give the best index of output and consumption, and quantity and value are shown below for the period 1937-1941:

Imports of Tantalum and Columbium Ores into the United States, 1937-1941

<u>Year</u>	<u>Tantalum Ore</u>		<u>Columbium Ore</u>	
	pounds	\$	pounds	\$
1937	20,897	40,742	922,654	306,086
1938	41,706	80,092	645,141	228,078
1939	56,561	82,990	109,132	37,062
1940	490,460	258,514	595,220	210,526
1941 (a)	276,968	126,282	983,495	348,087

(a) First 9 months.

The average unit price over the entire above five-year period, as indicated by the totals of quantity and value, was 66 cents per pound for the material classed as tantalum ore, and 35 cents for that classed as columbium ore. The annual unit price of the former, however, shows a progressive drop from a high of \$1.95 per pound in 1937 to \$0.45 in 1941, while that of the latter remained stable at 33 to 36 cents. From this it would appear that the tantalum content of imports classed as tantalum ore has shown a marked decline, the drop being particularly marked in the last two years, when the price average was from 45 to 52 cents, as against \$1.47 in 1939. Since tantalite has always commanded a much higher price than columbite, a large part of the imports of tantalum ore in these years would therefore, seem to belong more properly in the classification of columbium ore, notwithstanding that the specification for the former type has been lowered substantially from that of earlier days, when 60 per cent tantalum oxides was standard.

From actual official production records, and allowing for smaller additional quantities that may slightly increase this total, the annual world output of tantalite-columbite ores has seldom, if ever, exceeded the 1,000-ton mark, and has generally been considerably less. High-tantalum ore has always been much rarer and in shorter supply than columbite, and although both tantalum and columbium have found important industrial uses, recent increased demand for the former, for military purposes, has aggravated the situation and made tantalite one of the present highest-ranking critical mineral commodities. As in the case of beryllium, ore supply of both metals has lagged far behind advances in industrial applications, and has held up use, a condition that shows little promise of being rectified.

Tantalum: Tantalum metal is highly resistant to corrosion, and possesses remarkable conductivity for heat. One of its important uses is in equipment such as stills, condensers, tubes, and heaters in chemical plants and laboratories, and more particularly in the absorption systems of hydrochloric acid plants. It is also used in radio tubes, lamp filaments, neon tubes, electrolytic cathodes, surgical and dental instruments, plates, wire foil, and bolts, heat interchanges, pump and valve parts, nozzles, spinnerets for rayon and other synthetic textiles, electrical contacts, temperature-control

apparatus, etc. It is being used to an increasing extent in the field of electronics, more specially for the tubes of portable transmitters, where its remarkable gas-absorptive and electron-flow control properties make it of high value, as well as for other undivulged military purposes. Ultra-hard cemented carbides of tantalum, alone or in combination with tungsten or titanium carbides, are being used increasingly in wire-drawing dies, cutting tools, and wear-resistant machine parts, and in large dies used in the cold-nosing of artillery shells. A cast alloy containing tantalum, columbium, and tungsten has a hardness approaching that of the hard carbides, and has much greater strength and toughness. A glass made from tantalum, tungsten, lanthanum, and boric oxides is being used in the wide-aperture lenses of aerial cameras, where it gives improved definition. Other special purpose glasses contain from 5 to 36 per cent of tantalum oxide. A newly announced use for fine tantalum wire is for the joining of nerve tissues severed by war injuries, and for moulded plates of the metal in repairing skull fractures.

**Columbium:** Columbium is employed chiefly as an alloying component in various special-purpose steels, and also in copper, aluminium, and other metals. In chrome steels, used extensively in petroleum cracking stills, the addition of about 0.5 per cent columbium inhibits intergranular corrosion and improves weldability, reduces air-hardening, and increases resistance to oxidation, creep strength, and impact strength. It is used extensively in stainless steels, which contain about 0.8 per cent columbium, and which are used in air-craft exhausts, manifolds, and collector rings. Iron with 3 per cent columbium can be used for high-pressure steam turbines; and, added to chromium-aluminium-iron used in the resistance wire of electric elements, it overcomes the detrimental effect of carbon on the life of the element. The addition of 0.58 per cent columbium raises the softening temperature of cold-rolled copper from 250°C. to 450°, and the addition of 0.29 per cent increases that of cupronickel from 500°C to 550°.

#### Market and Prices:

There are no users of tantalum or columbium ores in Canada, the chief world market being in the United States. The principal American consumer-buyer of tantalite is Fansteel Metallurgical Corporation, North Chicago, Illinois, and of columbite, Electro-Metallurgical Company, 30 East 42nd Street, New York City. These companies have been pioneers in the fields of industrial applications for tantalum and columbium metals, alloys, and products, respectively, and are the leading companies engaged in treating the ores.

Under the latest purchasing schedule, of May, 1943, the following provisions were made for the two classes of ore by the Metals Reserve Company in the United States:

**Tantalite:** Minimum tantalum oxide content, 40 per cent, with maximum tin oxide content 3 per cent, and maximum titanium oxide 3 per cent. For small lots of 100 to 200 pounds, the material must consist of clean tantalite crystals. The price for 40 per cent ore was set at \$1.75 per pound of contained tantalum oxide, rising by increments of 5 cents per pound to \$3.25 for 70 per cent ore, with no payment made for contained columbium oxide.

**Columbite:** Minimum columbium oxide content, 50 per cent, with maximum tin oxide content 5 per cent, and maximum titanium oxide 7.5 per cent. The material must be in the form of clean crystals. The price for small lots of 100 to 500 pounds was set at 25 cents per pound of ore, and for larger lots at 50 cents per pound of contained columbium oxide, with no payment for contained tantalum oxide.

Contracts for the sale of either ore of Canadian origin to Metals Reserve Company may be negotiated through the Metals Controller's Office, Ottawa. There are no restrictions against open sale of Canadian material in the domestic market or for export, but export permits are required for both minerals.

Effective November 1, 1943, the exportation of tantalum-columbium ores from the Belgian Congo and from the Belgian-mandated territory of Ruanda-Urundi, in East Africa, was reserved to the Government of the colony and purchases and sales were made subject to permit.

Throughout 1943, tantalum was in Group I (supply insufficient for war and essential industrial needs) of the list of critical materials issued by the Conservation Division of the U. S. War Production Board. Columbium was placed in Group I in April, 1943.

Tantalum metal prices in 1943 were \$160.60 a kilogram for C.P. rod, and \$143 for sheet, with discounts on volume business. Columbium metal was quoted at \$560 a kilogram for rod, and \$500 for sheet. Ferro-columbium, 50 to 55 per cent, sold for \$2.25 per pound of contained columbium.

(Note: Additional information on the occurrence and distinguishing characteristics of tantalite and columbite, is contained in the Prospectors Guide, Third Edition, issued by the Mines and Geology Branch, Ottawa, in 1943.)

Prepared by Hugh S. Spence,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, March, 1944.



## TELLURIUM in 1943

### Source of Supply:

Tellurium occurs native and as an essential constituent of several minerals, none of which has been found in commercial quantities. 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.

The electrolytic copper refineries operating in Canada have plants for the recovery of tellurium from their refinery sludges, and for the production of the refined metal. Ontario Refining Company at Copper Cliff, Ontario, started to produce tellurium in 1934, and Canadian Copper Refineries, Limited, at Montreal East, Quebec, 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. There has been no recovery as yet in Canada from the sludge of sulphuric acid chambers.

### Production and Trade:

Canadian production of tellurium in 1943 was 61,300 pounds valued at \$107,275, compared with 11,084 pounds valued at \$17,735, in 1942.

World production is estimated at 150 short tons a year, or about double the pre-war figure, and Canada and the United States appear to be the main sources of supply.

### Market and Prices:

Metallic tellurium, until quite recently, was of little industrial importance. Formerly it was used to a small extent in some radio work and also in the photographic arts and for blackening art-silverware. Small quantities are used as a colouring agent in the ceramic industry. When alloyed with lead, the tensile strength and toughness of the lead is increased greatly. Lead alloys containing from 0.1 to 0.5 per cent tellurium have been in use for some time in applications requiring resistance to vibration and corrosion. 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 is 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. A new use for tellurium is as a carbon stabilizer in cast iron, when it is used in the form of a ferrotellurium.

A nominal price for tellurium of \$1.75 per pound at New York prevailed throughout 1943.

Prepared by A. Buisson,  
In the Bureau of Mines,  
Dept. of Mines and Resources,  
Ottawa, Canada, February, 1944.



## TIN IN 1943

### Occurrences and Sources of Supply:

Tin is widely distributed, but in only a few countries are the deposits sufficiently large for commercial development. Cassiterite ( $\text{SnO}_2$ ) is the only important ore of tin and in the pure state it contains 78.6 per cent of the metal. Stannite, a sulphide of copper, iron, and tin, has little importance as an ore. In British Columbia, stannite is present in the ore of the Snowflake property, near Revelstoke, and cassiterite and stannite have been noted at several other places in the province. The small cassiterite content of the silver-lead-zinc ore of the Sullivan mine, at Kimberley now being recovered from the zinc tailing, is the source of Canada's production of tin. Cassiterite occurs also in many other places in Canada, but no commercial deposits have so far been found. In the unglaciated parts of Yukon, stream tin has been found in small quantities, but no serious attempt seems to have been made to test the gravels thoroughly for tin. During the past few years it has become apparent that many creeks in the Mayo district carried some crystalline cassiterite in their gold placers. Some evidence has been gathered showing the likelihood of there being some 200 to 300 tons of tin available as cassiterite in the placers of Dublin Gulch and Haggart Creek. In August, 1943, a lode source of this tin was found on the north side of Dublin Gulch assaying from  $\frac{3}{4}$  to  $1\frac{1}{2}$  percent in tin across an approximate width of three feet.

The tin concentration plant of Consolidated Mining and Smelting Company at Kimberley commenced operation on March 1st, 1941, and has been functioning very satisfactorily. The plant for the production of refined tin was in commercial operation in April, 1942. The tin content of the ore is small and the recovery is proportionately small.

### Production and Trade:

Figures of production and trade are not available owing to the war.

The tin produced at Kimberley and the small domestic recovery of secondary tin are far from sufficient to meet the Canadian requirements, which in peacetime amounted to about 3,000 tons a year, and are now much larger. They were obtained mostly from smelters in the Straits Settlements. The position of the Allied countries in respect to tin became critical with the capture by Japan of these smelters and of the Malayan tin mines, and the civilian use of the metal has been greatly curtailed. The search for commercial deposits of tin in Canada was continued and some occurrences of possible economic interest were found by a Geological Survey party in the Yellowknife area, Northwest Territories. Elsewhere, the results were not encouraging.

### Market Conditions, Uses, and Prices:

Because of changing conditions and the wide range in the market value of the metal, no definite statement can be made as to what constitutes payable ore. Under wartime conditions, however, provided the deposit is reasonably large, it is worthy of attention, even though the grade of the material is lower than would ordinarily be regarded as suitable for commercial development. Most tin ores are too low in grade to be treated directly and accordingly must be concentrated. Concentrates are in most cases purchased on a 60 per cent tin basis and for each unit or fraction above or below 60 per cent the returning charge is reduced or increased. They are subject to penalties if they contain more than one per cent sulphur

and 5 per cent iron. Antimony, arsenic, bismuth, copper, lead, and other impurities are not penalized. Consolidated Mining and Smelting Company is prepared to treat tin concentrate at its new smelter at Kimberley to the limit of its relatively small capacity.

The only other tin smelter on the North American Continent is the new smelter at Texas City, Texas. This Government-sponsored smelter was built by Tin Processing Corporation of New York and has a capacity of 50,000 tons of concentrate a year. It was ready for operation in April, 1942. Following its entry into the war, the United States took over all the supplies of the metal in that country and specific allocation of tin was taken over by the Director of Priorities.

Tin is used chiefly in the manufacture of tin plate, mainly for use in the making of tin cans and of containers of all kinds. It is a necessary ingredient of solder and is a component part of most babbitt and other anti-friction metals, without which manufacturing and transportation would be impossible. Smaller quantities are used in foil, which in turn is used for wrapping food, tobacco, etc.; in terne-plate, pipe and tubing; type metal; bronze; galvanizing; and in bar tin.

The prices of tin in New York were fixed in August, 1941, at 52 cents a pound and remained at that level to the end of the year and throughout 1942 and 1943.

Prepared by A. Buisson,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, March, 1944.

## TITANIUM IN 1943

### Ores Mined and Producing Localities:

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

Ilmenite or titanite iron ( $\text{FeTiO}_3$ ) 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 ( $\text{TiO}_2$ ), 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 Vermilion 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 ferrotitanium, 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.

### Production and Trade:

The production of titanium ore in 1943 was 73,723 tons valued at \$312,032 compared with 10,031 tons valued at \$50,906 in 1942. Canadian 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, Australia, United States, and Canada. Brazil is the principal producer of rutile, and Norway is second in importance.

The United States has become virtually self-sufficient in supplies of ilmenite with the completion of the plan to exploit the Adirondack titaniferous iron ores. This deposit, known as the MacIntyre Development, is situated at Newcomb, Essex county, in northeastern New York State. Development of the property was started in 1941 by the Titanium Division of the National Lead Company, and the property was put into production in August, 1942. The program of operations called for a daily mine output of 5,500 long tons of ore analyzing 16 per cent  $\text{TiO}_2$ , from which were to be produced 800 long tons of ilmenite concentrate containing about 48 per cent  $\text{TiO}_2$ . Titanium ore is also produced in the United States in Arkansas, Carolina, Florida, and Virginia. The ilmenite concentrates shipped run from 42 to 54 per cent  $\text{TiO}_2$ , and rutile concentrates from 92 to 95 per cent  $\text{TiO}_2$ .

### Market and Prices:

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 deoxidizer 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 carbontitanium alloys are now available. 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, in steel manufacture, and in the ceramic industry.

The situation with respect to titanium dioxide pigments has remained unchanged during 1943. All of Canada's requirements were imported from the United States and the expanding demand continued to be met. Late in the year minor delays were encountered in completely filling orders, but this condition is expected to ease during 1944.

The New York quotation for ilmenite remained at \$28 to \$30 per gross ton of 60 per cent  $TiO_2$ , f.o.b. Atlantic seaboard. The price for rutile 94 per cent  $TiO_2$  remained at 8 to 10 cents per pound of concentrate. The price of ferrocabontitanium f.o.b. plant remained at \$142.50 a ton, and metallic titanium at \$5 to \$5.50 a pound throughout 1943.

PREPARED BY ARTHUR BUISSON,  
IN THE BUREAU OF MINES,  
DEPARTMENT OF MINES AND RESOURCES,  
OTTAWA, MARCH, 1944.

## TUNGSTEN IN 1943

### Ores Mined and Producing Localities:

Wolframite,  $(\text{Fe}, \text{Mn})\text{WO}_4$ , is the principal ore of tungsten, the next in importance being scheelite ( $\text{CaWO}_4$ ), a calcium tungstate. The former is a dark brown to black heavy mineral, which contains 76.4 per cent  $\text{WO}_3$  (tungstic oxide) when pure, and is not common in Canada. Scheelite, the chief Canadian ore of tungsten, is a heavy, fairly soft, usually buff, but sometimes white mineral with a dull lustre, which contains 80.6 per cent  $\text{WO}_3$  when pure. It is commonly associated with quartz and frequently occurs in gold-bearing veins and in certain contact metamorphic deposits. It can be detected readily (in the dark) by its brilliant pale bluish-white fluorescence under ultra-violet light and purple filter. Prospectors use ultra-violet lamps for this purpose are not made in Canada, but may be imported duty free from the United States. Information on these lamps may be obtained from the Bureau of Mines, Ottawa, or from the Provincial Departments of Mines. As a result of the marked improvement in the supply situation in 1943, Canadian requirements of tungsten are no longer difficult to obtain.

A total of 754 tons of concentrate containing 409 tons of  $\text{WO}_3$  was shipped in 1943 which was more than  $2\frac{1}{2}$  times greater than in 1942. Consolidated Mining and Smelting Company's Red Rose property in British Columbia, and Hollinger Consolidated Gold Mines Limited, Timmins, Ontario, contributed about 61 and 30 per cent respectively of the total  $\text{WO}_3$  content of the shipments. About five per cent of the total was shipped by Little Long Lac Gold Mines, east of Lake Nipigon, Ontario, and Bralorne Gold Mines, Bridge River area, British Columbia. The remainder came from a number of shippers who sent their crude ore to the Bureau of Mines, Ottawa, or to Val d'Or, Quebec, for treatment. The figure for total shipments in 1943 does not include a production of approximately 135 tons of  $\text{WO}_3$  in concentrate from the Emerald property in southern British Columbia, which was stockpiled. The property was operating during the two months ended September 30th, on which date it was closed down.

### Producing Localities and Important Developments:

In Nova Scotia, there was no activity during 1943 following the cessation of operations on the Government project at Moose River in January. After the workings were dewatered, it was disclosed that almost all of the ore had been stoped out. About a car lot of ore containing 2.2 per cent  $\text{WO}_3$  was shipped to Ottawa for treatment. Early in the year the remaining few tons of low-grade concentrate at the Indian Path mine, Lunenburg, was also shipped to Ottawa.

In Quebec, all shipments were made through the Val d'Or plant of the Quebec Department of Mines, in which were treated about 35 tons of ore, mainly from Lamaque and the remainder from Perron, Central Cadillac, and Sigma gold mines in Quebec, and also about 600 tons of one per cent ore from the Kerr-Addison mine in the Larder Lake area, Ontario. The treatment of tungsten ore at the plant was discontinued in November, and from the beginning of the year until the cessation of this service, shipments of concentrate produced in the plant from Quebec ores had a total  $\text{WO}_3$  content of slightly more than two tons. Sullivan Consolidated Gold Mines, three miles northwest of Val d'Or treated about five tons of ore from the picking belt that averaged 6.0 per cent  $\text{WO}_3$ , but no shipments were made. Some prospecting was carried out on the Manley property south of Dupuy station in LaReine township near the Ontario boundary; in Gaboury township, east of Lake Timiskaming, and at Dassarat Lake, west of Noranda.

In Ontario, Hollinger Consolidated Gold Mines treated almost 30,000 tons containing 0.4 per cent  $\text{WO}_3$  from which about 117 tons of  $\text{WO}_3$  contained in high-grade concentrate was shipped, this being approximately 87 per cent of the total  $\text{WO}_3$  content of shipments from mines in Ontario. Fairly massive scheelite occurs in the Hollinger mine in zones or bodies in quartz close to the porphyry, from the surface down

to the 5,150-foot level. The company also treated some ore from the Aunor property in the Porcupine area. Its scheelite mill was closed down in September, 1943. Little Long Lac Gold Mines treated, in a small scheelite mill, close to 1,300 tons of ore containing 1.2 per cent  $WO_3$  from its property south of Geraldton and also 65 tons of ore containing 2.4 per cent  $WO_3$  from the Leitch gold mines at Beardmore. Most of the concentrate produced was low-grade material which was shipped to Salt Lake City, Utah. As noted elsewhere, ore from the Kerr-Addison mine was treated in the Val d'Or plant. The scheelite in the mine occurs as fairly large low-grade bodies in the low gold bearing tuffs. Small tonnages of ore from gold mines in Ontario shipped to the Bureau of Mines, Ottawa, for treatment, include:- Preston-East Dome; McKenzie Red Lake, Pickle Crow, and Delnite. Prospecting for scheelite was carried out in a number of widely separated areas in Ontario some of which were at the old Boston Bulldog mine near Rosegrove; west of Michipicoten Harbour, Algoma district; near Port Hope in the Rich Lake-Patricia district and near Fort Francis in the southwest corner of the Province.

In Manitoba, prospecting was continued early in the year in the Falcon-West Hawk Lake area and a ton of 0.5 per cent  $WO_3$  ore was shipped to Ottawa.

In British Columbia close to 97 per cent of the total of 261 tons of  $WO_3$  contained in shipments of concentrate from the Province came from Consolidated Mining and Smelting Company's Red Rose mine north of Hazelton, and the remainder came mostly from the Lorentzen, Bralorne and Phillips properties in the Bridge River area, the ore from which properties was treated in the Bralorne mill. The scheelite in the Phillips deposit is an unusual massive white variety. From the commencement of the year until it was closed down because of the improvement in the tungsten supply situation, the mill on the Red Rose property treated 18,000 tons of ore containing 1.7 per cent  $WO_3$ . Most of the concentrate produced from the mine contained 74.5 per cent  $WO_3$  and was shipped to Welland, Ontario, and the remainder, which contained 14 per cent  $WO_3$  was shipped to Salt Lake City, Utah.

During the short time it was in operation the 300-ton mill on the Emerald property, six miles southeast of Salmo, treated close to 9,400 tons of ore containing 1.73 per cent of  $WO_3$ . From this, high- and low-grade concentrates with a total  $WO_3$  content of 135 tons were produced and stockpiled. The deposits were discovered early in 1942 and from diamond drilling it is estimated that they contain several hundred thousand tons of ore averaging at least one per cent  $WO_3$ . This amount of ore is sufficient to meet any likely Canadian demand. The ore is rather finely disseminated and occurs in several contact metamorphic zones, mainly between granite and argillite. The property, which was operated by a Crown company, was closed down as a result of the marked improvement in the tungsten situation. Many other scheelite-bearing deposits in the vicinity of the Emerald mine were prospected in 1943.

Work on nearly all of the 100 occurrences of scheelite that were found throughout British Columbia during the past two years had ceased by the fall of 1943. Prospecting is continuing, however, on a discovery made late in 1943 by C.V. Harrison at the south end of Whitesail Lake, about 50 miles southwest of Burns Lake on the Skeena River. The scheelite occurs in quartzite and the deposit is said to be large. The contact metamorphic zones in the Salmo (Emerald) area appear to offer best opportunities in Canada for the discovery of tungsten deposits.

In the Northwest Territories, there was little prospecting activity after the spring of 1943. Tungsten Developers, Limited did some work on the Storm group near Gilmour Lake and shipped about a ton of crude concentrates to the Bureau of Mines, Ottawa, for further treatment, this resulted in the production of a concentrate containing 550 pounds of  $WO_3$  which was shipped to Welland.

In Yukon Territory operations were carried out in adjoining claims in the Dublin Gulch area about 35 miles north of Mayo by Lunde,

Swanson, and Seaholm. A few tons of high-grade concentrate from clean up operations was shipped to Vancouver for storage. A previous shipment to Ottawa containing scheelite, ferberite, and some tin, was sent to the United States early in 1943 for special treatment.

#### Production and Trade:

A total of 58,421 tons of ore was treated and 1,170 tons of high-and low-grade concentrates containing 526 tons of  $WO_3$  were produced. Shipments amounted to 754 tons of concentrates containing 409 tons of  $WO_3$  (327 tons of tungsten metal), valued at approximately \$1,083,530. Nearly 92 per cent of the  $WO_3$  content was in high-grade (74.3 per cent  $WO_3$ ) concentrate that was shipped to Welland, Ontario, the remainder being in low-grade (13.2 per cent  $WO_3$ ) concentrate that was shipped to Salt Lake City for chemical treatment. In 1942 a total of 260 tons of high-and low-grade concentrates containing 161 tons of  $WO_3$  and valued at \$406,275 was shipped. Producers stocks at the end of 1943 were nearly 470 tons of high and low concentrates containing 140 tons of  $WO_3$ . Approximately 390 tons of tungsten metal (contained in addition agents, powders, wire, rod, etc.) was consumed in Canada in 1943. Three car lots of scheelite containing close to 48 tons of tungsten were imported from Mexico. Exports consisted of 254 tons of low-grade concentrates (containing 37 tons of  $WO_3$ ) that were shipped to the United States for special treatment, chiefly to Salt Lake City.

Atlas Steel Company, Welland, Ontario, is the only Canadian consumer of concentrate, but it takes scheelite concentrate only.

World production of tungsten ore and concentrate in 1939, on a basis of 60 per cent  $WO_3$ , was about 40,000 metric tons, the principal producers being China, Burma, United States, Bolivia, Malaya, Portugal, Korea, Japanese controlled areas in south China, Australia, and Argentina.

China was the chief source of tungsten for 20 years prior to 1939, the record production being 16,257 metric tons of 60 per cent  $WO_3$  in 1937. In 1941, however, only 9,000 tons was produced. About 95 per cent of the output has come from Kiangsi, Hunan, and Kwangtung provinces, about 70 per cent being from the Nanling region in Kiangsi province. The ore mainly occurs as wolframite. Most of the mines in Kiangsi are still under Chinese control.

In Burma, the Mawchi tin-tungsten mine in south Kerenni State, 170 miles northeast of Rangoon, was the principal producer prior to the Japanese occupation and contributed about 60 per cent of the total output of 8,300 metric tons in 1941. The Tavoy region near the centre of the south Burma Peninsula was the next important producer.

Bolivia, the principal producer in South America, had an output of wolframite and some scheelite of over 5,000 metric tons in 1941. The largest mines are in the Department of La Paz. The Argentine output, which in 1941 was 1,800 metric tons, is exported to the United States.

In Europe, the most extensive tungsten deposits occur in Trás-os-Montes in northeastern Portugal. The largest mine is operated by a British corporation and in 1942 it produced over 200 tons of 70 per cent wolframite concentrate monthly. For past few years it has been Britain's principal source of tungsten. Production from Portugal in 1941 was 5,500 metric tons. Spain is also a producer of wolframite.

In the United States most of the output comes from California, Nevada, and Idaho, the largest producer being Vanadium Corporation at Pine Creek near Bishop, California, where a 1300-ton concentrating and chemical plant is in operation. Bradley Mining Company at Yellow Pine in Valley county, Idaho, which is next on the list, obtains much of its output from open-pit operations. Nevada is next to California in total output, the principal producer being Nevada-Massachusetts Company with mills at Mill City, Golconda, and Toulon.

Most of the ore mined in the United States is scheelite which occurs mainly in contact metamorphic deposits of tactite or skarn

(garnet-epidote-diopside-calcite-quartz-complex) and is somewhat similar to the deposits in southern British Columbia.

#### Uses:

As an alloying metal in steel, tungsten is used essentially to impart hardness and toughness, which are maintained even when the steel is heated to a high temperature. Almost 85 per cent of the consumption of tungsten in the United States is used for the production of high speed steels for cutting tools, in which the tungsten content is 15 to 20 per cent. As tungsten was difficult to obtain this amount was reduced considerably by the partial substitution of molybdenum. This may not be the case at present, however, as supplies of tungsten are readily available. Alloy steels containing tungsten are being used extensively in making armour plate, armour-piercing projectiles and other military equipment. Minor amounts of tungsten are used in steels for dies, valves, and valve seats for internal combustion engines, and for permanent magnets. Stellite, the best known non-ferrous alloy, contains 10 to 15 per cent tungsten with higher percentages of chromium and cobalt, and accounts for about two per cent of the tungsten consumed. Tungsten carbide is widely used as an extra hard cutting tool and for projectiles. Pure tungsten is used in lamp filaments (about 1.5 per cent of the 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.

#### Recovery and Treatment:

In the concentrators of Canadian gold mines in which scheelite occurs, a portion of the picking belt can be darkened and an ultra-violet lamp set up. The lumps of ore containing the fluorescent scheelite can then be sorted and stockpiled. In some mines the lamp is used underground for collecting scheelite from the broken ore. Some zones high in scheelite are mined directly for the mineral. Because of their high-specific gravity, tungsten minerals, when present, are found in the clean-up of placer gold operations. Small lode operators can make rough concentrate by crushing and sluicing. Tungsten minerals can be readily concentrated by gravity methods, provided the ores are relatively high-grade and free from metallic sulphides; otherwise, combined gravity and flotation methods should be employed. Some success has been achieved by the "Sink and Float" method.

During 1943 custom ores and crude concentrates were treated by the Bureau of Mines, Ottawa; by the Quebec Department of Mines plant, Val d'Or, Quebec; and by the War Metals Research Board, University of British Columbia, Vancouver. Ores are no longer being treated in the above plants, except by special arrangement.

#### Specifications:

Tungsten ores are concentrated to 60 per cent or higher of tungsten trioxide ( $WO_3$ ). For adding to steel, the ore is generally converted into ferro-tungsten, but sometimes into tungsten oxide, calcium tungstate, or tungsten powder. Canada has no plants for the manufacture of ferro-tungsten or other tungsten addition agents and the only company making tungsten steels is Atlas Steels, Welland, Ontario. Only scheelite is used by the Company at present, and the high-grade concentrate (not less than 70 per cent  $WO_3$ ) is added directly to the steel bath. This is possible because of the comparative ease with which the calcium forms a slag.

Specifications for scheelite in the United States are:  $WO_3$ , minimum of 60 per cent; copper and phosphorus, maximum of 0.05 per cent each; arsenic, antimony and tin, maximum of 0.10 per cent each; bismuth and sulphur, maximum of 0.50 per cent each; molybdenum, 0.40 per cent; and manganese, 1.00 per cent. For wolframite (or ferberite), 1.50 per cent tin is allowed, and a little higher percentage of arsenic and bismuth than in the case of scheelite. The ores may be lump or fine, or a mixture of both.

#### Prices:

The purchase price in the United States of domestic concentrate during 1943 was \$30 per short ton unit (20 pounds) of contained  $WO_3$  in the standard concentrate, less freight and penalties below 60 per cent  $WO_3$  and above impurities specifications. This price is to remain until April 30, 1944, and will then be \$24 a unit until June 30, 1944. Duty into the United States is 50 cents per pound of contained tungsten metal, but there is no duty on Canadian low-grade concentrates shipped for treatment. The United States price of 75 to 80 per cent ferro-tungsten is \$1.90 per pound of contained tungsten metal. The price of tungsten metal of 99 per cent purity is \$2.50 to \$2.75 a pound; and of 99.7 per cent purity, \$5.40 a pound.

The price in Canada of scheelite concentrate containing 70 per cent  $WO_3$  (within specifications) was \$26.50 a short unit of  $WO_3$ , delivered at Welland, Ontario, this being equivalent to about \$1,855 a short ton of 70 per cent concentrate, delivered. All sales of Canadian concentrate were made through the Metals Controller, Ottawa.

#### Situation.

Consumption of tungsten is largely dependent upon production of high speed alloy steels, but this production has declined considerably owing to the accumulation of stocks of bars and billets and to changes in the military program. As a result of this and because of the large supply of ferro-tungsten, concentrates, and scrap on hand, the Metals Controller, before the end of 1943, instructed all producers to discontinue their operations and to immediately ship the material on hand. He also gave notice that no new contracts to purchase would be made.

Prepared by V.L. Eardley-Wilmot,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, March, 1944.



## ZINC IN 1943

### Ores Mined and Producing Facilities:

Close to 55 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; the Lake Geneva lead-zinc property, Sudbury district; the Normetal and Waite-Amulet copper-zinc mines in northwestern Quebec; and the Tetreault and New Calumet lead-zinc mines in Quebec.

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. This mine contributes the greater part of the Canadian production of lead.

The Monarch mine of Base Metals Mining Corporation, reopened in the latter part of 1939, has been in production since January, 1940. A labour shortage existed throughout 1943, with the result that the tonnage milled was 28 per cent lower than in 1942, and only a limited amount of development could be done.

Western Exploration Company at Silverton was re-treating the tailings accumulated during previous operations, mainly to recover the zinc. The company's Mammoth mine was also in production.

The Lucky Jim mine, at Zincton, was taken over late in 1940 by Zincton Mines, Limited, a new company owned by Sheep Creek Gold Mines, Limited. The mine and concentrator were in production in 1943.

Reco Mountain Base Metals Mines, Ltd., a subsidiary of Gold Frontier Mines, Ltd., took over in 1942 the Noble Five, Surprise, and Deadman mines, near Sandon, Slocan Mining Division. The properties were explored by diamond drilling and underground development. The 100-ton mill of the Noble Five was rehabilitated and the production of lead and zinc concentrates was commenced in September, 1943. The concentrates are shipped under contract to Metals Reserve Company, United States.

The Whitewater mines and mill were acquired in the fall of 1942 by Kootenay Belle Gold Mines, Limited, and were prepared for production. Retallack Mines, Limited a subsidiary of Kootenay Belle Gold Mines, Limited, was formed in December, 1943, to take over the management of the property, and production is expected in 1944. An agreement has been negotiated with U.S. Commercial Company, a subsidiary of Metals Reserve Company, for the disposal of the lead and zinc concentrates. All the mill machinery and mine equipment has been transferred from the Kootenay Belle Gold Mines at Sheep Creek, and when added to the existing facilities of the Whitewater is expected to give an initial milling capacity of 300 tons a day.

The Van Roi mine on Four-Mile Creek, near Silverton, was being prepared for operation in 1943, after being idle for many years. The old mill is being re-modelled and will have a capacity of 300 tons a day. The property is being operated by Van Roi Base Metals, Limited.

The Kootenay Florence mine at Ainsworth, on the west shore of Kootenay Lake, was taken over in 1943 by Wartime Metals Corporation, a Crown company, and was operated as the Kootenay Florence Project. The mill equipment and machinery of Ymir Consolidated Mines, Ltd. was re-erected in the old Kootenay Florence mill building. Production was started in the spring of 1943.

Several small lead-zinc properties, mainly in the Ainsworth-Slocan area, were shipping crude ore to the Trail smelter. The Reeves McDonald zinc-lead mine on the Pend d'Oreille River remained idle in 1943.

The Tyee zinc-lead-copper property, near Chemainus, Vancouver Island, was acquired in 1942 by Twin "J" Mines, Ltd., a subsidiary of Jason Gold Mines, Ltd., and is being operated by the company under the

supervision of Wartime Metals Corporation. The property started production in the early summer of 1943. The zinc, lead, and copper concentrates are sold under contract to Metals Reserve Company.

In Manitoba, the rate of output of the Flin Flon mine of Hudson Bay Mining and Smelting Company was further increased in 1943. Major development and exploration work were behind schedule as a result of labour shortages and the necessity of diverting manpower to maintain maximum ore production. The South Main shaft was completed to the 3,250-foot level. Diamond drilling or "blast hole" drilling has largely replaced air machine-drilling for stoping. Work in the open pit was confined mostly to the mining of benches and floor pillars. The concentrator treated an average of 6,140 tons a day, compared with 4,710 in 1939. The zinc plant operated at capacity treating a slightly greater tonnage of zinc concentrate and produced more slab zinc than in 1942. Production in 1943 reached a record of 54,250<sup>tons</sup>; in 1939 it was 38,790 tons.

Emergency Metals, Limited, a subsidiary of Hudson Bay Mining and Smelting Company, was organized in 1942, as a war measure, to mine the remainder of the orebody at old Mandy mine. The 200-ton mill was put into operation in April, 1943, and operated at capacity the rest of the year. The shaft was unwatered to the 825-foot level. An active exploration campaign was carried on, but results so far are reported to have been disappointing.

Cuprus Mines, Limited, controlled by Hudson Bay Mining and Smelting Company was organized in 1943 to acquire the Thompson copper-zinc property and various adjoining claims at Schist Lake. The property was drilled in 1942, and the work in 1943 was confined to making a detailed geophysical survey of one of the more favourable areas.

Sherritt Gordon Mines, Limited operated its mines and mill at capacity in 1943 and the tonnage milled reached a new record. Of the ore mined and milled 65 per cent came from the West mine and 35 per cent from the East mine. In the West mine, No. 2 winze, which was started in 1942 from the 8th level, was completed in 1943 and stations were cut at the 9th and 10th levels at vertical depths of 150 feet and 300 feet respectively, below the 8th level. The winze was sunk on a 20-degree incline following the dip and rake of the bottom of the West orebody. A considerable amount of lateral development work was done on the two new levels. In the East mine, development was greatly curtailed from the spring to the fall of the year, owing to the shortage of underground labour. The zinc ore reserves are mainly in the East mine and these are being mined as rapidly as possible in order to take advantage of the present market for zinc concentrate. This ore is very low in copper and contains little gold. These reserves at the end of the year were 29,400 tons of 8.7 per cent zinc.

In Ontario, Lake Geneva Mining Company, Limited continued to produce lead and zinc concentrates in its 100-ton mill for Metals Reserve Company. The operation is performed through Wartime Metals Corporation. Extensive exploration was completed. This indicated the continuation of the veins and two new levels were opened up.

In Quebec, Normetal Mining Corporation, with mine and mill north of Dupuy, produced at a 20 per cent lower rate than in 1942. The mill averaged 563 tons of ore a day, compared with a rated capacity of 780 tons. Development was confined largely to lateral work on the 2,150-, 2,300-, 2,400-, and 2,600-foot levels. On the 2,700-foot level the main crosscut was driven through the ore zone. Mill feed averaged 3.25 per cent copper and 5.32 per cent zinc and the recovery was 6,224 tons of copper and 7,611 tons of zinc. Ore reserves reached a peak of 1,437,700 tons, with an average grade of 3.67 per cent copper and 6.94 per cent zinc.

Waite Amulet Mines, Limited continued the exploration and development of its various orebodies including the large "A" orebody in the Amulet-Dufault section of the mine. Its concentrator, put into

operation in 1939, was enlarged by a 300-ton extension for treating zinc ore from the Waito mine, which brought the capacity to 1,800 tons a day. The production in 1943 included 24,720 tons of copper, 40,740 tons of zinc, 41,483 ounces of gold and 702,330 ounces of silver. The company has entered into an agreement with an American company for the sale of its iron pyrites, which was previously discarded.

The Tetreault property near Notre Dame-des-Anges, Portneuf county, which was taken over in 1942 by Siscoo Gold Mines, Ltd., was operated under the supervision of Wartime Metals Corporation. The lead and zinc concentrates are sold under contract to Metals Reserve Company.

The Calumet mine, on Calumet Island, Pontiac county and about 60 miles west of Ottawa, was actively explored and developed. The property is operated by New Calumet Mines, Ltd., under the direction of Frobisher Exploration Company. The 300-ton mill of Stirling mine, Cape Breton, N.S., was purchased and this, with additional equipment, was installed to bring the capacity to 500 tons a day. The property entered production in September, 1943. The zinc concentrate is sold under contract to Metals Reserve Company.

Golden Manitou Mines, Ltd. took over in 1941 part of the holdings near Val D'Or of Quebec-Manitou Mines, Limited, and in 1942 completed the erection of a 600-ton mill for the production of zinc and gold concentrates. The capacity of the mill has since been increased to 900 tons.

Aldermac Copper Corporation is opening a property at Moulton Hill, Ascot Township, 4 miles from Sherbrooke. Underground development is proceeding; and expectations are that a 250-ton concentrator will be in operation in June, 1944. The ore is composed of copper, lead, and zinc sulphides, and contains appreciable amounts of gold and silver. The mill will produce copper, lead, and zinc concentrates for shipment to the United States. The proportion of metals in the sulphide is approximately 3 zinc, 1 lead, and 1 copper. A pyrites concentrates may also be produced.

Investigation in 1943 by Hollinger North Shore Exploration Company, (subsidiary of Hollinger Consolidated Gold Mines), of its concession near the Quebec-Labrador boundary, disclosed occurrences of zinc, which will be drilled in 1944.

#### Production and Trade:

Canadian production of zinc in 1943 was 304,284 tons valued at \$24,342,738, compared with 290,129 tons valued at \$19,792,579 in 1942. The exports in 1943, chiefly in the form of spelter, were 242,736 tons (zinc content) valued at \$16,516,365, compared with 231,816 tons (zinc content) valued at \$10,783,049 in 1942. The imports of zinc products of all kinds, including oxide and chemicals, were valued at \$4,116,156, compared with \$2,810,928 in 1942.

Figures for world production of zinc in 1943 are not available, nor are those for 1940, 1941, and 1942. Prior to the war, the principal producing countries, according to the origin of ore, were: United States, Canada, Australia, Germany, Poland, Mexico, and Russia.

Canada prior to the war, held fourth position as a producer of slab zinc, being surpassed by the United States, Belgium, and Germany. The last two countries, in addition to domestic ore, treated large quantities of imported ore. Canada now probably occupies second position.

#### Market and Prices:

The basic uses of zinc under war conditions are the same as those in peacetime, but in all fields of use the wartime demand for the metal is exceptionally large. 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.

A large percentage of the Canadian consumption of zinc is used in the war effort in the making of brass and bronze products, for galvanizing, for die casting, in zinc oxide, in dry batteries; and for miscellaneous purposes.

The average price of zinc for 1943, in Canadian funds (based on London quotations), was 4.00 cents per pound, compared with 3.41 cents in 1942. The St. Louis price was 8.25 cents throughout 1942 and 1943.

Prepared by A. Buisson,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, March, 1944.

## ASBESTOS IN 1943

### Ores Mined and Producing Localities:

Asbestos of commerce consists mostly of the three varieties known as chrysotile, amosite, and crocidolite or blue asbestos, with chrysotile being by far the most important and widely used. Three other varieties that have only a limited field of usefulness are fibrous actinolite, fibrous tremolite, and anthophyllite.

The asbestos produced in Canada is practically all of the chrysotile variety and comes almost entirely from areas of serpentized rock in the Eastern Townships, Quebec, where the producing centres are Thetford Mines, Black Lake, East Broughton, Vimy Ridge, Asbestos, and St. Remi de Tingwick. 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 14700 feet has revealed the presence of fibre comparable in quantity and quality with that in the present workings. Most of the output consists of vein fibre obtained from veins  $\frac{1}{4}$  to  $\frac{1}{2}$  inch in width, though veins exceeding 5 inches in width do occur. The fibres run crosswise of the vein 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.

In 1943 there were six producing companies. Asbestos Corporation, Limited worked two properties at Thetford Mines and one each at Black Lake and Vimy Ridge. Johnson's Company operated at Thetford Mines and at Black Lake. Bell Asbestos Mines, Limited operated at Thetford Mines; Quebec Asbestos Corporation, Limited, at East Broughton; Canadian Johns-Manville Company, Limited, at Asbestos; and Nicolet Asbestos Mines, Limited, at St. Remi de Tingwick.

The asbestos-bearing rock is mined in open pits and underground. Most of the underground work consists of block-caving, though other methods of underground mining are also used.

Small deposits of chrysotile asbestos are known in other parts of Quebec and also in Ontario and British Columbia. Several have been worked from time to time. The asbestos from some of these small deposits has a very low content of iron and is entirely free from magnetite, and should be suitable for use in making insulation for electrical machinery.

No amosite or crocidolite has yet been found in Canada, but there are numerous deposits of fibrous tremolite, fibrous actinolite, and anthophyllite, which varieties are commercially termed amphibole asbestos. The fibres of these varieties are harsher and weaker than those of chrysotile and there is little demand for them at present. 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 and in northern and western Ontario are of the amphibole varieties. The amphibole fibres are too harsh and brittle to be spun, but they have a higher resistance to acids than has chrysotile and it is possible that material from some of the deposits may be suitable for use in acid filters and for other purposes where long harsh fibres are required.

### Production and Trade:

The production of asbestos in 1943 amounted to 467,196 tons valued at \$23,169,505, compared with 439,459 tons valued at \$22,663,283 in 1942.

No data on imports and exports are available for publication owing to the war.

Few figures on recent world production are available, but it is known that Canada maintained its position as the principal asbestos-producing country. Other countries producing relatively large quantities of asbestos are Russia, Rhodesia, Union of South Africa, Swaziland, the United States, and Cyprus. Small shipments of asbestos are made from Australia (crocidolite), Bolivia (crocidolite), China (chrysotile), India (chrysotile), and Venezuela (chrysotile). The world's largest market for asbestos is in the United States, and Canada's proximity to

this market confers very real advantages on the asbestos industry in this country. Another development favouring the Canadian industry is the increasing demand for short grades of fibre for use in newly developed asbestos-cement products, and in moulded plastic articles.

Most of the Canadian production of asbestos is exported in the unmanufactured state, i.e. either in the crude condition (long-fibred material only), in a partly opened state, or completely fluffed out and ready for manufacture. The great bulk of exports goes to the United States, but substantial quantities are also exported to the United Kingdom and Australia. Since September 20, 1939, the Dominion Government has controlled the export of asbestos. Late in 1942 some minor modifications were made in the classification of standard grades of Canadian asbestos and this revised classification has been adopted by the Quebec Asbestos Producers' Association.

Market and Prices:

Asbestos is used for a great variety of purposes, the principal asbestos products being: brake linings, clutch facings, packings, cloth, insulation, mill-board, siding, shingles, roofing, tile, and pipes.

Current prices f.o.b. Quebec mines, in U.S. funds, tax and bags included are as follows: No. 1 crude, \$650 to \$750 per ton; No. 2 crude, \$165 to \$385; spinning fibre, \$124 to \$233; shingle fibre, \$62.50 to \$85; paper fibre, \$44 to \$49; cement stock, \$28.50 to \$33; floats, \$19.50 to \$21; shorts, \$12 to \$16.50 per ton.

Prepared by M.F. Goudge,  
In the Bureau of Mines and Resources,  
Department of Mines and Resources,  
Ottawa, June, 1944.

## BARITE IN 1943

### Ores Mined and Producing Localities:

Most of the relatively small amount of barite produced in Canada has come from Nova Scotia, and that Province contains the country's largest known reserves. Deposits are known in various parts of Nova Scotia, where mining for the mineral commenced between 1865 and 1870 and was conducted intermittently on a small scale for a number of years. The greater part of the production until recently came from deposits at Lake Ainslie, Inverness county, Cape Breton Island. The most important development in the history of the industry was the discovery in 1940 of a deposit of exceptional size and richness near Walton, Hants county. This deposit is being actively developed, and since the commencement of operations, three years ago, it has produced about 45,000 tons, or approximately 50 per cent of the total recorded Canadian output.

Scattered occurrences of barite are known in Ontario, the chief of which are in the Elk Lake, Porcupine, and Sudbury areas. Spasmodic attempts at development have been made, but with limited success and only a small total output.

In British Columbia, development was commenced in 1941 of a deposit near Parson, 25 miles south of Golden, and this is now supplying a substantial part of the domestic requirements.

Only Nova Scotia and British Columbia recorded sales of barite in 1943. The fluorspar ores of the Madoc area, Ontario, and of a deposit operated in 1942-1943 at Lake Ainslie, Nova Scotia, contain important amounts of barite. A small tonnage of handpicked barite has been stock-piled at the Lake Ainslie operation. Tests made by the Bureau of Mines, Ottawa, on ores from these two areas indicate the possibility of recovering a marketable barite by-product from them by flotation.

### Important Developments:

The barite deposit at Walton, Nova Scotia, shows promise of proving to be one of the largest known world occurrences of the mineral. Preliminary drilling of the property indicated reserves of  $1\frac{1}{2}$  million tons to a depth of 200 feet, and this tonnage was increased by further drilling in 1943 to a total of 3,000,000 tons, with one hole showing over 200 feet of barite. The deposit is being operated by Canadian Industrial Minerals, Limited (subsidiary of Springer-Sturgeon Gold Mines, 67 Yonge Street, Toronto), which to date has given chief attention to the production of a 325-mesh product for use in oil-well drilling. Shipments of crude ore have been made to the United States for use in the manufacture of lithopone and barium chemicals. The Walton barite is mostly off-colour material and rather heavily stained by iron, and is thus not suitable for the general pigment and filler trade without bleaching. It is high in barium sulphate, however, with a correspondingly high specific gravity, and is thus well adapted for use in drilling muds. The deposit is only  $2\frac{1}{2}$  miles from tidewater; and its large area permits open-cast methods of mining. Shipments in 1943 totalled about 20,000 tons, as compared with 16,000 tons in 1942, and 6,000 tons in 1941. Most of the production has gone to Trinidad, but it is expected that further important outlets will develop in the Venezuelan oil fields, and elsewhere.

Production from the Parson deposit, in British Columbia, operated by R. A. Thrall, Summit Lime Works, Lethbridge, Alberta, totalled 1,924 tons in 1943, compared with 1,917 tons in 1942. Most of the shipments have comprised crude ore, consigned to the plant of Pulverized Products Limited, 4820 Fourth Avenue, Rosemount, Montreal, for grinding. Some crushed or ground material is produced locally for sale to a western glass plant and for use in oil-well drilling. Colour and grade are good, with an average barium sulphate content of 96 to 98 per cent.

### Production and Trade:

Total production of barite in Canada in 1943 was 24,474 tons, valued at \$255,525, compared with 19,667 tons, valued at \$188,144, in 1942. These are by far the largest annual production figures in the history of Canadian barite mining.

Exports of barite are not separately shown in trade statistics, but approximated 20,000 tons. Most of the material was ground Walton barite consigned to Trinidad and Venezuela for use in oil-well drilling. Imports totalled 1,686 tons valued at \$43,239, as compared with 2,536 tons valued at \$68,196, in 1942.

World production of barite prior to the war approximated one million tons a year, of which Germany supplied 50 per cent and the United States 30 per cent. The remainder came mainly from the United Kingdom, Italy, Greece, France, and India.

### Market and Prices:

Canadian consumption of ground barite, estimated from import figures and domestic production, is less than 5,000 tons a year. There is little demand in Canada for crude barite for chemical uses.

Ground barite has a number of industrial uses, the chief of which are as a heavy, inert filler or loader in rubber, paper, oil-cloth, textiles, leather, and plastics. It is one of the most important pigments and extenders in paints, and it is used extensively as a weighting material in oil drilling muds to overcome gas pressures. In the United States, 66 per cent of the ground and crushed barite sold in 1942 was used in oil-well drilling; 12 per cent in the glass industry, where it serves as a batch fluxing ingredient for moulded flint glass; and 10 per cent in the paint trade.

For most filler and loader uses, and also for paints, barite is required to contain not less than 95 per cent barium sulphate and to have a good white colour; some off-colour material is also employed for less essential purposes. The best grades of prime white barite are produced by bleaching with sulphuric acid. A 325-mesh material is usually specified. For use in glass, barite must contain not less than 96 per cent barium sulphate, under 3 per cent moisture, and not over 0.4 per cent iron oxide, with a fineness within the range of 20 to 100 mesh. Colour is immaterial in barite for use in oil-well drilling, the requirements for which are a minimum specific gravity of 4.25 (corresponding to a barium sulphate content of 93 per cent) and a grind of 325-mesh. The Walton product more than meets this specification, having an average gravity of 4.40 and a barium sulphate content of 95 - 96 per cent,

Large quantities of barite are used in the lithopone and barium chemicals trades. In 1942, consumption of barite for lithopone use in the United States was 32 per cent of the total, and for barium chemicals 23 per cent, the remaining 45 per cent representing ground material employed for oil-well drilling, paints, and general filler and loader use. Barite for use in lithopone should contain not less than 96 per cent barium sulphate and not more than 3 per cent silica and 1 per cent iron ( $Fe_2O_3$ ). The ore must be crushed to not larger than  $1\frac{1}{2}$  inches.

Certain barium chemicals, notably the nitrate and carbonate, are used in making green flares, tracers, incendiary bombs, shell primers, etc., and for case-hardening of steel. Blanc fixe, or precipitated barium sulphate, is used in white paints, rubber, linoleum, and oil-cloth. Barium carbonate is the principal intermediate salt used in the manufacture of other barium chemicals, particularly the peroxide and nitrate. It is also used to inhibit scumming in bricks and other heavy clay products (see below under "witherite"). Barium chloride, obtained by crystallization from a solution of barium sulphide and calcium chloride, is used to purify salt brines for the manufacture of chlorine and sodium hydroxide; in coatings for photographic paper; as an extender in titanium pigments; in colour lakes; in finishing white leather, and in the purification of beet sugar. Barium hydroxide is

used in the purification of beet sugar, and in refining animal and vegetable oils.

Barium metal has only limited industrial uses. It is a very active deoxidizer, and is used in the form of wire coatings as a "getter" to remove traces of gas from radio, vacuum, and thermionic tubes. It also serves as a high-temperature lubricating film or coating on steel balls used for the rotating anodes of highly-evacuated small X-ray tubes, where oil cannot be used. Lead-calcium-barium alloys ("Frary" or "Ferry" metal) are used for bearings; and alloys of barium ("Baral" or "Barmag") with aluminium or magnesium, containing 25 to 50 per cent of barium, are on the market. Nickel-barium alloys with 0.2 per cent barium, are highly corrosion-resistant to hot gases and have been used in sparkplug electrodes. Nickel cathodes coated with barium oxide are used in electron tubes in place of tungsten, and are particularly advantageous in the smaller types of such tubes as they give a high yield of electrons per watt of heating energy.

Ample reserves of barite are available to the Allied nations. In the latter part of 1943, however, a production shortage started to develop in the United States as a result of increased demand for the mineral for use in the accelerated program of oil-well drilling, and the situation was aggravated by internal trade barriers. The lithopone and barium chemicals trades, which demand lump ore, were chiefly affected, the supply of ground material, available in part from concentrating mills, being less critical. As a result the American chemical trade began to evince interest in the large potential reserves of the Walton deposit in Nova Scotia, and early in 1944 substantial contracts for crude barite from this source were reported to have been negotiated by a leading American company.

Barite is a relatively low-price commodity. Canadian quotations for good white crude range from \$7 to \$10 per ton, f.o.b. mines, freight costs governing the price offered. Domestic ground barite sold in 1943 for \$40 per ton, f.o.b. works, and prime white imported for \$50.

In the American market, crude barite is usually sold on a penalty-premium basis, with a content of 95 per cent barium sulphate and 1 per cent iron oxide considered as standard. A premium or penalty of 25 cents per short ton is set for each per cent of barium sulphate above or below 95 per cent, and a similar premium or penalty for each 0.1 per cent of iron oxide below or above 1 per cent. Average prices for standard crude in the American market have been showing an upward tendency in recent years, and in 1942 stood at \$7.25 per ton, f.o.b. mines, with the average overall figure for all grades \$6.22. Early in 1943, the Office of Price Administration authorized price increases for crude from mines in the Georgia-Tennessee field, with a ceiling at \$8.50 per ton for 1943 contracts. Total United States consumption of barite in 1942 was 450,000 short tons.

#### Tariff:

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.

#### Witherite:

Commercial deposits of witherite (barium carbonate), the only other ore of barium, are rare and no occurrences of economic interest are known in Canada. Most of the world supply has come from England, but in 1942 a small amount was mined in California. American imports in recent years have been running at around 3,000 to 3,500 tons a year.

Interest in the mineral has been increasing, chiefly for the production of other barium salts for military use. Witherite is used in industry chiefly as an addition to heavy clay products and to mortar, in which it combines with soluble sulphates and prevents the formation of the unsightly white efflorescence known as "scumming". Artificial barium carbonate is being produced in Canada by Laprairie Company, Montreal, from Walton barite, this being the only important manufacture of barium salts in the Dominion. Witherite is also used as a carburizing agent in the case-hardening of steel, as a water softener, and in certain kinds of glass.

The Bureau of Mines, Ottawa, is interested in receiving samples from Canadian sources of mineral believed to be witherite, together with details of the locality of the occurrence, extent of deposit, etc.

United States quotations for ground, 90 per cent grade witherite in 1943 were \$43 per ton.

Prepared by Hugh S. Spence,  
 In the Bureau of Mines,  
 Department of Mines and Resources,  
 Ottawa, Canada, March, 1944.

## BENTONITE IN 1943.

### Ores Mined and Producing Localities:

Bentonite is a variety of clay derived from volcanic ash. Known commercial deposits in Canada are confined to the Prairie Provinces and British Columbia. All the clay is of the highly-colloidal or swelling variety.

In southern Manitoba, deposits have been under development for several years in the Morden area, where Pembina Mountain Clays, Ltd., 915 Paris Building, Winnipeg, has established a substantial production. This company originally produced clay for foundry use, but it has recently developed a domestic market for both natural and activated bleaching clay. Much of the activated material in 1943 was sold for use in oil refining, and production was increased to about 250 tons a month. The other main outlets are the soap and packing-house trades. In 1943, the company installed a drying plant and warehouse at Morden and added further drying equipment to its original Winnipeg plant, which is now engaged chiefly in producing activated clay. It also secured an option on other bentonite ground at Rockglen, Saskatchewan.

In southern Saskatchewan, numerous occurrences of bentonite exist in the Willowbunch-St. Victor-Eastend district, but so far there has been very little development there. In 1943, International Clay Products began production of a clay that underlies the Estevan lignite beds. This clay is not a true bentonite, but it has properties that make it a satisfactory substitute for bentonite for use in oil-well drilling, and a small initial output was marketed for this purpose in the Province. The material is reported to be specially suitable for drilling in brine formations.

In Alberta most of the production has come from the Red Deer Valley region, in the vicinity of Drumheller, where Gordon L. Kidd, of Drumheller, is the chief operator. Aetna Coal Company, of East Coulee, also produces a small tonnage as a by-product of its coal mining operations. Total output from this area in recent years has averaged about 1,000 tons a year, all of which was shipped to Alberta Mud Company, 502 Lancaster Building, Calgary, and to Mineral Sales, Ltd., 8th Avenue West, Calgary, for use in oil-well drilling in the Turner Valley field. The price of the crude clay has been \$5 to \$6 per ton, f.o.b. cars. Since 1937, when shipments began, to the end of 1943, production from the district has totalled about 6,500 tons.

In southern British Columbia, bentonite occurs in beds of considerable thickness near Merritt and Princeton. Occasional small shipments have been made from the latter area, mostly to Vancouver for grinding and local use. The Princeton deposit is controlled by Francis Glover, 1029 Marine Building, Vancouver, who reported a shipment of one carload in 1943 to Gypsum, Lime, and Alabastine Canada, Ltd., New Westminster.

The bentonite of the Prairie Provinces occurs at various horizons in beds of Upper Cretaceous age. The deposits in British Columbia are of Tertiary age.

### Production and Trade:

Production of bentonite in Canada in 1943, including both natural and activated clay, was valued at \$116,932, compared with \$44,204 in 1942, an increase of more than 250 per cent. The value of the Manitoba production was \$110,428, or nearly 95 per cent of the total.

Canada exports little or no bentonite. Substantial quantities of activated clay of the "Filtrol" type are imported from the United States for bleaching in oil refineries and for packing house products and possibly also some ground natural bentonite for similar use. Considerable quantities of American ground bentonite for foundry use and for other minor industrial purposes are also imported. Imports of activated clay for oil refining in 1943 were valued at \$295,066.

No world figures of bentonite production are available. The United States produces and uses most of the output, but also exports ground natural clay for foundry and other uses, as well as activated

material for bleaching. Production in the United States amounted to 375,000 tons in 1942, and the output in 1943 is estimated to have risen to about 450,000 tons, a gain of 20 per cent and an all-time record. Value of the production in 1942 was \$2,548,509. In that year, 61 per cent of the total tonnage came from the Wyoming-South Dakota field, the remainder being derived mainly from Texas, California, Arizona, Mississippi, and Utah.

#### Market and Prices:

The chief uses for bentonite are as a bonding ingredient in foundry sands; for the bleaching of mineral and vegetable oils and packing-house products; and to control the viscosity of oil-well drilling muds. In the United States, in 1942, 84 per cent of total bentonite sales went to these three major uses. For bleaching purposes, both natural and activated clay are employed.

Improved technique developed in the United States in 1943 in the use of synthetic moulding sands bonded with bentonite has reduced consumption of sand to only about 500 pounds per ton of castings as compared with the "ton for ton" proportion formerly required and has materially reduced foundry freight and handling charges.

The colloidal or "swelling" type of bentonite is employed for a wide range of minor uses, including fillers, concrete admixture, and for preventing seepage around dams, irrigation ditches, reservoirs, and structural foundations. It is used as an emulsifying agent in asphaltic and resinous compounds; in soaps and detergents; in various 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; in cement manufacture; and in the clarifying of wines, vinegar, etc.

A new reported use is for the recovery of stock-feed proteins from distillery wastes and brewery press-waters. Bentonite is also stated to be an important ingredient in a new lightweight aggregate for concrete ships.

In 1943, Wyoming dried and granulated clay continued to sell for \$7.50 per ton f.o.b. mines, in carload lots, and air-floated 200-mesh material for \$9.50, bagged. Special-grade, selected, air-floated clay was priced at \$26 per ton, f.o.b. Chicago. Freight rates from Wyoming points to Montreal are about \$14 per ton. Imported activated (Filtrol-type) bentonite has been costing \$75 to \$80 per ton, in carload lots, delivered eastern Canadian points, and American natural bleaching clay has sold for \$25 per ton laid down. Alberta oil-drilling bentonite sold in 1943 for \$40.75 per ton, f.o.b. Calgary plant, or \$42.75 delivered at Turner Valley, inclusive of 8 per cent sales tax. Effective January 1, 1944, the sales tax was cancelled, and 1944 prices have been reduced to \$38 and \$40, respectively.

Prepared by H. S. Spence,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, March, 1944.

## BERYL IN 1943

### Ores Mined and Producing Localities:

Although Canada produces no beryl, some attention has been directed in recent years to a few occurrences of the mineral, the most important of which are in Ontario and Manitoba.

Beryl, a silicate of aluminium and beryllium, usually contains from 10 to 12 per cent of beryllium oxide, corresponding to from 4 to 4.5 per cent of metallic beryllium. It is the commonest beryllium mineral and is the only present commercial source of the element. Its occurrence is restricted to pegmatite dykes, in which it is usually found as disseminated crystals; and a large part of the comparatively small world supply has been obtained as a by-product from the mining of such dykes for feldspar, mica, or lithium minerals. The recent increased demand and higher prices for the mineral have, however, stimulated mining for beryl itself in certain countries, notably in Argentina and Brazil, which now supply a substantial part of the requirements. The United States, India, and South Africa have been the other chief sources.

In Ontario, the most important occurrence is near Quadville, in Lyndoch township, Renfrew county, and this is probably the richest known Canadian concentration of beryl. The beryl-bearing pegmatite is believed to extend for a considerable distance along the strike, but owing to heavy overburden it is exposed at only two points about two miles apart. The property is owned by Canadian Beryllium Mines and Alloys, Ltd., 901 Royal Bank Building, Toronto, who have recovered a few tons of cobbled crystals, and stockpiled about 200 tons of rock that will require milling to recover the contained beryl. The mine has been inactive since 1940. In 1943, a detailed examination of the main working at the east end of the property was made by officers of the Bureau of Mines, Ottawa, and of the Metals Controller's Office, in an effort to appraise the economic possibilities of the deposit. The examination revealed an average content of 0.188 per cent of beryl in the total rock excavated, with a maximum for the richest quarry sections of 1.24 per cent. The grade of selected clean beryl crystals was 10.41 per cent BeO. Universal Light Metals Company, 28 James Street South, Hamilton, Ontario, has announced plans for the development of ground adjoining the Canadian Beryllium property.

In Manitoba, in the Winnipeg River and Bird River areas, small amounts of beryl occur in pegmatites that have been worked for the production of feldspar and lithium minerals. Winnipeg River Tin Mines, 403 Avenue Building, Winnipeg, and, Mobirk Beryllium Mining, Ltd., Victory Building, Toronto, have done some development work on their holdings, ~~in 1943~~, but no shipments were made.

In Quebec, several scattered occurrences of beryl have been reported, but these are not believed to be of economic interest.

In the Northwest Territories, field parties of the Geological Survey have reported numerous occurrences of beryl-pegmatites in the area north and east of the Yellowknife gold camp. Most of the beryl occurs as scattered crystals, and as yet no dykes rich enough to be considered of possible commercial interest have been discovered.

### Production and Trade:

No sales of beryl from Canadian sources have been recorded. The only known shipment consisted of a few tons taken from the Lyndoch deposit, in Ontario, about fifteen years ago for experimental purposes. No records of imports of beryllium or its compounds are available, and no beryl is known to be used or required for any purpose in Canada.

No figures of world production of beryl are available. The mineral, however, is produced on a very small scale, and the estimated output in 1940 was only about 2,500 tons. Because of increased demand and higher prices, production may have risen slightly since then.

Brazil and Argentina are the present leading sources of beryl, and production in both countries has increased considerably in the past

few years. In order to conserve supply for domestic needs, Argentina's exports of beryl are now limited to 1,200 metric tons a year. The United States, India, and South Africa produce small amounts of beryl. What is regarded as a potentially important source of beryllium is a recent discovery at Iron Mountain, New Mexico, of large deposits of the mineral helvite, a silicate-sulphide of beryllium, manganese, and iron. Helvite, a rare mineral, closely resembles garnet in outward appearance and is difficult to distinguish from that mineral. It contains about the same percentage of beryllium as beryl.

The United States is the chief consumer of beryl, and is the leading producer of beryllium metal and alloys, and of beryllium oxide and other salts. It is largely dependent, however, upon foreign sources of supply, and in the period 1937-1941, imported 86 per cent of its requirements. Because of extended applications for military purposes, American consumption of beryl has shown a marked increase and demand is proving difficult to meet. Prices have been advanced to nearly treble the pre-war level, and ores and the derivatives of beryl have been placed under strict allocation control by the United States Government. A 3,000-ton beryl stockpile has been authorized by the War Production Board. Any large scale expansion in the uses of beryllium products rests upon the discovery of large deposits of low-grade ore amenable to concentration or of new sources of high-grade ore.

Research work has been proceeding in the United States on the concentration of beryl ores, and froth flotation and sink-and-float methods are reported to have given encouraging results. No such concentration, however, has been applied as yet in commercial practice. Flotation tests by the U.S. Bureau of Mines are reported to have given an 83 per cent recovery, with a 97 per cent beryl concentrate, from feed carrying one per cent beryl. Combined sink-and-float and flotation tests by the American Cyanamid Company yielded a concentrate containing 8.4 per cent  $\text{BeO}$ , from feed running 1.5 per cent beryl.

#### Properties and Uses:

Beryllium hardens copper and increases its tensile properties without greatly decreasing its electrical conductivity. Beryllium-copper alloys usually contain about 2 per cent beryllium, though the content may range from as low as 0.1 per cent up to 3.5 per cent, and small additions of cobalt, chromium, or silver are sometimes made. These alloys are fabricated into springs and various mechanical parts subject to wear, vibration, or shock. They are used to an increasing extent in aircraft instruments, radio equipment, camera shutters, and for various peace-time purposes. Being non-magnetic and with structural properties comparable to alloy steels, beryllium copper alloy is used for parachute harness fasteners and release springs, where it obviates magnetic disturbance of instruments. Being spark-proof, considerable quantities are used in making tools for use in chemical and munition plants and in petroleum refineries. These tools are simply edged with the alloy to conserve supply.

Beryllium-nickel-copper alloy, being more resistant to heat checking than is nickel cast iron, is adapted for use in brake blocks and clutch facings. Beryllium-nickel, with 2 per cent beryllium, is used in springs subject to corrosion and high temperatures, and for surgical instruments. Beryllium-nickel master alloy, containing 12.5 per cent beryllium is marketed in powder or ingot form by Metal Hydrides, Incorporated, Beverly, Massachusetts.

Beryllium is one of the group of light metals, and ~~as a~~ beryllium-aluminium alloys containing 25 to 50 per cent beryllium are finding use in aircraft.

Beryllium metal has only limited applications, notably in the windows of X-ray tubes, where it is used on account of its transparency to X-rays.

Various beryllium salts, principally the oxide and carbonate, are used in industry. A growing demand has developed for the oxide for the preparation of zinc-beryllium silicate, used as a coating for fluorescent lighting tubes and lamps and for fluorescent screens. The oxide and carbonate, activated by uranium salts or rare earths, act as "phosphors" and are utilized in luminescent paints. The oxide is a super-refractory, with a melting-point of 2,570°C., and is used in crucibles, insulators, electrodes, furnace linings, and as a filament coating in lamps. Beryllium acetate is used as a coagulating, hardening bath for sodium alginate, a new English textile made from seaweed.

Ground beryl is used as a batch ingredient in sparkplugs and other ceramic specialties, to which it imparts high electrical and impact resistance and transverse strength. Consumption for such uses is estimated at about 100 tons a year. Beryllium compounds give chrome-green glazes at cone 12.

#### Market Conditions:

The leading users of beryl on the American continent are Beryllium Corporation of Pennsylvania, Temple (Reading), Pennsylvania, and Brush Beryllium Company, 3714 Chester Avenue, Cleveland, Ohio, both of which are engaged in treating the mineral for the production of metal, alloys, and compounds. Beryllium oxide also is produced by Clifton Products Incorporated, Painesville, Ohio; and a plant for the manufacture of oxide and carbonate was being built in 1941 at Harbor City, California, by the Calloy Company.

Importation of beryl into the United States, and purchase of the mineral, have been restricted to Government agencies, or their authorized representatives. Contracts for sale and export of beryl from Canada for United States Government account may be negotiated through the Metals Controller, Ottawa. All such exports are subject to special export permit. From February until October, beryllium was placed in Group I (supply insufficient for war and essential industrial needs) of the list of critical materials issued by the Conservation Division of the United States War Production Board, but in the latter month it was moved down into Group II, comprising materials in adequate supply for current requirements.

#### Prices:

In the latter part of 1942 the price of beryl was stabilized by the United States Government at \$8.33 per unit of contained BeO, equivalent to \$83 and \$100 per ton for 10 per cent and 12 per cent grades, respectively, this price being for purchases for Government account, f.o.b. New York. In 1943, quotations for Metals Reserve Company account were raised to \$120 per ton, United States funds, for clean, cobbled crystals of 10 per cent grade, f.o.b. specified Purchase Depot. A premium or penalty of \$12 per ton was provided for each one per cent BeO above or below 10 per cent, the minimum acceptable grade being 8 per cent. These prices were made effective until December 31, 1943.

The price of beryllium-copper master alloy, containing 4 per cent beryllium, has remained unchanged for some time at \$15 per pound of contained Be. The base price of beryllium-copper-cobalt alloys, with from 0.5 to 3.75 per cent Be content, ranged from \$0.85 to \$2.00 per pound as strip, rod or wire in 1943. Beryllium-iron, beryllium-nickel, and beryllium-aluminium sold at \$47.00 per pound of contained Be, in minimum 5-pound lots, and at \$50.00 for smaller quantities. Beryllium metal, 96 per cent pure, was quoted at \$47.00 per pound for lump and turnings and \$50.00 cast in bars. Calcined beryllium oxide continued firm at \$4.00 per pound.

Prepared by Hugh S. Spence,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, March, 1944.



## BITUMINOUS SAND IN 1943

### Source of supply:

A deposit of bituminous sand occurs along Athabaska River in the McMurray area, Alberta, between the twenty-third and twenty-sixth base lines. Intermittent exposures are seen along both sides of the river and also along certain of its tributaries. Investigations by the Bureau of Mines, Ottawa, between 1913 and 1942, provided much information on certain parts of the area.

### Production:

In connection with the above-mentioned investigations, about 5,000 tons of bituminous sand was mined and shipped during the period 1926-1930. Part of this material was used as a basis for laboratory studies, but the greater part was successfully used in the construction of a variety of types of wearing surfaces.

During the period 1931-1938, International Bitumen Company processed a limited tonnage of bituminous sand at its plant at Bitumont, Alberta, with the production of asphalts for paving and roofing and also 37,000 gallons of fuel oil. Operation of the plant was discontinued in 1938, but was resumed by Oil Sands, Ltd., during the late summer of 1943. The separation unit was operated during parts of September and October, 1943, and several hundred barrels of bitumen were recovered.

In 1941, Abasand Oils, Limited, completed its revised separation and refining plant on Horse River near McMurray. The plant was operated from May 19th to November 21st, 1941, when the separation and power units were destroyed by fire. During that period, production included 41,265 gallons of gasoline, 70,700 gallons of Diesel oil, 137,550 gallons of fuel oil, 375,235 gallons of residuum, and 319 tons of coke. Following reconstruction in 1942, the Abasand plant was operated intermittently from June 10th to November 6th. During this period approximately 12,800 tons of sand were mined and approximately 385,000 gallons of crude bitumen were produced. Refinery products made during this period were 12,600 gallons of gasoline, 79,555 gallons of Diesel oil, 27,300 gallons of fuel oil, and 266,139 gallons of residuum. Operations indicated the desirability of further revisions of equipment and flow sheets.

### New Developments:

In 1942, as a war project, an agreement was entered into between the Dominion Government, represented by the Department of Mines and Resources, and Consolidated Mining and Smelting Company of Canada, Limited. This agreement provided that the company would undertake investigations concerning the utilization of the bituminous sand resources of the McMurray area and would carry out an exploratory program. The company did several thousand feet of drilling in the Wheeler Island and Steepbank River areas, respectively 54 and 20 miles north of McMurray in the Athabaska River valley. In 1943 the Department continued the exploration in the Steepbank River area where some 3,300 feet of drilling was done. The drilling has shown that only after detailed exploration by the use of core drilling equipment can the true value of the bituminous sand resources of individual areas be determined.

On April 1st, 1943, an agreement was entered into between the Dominion Government, represented by the Department of Mines and Resources, and Abasand Oils, Limited, whereby Government funds were provided for the rehabilitation and enlargement of the Abasand separation and refining units. It is the intention to operate the rehabilitated plant, on which work is proceeding, as a pilot plant in order to determine the cost of mining and of the separation of the bitumen from the sand.

Prepared by S.C. Ellis,  
In the Bureau of Mines,  
Dept. of Mines and Resources,  
Ottawa, Canada, March, 1944.



## CEMENT IN 1943

### Ores Mined and Producing Localities:

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 made in this country, the last named, however, is made from imported clinker.

Canada Cement Company, Limited operates plants at Hull and Montreal East in Quebec; at Fort Colborne and Belleville in Ontario; at Fort Whyte, Manitoba; and at Exshaw, Alberta. St. Mary's Cement Company, Limited operates a plant at St. Mary's, Ontario. Medusa Products Company of Canada, Limited has a plant at Paris, Ontario, making white cement, cement paints, etc., from imported clinker. British Columbia Cement Company operates at Bamberton, British Columbia. The total rated daily-capacity of all plants is about 37,000 barrels (a barrel of cement weighs 350 pounds net).

All Canadian plants except one making cement from domestic raw materials are using the wet process. Remarkable uniformity in the chemical and physical properties of the standard variety of cement is achieved throughout the country as the result of close technical control and improvements in plant equipment.

Froth flotation is 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 that, though advantageously situated, were not sufficiently pure in their natural state for cement manufacture.

### Production and Trade:

Production of cement in 1943 was 7,302,289 barrels valued at \$11,599,033, compared with 9,126,041 barrels valued at \$14,365,237 in 1942.

Production was at first greatly stimulated by the war where cement played an important part in the wartime construction program, but now that this program is completed the demand for Portland cement has lessened. When the war is over, however, a large increase in demand for Portland cement is to be expected in connection with the lifting of restrictions on non-military construction. This will permit a start on the program of highway, public works, and industrial construction, plans for which are already made.

Imports of Portland cement in 1943 amounted to 18,577 tons valued at \$83,975, compared with 26,320 tons valued at \$116,126 in 1942.

Exports of Portland cement in 1943 totalled 172,575 tons valued at \$344,575, compared with 273,880 tons valued at \$476,284 in 1942.

### Market and Prices:

Cement is one of the most important of the structural materials and finds use in all construction work, such as bridges, canals, dams, highways, foundations, or buildings. In addition, the cement-products industry making building blocks, bricks, pipe, artificial stone, garden furniture, etc., uses cement as its principal raw material.

White cement has found favour for floors in a number of large war plants where it was used with the object of obtaining more even illumination and to conserve electric light by reflecting and diffusing it.

There is now a trend toward the use of vinsol-resin-treated cements for highways to prevent scaling when calcium chloride is used

in winter for prevention and removal of ice.

The average selling prices of cement per barrel f.o.b. plant in the several producing provinces during the period 1937 to 1943 were as follows:

	<u>1937</u>	<u>1938</u>	<u>1939</u>	<u>1940</u>	<u>1941</u>	<u>1942</u>	<u>1943</u>
Quebec	\$1.37	\$1.35	\$1.35	\$1.41	\$1.43	\$1.46	\$1.44
Ontario	1.38	1.40	1.43	1.49	1.46	1.43	1.46
Manitoba	2.27	2.28	2.25	2.25	2.21	2.10	1.89
Alberta	1.99	2.01	1.97	2.01	2.00	1.96	1.94
British Columbia	1.81	1.87	1.91	1.94	1.97	2.07	2.14

The average selling price for Canada in 1943 was \$1.59 a barrel.

Prepared by M.F. Goudge,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, June, 1944.

## CLAYS AND CLAY PRODUCTS IN 1943

The industrial clays of Canada may be classified as common clays, stoneware clays, fireclays, china clays, and ball clays. Statistically, the ceramic industry\* of Canada is conveniently classified into two divisions, namely: production from domestic clays, which includes the production of building brick, structural tile, drain tile, roofing tile, stoneware, sewer pipe, pottery, and refractories; and production from imported clays, which includes the manufacture of electrical porcelain, sanitary ware, sewer pipe, tableware, pottery, ceramic floor and wall tile, and various kinds of fireclay refractories. The gross value of ceramic products manufactured from Canadian clays (including sales of domestic clays) was \$6,599,699 in 1943, compared with \$7,081,723 in 1942. The total value of ceramic products manufactured from imported clays was \$4,350,718 in 1943, compared with \$5,397,228 in 1942.

Compared to world production, the value of ceramic products manufactured in Canada is small, and large quantities of the various kinds are imported annually.

### Common Clays

Common clays suitable for the production of building brick and tile are found in all the provinces of Canada. The value of structural clay products made from domestic clays (building brick, hollow building tile, drain tile, roofing tile, etc.) was \$4,048,479 in 1943, compared with \$4,453,720 in 1942.

### Stoneware Clays

The largest production in Canada of stoneware clay or semi-fireclays comes from the Eastend and Willows area, Saskatchewan. Large quantities of the clays from the area are selectively mined and shipped to Medicine Hat, Alberta, where, owing to the availability of cheap gas fuel, they are used extensively in the manufacture of stoneware, sewer pipe, pottery, tableware, etc.

Stoneware clays and moderately refractory fireclays occur near Subenacadie and Musquodoboit, Nova Scotia. Some of the Musquodoboit clay is used for the production of pottery, but it has not been extensively developed for ceramic use.

Stoneware clays or low-grade fireclays occur near Williams Lake, and Chimney Creek Bridge in British Columbia; in the Cypress Hills of Alberta; and near Swan River, Manitoba; but they are difficult of access and have not been developed.

The value of stoneware articles (sewer pipe, pottery, etc.) produced in Canada from domestic clays in 1943 is reported to have been \$1,817,990, compared with \$2,038,633 in 1942. Stoneware products are also manufactured by a few plants from imported clays. Production figures are not given.

### Fireclays

Two large plants and a few small plants manufacture fireclay refractories from domestic clay. At one plant, about 50 miles south of Vancouver, a high-grade, moderately plastic fireclay is extracted by underground mining from the clay beds in the Sumas Mountain, and the plant manufactures firebrick and other refractory materials. Another plant at Claybank, Saskatchewan, by selective 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, Nova Scotia, for refractory purposes and some of the Musquodoboit clay is used for stove linings. Almost all other manufacturers of

\*Note: Such ceramic products as glass, cement, and artificial abrasives are not included in this review.

fireclay refractories (including high temperature cements, plastic refractories, etc.) use imported clay.

The value (sales) of the refractories produced in Canada from domestic clays in 1943 was \$489,956, compared with \$448,798 in 1942; the value of refractories produced from imported clays in 1943 was \$926,402, compared with \$1,514,092 in 1942.

#### China Clay, Ball Clay, Etc.

China clay (kaolin) has been produced commercially in Canada only from the vicinity of St. Remi d'Amherst, Papineau county, Quebec, where mining operations were carried on for several years prior to 1923. The large-scale operation of this deposit has been under consideration for a number of years and a company was organized a few years ago to extract the kaolinized material by underground mining, to refine it into high-grade china clay, and to recover washed silica sand as a by-product. Following its reorganization as Canada China Clay and Silica Products, Limited, the company constructed a modern plant equipped to carry out the washing process in accordance with the most up-to-date and scientific methods. The plant has been producing glass sand regularly. The Canadian production of grades of silica sand suitable for the glass trade is of importance, now that the Belgian source of supply has been cut off. Canadian Kaolin-Silica Products' property at Lac Remi, Quebec, which was operated chiefly for the production of high-grade silica sand, has been idle since the destruction of the plant by fire a few years ago.

Several other interesting occurrences of kaolin have been discovered in Quebec in recent years. One of these, located on Thirty-One Mile Lake, near Point Comfort, Hull county, is being explored and portions of the deposit yield china clay of a high-grade in the crude state. The extent and uniformity of the deposit is not as yet proved, but its possibilities as a source of high-grade fireclay are receiving attention. Kaolin has also been discovered near Brebeuf; on Lake Labelle; and near Chateau Richer in Quebec, but there has been little exploratory work on the deposits.

Important deposits of high-grade, plastic, white-burning and buff-burning clays occur on the Mattagami, Abitibi, and Missinabi Rivers in northern Ontario. Some of these can be classed as china clays, others as fireclays, and still others as ball clays. The deposits have attracted considerable interest in recent years, but efforts to develop them have been handicapped owing to the distance of the deposits from industrial centres, and to the lack of transportation facilities.

In British Columbia, along the Fraser River, about 25 miles above Prince George, is an extensive clay deposit, parts of which yield a high grade of china clay. As china clay from England is difficult to obtain on the West coast, owing to shipping risks, consideration is being given to the possibility of using material from this deposit as a source of china clay suitable for the pulp and paper trade.

In the manufacture of porcelain, sanitary ware, dinner ware, ceramic floor and wall tile, etc., china clay and ball clay from England has been used almost entirely. Separate production figures are not published for these classes of ceramic ware as there are only one or two producers in each case. Canada also imports large quantities of china clay for use in the production of paper; in the rubber industry; and for other industrial purposes.

Ball clays of high bond strength occur in the "White Mud" beds of southern Saskatchewan, but as yet they have not been developed.

#### Bleaching Clays

Activated clays for oil bleaching are largely imported. The value of such clays imported into Canada by oil refineries in 1943

was \$295,066, compared with \$348,068 in 1942. Fuller's and infusorial earths are also imported for use in sugar refineries, vegetable oil mills, etc. It has been reported that certain western bentonitic materials have been finding a market in Canada for oil bleaching purposes.

Prepared by J. G. Phillips,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, July, 1944.

was 2,250,000, compared with 2,312,000 in 1942. The 1943-44  
figures are also reported in the report.  
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Prepared by J. G. Ballin,  
The Bureau of Mines,  
Department of Mines and Technical  
Surveys, Ottawa, 1944.

## DIATOMITE IN 1943

### Material Mined and Producing Localities:

Diatomite consists of the microscopically small remains of siliceous shells of diatoms, a form of algae that at one time lived under water. The material of Recent fresh water 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 to colour.

For many years International Diatomite Limited, Tatamogouche, Nova Scotia, has been the principal producer, but operations in the ponds near New Annan ceased in the fall of 1940. The two producers during the past 3 years were G. Wightman, from a deposit on Digby Neck, Nova Scotia; and R.L. Marsh for L.T. Rairey of Vancouver, from lot 1122 on the west bank of Fraser River, north of Quesnel in the Cariboo district, British Columbia.

Northern Diatomite Company of Toronto started the erection of a treatment plant on its deposit south of Gravenhurst in the Muskoka district in the fall of 1942, but it was not completed. Some prospecting was done on deposits in Quebec and in British Columbia.

### Production and Trade:

Production in 1943 was 102 tons and sales 108 tons, valued at \$3,220, compared with sales of 365 tons valued at \$9,088 in 1942.

Prior to the war diatomite was produced by about thirty countries, but, outside the North American continent, statistics for the past five years are not available. The United States, with about 20 operators, is by far the largest producer and since the war was followed in order by Denmark, Germany, Japan, Algeria, and Northern Ireland. Output from the United States, which is of very high quality, was about 150,000 short tons in 1943, an increase of about 5 per cent over that of 1942.

No Canadian diatomite was exported in 1943. Although there is a large demand in England for insulation and filler material, the difficulty in shipping, high costs, and relatively low price of the English and Irish diatomite, prohibit the export of the Canadian product to England. Imports into Canada were 5,623 tons valued at \$184,012, mainly from California, with a small tonnage from Oregon. This compared with imports of 4,294 tons valued at \$155,802 in 1942.

Consumption in Canada was approximately 5,700 tons, a 22 per cent increase as compared with 1942. This was due to an increase in the consumption for sugar filtration and to the extended use of diatomite as a filler. The use of new diatomite bricks and mortars required for insulation of the numerous furnaces in operation in plants making war materials decreased slightly as, once installed, such products will last for several years.

### Uses:

In 1943 slightly more than 70 per cent of the diatomite consumed in Canada was used in the form of filter-aids, mainly in the refining of cane sugar. Eleven per cent was used for insulation, including a small amount for the slow cooling and tempering of steel parts; and the remainder was used principally as a filler in the paint, chemical, paper, rubber, soap, and textile industries, and to a small extent in silver polish bases and as an admixture in concrete. In the United States diatomite is used for blocks and pipe insulation in combination with asbestos in the naval construction program; in light weight fireproof structural sheets for minimizing fire hazards on warships; and as an extender for painting army equipment to cut down lustre.

Market Conditions and Prices:

Deposits containing medium quality diatomite are very common in some parts of Canada. 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 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 about 1,600 tons annually, close to half of it being in the form of diatomite insulation bricks; a greatly increased production of these bricks by Canadian firms is necessary before the Canadian diatomite industry can operate on a profitable basis.

The price of Canadian diatomite for insulation varies from \$25 to \$40 and of imported diatomite for insulation and filtration from \$26 to \$75 per ton; for material suitable for polishes the price for small lots ranges up to \$200 a ton. Imported insulation bricks vary in price from \$85 to \$140 per 1,000, according to grade and density.

Prepared by V.L. Eardley-Wilmot,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, March, 1944.

## FELDSPAR IN 1943

### Ores Mined and Producing Localities:

Most of the feldspar mined in Canada is of high potash grade, though some operators also produce small amounts of soda spar. The latter type is rather uncommon as large deposits, but is sometimes found as zonal bodies in potash-feldspar pegmatites, usually along the walls. With the exception of 5,000 tons mined in the Pointe du Bois area, Manitoba, during the years 1934 to 1936, almost the entire production has come from adjacent sections of western Quebec and eastern Ontario, in the general Ottawa region. There has been a small production, also, from scattered properties in Ontario as far west as Parry Sound and Sudbury Districts. In recent years most of the production has come from about half a dozen mines, and until 1942 it was about equally divided between Ontario and Quebec. In that year and in 1943, however, the output from Ontario declined to only 25 per cent of the total.

In Ontario, the large quarry of Bathurst Feldspar Mines, in Bathurst township, Lanark county, which had been the leading producer in the Province, was closed down in 1942, having reached the limit in depth of open-cast mining. Operations were continued through 1943, however, from surface on the southerly extension of the dyke, and production on a reduced scale was maintained. Frontenac Floor and Wall Tile Company, Kingston, operated its new Charles mine, also in Bathurst township, until September, when work was suspended. Most of the remaining output from Ontario in 1943 came from the Madawaska area, Nipissing District, where Madawaska Feldspar Company, in Murchison township, was the chief producer. Other operators in the same township were Keystone Contractors, Ltd., working the old Cameron mine, and Royal Feldspar Company, conducting development operations on the Hamilton property. Keystone Contractors, Ltd. also made shipments of low-grade spar (graphic granite) from a deposit in Gratton township, south of Eganville, Renfrew county, and for a short time Canadian Flint and Spar Company operated the old Cameron property in Dickens township, Nipissing district, near Barry's Bay. Some feldspar was also recovered and stockpiled at the property of Purdy Mica Mines, near Eau Claire, Mattawa district.

In Quebec, the chief source of supply continued to be the large mine of Canadian Flint and Spar Company in Derry township, Papineau county, in the Lievre River section. This company also operated its New York mine, in Buckingham township, and a property near St. Pierre de Wakefield, in Wakefield township. United Mining Industries Limited, of Montreal, made shipments from a deposit in Buckingham township, west of the Lievre River, part of which was dental spar, and later moved to the old Lapointe mine in West Portland township.

### Production and Trade:

Canadian feldspar production in 1943 totalled 25,903 tons valued at \$236,991, compared with 22,270 tons valued at \$213,941 in 1942. The production from Quebec in 1943 was 19,273 tons, and that from Ontario, 6,630 tons.

A considerable part of the Canadian output is exported, mainly to grinding plants of Consolidated Feldspar Corporation, and Genesee Feldspar Company, at Rochester, New York. Exports of crude spar rose 15 per cent in 1943, from 11,016 tons valued at \$85,360 in 1942 to 12,724 tons valued at \$96,453. Imports of ground spar totalled 526 tons valued at \$12,886, compared with 563 tons valued at \$12,021 in 1942.

Feldspar for domestic use is ground in mills operated by the following:

- 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 material for ceramic uses, while the Bon Ami product is used in scouring compounds. Total domestic consumption of feldspar in 1942 was reported to be 12,253 tons. Of this, 4,344 tons was sold for the manufacture of scouring soaps and cleaners; 3,234 tons was used by the clay products industry; 2,880 tons by the glass trade; 1,676 tons for sheet-metal enamelling; and 119 tons in abrasive wheels, etc. Production of milled spar in the same year was 12,428 tons.

#### Market and Prices:

All of the feldspar used in industry is 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. Some manufacturers of ceramic products mine and grind spar for their own use. By far the greater part of the production is used in the ceramic industries.

Most of the feldspar sold is of high-potash type, but a certain amount of high-soda spar also is in demand and is employed mainly for blending purposes for ceramic use. Feldspar has a relatively low fusion point and serves as the fluxing ingredient in all types of ceramic bodies. It is an essential raw material for the manufacture of white wares, in glazes, and in porcelain enamels. In glass, it serves as an economical source of alumina and alkalis. All ceramic grades of feldspar are required to have a low content of iron oxide, the tolerance for which in pottery spar is 0.15 per cent and in glass spar, 0.05 per cent. For this reason, the crude shipping product should be kept free of material carrying rust stain or such iron-bearing minerals as tourmaline, mica, pyrite, etc. Most commercial feldspars contain some quartz, which acts as a diluent, decreasing the fluxing power, and the content should be kept to a minimum. The fusion point of high-soda spars is lower than that of the high-potash types, the extremes for the two varieties ranging from cone 4 (1165°C) to cone 10 (1260°C), with the general average of commercial material around cones 8 to 9 (1225° to 1250°C). Practically all colours of feldspar are equally acceptable for ceramic uses, but for cleanser purposes, pale shades of white to buff are demanded.

Commercial No. 1 feldspar for the ceramic trade consists of crude lump cobbled free of quartz and other objectionable impurities. Inferior grades, including graphic granito, which may contain 25 to 30 per cent quartz, are used for less exacting ceramic requirements. Quarry and cobbing fines are not acceptable, and go either to waste or may be sold for stucco dash, chicken grit, etc.

Canada has large reserves of feldspar and production could be increased to meet any likely demand. Recent reports indicate that the supply of crude potash spar from mines in the Eastern United States is proving inadequate to meet requirements, and this may result in an increase in Canada's exports to that country. One outcome of the growing shortage is that renewed attention is being directed to the possibility that feldspar grinders may ultimately be compelled to resort to milling and concentrating of sub-grade rock to fill their needs. One plant for the production of glass-grade spar by flotation methods from straight quarry-run rock was installed during the year in North Carolina.

Canadian feldspar prices in 1943 increased slightly over those of previous years, quotations for crude ranging from \$6.50 to \$8.50 per ton, f.o.b. rail for domestic mills and export. Ground spar, 200-mesh, sold at \$16 to \$18, and granular glass spar at \$12, both f.o.b. mill, in carload lots. Special selected crude dental spar, for export, sold as high as \$48.50 U.S. funds.

#### Tariff:

Crude feldspar entering the United States pays a duty of 25

cents per long ton. The duty on ground feldspar is 15 per cent  
ad valorem.

Prepared by Hugh S. Spence,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, March, 1944.

THE COST OF PAPER IS 15 PER CENT  
OF THE TOTAL COST.

Prepared by Miss E. Spence  
In the Bureau of Mines,  
Department of Mines and Technical  
Surveys, Ottawa, Canada, March, 1934.

## FLUORSPAR IN 1943

### Ores Mined and Producing Localities:

The mining of fluorspar in Canada in 1943 was more active than at any time since the war years of 1914-18, and production slightly exceeded the previous record output of 11,235 tons in 1920.

Fluorspar is not widely distributed in Canada, and commercial deposits are restricted to a few local areas which have supplied practically all of the comparatively small production, totalling about 75,000 tons to the end of 1943.

Chief centre of production has been the Madoc area, Hastings county, Ontario, where intermittent mining for fluorspar has been carried on for about forty years. The region first became prominent as a source of the mineral during and immediately following the last war, when active prospecting disclosed the existence of fluorspar on some thirty properties, about half of which became producers and contributed to the total of 20,000 tons mined in the district from 1916 to 1920 inclusive. The largest annual output during this period was a little over 7,000 tons in 1918. Production was small and intermittent during the ensuing twenty years and was not actively revived until the present war, when serious shortages led to a renewal of mining at a number of the old properties.

In 1943, seven producers reported shipments from the Madoc district, most of the production being derived from the Noyes, Perry, and Keene mines. The Blakely, Lee Jr., Rogers, Ben Lee, and South Reynolds mines also contributed to the total. In order of production the operators were: R. T. Gilman (Noyes mine), Reliance Fluorspar Mining Syndicate (Perry and Rogers mines), H.C. Miller (Keene mine), Charles Stoklosar (Blakely mine), Bassett Fluorspar Mining Syndicate (Lee Jr. mine), Trent Mining Syndicate (Ben Lee mine), and Wood Land Mineral Company (South Reynolds mine). In addition to new ore mined, a few hundred tons of low-grade screenings recovered from waste dumps was shipped from the Noyes property.

No beneficiation, other than cobbing and picking, is practised on Madoc ores, and shipments consist of screened fines sweetened with clean picked lump. All of the output has been for metallurgical use. The average grade has been considerably below standard, ranging from 60 to 65 per cent  $\text{CaF}_2$ , though a number of cars of high-grade ore also were shipped. The general character of the ore is similar throughout the area, consisting of a mixture of fluorspar, calcite, and barite, in varying proportions, and often in banded intergrowths.

This association presents serious difficulties in regard to possible concentration of the ores, but test work under way by the Bureau of Mines, Ottawa, is giving encouraging results by the use of selective flotation. The results also indicate the possible recovery of a marketable barite by-product.

Most of the activity in the Madoc field in 1943 resulted from financial assistance given by the Dominion Government in an effort to stimulate production. A supervising engineer's office was maintained at Madoc by the Department of Mines and Resources, which also assigned one of its geologists to make periodic surveys of development. A Government-financed program of diamond drilling was carried out on the properties situated along the main "break" and eighty holes, totalling 13,625 feet were drilled. The Ontario Department of Mines made a geophysical survey over part of the same area. A total of 178,000 tons of ore averaging 45 per cent  $\text{CaF}_2$  was indicated by the drilling, and in the above-mentioned test work by the Bureau of Mines the problem of beneficiating this material up to acceptable metallurgical grade is being investigated. A large bulk shipment of low-grade ore from the Keene property is being used as a basis for the work. By the end of 1943, production from the Madoc area had assisted materially in averting a serious shortage of fluorspar.

for the domestic steel trade, and most of the mining operations were closed down for the winter. Total production in 1943 was about 10,500 tons.

Interest also developed during the year in the commercial possibilities of fluorspar occurrences in the Harcourt-Wilberforce area, Haliburton county, about 50 miles north of Madoc, where considerable prospecting was undertaken and several deposits of possible commercial interest were located. The deposits are associated with pegmatite intrusions along the margin of a large granite batholith, the ore being a mixture of fluorspar and calcite, with some apatite and silicate minerals. Tests made by the Bureau of Mines on a shipment from one of the properties being investigated indicate that the ore is amenable to flotation at a 65-mesh grind, with a 75 per cent recovery and a 97 per cent  $\text{CaF}_2$  product. The heads had an apatite content of 6.5 per cent which was reduced to 1.5 per cent in the fluorspar concentrate, representing a 94 per cent removal. Samples submitted to steel companies were approved as being suitable for metallurgical use and might also be acceptable as acid grade spar. Most of the exploration work in the area has been done by Cardiff Fluorite Mines, Limited, 26 Queen Street East, Toronto, and by W. E. Clark, 30 Edgevale Road, Hamilton. The Clark holdings were taken over late in 1943 by Tops Mining Syndicate, Limited. The old radium property of Wilberforce Minerals, Limited, originally opened by Ontario Radium Corporation, and the ore of which contains considerable fluorspar, was optioned by Frobisher Exploration Company (Ventures Limited).

The only other fluorspar mined in 1943 came from Nova Scotia, where W. Papke continued development of the old MacKay property at Lake Ainslie, Cape Breton, working on a royalty basis to the owners, North American Mining and Chemical Company, of Halifax. Mining was started in 1942 as an open-cut operation, and is now being conducted underground. Operations have indicated a substantial ore-body. The ore consists of an intimate mixture of fluorspar, calcite, and barite, which is shipped for metallurgical use after cobbing and picking, the average grade of the product being 55 to 60 per cent  $\text{CaF}_2$ . As a means of assistance, the Provincial Department of Mines is conducting diamond-drilling of the deposit.

Scattered occurrences of fluorspar are known in Quebec, but there has been no recorded production. Some interest has been shown in a deposit north of Otter Lake, in Huddersfield township, Pontiac county, where small amounts of clean high-grade spar are found as the filling of veins and pockets in mica-bearing pyroxenite. Recent prospecting is reported to have disclosed fluorspar showings over a considerable area outside the original discovery location.

In British Columbia, an important deposit of fluorspar exists at the Rock Candy mine, near Grand Forks. The deposit was operated by Consolidated Mining and Smelting Company between 1919 and 1929, but it has since been idle. Output 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, but sufficient by-product fluorine for this purpose is now recovered from the treatment of phosphate rock in the Company's fertilizer plant at Trail. No information is available on ore reserves at the property but they are probably large. In the latter part of 1942, interest developed in a fluorspar occurrence near Birch Island, North Thomson River, where drilling operations have been undertaken by G.B. Webster, 11 King Street West, Toronto. The deposit consists of a fine-grained, intimate mixture of fluorspar, celestite, and feldspar, with considerable pyrite. Trial shipments have been under test by the Bureau of Mines, Ottawa, the preliminary results of which indicate that the ore is amenable to flotation.

### Production and Trade:

Canadian production of fluorspar in 1943 totalled 12,087 tons valued at \$332,067, compared with 6,199 tons valued at \$146,039 in 1942. In 1941, the output was 5,534 tons, and in 1940, 4,454 tons. Imports in 1943 were 77,436 tons valued at \$1,738,669, compared with 47,783 tons valued at \$1,046,526, in 1942, an increase of 62 per cent in quantity and 66 per cent in value.

World production of fluorspar prior to the war averaged about 500,000 short tons annually, the United States and Germany supplying about 75 per cent of the total. The remainder came mainly from Russia, the United Kingdom, Newfoundland, France, Korea, Italy, and the Union of South Africa.

The United States produced 313,000 short tons in 1941, an increase of 28 per cent over 1940, and in 1942 production was raised to 337,000 tons. Total output in 1943, including an estimated 27,000 tons of shipping grade contained in unmilled ore rose to the record figure of 433,000 tons. Domestic consumption in 1943 totalled 389,000 tons and stocks on hand at the end of the year amounted to 161,000 tons, of which 40,000 tons was in Government stockpile.

About 77 per cent of the shipments came from the Illinois-Kentucky field, production from which was 4 per cent higher than in 1942, whereas the increase from other producing States (mainly Colorado, New Mexico, and Nevada) was 51 per cent. Production of metallurgical-grade spar lagged behind consumption during the first half of 1943, but an increase in the base price of \$5 per ton, together with wage increases of 24 per cent in the Illinois-Kentucky district, stimulated output and reversed this condition. Production of acid and ceramic grades exceeded consumption in the first six months of 1943, but an increase in consumption of the former tended to upset this balance in the latter part of the year. Prices for these grades were advanced in July to \$37 a ton from the 1942 levels of \$32 and \$34, respectively.

Around 55 per cent of fluorspar shipments in the United States in 1943 went to the steel industry, and 29 per cent to manufacturers of hydrofluoric acid. The remainder was used for ceramic purposes, mainly in the glass industry, and various unspecified minor uses. The consumption of acid spar showed a 39 per cent increase over 1942, while consumption of fluorspar in the steel industry declined 3 per cent, largely as a result of conservation measures urged by the Government and through the use of sub-standard grade material. Domestic production was augmented to some extent by imports, mainly from Spain and Mexico.

Canada obtains a large part of its requirements of fluorspar from Newfoundland where production has been increasing steadily, the output in 1943 being estimated at 100,000 tons. Prior to the war, Canada used from 12,000 to 15,000 tons of fluorspar a year, about half of which went to the steel trade. The expansion in the production of aluminium has materially stepped up the Canadian demand for acid-grade spar, most of which is supplied by Newfoundland Fluorspar Limited, a subsidiary of Aluminum Company of Canada, and by St. Lawrence Corporation of Newfoundland. Consumption of metallurgical spar in Canada has risen to about 20,000 tons annually, and the total indicated consumption of all grades in 1943 was close to 90,000 tons.

### Market and Prices:

Fluorspar has a number of industrial uses, but as indicated above, the steel trade is by far the largest consumer. The mineral serves as a fluxing ingredient in basic open-hearth and electric furnace charges, where it imparts fluidity to the slag and permits the use of larger quantities of lime, the agent most effective in removing sulphur, phosphorus, and other impurities in the ore. About 6 pounds of spar are used per ton of steel made in the open hearth, and 20

pounds per ton for that made in the electric furnace. In order to conserve supply, it was reported in 1943 that some American steel companies had resorted to the use of ilmenite as a substitute for fluorspar, on a pound for pound basis. In the production of aluminium, about 7 pounds of fluorspar are required per 100 pounds of metal.

Hydrofluoric acid is employed mainly in making artificial cryolite and aluminium fluoride, used in the production of aluminium, and it is used also in making various chemical products, including insecticides, and in ore-dressing, etc. The anhydrous acid is being used to an increasing extent in making organic refrigerants of the "Freon" type and as an improved catalyst, in place of sulphuric acid, for the alkylation of olefins in the production of 100-octane aviation gasoline. There was a large increase in 1943 in the use of Freon as an aerosol insecticide (pyrethrum) carrier in so-called "mosquito bombs" for use against malarial mosquitoes in the Pacific war theatre. The liquid Freon, containing insecticide in solution, is placed in small metal cylinders under high pressure, from which it can be released by a stop-cock as a fine vapour or mist. Cargo and transport aircraft, barracks, dug-outs, etc., can be rid of such insects by this means much more quickly and effectually than by ordinary spray methods. An estimated 12,000 tons of acid-grade fluorspar is expected to be required in 1944 for the manufacture of Freon for this important war use, which now provides one of the largest outlets for the compound.

In the ceramic trade, fluorspar is employed as a fluxing and opacifying ingredient in glass and enamels, and the glass industry is now using substantial amounts of sodium silicofluoride. Fluorspar is also used in welding-rod coatings and abrasives, in the production of ferro-alloys, in precious metals metallurgy, in the making of cement, carbon electrodes, calcium carbide and cyanamid, in foundry work, and for the production of hydrofluosilicic acid, used in lead refining.

Consumption of fluorspar in Canada in 1941, totalled about 30,291 tons valued at \$790,297. Of this quantity, 56 per cent was used by the steel trade, and 41 per cent in chemicals (acid, alkalis, and salts), most of the latter representing consumption in the aluminium industry.

Clear, glassy, crystal fluorspar, which is very rare and sells at about \$1.00 an ounce, is used in microscopes, telescopes, spectroscopes, and other optical instruments, where its low refractive and dispersive powers serve to correct spherical and chromatic errors in the lenses. 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 eight pounds in weight.

Standard fluxing gravel or lump grade for metallurgical use is usually sold on a specification of a minimum 85 per cent  $\text{CaF}_2$  and not over 5 per cent silica or 0.3 per cent sulphur. It should not contain more than 15 per cent of fines. Owing to recent shortages, however, sales in the United States now are being made on the basis of 78 per cent  $\text{CaF}_2$ , with a minimum of 55 "effective units", and up to 1 per cent sulphur. Effective units are computed as being the  $\text{CaF}_2$  percentage less  $2\frac{1}{2}$  times the silica content. Canadian shipments have been much below even this reduced standard and in some cases consumers sweeten the material with higher grade imported spar. By arrangement with consumers, the price of domestic metallurgical fluor-spar was set in 1942 by the Metals Controller on the following basis: \$24 in U. S. funds, per short ton, f.o.b. Kentucky-Illinois mines, plus 11 per cent exchange, plus 10 per cent war exchange tax, plus freight from above field to Canadian consuming point, less freight from Canadian mine to same point, less 25 cents for each per cent  $\text{CaF}_2$  below 85 per cent. As an example, this would work out at \$36.36 per short ton for standard 85 per cent grade, f.o.b. Madoc, for shipment to Sault Ste. Marie, Ontario, or \$32.38 for shipment to Hamilton, Ontario. Although revised maximum prices went into effect

in the Illinois-Kentucky field in July, 1943, there was no change in the above agreement as a result of the increases. The revised prices were in the nature of premiums offered in an effort to increase production and were as follows:

	70 effective units and over	\$33 per ton
65 to 70	" "	\$32 " "
60 to 65	" "	\$31 " "
Under 60	" "	\$30 " "

Glass and enamel grades call for not less than 95 per cent  $\text{CaF}_2$ , with a maximum of  $2\frac{1}{2}$  to 3 per cent silica and 0.12 per cent iron ( $\text{Fe}_2\text{O}_3$ ). The material must be in ground form in mesh sizes ranging from coarse to extra fine.

Acid-grade spar has the most rigid specification, namely a minimum of 98 per cent  $\text{CaF}_2$  and not over 1 per cent silica. Like the ceramic grade, it must be in powder form, and most of the material supplied to both the acid and ceramic trades is a flotation concentrate. In July, 1943, the United States price for both acid and ceramic spar was raised to \$37 per short ton, f.o.b. mines, an increase of \$2 to \$3 over the 1942 levels. There has been little or no production of these grades in Canada, so that no price has been set for them.

It is estimated that 95 per cent of all fluorspar now being used in the United States and Canada is consumed in war industries. Prior to October 1943, only metallurgical grade spar was placed in Group I (supply insufficient for war and essential industrial needs) of materials listed by the Conservation Division of the United States War Production Board, with acid spar being placed in Group II (supply sufficient for all current requirements). On October 1, acid grade was moved into Group I and both grades were in that group in the listing of January 15, 1944. At no time has specific mention been made of ceramic grade spar. Early in 1944 it was reported that an easier situation was developing in the supply of metallurgical spar in the United States, where production was catching up with consumption. Imports of high-grade lump, mainly from Newfoundland, Spain, and Mexico, were being diverted to Government stock-pile, requirements for which were increased to 120,000 tons, and Government support was being withdrawn from domestic mines.

The Canadian requirements in 1944 are expected to be only about 75 per cent of the 1943 figure, and consumers are not likely to have any difficulty in obtaining supplies of high-grade spar from the United States. In 1942, fluorspar was placed on the list of minerals requiring a permit for exportation from Canada, but this restriction was withdrawn, effective April, 1, 1944, in respect to shipments consigned to the United States or to any part of the British Empire.

#### Tariff:

Prior to 1942, the duty on metallurgical grade fluorspar entering the United States was \$7.50 a short ton, but in that year this was reduced to \$5.625 a ton. The duty on acid and ceramic grades is \$3.75 a ton. There is no duty on fluorspar imported into Canada.

Prepared by Hugh S. Spence,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, March, 1944.

In the 1940-1941 season, there was no change in the above expression as a result of the increase in the number of specimens obtained in an effort to increase production and were as follows:

70 effective units and over	100
" " " " " "	100
" " " " " "	100
" " " " " "	100

Class and annual production data for not less than 25 per cent (25%) with a maximum of 25 per cent of the total production from (25%). The material must be in storage for a year before being used for any other purpose.

As the above data show, the most rapid accumulation of material is in the 70 per cent class and over 1 per cent will be accumulated in the 70 per cent class. It must be in storage for a year and most of the material is used to both the acid and organic acids in a production process. In July, 1942, the United States tried to limit the production of these acids to 100,000 tons, a 50 per cent reduction in production. In 1942, the United States tried to limit the production of these acids to 100,000 tons, a 50 per cent reduction in production.

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## GARNET IN 1943.

### Ores Mined and Producing Localities:

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, the amount of garnet produced in the Dominion is negligible.

### Production:

There were no shipments of garnet in 1943, but the Niagara Garnet Company, Niagara Falls, N.Y. mined and stock-piled about 150 tons of crude garnet rock from Dana township near River Valley, about fifty miles northwest of North Bay, Ontario, and has purchased a small plant at Sturgeon Falls, in which the ore will be treated. The product will be used for optical finishing powders. In 1942, this company, under management of W.A. Yarwood, shipped to the United States for experimental purposes about 18 tons of ore valued at \$176.00 from the same deposit.

About 80 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. Total sales of the four active companies in the United States in 1943 amounted to about 6,300 tons, compared with 4,357 tons valued at \$299,904 in 1942. About 800 tons of garnet are shipped annually from the Transvaal, Union of South Africa.

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 been found in sufficient quantities.

Garnet, crushed and suitably graded as to size, is used for making abrasive-coated papers and cloth, which in turn are used mainly in the wood working (hard woods) and to a lesser extent in the shoe leather industries. Artificial abrasives rather than those made from garnet are used in the surfacing of metals.

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 fractures. 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. Minor uses for garnet are for sand-blasting, for surfacing plate glass, and for optical lens polishing.

### Trade and Market Conditions:

Canadian consumption of prepared garnet grain suitable for "sand paper" manufacture has decreased and is now less than 200 tons annually. If it were not for shipping restrictions, coated abrasive manufacturers in England, who prior to the war consumed about 800 tons annually, would be willing 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. Chalk flint, which is used to a large extent in England, is mined locally

and although it is less suitable than garnet, it is much cheaper and could be substituted almost entirely if necessary. Competition from the artificial abrasives (silicon carbide and oxide of alumina) is another serious factor in the marketing of garnet.

Prices:

The price in the United States of the best-quality concentrate from which grain is prepared for abrasive papers and cloths ranges from \$65 to \$80 a ton f.o.b. mines and of graded grain, \$90 a ton. Canadian prices of crushed garnet rock for sand-blasting were \$7 to \$10 a ton in 1942, but none was sold in 1943.

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.

Prepared by V.L. Eardley-Wilmont,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, March, 1944.

## GRANITE IN 1943

(Building, Ornamental, and Crushed)

### Sources of Supply:

The stone quarried 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.

Granite for monumental use is produced in the Maritime Provinces and in Quebec, Ontario, Manitoba, and British Columbia. Early in 1939 an appreciable amount of foreign stone, principally of the black and red varieties, was imported, mainly from Finland and Sweden. 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.

### Producing Localities:

The industry in the Maritime Provinces was comparatively quiet in 1943. No new deposits were opened and production came from the well-established firms, with quarries situated near St. George, Charlotte county, and on Spoon Island, Queens county.

Quebec furnishes most of the granite for building, the leading producing areas being Stanstead, Stanstead county; St. Samuel, Frontenac county; Riviere-a-Pierre, Portneuf county, and Lake St. John. The largest output of granite in Quebec was supplied from quarries in Simard township, by Foundation Company of Canada, for the Shipshaw power plant development of Aluminum Company of Canada. McNamara Construction Company obtained stone for the same purpose from the quarry at Long Point of Mingan, Saguenay county.

Le Granit National Ltée operated its quarries at St. Gédéon and St. Joseph d'Alma, Lake St. John district. Brodies, Limited, of Montreal operated its dressing plant at Iberville, and obtained its granite from Graniteville, Stanstead county; from Guenette, Labelle county; and to a small extent, from Mt. Johnson, near Iberville. Stanstead Granite Quarries Company of Beebe did not operate its quarries. Scotstown Granite Company of Montreal operated its quarry at Cap St. Martin, Laval county.

In Ontario, the Ontario Rock Company of Toronto operated a quarry at Havelock; and Building Products, Limited, of Montreal quarried some stone from near Madoc.

A red granite of medium to coarse texture and of uniform mixture was being developed prior to the war near Coe Hill, Wollaston township, Hastings county, Ontario. The property, which is owned by Upper Canada Granite Quarries, Limited, 1406 Concourse Building, Toronto, was being developed to supply the domestic and exports markets for monumental and building stones. It is lying dormant for the duration of the war.

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

In British Columbia, granite was produced on a small scale by several operators in 1943, mostly by municipalities and the railway companies.

Production and Trade:

The Canadian production of granite in 1943 was 773,554 tons valued at \$1,516,344, compared with 1,351,815 tons valued at \$1,940,304 in 1942, and 600,922 tons valued at \$1,498,786 in 1941. The large output in 1942 was mainly attributed to the large power plant development at Shipshaw, Quebec.

Imports of granite in 1942 (1943 figures not yet available) were valued at \$64,248. The annual value of the imports prior to the war was approximately \$100,000.

Markets:

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. Granite from quarries in Quebec has been used in the construction of public buildings in different parts of Canada, in competition with local stone. Most operations in which granite is used have been greatly curtailed during the war.

Some granite is being imported from the United States for monumental use, but Canadian granite is being used to an increasing extent for this purpose. Stone for monumental use 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.

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.

Prepared by A. Buisson,  
Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, August, 1944.

## GRAPHITE IN 1943

### Ores Mined and Producing Localities:

Production of graphite in Canada in 1943 continued to be confined to the old-established Black Donald mine at Whitefish Lake, near Calabogie, Renfrew county, Ontario, which now has a record of 35 years of operation.

Flake graphite is widely distributed in the Archaean gneisses and crystalline limestones of western Quebec, and eastern Ontario, and this region formerly supported a somewhat extensive graphite industry; but growing dependence on Madagascar as a source of supply, more especially of high-grade crucible flake, led to a gradual closing down of operations, and all of the plants except that of the Black Donald Company were dismantled many years ago.

In 1942, owing to the possibility of supplies from Madagascar being cut off, renewed investigation of deposits in Canada was encouraged and surface stripping was done by established mining companies on some of the discoveries that were made, with a view to possible development. Various properties, including old idle mines, were examined by the Bureau of Mines and the Metals Controller, Ottawa, in company with representatives of the United States War Production Board, and several sample shipments were tested by the Bureau of Mines. The threatened emergency was averted by the British occupation of Madagascar, and it was not found necessary to take further steps to encourage interest in the development of a Canadian supply. Ore reserves at many of the old properties are believed to be considerable, and could probably be used in an emergency, though this would entail the erection of new mills, or possibly of a central custom mill, to treat the ore.

The Black Donald Graphite Company's main orebody was mined out several years ago, following which, the Company confined its operations to re-treatment of old mill tailing. In 1942, Frobisher Exploration Company (Ventures Limited) undertook a geological investigation of the property and conducted a diamond-drilling program, as a result of which a substantial tonnage of new ore was located. Frobisher Exploration took over the property in 1943, and it is now being operated under the name of Black Donald Graphite, Limited. Production from the property in 1943 came mainly from old mill tailing. About 3,500 tons of this tailing and 300 tons of newly mined ore were treated. The Company's power plant on the Madawaska River was washed out in early May, and was not replaced until the end of the year. A 150 H.P. Diesel engine was installed in July to tide over the emergency. The existing milling system was retained, except for substitution of a ball mill for stamps, and the capacity of the mill was increased by the installation of six Denver flotation cells. The flake of the Black Donald deposit is too small for crucible use, but the products made are high in carbon and are well adapted for lubricants, packings, polishes, and foundry requirements, for which most of the output is sold. Prepared facings for the domestic foundry trade are also made.

There are occurrences of flake graphite in Manitoba and British Columbia, but so far they have attracted little interest. Bodies of amorphous graphite occur near St. John, New Brunswick, and were worked on a small scale many years ago.

Artificial graphite is made in Canada by Electro-Metallurgical Company of Canada, Welland, Ontario, and by the Exolon Company, at Thorold, Ontario. These companies supply the United States with part of its requirements.

### Production and Trade:

Canada produced graphite to a value of \$204,894, in 1943, an increase of 74 per cent as compared with 1942. Exports of milled products were valued at \$42,987, compared with \$58,572 in 1942. Imports of unmanufactured graphite were valued at \$23,773; of manufactured, at \$286,583; and of graphite crucibles at \$191,296. These values compare

with \$39,361, \$273,301, and \$340,761, respectively, in 1942.

World production of natural graphite of all grades and including flake, crystalline (plumbago) and amorphous, averaged about 140,000 short tons a year prior to the present war. Madagascar, Germany, Austria, and Czechoslovakia were the principal producers of flake graphite; Ceylon of crystalline; and Mexico and Korea of the amorphous variety. The United States obtains most of its requirements of graphite from Madagascar and Ceylon, but there was a production of flake in 1943 from Alabama, Texas, and Montana; of low-grade amorphous graphite from Nevada and Michigan; and of anthracite-graphite (so-called "sea-coal") from Rhode Island. Combined production of all grades in the United States in 1943 totalled 9,939 tons, an increase of 40 per cent over 1942. As insurance against a threatened shortage of graphite for essential war uses, particularly for crucibles, the United States Government in 1942 instituted stockpiling of domestic flake and also took steps to increase production by financing the erection of additional mills. However, by the end of 1943 supply and stocks of strategic graphite had become adequate for essential needs and the new plants were closed down.

#### Market, Uses, and Prices:

Graphite has many uses in industry, but is employed principally in foundry facings, lubricants, crucibles, retorts and stoppers, packings, pencils and crayons, paints, and stove polish. Dry batteries, electrodes, and commutator brushes use important quantities, mostly amorphous or artificial.

Canadian graphite requirements are principally for the foundry, dry battery, packings, lubricants, and paint trades. Foundry needs are met in part by domestic (Black Donald) production, and in part by imported Ceylon plumbago. The battery trade uses mainly Mexican amorphous; and paint requirements are filled largely by low-grade amorphous and flake.

Owing to the fine grinding required to free the graphite, the ores of many of the earlier-worked Canadian deposits yielded a relatively small proportion by high-value, coarse crucible flake. In the interval, also, crucible graphite specifications have become much stricter and, in addition to size of flake and carbon content, have stipulations regarding fusibility of ash, break-down, and volume. In general, a No. 1 crucible flake should be coarser than 50-mesh, with about 40 per cent standing on a 35-mesh screen and 40 per cent on a 28-mesh screen. Carbon content should be 85 per cent, or over.

In order to conserve supply of "strategic" graphite which includes crystalline graphite in flake, lump, or chip form, and coarser than 50-mesh, the United States War Production Board early in 1942 restricted the use of plus-35-mesh Madagascar flake to the manufacture of crucibles required for the war effort, and named Metals Reserve Company as the sole importer of such material. All strategic graphite was also placed under strict control and allocation to the various essential consuming industries. Buying of all Ceylon and Madagascar graphite is undertaken by the British Ministry of Supply, under allocation agreement with the United States for Allied use.

Prices showed little change in 1943 from those of the previous year. Average quotations in the American market were as shown below. Ceylon graphite, which is marketed in a considerable range of types and qualities, sold as follows: crude lump, 97 per cent carbon, 15 cents per pound; high carbon lump, 85 to 98 per cent, 10 to 13 cents; chip, 85 to 90 per cent, 11 to 12½ cents; crystalline dust, 65 to 80 per cent, 6½ to 9 cents; flying dust, 55 to 80 per cent, 4½ to 8 cents; carbon dust, 55 to 60 per cent, 4 to 5 cents. Madagascar crucible flake, 85 per cent carbon and up, was nominal, under allocation control, at 10 to 11 cents. Domestic lubricating flake, 90 per cent plus, sold at 15 to 20 cents, and domestic fine flake, 65 to 70 per cent, for use in the manufacture of foundry facings, at 4½ cents. Metals Reserve

Company prices, per pound, for domestic flake, were as follows: No. 1A, 14 cents; No. 1, 13 cents; No. 1B, 12 cents; No. 2, 11 cents; No. 3, 7 cents; No. 4, 5 cents. Mexican amorphous, 80 to 90 per cent carbon, crude lump, sold for \$20 per ton, f.o.b. Sonora, and powdered, for 4 to 6 cents per pound.

At the beginning of the year, all graphite was placed in Group I (supply insufficient for war and essential industrial needs) of the list of materials in critical supply issued by the Conservation Division of the United States War Production Board. In July, only flake and lump were included in Group I, with all other placed in Group III (supply in excess of current essential requirements). In October, and through to January, 1944, only flake remained in Group I; lump had dropped to Group II (supply sufficient for current war and essential industrial demand); and amorphous was listed in Group III. In general, at year-end, the graphite situation had eased materially, and concern over supply of strategic grades for war needs had been largely relieved.

#### Tariff:

The duty on Canadian graphite entering the United States under the general tariff is 5 per cent ad valorem on natural amorphous and artificial grades and 15 per cent on crystalline lump, chip, and dust grades. The Canadian tariff is as follows: graphite, not ground or otherwise manufactured, British, free; Intermediate (including the United States),  $7\frac{1}{2}$  per cent ad valorem; General, 10 per cent; on ground and manufactures of, including foundry facings, but not crucibles, British, 15 per cent; Intermediate,  $22\frac{1}{2}$  per cent; General, 25 per cent.

Exports of Canadian graphite and graphite products have been subject to special export license, since January, 1941.

Prepared by Hugh S. Spence,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, March, 1944.



## GRINDSTONES, PULPSTONES, AND SCYTHESTONES IN 1943.

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

Grindstones - Read Stone Company, Sackville, New Brunswick, the only producer of these stones in Canada in 1943, shipped from quarries near Stonehaven on the Bay of Chaleur. Total sales amounted to 162 tons valued at \$6,000, as against 200 tons valued at \$8,000 in 1942.

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 sheer manufacturing industries. The small stones are used for grinding scythes and axes. Because of the competition from the artificial grinding wheel and from foreign natural stones, production of grindstones from quarries continues to decline.

Pulpstones - There has been no output of pulpstones since 1937, when the J.A. and C.H. McDonald Company ceased production from the sandstone beds on the northwest end of Gabriola Island, near Nanaimo, Vancouver Island, British Columbia.

Good pulpstones are in demand, particularly for use in the large magazine grinders, but known Canadian deposits containing thick beds of sandstone of the proper quality appear to have been worked out and production has ceased. There is also an increasing competition from Canadian-made artificial segmental pulpstones, mainly of silicon carbide grit, and about 620 of these stones are in use and in stock in the various Canadian pulp mills. The imported natural pulpstones come mainly from West Virginia.

Scythestones - About 6,500 of these small hand-operated stones, with a total weight of 2 tons and valued at \$225, were sold in 1943 by Read Stone Company, compared with 16 tons valued at \$2,000 in 1942. These stones have been obtained for many years from the same quarry from which the Company's grindstones are produced, but from finer textured beds of the sandstone.

The production of all grades of stone in 1943 was 164 tons valued at \$6,225, compared with 216 tons valued at \$10,000 in 1942.

Exports in 1943 were 10 tons of grindstones to the United States valued at \$400.

Prepared by V. L. Eardley-Wilmot,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, March, 1944.



## GYPSUM IN 1943

### Sources of Supply:

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

### Producing Localities:

In Nova Scotia production of gypsum decreased from 394,000 tons in 1942 to 251,000 tons in 1943. Canadian Gypsum Company, Limited, operating at Wentworth, Hants county, about two miles from Windsor, is the largest gypsum operator in the Province. During the summer it ships part of the crushed stone by steamer to the United States and part by rail to its large storage plant at Deep Brook, Digby county. In the winter, when Wentworth is closed to navigation, the crushed stone from the storage plant is shipped by steamer to the United States. The company operated for five months during 1943 at about one-quarter capacity.

National Gypsum (Canada) Company continued its operations at Walton, but suspended its operations at Dingwell. However, it shipped some gypsum from storage at Dingwell. Windsor Plaster Company quarried stone from the old Mosher quarry on the property of Windsor Gypsum Company and also from the George Haley property at Martock and the Vienot quarry at Brooklyn. Connecticut Adamant Gypsum Company reports a small shipment from its stockpile at Cheverie, Hants county.

In New Brunswick, the gypsum quarries and plant of Canadian Gypsum Company at Hillsborough were operated at capacity and all grades of plaster and wall boards were produced for the markets in eastern Canada. No shipments of crude gypsum were made to the United States due to the difficulty of obtaining vessels.

In Ontario, gypsum is mined at Caledonia by Gypsum, Lime and Alabastine, Canada, Ltd., and at Hagersville by Canadian Gypsum Company, Limited, both centres being in Haldimand county. All grades of plaster and plaster products are manufactured for markets in Ontario and Quebec. So far, the extensive deposits of gypsum known to occur in northern Ontario, have not been developed.

In Manitoba, Gypsum, Lime and Alabastine (Canada) Limited and Western Gypsum Products, Limited operated their quarries at Gypsumville and at Amaranth respectively, and their plants in Winnipeg throughout the year.

In British Columbia, Gypsum Lime and Alabastine continued the production from its deposits at Falkland to supply its plant at Port Mann, near 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 Consolidated Mining and Smelting Company at Tadanaac, and efforts to find an outlet for this material are being continued.

### Production and Trade:

The production of gypsum in 1943 was 429,968 tons valued at \$1,176,269, compared with 566,166 tons valued at \$1,254,182 in 1942 and the record production of 1,593,406 tons valued at \$2,248,428 in 1941.

The decline in output in 1942 and 1943 can be traced largely to a shortage of cargo space for the export of Nova Scotia's production to the United States.

The world production of gypsum, is estimated at 8,000,000 tons. Canada probably occupies third place among the producers.

Markets:

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 is used in the manufacture of wallboard, gypsum blocks, insulating material, acoustic plaster, etc.

The use of gypsum products in the building trades has made rapid progress because of their lightness, durability, fire-resisting, insulating, and acoustic properties; and tiles, wallboards, blocks, and special insulating and acoustic plasters have been developed. It is probable that the production of gypsum for domestic use will continue to decline during 1944. As most of the crude gypsum is shipped to the United States for the manufacture of gypsum products, industrial conditions in that country will continue to have an important bearing on the industry.

The use of anhydrite for the manufacture of sulphuric acid, ammonium sulphate, cement and special plasters is increasing, and, normally, there is a good opportunity for the Canadian material in this market. Canada has extensive deposits favourably situated for commercial development, the material from which has been proved by tests carried out by the Department of Mines and Resources to be of excellent grade. Prior to 1937 the small Canadian production was exported principally for use as a fertilizer for the peanut crop, but it is possible that an industry will eventually be started in this country in which the anhydrite may be used for the manufacture of sulphur or sulphur compounds and of special plasters, similar to those being marketed in England.

The manufacture of gypsum boards, for which there has been a large demand in recent years, has partly compensated for the decrease in use for residential building purposes.

Crude gypsum is a low-priced commodity, and its selling price f.o.b. quarry is dependent largely upon the quantity produced and the production facilities available. For export, contracts are generally made with the producer for the year's requirements of the purchaser and these contracts are generally made early in each year. The price of crude gypsum as quoted by the Canadian Chemistry and Process Industries remained at \$2.50 to \$3.50 per ton f.o.b. mine throughout 1943.

Prepared by A. Buisson,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, March, 1944.

## IRON OXIDES (MINERAL PIGMENTS) IN 1943

### Ores Mined and Producing Localities:

Ochreous iron oxide, which is sold uncalcined and is used chiefly in the purification of illuminating gas, comprises the bulk of the minerals produced under this category. The 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 the raw and in the calcined state for use as pigments in paints. The Canadian iron oxide industry is small and the quantity produced shows little change from year to year. Present producing localities have met the requirements of the domestic pigment trade for the cheaper grades for many years. The production for some time past has come mostly from deposits near Trois Rivieres, Quebec, but there are other deposits in different parts of Canada that could be operated were the demand sufficient to warrant doing so.

In 1943 Sherwin-Williams Company of Canada operated deposits at Red Mill and near Champlain, Champlain county, Quebec. It was the only producer of calcined iron oxides, the others having marketed only air-dried products. Its calcined and air-floated mineral products, produced to rigid specifications, are essential for use in the war industries. An additional calcining unit of a new design was put in production in 1943. The shortage of cord wood had become so serious that the operators were faced with the closing of the plant or the rebuilding of the furnaces to utilize other fuels that might be available. It was finally decided to convert the furnaces to the use of bituminous coal as fuel, and this required considerable structural changes in the furnaces, including the installation of underfeed stokers. The problem of the sulphur gases (SO<sub>2</sub> and SO<sub>3</sub>) from the use of bituminous coal was satisfactorily solved and the furnaces are now operating as efficiently as with fuel, with the added advantage that pyrometric control of the furnace heats can be adapted to stoker firing with coal, if deemed advisable, which was impossible with wood firing by hand. During 1943 some changes in processing of some of the oxides was made to better fit them for the requirements for war purposes.

Deposits at Almaville and St. Louis, Champlain county, and at Les Forges, St. Maurice county, were operated by Charles D. Girardin of Yamachiche. Mauricy Oxide Company of Grand'Mere operated its property at St. Adelphe, Champlain county, and Thos. H. Argall of Trois Rivieres operated his property near Pointe-du-Lac, St. Maurice county. In the past, deposits near St. Anne de Beaupre, Montmorency county; in Lynch township, Labelle county; and at St. Raymond, Port-neuf county, Quebec, were operated.

In British Columbia, there has been a small production of iron oxide from Alta Lake, New Westminster district, and from oxide beds in the Windermere district, since 1923. The oxide is used chiefly for gas purification.

In Alberta and Saskatchewan, several deposits of ochre are known, some of which have commercial possibilities, but they are difficult of access and the market is limited and they have received little active attention. Large deposits near Grand Rapids and Cedar Lake in northern Manitoba remain undeveloped for similar reasons. In Nova Scotia, beds of ochre and umber were operated to a small extent in the past.

### Production, Trade, and Prices:

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 1943 totalled 7,879 tons valued at \$126,195, compared with 9,304 tons valued at \$151,653 in 1942. Shipments by producers in the

Province of Quebec totalled 7,479 tons valued at \$122,195, compared with 8,866 tons valued at \$147,049 in 1942.

Most of the higher grade oxides, ochres, and umbers used in the paint trade were formerly imported from Europe, and, prior to the war, some of the cheaper grades of European oxides even competed with the domestic products, as they do not require calcining to produce the desired colour.

The consumption of iron oxide by the illuminating gas industry in 1941 (figures for 1942 and 1943 not available) was 8,575 tons, and the amount consumed in the paint industry was 1,600 tons.

The Canadian price of red iron oxide in 1943, as given by Canadian Chemistry and Process Industries, remained at 2 to 7 cents a pound throughout 1943.

Prepared by A. Buisson,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, March, 1944.

## LIME IN 1943

### Sources of Supply:

Lime is manufactured in every province except Prince Edward Island, though the Saskatchewan production is intermittent and small. 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, the leading lime-producing province, supplies nearly one-half of the total output; Quebec being next with slightly more than one-third of the total.

The steadily increasing demand for lime by the war industries has raised production above all previous records. Most of the forty-eight plants throughout the country operated at capacity during 1943, and in the early part of the year there was a serious shortage of high-calcium chemical lime in Eastern Canada. At Beachville, Ontario, which is one of the most important centres of chemical lime production in Canada, the diversion of the Thames River in the quarry area was begun in 1943, to make available much more rock for quarrying and to lessen the danger from floods.

There are many prospective lime-producing localities in Canada because of the abundance of limestone throughout the country, but in the more industrialized area, particularly in Ontario and Quebec, large unworked deposits of pure high-calcium limestone that will yield a white lime suitable for chemical purposes are becoming scarce. With the northward development of the mining industry considerable interest is being manifested in making lime from limestone deposits in the more northerly parts of the country.

### Production and Trade:

Lime production, which includes both quicklime and hydrated lime, in 1943, amounted to 938,143 tons valued at \$6,750,093, an all-time record both in quantity and value, compared with 884,830 tons valued at \$6,530,839 in 1942.

Exports of lime in 1943 amounted to 15,391 tons valued at \$133,320, compared with 8,431 tons valued at \$74,517 in 1942.

Imports of lime amounted to 9,077 tons valued at \$64,303, compared with 6,231 tons valued at \$43,854 in 1942.

### Market and Prices:

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, in agriculture, in construction, and for various other purposes. It is one of the great basic raw materials of the chemical industry and well over 90 per cent of the present production is used in chemical processes.

Prices of the various lime products vary over a wide range, depending on the geographical position of the plants and on difference in quality of the lime. No significant change occurred in prices of lime during 1943.

Prepared by M.F. Goudge,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, June, 1944.



## LIMESTONE (GENERAL) IN 1943

### Sources of Supply:

Limestone is the most widely used of all rocks because of the great variety and importance of its industrial uses and because of its widespread occurrence. 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 1943 production of limestone for all purposes, including the manufacture of lime and cement, constituted about 90 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 purposes, 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, and it may be expected to be more widely applied in the future.

### Production and Trade:

The 1943 production of limestone for general use, exclusive of that used for lime and cement, is estimated at 6,302,888 tons valued at \$6,218,314, compared with 6,442,583 tons valued at \$6,468,525 in 1942. The production for all purposes in 1943 is estimated at 9,836,111 tons, compared with 10,172,841 tons 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 than the domestic at certain large consuming centres in Canada, considerable quantities are imported for use as blast furnace flux, 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.

### Markets:

For industrial 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 of the products are processed 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.

The great bulk of limestone used in chemical and metallurgical industries is of the high-calcium variety, but dolomite is rapidly increasing in importance as an industrial raw material. Argillaceous dolomite is used for the manufacture of rock-wool, a widely used insulating material. The value of rock-wool and slag wool produced in 1943 by the six Canadian plants was \$1,721,141. Several additional plants are in prospect for 1944. Pure dolomite is now an important source of magnesia and magnesium metal. The metal is recovered directly from calcined dolomite by reduction with ferrosilicon, and indirectly by

reacting calcined dolomite with sea water or with magnesium chloride brine, thereby forming magnesium hydroxide that is converted into the chloride from which, after dehydration, magnesium is recovered by electrolysis. High-calcium lime may be used in place of dolomitic lime for precipitating magnesium hydroxide from seawater and brine, but where the dolomitic lime is used the yield of magnesia is increased by the magnesia content of the latter. Dolomite is the raw material from which basic magnesium carbonate and magnesia are made by the Pattinson process. Dead-burned dolomite is widely used as a refractory material in the steel industry.

A use for limestone that is 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 many 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.

Prepared by M.F. Goudge,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, June, 1944.

## LIMESTONE (STRUCTURAL) IN 1943

### Sources of Supply:

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, two quarries near Queenston in the Niagara Peninsula yield silver-grey limestone as well as small quantities of buff and of variegated buff and grey. At Longford Mills, near Orillia, buff, silver-grey, and brown limestone for use as marble and as building stone is available, but has not been quarried for the past several years. 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 Quebec; and at Ottawa, Kingston, and Warton 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.

There were no developments of importance in 1943. Although building construction is active owing to defence needs, most of the buildings are of the factory type and require little cut stone; thus, the building-stone industry is relatively inactive and a number of the quarries are either shut down or operated only for a short time each year.

After the war, however, a good demand for building stone is expected in connection with many office buildings already planned but actual work on which has been deferred until the war is over.

The limestone deposits being worked for building stone are favourably situated in respect to centres of population and the supply of stone is adequate for present and future demands.

### Production and Trade:

The production of limestone for structural purposes in 1943 was 9,536 tons valued at \$171,655, compared with 24,857 tons valued at \$361,781 in 1942. This production was largely from quarries in Ontario and Quebec. The value 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 at present between Canada and other countries. Exports of limestone for building purposes are very small and are not separately recorded, but exports of all varieties of building stone except marble and granite had a value of only \$7,864 in 1943. Imports of all varieties of building stone except marble and granite in 1943 had a value of \$4,000.

### Prices:

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 a cubic foot, depending on the size of block and grade of stone.

Prepared by M.F. Goudge,  
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Department of Mines and Resources,  
Ottawa, Canada, June, 1944.



## LITHIUM MINERALS IN 1943

### Canadian Occurrences:

Lithium minerals were mined intermittently on a small scale in Manitoba between 1925 and 1937, but there has been little activity since. The last recorded shipment was made in 1937 and was valued at \$1,694.

Amblygonite, spodumene, and lepidolite are the chief lithium minerals of commerce, with spodumene in greatest supply, and their ores usually contain, respectively, about 8, 6, and 4 per cent of lithium oxide. The known Canadian occurrences of these minerals of present economic interest are confined to Manitoba, where there is a considerable development of lithium-bearing pegmatites, notably in the Pointe du Bois area in the southeastern part of the Province. This district has furnished all of the small Canadian production, amounting to a few hundred tons, the material shipped, <sup>being</sup> mainly spodumene. Lithium Corporation of Canada, 403 Avenue Bldg., Winnipeg, is the company that has been most actively interested in promoting development of deposits in the above section, and it has carried out considerable work on its holdings, mainly on those at Bernic Lake. It mined and stockpiled about 50 tons of mixed ore in 1941, but was inactive during 1942 and 1943. The material taken out in 1941 comprised about equal amounts of clobbered amblygonite and spodumene and included also a few tons of triphylite, a phosphate of lithium and iron, containing, theoretically, about 9 per cent of lithium oxide. Other occurrences of lithium minerals in Manitoba, include those on the Silver Leaf property, on Winnipeg River; on the Irgon and Page-Johnson claims, at Cat Lake, north of Oiseau River; on the Picard and Scott claims, near East Braintree, 84 miles east of Winnipeg, near the Ontario-Manitoba boundary; and on the Kobar claims, near Mile 81 on the Hudson Bay railway. Spodumene is the chief lithium mineral in most of these occurrences, and it is usually mixed with considerable quartz; necessitating concentration to make a commercial shipping product.

Increased interest was evidenced in the commercial possibilities of Manitoba's lithium deposits in 1942 and 1943. Sherritt-Gordon Mines in 1942 drilled about 20 holes on the Kobar group of claims at Crowduck Lake, in the Herb Lake area; the deepest of which cut the deposit at a depth of 175 feet. Spodumene-bearing pegmatite was found to extend over a length of at least 900 feet, with an average width of 18 feet, and with a spodumene content of nearly 14 per cent. The indicated amount of spodumene present in the section drilled was 1,400 tons per vertical foot. In 1943, Sherritt-Gordon drilled the Scott (Atyfor) claim near East Braintree; the results indicated a number of irregular tongues or lenses of spodumene-bearing pegmatite. The two best holes showed, respectively, 18 per cent spodumene over a width of 40 feet, and 22 per cent over 39 feet. Further prospecting in the Cat Lake area in 1943 disclosed extensive surface showings of spodumene-pegmatite over considerable distances beyond the previously known Irgon deposit, with estimated contents of 25 to 30 per cent spodumene over widths of 25 to 30 feet in many sections. This work indicates that the Cat Lake area probably contains the most important spodumene deposits so far located in the Province: the discoveries are under option to Hudson Bay Mining and Smelting Company, who plan to drill in 1944.

In its work in the Yellowknife - Beaulieu River area, Northwest Territories, in 1943, the Geological Survey located further occurrences of lithium-bearing pegmatites, thus confirming the existence there of extensive lithium-mineralization. Many of the dykes contain also tantalite-columbite, cassiterite, and beryl. Frobisher Exploration Company (Ventures) had parties in the region, and investigated showings in the Ross Lake and Buckham Lake areas, staking the Lita group of claims on the MacDonald dyke west of Buckham Lake. This occurrence is reported to be 400 feet long and 22 feet wide, with an estimated spodumene content of 30 per cent, and to contain 750 tons of spodumene per vertical foot. The dyke also carries tantalite, the content of which in some sections is estimated to be one to five pounds per ton of rock.

Several other mining companies were active in prospecting in the region, during the year, but results of this work have not been made public.

In Quebec, platy books of lepidolite occur in small amounts in a pegmatite in Wakefield township, Gatineau county; and spodumene is reported to occur in Lacorne township, Abitibi county, about 10 miles from Barraute station on the Canadian National railway.

#### Production and Trade:

No production of lithium minerals in Canada was reported in 1943.

Figures of world production, exports and imports, are not published. The United States and Southwest Africa, are the two chief producers, output in the United States being probably over 50 per cent of the annual total. Production of lithium minerals, chiefly spodumene and amblygonite, in the United States has come mainly from the Black Hills region, in South Dakota, although some lepidolite formerly was obtained from California and New Mexico. As a result of increased war demand provision was made, with Government assistance, in 1942-1943 for increasing American production, and mills for concentrating spodumene ores were built at Tinton, near Lead, South Dakota, and at King's Mountain, North Carolina. The Tinton plant was destroyed by fire before it came into operation, but was re-built and started production in January, 1944, on a 350-tons per month basis: rated capacity is 500 tons per month. The King's Mountain mill, built by the Solvay Process Company, commenced production in May, 1943, on a 600-tons per month scale: rated capacity is 1,000 tons per month. In both plants flotation is employed, and the entire output is used in the manufacture of lithium salts and metal. Capacity is expected to be ample for all essential industrial and war needs.

Much lithia is recovered in the form of lithium-sodium phosphate from the brine of Searle's Lake, California, and this source in recent years has furnished nearly 50 per cent of the American supply of lithia. In 1943, the United States produced 8,155 tons of lithium minerals, including lithia recovered from Searle's Lake, an increase of 51 per cent over the 1942 output, and the highest figure since 1920. Most of the increase consisted of spodumene, production of other lithium minerals showing a decrease.

#### Uses:

The high-lithia minerals amblygonite and spodumene are used chiefly in the production of lithium chemicals and metal. The principal use of lepidolite is as a batch constituent in the making of opal and heat-resistant glass, and increasing amounts are now employed in glass for electronic tubes and boiler gauges. In recent years, spodumene has been receiving increasing attention as a ceramic raw material. Spodumene is rather refractory, but spodumene-feldspar mixtures have lower melting points than has feldspar alone. The objectionable high thermal expansion of spodumene can be overcome by calcining and converting it to the stable "beta" form, as is done in the so-called decrepitation process for the recovery of spodumene in the form of fine powder from rock consisting of intimate mixtures of spodumene and quartz, or of spodumene and feldspar. The mineral appears to have possibilities for use in pottery bodies, glazes and enamels, where it would replace more costly prepared lithium carbonate, provided that it can be obtained in standard grade of the required purity. Lepidolite is highly effective as a fluxing addition in high-talc bodies. Amblygonite is of value for use in opaque glasses.

Lithium and its compounds have attained importance to fill war needs in the electro-chemical, aircraft, and foundry industries, and

military uses now exceed industrial requirements. The chloride is one of the most hygroscopic inorganic compounds known, and is being used to an increasing extent as a drying agent in air-conditioning units. Originally developed for industrial and domestic use, such units are being employed to dry the air for blast furnaces, giving 10 per cent greater efficiency. The chloride, fluoride, and carbonate are used as a flux in coatings for aluminium welding rods. Lithium hydroxide is used in Edison storage batteries, mainly for use in mine locomotives. A method of making single crystals of lithium fluoride up to eight pounds in weight from a molten bath has been perfected; the material has valuable optical properties and is replacing fluorspar for general use in instruments. Lithium stearate has become established as a water-resistant grease that works well under extreme ranges of temperature and is used extensively as an aircraft lubricant. It is also employed in waxes and polishes. Lithium hydride provides a convenient and safe means of transporting and storing hydrogen gas, and this has become a commodity of primary military importance. Lithium nitride serves a similar purpose in the case of ammonia. The carbonate is being used to an increasing extent to improve gloss in ceramic glazes and enamels, and to decrease scaling and decarburization in steel heat-treating furnaces.

Lithium is the lightest of the metals, having a specific gravity of only 0.53. A wide range of master alloys of lithium with calcium, silicon, brass, copper, manganese, zinc, lead, tin, magnesium, and aluminium has been developed in the United States. The lithium content of the base metal varieties ranges from 0.5 per cent to 10 per cent, and rises to as high as 50 per cent in the light calcium and silicon series. The component metals are produced by electrolysis and the alloys are made in an electric vacuum furnace. The alloys are furnished in lumps, slabs, cubes, or plates, and are being used to an increasing extent as de-oxidizing, de-gasifying, and de-sulphurizing agents in copper, brasses, bronzes, etc., and for the hardening of lead and aluminium. Alloys of lithium with zinc, aluminium, and magnesium are strong and highly resistant to corrosion. The addition of one-third of a pound of lithium per ton is reported to impart ductility to alloy steels. The metal is also a useful addition to silver solder, used in brazing ferrous and non-ferrous alloys.

Lithium, in the vapour form, also furnishes a neutralizing atmosphere for furnaces used in the heat-treating and annealing of steel and non-ferrous alloys. The desired effect is achieved by placing a lithium cartridge 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 carburizing, decarburizing, or scaling of the finished work, and 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.

#### Market Conditions:

There are no plants in Canada for the chemical treatment of lithium ores. Most of the world production marketed prior to the war was treated by a few large chemical firms specializing in the business, the principal plants being in the United States, Great Britain, Germany, and France. Such firms usually purchased their requirements under individual contract and there has thus been little in the way of an open market, price quotations given in trade journals being merely nominal. Such of the larger consumers own and operate their own mines. Leading buyers, consumers, and manufacturers in the United States, as given in a December, 1942, publication of the U. S. Bureau of Mines, include the following firms:

Maywood Chemical Company, Maywood, N.J.  
Foote Mineral Company, 16th and Summer Street, Philadelphia, Pa.  
Harshaw Chemical Company, 1945 East 97th Street, Cleveland, Ohio.  
Mallinckrodt Chemical Works, 2nd and Mallinckrodt Street, St.  
Louis, Mo.  
Lithalloys Corporation, 444 Madison Avenue, New York, N. Y.  
Metalloys Corporation, 730 Rand Tower, Minneapolis, Minn.  
Lithium Corporation of America, Raymond and Commerce Bldg.,  
Newark, N. J.  
Corning Glass Works, Corning, N. Y. (Lepidolite).  
B. F. Drakenfeld and Company, 45 Park Place, New York, N.Y.  
(Lepidolite).

To conserve supply for defence needs, the United States Government in September, 1942, placed lithium compounds under allocation control and a similar order was extended to lithium ores in December, 1942. These orders prohibit sale, purchase, and delivery of such commodities without specific authorization of the War Production Board.

During the first half of 1943, lithium metal, lithium chemicals, and spodumene were included in Group I (supply insufficient for war and essential industrial demands) of the list of materials in critical supply issued by the Conservation Division of the United States War Production Board. In July, spodumene was placed in Group II (supply sufficient for current war and industrial requirements). Lithium chemicals remained in Group I to January 1944, but the metal was dropped from mention in lists issued after July 15, 1943.

Prices:

Prices of lithium minerals in 1943 showed little change from those of the previous year. Amblygonite was quoted at \$40 to \$50 per ton, f.o.b. mines, for crude containing 8 to 9 per cent  $\text{Li}_2\text{O}$ ; spodumene, 6 per cent grade, sold for \$5 to \$6 per unit, nominal, for mill concentrate in carload lots, f.o.b. North Carolina; lepidolite, crude lump, brought \$24 to \$25, f.o.b. mines. Price of lithium metal, 98 to 99 per cent, continued unchanged at \$15 per pound, in 100-pound lots, and the various master alloys of lithium sold at \$0.50 to \$8 per pound, in ton lots. Prices of the leading lithium chemicals, all under allocation, were \$1.25 for the carbonate and hydroxide, \$1.65 for the chloride, and \$2.45 for the fluoride.

Prepared by Hugh S. Spence,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, March 1944.

## MAGNESITE AND BRUCITE IN 1943

### Ores Mined and Producing Localities:

Magnesitic dolomite consisting of an intimate mixture of magnesite and dolomite is quarried at Kilmar and at Harrington East, Argenteuil county, Quebec, and is processed for use as refractory materials. Products at present marketed include caustic calcined magnesitic dolomite, dead-burned or grain materials, 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.

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 Yukon, but either because of their limited extent or remoteness from transportation they are not of commercial importance at present.

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.

Brucite (magnesium hydroxide) in the form of granules thickly disseminated through a matrix of crystalline limestone occurs in large deposits at Rutherglen, Ontario, and at Bryson and Wakefield in the province of Quebec. By a process developed in the Bureau of Mines laboratories, Ottawa, it is possible to recover these brucite granules in the form of magnesia of a high degree of purity and to have hydrated lime as a co-product. A plant using this process is now in operation near Wakefield, Quebec. The granular magnesia produced is at present used mostly for making basic refractories, and for making a special grade of paper.

### Production and Trade:

The 1943 production of magnesitic dolomite and brucite combined was valued at \$1,298,775 compared with \$1,059,374 in 1942,

### Markets and Prices:

Magnesite is available in many countries; Russia is probably the world's greatest producer of magnesite, but almost all is for domestic use.

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 3 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 continental Europe, England, and the United States.

Brucite is much less common than magnesite. The only deposits being worked commercially are in Canada and the United States. The magnesia obtained by calcining brucite may be used for the same purposes as that obtained from magnesite and also has some special applications of its own.

Competing with magnesite and brucite as sources of magnesia products are dolomite and sea-water. Dolomite, in addition to its use as a refractory material, 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. The extraction of magnesia from sea-water is being done on a very large scale in England and the United States, the material so obtained being used for making magnesium metal as well as for various industrial and pharmaceutical purposes.

Prices of calcined magnesite in 1943 f.o.b. Montreal or Toronto, as quoted by Canadian Chemistry and Process Industries, were \$7.0 to \$9.0 a ton. This price has continued since November 1939 when the price rose from the \$4.8 to \$6.0 range that had prevailed for more than a year previously.

Prepared by M.F. Goudge,  
In the Bureau of Mines,  
Department of Mines and Resources,  
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## MAGNESIUM SULPHATE IN 1943

### Source of Supply and Producing Localities

Natural hydrous magnesium sulphate (Epsom 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. Attempts have been made to produce refined salts, and a number of years ago there was a considerable production from several of the "lakes" in British Columbia, and experimental shipments have been made from one of the lakes in Saskatchewan.

Canada's output of magnesium sulphate has come chiefly from a deposit in Basque, British Columbia, production from which was discontinued in the autumn of 1942. The salt was refined at Ashcroft, 15 miles south of the deposit and the grade of the product was high. The refinery, now owned by Ashcroft Salts Company, Limited, had a capacity of 10 tons of salt a day. 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.

### Production and Trade:

The Canadian production of magnesium sulphate in 1942 was 1,140 tons valued at \$38,750. None was reported for 1943.

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

### Market Conditions and Prices:

In the chemical industries, Epsom salt has many uses. It is employed for tanning and in dyeing, and for textile and medicinal use. Magnesium sulphate is used in the paper industry for weighting paper. In the sole leather industry it is used to obtain a clean shiny cut, and it also helps to retain moisture in the leather and increases its weight. Magnesium salt is used to a small extent in the dyeing industry. In some cases it is used in the after treatment of leather to increase the fastness of the colour in washing. It is used extensively and in large quantities in medicine and for various purposes in the manufacture of textiles. In bleaching wool, magnesium sulphate is added to destroy the corrosive effect of sodium peroxide. It is also used for weighting textile fabric, especially silk. Mixed with gypsum and ammonium sulphate it is used in the manufacture of non-inflammable fabrics.

Prices for Epsom salts remained steady, due to the discontinuance of supplies from European countries, hitherto the main sources of supply. Quotations for the technical grade, as given by Canadian Chemistry and Process Industries for Toronto or Montreal delivery, ranged from \$63.00 to \$65.00 per short ton in bags, whereas the B.P. material was quoted at \$3.60 per barrel throughout the year.

### Tariffs:

When magnesium sulphate is not being made in Canada, imports are dutiable at the rate of 17½ per cent, otherwise the duty is 20 per cent. The tariff on the material entering the United States is ¾ of a cent per pound, or \$15.00 per ton.

Prepared by A. Buisson,  
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Department of Mines and Resources,  
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## MARBLE IN 1943

### Sources of Supply:

Marble quarries are operated in 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, poultry grit, 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 Philipsburg 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 limestone 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 chemical and ceramic uses. A small quantity of dark red marble has been quarried at Cap St. Martin near Montreal, chiefly for making tombstones.

In Ontario, black marble in beds up to 40 inches thick is quarried at St. Albert, near Ottawa, by Silvertone Black Quarries Limited. 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. Buff, red, white, green, and black marbles are quarried north of Madoc by Karl Stocklosar and by Connolly Marble, Mosaic and Tile Company, Limited 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 British Columbia there are many deposits of marble, but there is only a small production of white marble from near Victoria and from Texada Island for use as 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.

### Production and Trade:

Production of marble in 1943 amounted to 11,848 tons valued at \$ 68,022 , compared with 13,824 tons valued at \$88,209 in 1942.

Exports of marble are recorded with exports of granite, and the exports of the two during 1943 amounted to 3,762 tons valued at \$47,258, compared with 3,245 tons valued at \$47,155 in 1942.

Imports of marble during 1943 had a value of \$ 50,630, compared with a value of \$33,964 in 1942. Present imports are largely in the form of unpolished slabs and sawn stock, the finishing being done in marble mills throughout Canada.

### Market Conditions:

The war has adversely affected the Canadian marble industry, for in 1943 most of the buildings erected were of the industrial type in which little or no standing marble was used. Few of the quarries were in active operation and such shipments as were made of block or slab marble were from stock. Some of the operators have recently taken on as a side line the production of terrazzo and poultry grit from waste marble. Most of the terrazzo previously originated in Europe but now a good range of colours is available in domestic material. Colours that are still in short supply are deep reds and some shades of yellow.

There is a wide range in the price of marble depending on quality and rareness of colouring.

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Department of Mines and Resources,  
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Ores Mined and Producing Localities

Canada and the island of Madagascar are the two chief sources of phlogopite, or amber mica, and there is also a small production from recently discovered deposits in Mexico. Deposits of phlogopite occur also in Ceylon, Korea, Tanganyika, and Portuguese East Africa and the discovery of occurrences of phlogopite in the Northern Territory of Australia was reported recently. The known occurrences of phlogopite in Canada are confined chiefly to a belt of rocks extending from Kingston to Ottawa and thence northward into Quebec between the Gatineau and Lièvre Rivers. The belt is from sixty to seventy miles wide. Scattered deposits occur also in Pontiac and Argenteuil counties, Quebec, and as far east as Quebec City; and in Ontario similar deposits have been mined in Hastings and Haliburton counties. In recent years most of the Canadian production of phlogopite has come from mines in Quebec, though substantial quantities of scrap have been shipped from waste dumps of idle properties in Ontario.

There are many known occurrences of muscovite, or white mica, in Canada, but prior to the discovery of important deposits in the Eau Claire area near Mattawa, Ontario, in the winter of 1941-42, production was negligible, as, in general, the quality of the mica and the yield proved to be too low for profitable mining. In 1943, there was a large production from deposits in the Eau Claire area, chiefly from the Purdy property, a conspicuous feature of the mica being the phenomenal size of the crystals, or books, some of which measured up to 5 by 8 feet across. The average size of trimmed sheet produced here is far above that of most mica mines.

Muscovite of "ruby" quality was found a few years ago in the Saguenay district, Quebec, where there was a small production in 1942 and 1943, most of which came from the Simard mine, Bergeronnes township. A small quantity of heavily spotted muscovite was shipped out by airplane from a remote locality near Lac Manouan, in the Peribonka River region, north of St. John.

There are a number of muscovite occurrences in British Columbia mainly in the Tête Jaune, Big Bend, and Fort Grahame areas. Small quantities of mica were recovered from some of these deposits years ago, but many of the deposits are located above timber line, and they could be operated only during the summer. Some mica, or sericite schist, has been mined in recent years at Baker Inlet, near Prince Rupert, by P. M. Ray, 23 Besnor Block, Prince Rupert, and was shipped to the grinding plant of Fairey and Company, 661 Taylor Street, Vancouver, for local roofing use. There were no shipments in 1943, however. Scrap mica is mined by R. C. McKay near Oliver, south of Penticton, in the Osoyoos mining division, and is ground by Fairey and Company and by George W. Richmond, 3239 West King Edward Avenue, Vancouver. Shipments in 1943 amounted to 374 tons.

Black mica (biotite) occurs near Bancroft, in Hastings county, Ontario, and the deposit has been operated on a small scale for the production of grinding scrap. The mica occurs in very large sheets, but is mostly of poor splitting quality and is too high in iron for general electrical use, though some of it has been used in low voltage domestic heater appliances. The deposit was operated in 1943 by S. H. Orser, of Verona, Ontario, who shipped a small tonnage to the United States for grinding.

There are no known occurrences of vermiculite (an altered phlogopite or biotite) in Canada, but five plants are engaged in processing raw material imported from the United States, chiefly from Montana, and these plants supply the domestic building trades. Vermiculite is a type of mica that expands tremendously on heating.

Phlogopite (General Information)

Most of the production in 1943 came from Quebec, the leading producers in that Province being Messrs. Blackburn Bros., Blackburn Building, Ottawa, who operated the Nellis mine and grinding plant at Cantley, in Hull township, and reported capacity business throughout the year; E. Wallingford, at Perkins, in Templeton township; and A. P. Blood, who operated the Ericson mine, near Farrelton, in Denholm

township. Output of the grinding plant of Blackburn Bros. at Cantley comprises 20, 60, and 150 mesh products, part of which is used in the domestic roofing, rubber, and plastics trades and the remainder exported. Early in 1944, consideration was being given to the possible recovery of flake mica from the mill tailings at the lead-zinc mine of New Calumet Mines, Limited, on Calumet Island, and to the production of wet-ground mica therefrom.

The larger producers of phlogopite operate their own mica shops and sell direct to the trade, but a substantial volume of business is done, also, by dealers who purchase small lots of mine-run or trimmed block from small operators and grade, trim, or split the material for sale. Most of the splitting work is farmed out in small rural communities and is done on a piecework basis. The principal dealer-purchasers in 1943 were W. C. Cross, 209 Bridge Street, Hull, and Dominion Mica, Registered, 14 St. Valier Street, Quebec City.

In Ontario, most of the production came from Kingston Mica Company's property near Godfrey, in Bedford township. It, and the Ericson mine, in Quebec, were the chief sources in 1943 of a special type of heat-resistant phlogopite suitable for use in aviation sparkplugs. The other important Canadian source of this type of mica, namely St. Lawrence Mica Corporation's mine at Petit Pre, a few miles east of Quebec City, was idle in 1943.

For many years, Canada has been supplying plants of United States Mica Manufacturing Company, at East Rutherford, New Jersey and Forest Park, Chicago, with a large part of the Company's requirements of scrap mica, the Canadian supply of which from current production and salvaged from old waste dumps, appears to be adequate to meet any likely demand for the material. In recent years, also, important amounts of small-sized sheet phlogopite, recovered in part from old waste dumps, have been shipped in untrimmed form to the United States, where they are made into splittings by a mechanical process. Such splittings are rougher and heavier than those made by hand, but they are suitable for the manufacture of certain types of plate. Most of material is shipped to New England Mica Company, Waltham, Massachusetts.

A threatened Allied shortage of phlogopite was averted by the British occupation of Madagascar in 1942, and the island has since continued to supply block and splittings on a satisfactory basis. The increased supply from Mexico has also helped to bring about an improvement in the situation, as has the substantial increase in the manufacture in the United States of heavy splittings made from the aforementioned shipments of untrimmed mica from Canada. Canadian exports of such mica are estimated at 800,000 pounds in 1943, this amount being five times greater than shipments in 1942. Toward the end of 1943, however, stocks of Madagascar book-form phlogopite in the United States were becoming depleted and this class of mica was placed in Group 1 (supply insufficient for war and essential industrial needs) in the list of materials issued in January, 1944, by the Conservation Division of the United States War Production Board. Block phlogopite of sparkplug quality was also placed in Group 1 of the above list for the first time. Early in 1944 the War Production Board instituted inquiries relative to the possibility of increasing the production of Canadian splittings, output of which showed a considerable decrease in 1943.

#### Muscovite (General Information)

Activities in the Eau Claire area, Nipissing district, Ontario, were confined mainly to the operations on the property of Purdy Mica Mines, Limited. The Company is a subsidiary of Inspiration Mining and Development Company, of Amos, Quebec, which acquired the original Purdy claims in 1942. During the first nine months of 1943, two adjacent dykes comprising the most westerly showings on the property were developed by a succession of benches from which most of the production was obtained. Later in the year, development of several dykes lying east of the above was undertaken, and preparations were made to develop the Croteau showings, which are located on

ground staked originally by the Inspiration Company northwest of the Purdy claims.

The Purdy Company's mica shop at Mattawa was operated at capacity during most of the year and employed about 100 persons. In October, the Company opened a second and larger shop, capable of accomodating up to 500 workers, at North Bay. Most of the production was sold to Colonial Mica Corporation, New York, mica purchasing agent for the United States Government, and sales for the year were reported at \$230,619. The yield of trimmed mica from an estimated total of 470,000 pounds of mine-run was better than 18 per cent, an exceptionally high figure. Shipments of trimmed sheet totalled about 88,000 pounds, and of scrap, about 150 tons. Of the total sheet sold, 18 per cent by quantity and 37 per cent by value was No. 1 (clear) mica; 37 per cent by quantity and 40 per cent by value was No. 2; and 45 per cent by quantity and 23 per cent by value was No. 3. In quantity, the largest proportion (17 per cent) of the muscovite sold by the Company was in the 2 by 3 inch size range, the value of which represented about 15 per cent of the total. Sheet in the 10 by 12 inch size represented about 9 per cent of the total sales value. These remarkable yields indicate the outstanding importance of the property as a source of large sized mica. As a further indication of its unusual richness, it may be noted that the deposit furnished about 8 per cent of the total Canadian and American production of strategic mica in 1943, supply of which was drawn from many hundreds of mines.

Prospecting in the Eau Claire area in 1943 was much less active than in 1942, and no new discoveries of importance were reported. Mica Consolidated Mines (reorganized during 1943 as Amic Mica Mines) Victoria Building, Toronto, continued work on its claims which adjoin the Purdy property, but the results were unsatisfactory and in September the Company moved its equipment to the Simard mine in Saguenay county, Quebec, which it had acquired. This property was operated during the early part of 1943 by Mica Laurentian, Limited, a subsidiary of Sullivan Consolidated Mines, Limited. After it had taken over the property, Amic Mica Mines installed further equipment and established a trimming shop at Les Escoumains. Amic also maintained a mica shop at the village of Bonfield, a short distance west of Eau Claire station, in which it installed presses for punching out condenser films, and also produced cut mica for use in stoves. Late in 1943, the Company acquired Mica Company of Canada, an old established firm at Hull, Quebec, which manufactures mica plate and other mica products. Mattarig Mica Syndicate, Rochester, New York, the only other operator in the Eau Claire area, was proceeding with the development of its Anderson claims late in 1943.

As a result of the active interest in strategic muscovite, work was undertaken on a number of properties, some of them old abandoned mines, in the Sudbury, Parry Sound, and Nipissing districts of Ontario. In the main, however, the results were discouraging and most of the mica produced was of poor quality. The Orser mine near Mazinaw Lake, in Addington county, was taken over by Marston Minerals Limited, Toronto, late in 1943 and the Company made preparations for underground development.

#### Production and Trade

The quantity of mica produced in Canada in 1943 was not reported by the Dominion Bureau of Statistics, but the value of production reached a record total of \$539,595. In 1942, the previous record year, production amounted to 6,019,617 pounds valued at \$383,567. Canada uses comparatively little mica and most of the output is exported to the United States and Great Britain.

Exports of trimmed block reached a total of 863,100 pounds valued at \$422,710, compared with 484,700 pounds valued at \$224,481 in 1942, an increase of 78 per cent in quantity and 88 per cent in value. In quantity, muscovite represented about 10 per cent of the exports and in value, about 47 per cent. Exports of splittings (all phlogopite) amounted to 65,900 pounds valued at \$47,108, compared with 148,300 pounds valued at \$112,756 in 1942, a decline of 56 per cent in quantity and 58 per cent in value. Exports of scrap totalled 2,410

tons valued at \$34,660, compared with 2,162 tons valued at \$27,167 in 1942. In quantity, muscovite represented about 10 per cent of the exports of scrap and in value about 6 per cent. Exports of manufactured mica, chiefly micanite, or built-up mica plate, were valued at \$16,540, compared with \$18,091 in 1942. Exports of ground mica are not shown in the official returns, but are estimated at about 600 tons valued at \$32,000.

Imports of mica and manufactures of mica, n.o.p. were valued at \$220,356 compared with \$177,695 in 1942.

No recent figures for world production of mica are available. India has long been the chief source of supply, and its production in 1942 and 1943 exceeded all previous records. Indian "ruby" muscovite, obtained from Bihar Province, has long been the world standard for exacting electrical uses, particularly for magneto and radio condenser films. India also supplies green muscovite, produced in Madras.

As a producer of muscovite, India holds a particularly advantageous position, as is apparent from the data that follow, which compare yield and costs of production in the United States with those of India. The comparisons are based on information of a general character, but they serve to illustrate the great discrepancy:

	<u>United States</u>	<u>India</u>
Yield of rough mica per ton of rock broken	14 lbs.	120 lbs.
Recovery of trimmed sheet do	0.1 "	0.3 "
Cost of rock broken, per ton	\$6.00	\$0.156
Mining costs per pound of sheet mica recovered	\$6.00	\$0.52
Cost of preparation, per pound	\$1.00	\$0.03
Total mining and preparation cost per pound	\$7.00	\$0.55

In reference to Canada, it may be noted that notwithstanding the high prices that are being obtained for strategic quality mica, the records of Purdy Mica Mines, Limited, show that, after writing off trimming and other charges, little profit has been derived from the handling of mica in the smaller sizes. All things considered, it is doubtful whether the production of muscovite in Canada will prove to be a profitable undertaking under peacetime conditions, when prices are likely to be appreciably lower than at present, except perhaps in the case of unusually rich deposits.

Brazil also produces ruby muscovite and as a result of measures taken during the past few years to increase its output, it is now second to India as a source of supply. Exports of mica from Brazil have shown a marked increase since 1939.

The United States holds third position as a producer of muscovite, the chief producing States being North Carolina, New Hampshire, Connecticut, and South Dakota. Production in 1943 is estimated to have increased seven per cent. as compared with 1942 and to have reached a new record. The increasing output in the United States can be credited largely to the efforts of Colonial Mica Corporation, established by the Government to assist operators, encourage the opening of new mines, open offices at various strategic centres, set up price levels, and to purchase the entire production of strategic material. Direct aid is furnished for the development of approved properties by loans and by equipment supplied on a low rental basis. As a result of such action, several hundred mines have been brought into production and the industry currently employs about 5,000 persons. In 1942 and 1943, the United States obtained about 70 per cent of its imports of strategic mica from India, where more than 100,000 people are employed in the industry.

Argentina is an important producer of muscovite, but a large part of the output is green, spotted mica, and is not of strategic quality.

Market Conditions, Specifications, Purchase Arrangements, Etc.

Demand for block phlogopite was active throughout 1943, as is indicated by the marked increase in the quantity and value of

exports. Heat-resistant phlogopite suitable for sparkplug use is comparatively rare and only a small part of the phlogopite production in Canada and Madagascar is of this character. Outlets for domestic ground phlogopite have been increasing, more especially for the finer mesh sizes now being used extensively in the manufacture of resin-bonded and glass-bonded insulation and in other plastic products.

Muscovite of strategic quality continued in short supply throughout 1943, and despite efforts to increase output in India, Brazil, the United States, and Canada, production failed to keep pace with the steady increase in the demand. Early in 1944, muscovite mica of strategic quality was listed in the United States as the leading critical mineral commodity.

"Strategic" muscovite is defined as: "block and punch mica of better than heavy-stained quality, free of mineral inclusions (black or red spots, stains, or streaks), cracks, pinholes, cross-grains, reeves and ribs, and relatively free of clay staining. It must be hard, clear, and reasonably flat, and capable of being evenly and easily split into laminations or sheets of uniform thickness over the entire area, yielding sheets of at least one inch square in size". To aid in conserving supply, the United States War Production Board placed all such mica under strict control and allocation in 1942, and the Board also issued regulations designed to improve wasteful shop practices, reduce unnecessary use of large mica where smaller sizes would suffice, and to require the employment of stained and heavy stained qualities for less exacting uses, particularly in radio tubes and sparkplugs.

All purchases by the United States Government of foreign mica, with the exception of Canadian muscovite, are handled by the Foreign Economic Administration; and the world supply, most of which is controlled by the Allied Nations, is allocated between the United Kingdom and the United States by the Combined Raw Materials and Resources Board, Washington. The Indian production is controlled, bought, and exported by the British-United States Joint Mica Mission. All foreign mica imported into the United States for Government account is turned over to Metals Reserve Company for sale, either through Colonial Mica Corporation, which disposes of all material other than that from Brazil, sale of which is made by Leonard J. Buck, Inc., New York. All purchases by the United States Government of domestic and Canadian mica are made for Metals Reserve Company account, by Colonial Mica Corporation, which also sells the material. All sales of Government-owned mica to consumers are subject to allocation by the War Production Board.

Owing to the importance of the discoveries in the Eau Claire area, Colonial Mica Corporation was empowered in 1942 to extend its buying program to Canada. A special schedule of prices for Canadian mica was established, and a contract was entered into with Purdy Mica Mines, Limited to buy the company's entire output of strategic quality material, together with a certain percentage of No. 3 quality. As mentioned above, mica purchased from the Purdy mine in 1943 represented about 8 per cent of total strategic mica bought by Colonial during the year, and the property was the largest individual supplier on the continent. In the latter part of 1943, Colonial opened a Canadian office at North Bay, Ontario, and appointed a resident agent. Provision was also made for assisting in the development of promising properties by means of leased equipment, and one operator was aided in this manner. Unless under contract to Colonial, Canadian producers of such mica are free to sell openly in the domestic market.

As an aid in the development of approved properties, the Department of Mines and Resources, Ottawa, leased drilling equipment to several operators in 1943.

Appraisal of muscovite mica for electrical quality, governing decision as to whether it is to be classed and purchased as strategic material, has been based, up to the present, solely on visual inspection, the determining factors being freedom from such obvious imperfections as spots and stains, mineral inclusions, air bubbles, cracks, pinholes, creases, waves, and such faults as ribs, cross-grain, wedge structure; etc., caused by abnormal crystal growth. Appraisal by such means has proved inconclusive, and has caused the

rejection of important amounts of sound mica, due to the varying ability of individual examiners and to the fact that electrical performance does not always agree with appearance. The need for some more reliable method of determining quality led to the development in 1943 of testing instruments that would give precise and rapid determinations of two important electrical properties, namely conductivity, due to the presence of mineral inclusions, pinholes, or flaws, and power factor. These instruments are, respectively, the direct-reading Q-meter and the point-electrode conductivity tester, both developed by the Bell Telephone Laboratories. They are not intended to supplant visual inspection, which will always be required to gauge general quality and detect gross imperfections; but they afford a ready means of determining inherent electrical quality, which is beyond the power of the eye to do, and by their use it is expected that important amounts of mica of a quality hitherto rejected on account of appearance will become available for capacitor and other more exacting electrical needs.

Methods of making thin mica splittings by other than hand-knife means have been under investigation in the United States, but no success has as yet been reported. Mechanical methods of trimming have also been receiving attention and a device employing a fine-toothed band saw inclined at an angle to a base plate against which the mica is held, thus yielding a bevel cut, is stated to have shown some promise.

#### Uses:

Muscovite and phlogopite sheet mica are used almost entirely for electrical insulation. They are cut or punched into a great variety of shapes and sizes, and in the form of splittings are bonded and pressed into large sheets that can be sawn, bored, and machined into any desired form; splittings are also similarly bonded and layered with paper, cambric, or silk to form flexible "micafolium" and tape insulation for windings and bars. Some clear mica, mostly muscovite, is used as stove windows and in lighting equipment, and there is a limited demand for special large-sized, flawless sheet for use in marine compass dials, boiler gauges, and in the iniconoscopes of television transmitters. Both 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, and the former, in the shape of washers, for the barrel, and as thin sheets (so-called "cigarette mica") for the spindle-wrapping and radio shield.

Large quantities of muscovite are used in the form of thin sheets for radio and magneto condenser films, and for the bridges in radio tubes, requirements for both of which uses constitute the most pressing need at present. For such uses, muscovite of the best quality, free from spotting or heavy staining, has been specified. It has recently been found, however, that stained and even heavy-stained material gives satisfactory performance in radio tubes, sparkplugs, magneto coil insulation, and low-tension primary condensers, and substitution in these fields is now conserving large amounts of better-quality mica for condenser use.

Heavily spotted and stained muscovite ("electric" mica) is used mainly in domestic heater appliances, such as toasters and flat-irons; and inferior, ribbed material is punched into washers and disks for various insulating purposes. Because of the restrictions on the manufacture of a wide range of electrical equipment, an abundant supply of low-grade muscovite is available and such material is difficult to market at remunerative prices.

Fine flake or powdered mica, made mainly from muscovite, but also from phlogopite and even biotite, has become an important industrial product, particularly in the United States where a number of plants are engaged in its manufacture by wet and dry systems of grinding. The raw material is, variously, mine and shop waste or scrap, small sheets and flakes recovered from clay-washing plants and also from schist rock mined for the purpose. In a few cases,

pegmatites also are mined as a source of grinding mica. Most of the production goes to the roofing and rubber trades. Other uses are in weather and corrosion-resistant paints; in resin varnishes for coating foodstuff cans; as a decorative medium in wallpaper and for Christmas tree "snow"; in the ceramic type of insulation termed "Mycalex"; and in a wide range of resin-bonded, moulded insulation and plastics. "Watsonite" is a flexible, resin-bonded insulating material made with dehydrated, heat-treated mica powder. Ground mica is also employed as a mould and core wash (trade-name "Micawash") in foundry work. Important new outlets for coarser grades are developing for use in oil drilling to prevent circulation loss of water into uncased and porous formations.

Vermiculite is used extensively for thermal and acoustic insulation. The expanded product, also termed "Zonolite", has a specific gravity of only 6 to 8 pounds per cubic foot, is comparatively refractory, and has low thermal and sound conductivity. In the form of loose-fill, it is a valuable insulator in the walls and roofs of dwellings, industrial buildings, furnaces, ovens, and refrigerators, in which fields it competes with rock and glass wool. Combined with various bonding materials, it is fabricated into pipe covering, insulating blocks, plasters, tiles, and structural roof slabs, and it is also widely employed as a light-weight aggregate in concrete, including cast slabs for pre-fabricated houses. Such slabs are also being used for the decks, roofs, and fire-walls of ships and buildings subject to bombing attack. Plastic insulation made with vermiculite is used as a heat insulator on the outside of boilers and refinery columns, and as a sound-proofing agent in automobiles and aircraft.

Most of the world supply of vermiculite is produced and used in the United States; where production in 1943 totalled 46,645 tons valued at \$471,595. Montana, Wyoming, and North Carolina furnish most of the output, but some has been mined also in Colorado, South Carolina, California, and Nevada.

Much attention has been given to the possibility of developing satisfactory substitutes for mica, but so far efforts in this direction have not been encouraging. Materials proposed have included glass and other ceramic products, oil and resin-treated paper, plastics, and "Diaplex" or "Alsifilm", made from centrifuged bentonite, but none of these has proved to be as suitable as mica from the viewpoint of desired properties and performance. Even if found usable, employment of such substitutes would require fundamental changes in design of equipment, which would have to be made progressively over an extended period. At present, therefore, there is no likelihood of any lessening in the demand for high-grade, strategic-quality mica, of which every available pound is needed for essential war service.

Prices:

Phlogopite: Dealers' quotations in 1943 showed little change from 1942 and were approximately as shown below, according to quality as based on colour, hardness, and splitting properties:

<u>Knife-trimmed Block or Sheet</u>		<u>Splittings</u>	
<u>Size, Inches</u>	<u>Per Pound</u>	<u>Size, Inches</u>	<u>Per Pound</u>
1 x 1 and 1 x 2	\$0.25 to \$0.30	1 x 1	\$0.65
1 x 3 and 2 x 2	0.45 to 0.50	1 x 2	0.75
2 x 3	0.70 to 0.80	1 x 3	0.90
2 x 4	0.95 to 1.00		
3 x 5	1.50 to 2.00		
4 x 6	1.75 to 2.50		
5 x 8	2.75 to 3.25		

(Splittings prices in U. S. funds)

Ground phlogopite sold as follows, according to fineness: 20 mesh, \$30 per ton; 60 mesh, \$40; 150 mesh, \$65; all prices f.o.b. Ottawa, in ton lots, bags extra. Scrap phlogopite, for-export

sold for \$10 to \$11 per short ton, in carload lots.

Muscovite: There is comparatively little domestic demand for block muscovite, most of the consumption being in the form of splittings for micaite manufacture, prepared films for condensers, and punched disks, segments, and washers, most of which are imported. There are thus no established trade quotations for trimmed sheet muscovite, and little is handled by Canadian mica dealers. The scale of prices set up by Colonial Mica Corporation for Canadian muscovite in 1942 was revised upward in 1943, except for No. 3 quality, which remained unchanged. The new schedule, which is to remain in effect until December 31, 1944, is shown below. All mica must be prepared in full sickle-trimmed form, with bevelled edges, no sheets to be thinner than 0.007 inch, or 7 mils. Purchase will be made subject to inspection and appraisal for quality and perfection of trim, and the proportion of No. 3 quality under 6 by 8 inches in size is limited to two-thirds by weight of the combined amount of No. 1 and No. 2 mica in any one lot. Prices shown are in Canadian funds, f.o.b. shipping point:

Size or grade inches	No. 1 quality \$	No. 2 quality \$	No. 3 quality \$
1 x 1	1.54	0.66	0.33
1½ x 1½	2.09	0.88	0.44
1½ x 2	2.75	1.485	0.77
2 x 2	4.125	2.31	1.21
2 x 3	5.225	2.97	1.54
3 x 3	5.775	3.41	1.76
3 x 4	6.16	3.96	2.09
3 x 5	6.60	4.62	2.42
4 x 6	7.70	5.17	2.75
6 x 8	8.80	6.05	3.19
8 x 10	11.00	8.25	4.40
10 x 12	13.20	9.90	5.28

Prices set for "thins" (under 7 mils) range from \$0.50 to \$2.50 per pound, according to size and quality.

Domestic outlets for limited amounts of No. 3 quality muscovite exist with manufacturers of heater appliances, electrical repair shops, stove manufacturers, and the hardware trade, but such material is in ample supply and prices offer little encouragement for mining for this quality alone.

Montana cleaned and screened crude vermiculite was quoted in 1943 at \$12 a short ton, f.o.b. mine, and North Carolina crude at \$9.50. The expanded product weighs only 6 pounds per cubic foot, as compared with 60 pounds for the natural mineral. It is usually marketed in 24-pound bags, and American quotations average \$75 to \$80 a ton f.o.b. plant. Value of sales in the United States in 1942 was over \$4,000,000.

Tariff:

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 by 2 inches, 10 per cent ad valorem. Mica unmanufactured, valued at not over 15 cents per pound, 4 cents a 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 a pound, 15 per cent ad valorem. Mica waste and scrap valued at over 5 cents and not over 15 cents a pound, 4 cents a pound plus 25 per cent. Mica, ground or pulverized, 15 per cent ad valorem.

Since 1940, permit licences have been required for the export of all mica and mica products. These are obtainable from the Export Permit Branch, Department of Trade and Commerce, Ottawa. In September, 1943, this restriction was lifted in respect to scrap and waste consigned to the United States.

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

Prepared by Hugh S. Spence,  
Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, July, 1944.



## MOULDING SAND (NATURAL BONDED) IN 1943

### Ores Mined and Producing Localities:

Every province except New Brunswick and Prince Edward Island produces natural bonded moulding sand. One deposit in New Brunswick was operated in 1918 and another in 1921 and 1922. By far the greater part of the output has come from the Niagara peninsula, Ontario. Occasionally new deposits have been opened up, mostly in Ontario and in the western provinces.

The results of a general investigation of moulding sands in Canada were published in 1936 by the Bureau of Mines, Ottawa, in Report No. 767, "Natural Bonded Moulding Sands of Canada". This report directs attention to the large number of deposits from which supplies have been obtained for local foundries and the possibility of replacing imported material with Canadian sands.

### Production and Trade:

The Canadian production in 1943 was 42,327 tons valued at \$49,047,, compared with 35,807 tons valued at \$41,825 in 1942, and 38,309 tons valued at \$40,066 in 1941.

Silica sands without clay bond, used in steel foundries and the glass industry, are not included in the production figures. 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 part time operators such as farmers for local foundries.

Imports, which greatly exceed production, are not recorded separately and are mostly from the United States. Moulding sands and other sands and gravels enter Canada duty free.

Data on the consumption of moulding sand, core sand, and other foundry sand are incomplete, but it is likely that, consumption greatly exceeds 200,000 tons a year.

Prepared by C.H. Freeman,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, April, 1944.



## NEPHELINE SYENITE IN 1943

### Ores Mined and Producing Localities:

- Nepheline syenite is a quartz-free crystalline rock consisting essentially of the feldspathoid mineral nephelinite, a silicate of alumina, potash, and soda, with albite and microcline feldspars. It often contains varying amounts of iron-bearing minerals in the form chiefly of black mica and magnetite, together with such accessory minerals as zircon, corundum, calcite, scapolite, etc. It has no free silica, and is high in alumina (20 to 30 per cent in average commercial rock) as compared with straight feldspar (17 to 20 per cent), and it has thus found favour with the ceramic industries, particularly in the glass trade. For ceramic use the crude rock must be freed of its iron-bearing constituents, removal of which can often be readily effected by a relatively cheap process of magnetic separation of about 20-mesh size.

The known occurrences of commercial nepheline syenite in Canada are situated mainly in Ontario, the developed deposits being in Peterborough, Hastings, and Haliburton counties. The large operation of American Nepheline Corporation (a subsidiary of Ventures Limited) at Blue Mountain, near Lakefield, in Peterborough county, has accounted for most of the output and was the only producer in 1943. Prior to that year small tonnages were produced intermittently from deposits near Bancroft, in Hastings county, and near Gooderham, in Haliburton county, the material being shipped in the crude state to grinding mills in the United States. The rock of the Blue Mountain occurrence is massive and medium-textured, whereas most of the production from the Bancroft and Gooderham areas has consisted of coarse pegmatitic material. Other known, but undeveloped occurrences in Ontario are in the French River area, Georgian Bay district, and at Port Coldwell, Thunder Bay district, on the north shore of Lake Superior. In Quebec, nephelinite is a constituent of syenites of the Montreal, Labelle-Annonciation, and other areas. In British Columbia, there are extensive bodies in the Ice River district, near Field.

Part of the output of American Nepheline Corporation's quarry is treated at the company's mill at Lakefield, which supplies the domestic trade, but most of it is shipped crude to the company's plant at Rochester, New York.

In 1943, American Nepheline Corporation quarried 56,000 tons of crude rock and produced 28,000 tons of finished material in its Rochester mill and 6,200 tons in its Lakefield plant. In recent years, some of the milled granular product from the Lakefield mill has been custom-ground for ceramic use at the plant of Frontenac Floor and Wall Tile Company, Kingston, Ontario, but this arrangement was discontinued in 1943 and 200-mesh material for domestic use is now supplied from Rochester. Port Coldwell Mines and Metals, Ltd., which in 1943 took over nepheline syenite holdings of Port Coldwell Mining Syndicate on Lake Superior, acquired further ground in the Bancroft area and announced plans for developing a deposit there, including the erection of a 100-ton mill.

### Production and Trade:

Production of nepheline syenite in 1943 was valued at \$213,197 compared with \$246,893 in 1942. This takes into account crude rock shipped to the United States for cleaning and grinding, and also finished products made in Canada for domestic consumption and export. Exports totalled 36,240 tons valued at \$129,826, compared with 32,840 tons valued at \$89,520 in 1942.

Except for Russia, the output of which is unknown, Canada is the only producer of nepheline syenite. Russia recovers large tonnages of apatite (phosphate) from apatite-nephelinite rock, extensive bodies of which occur in the Kola Peninsula, and much research has been carried out in that country on commercial uses for the by-product nephelinite, including its substitution for bauxite as a raw material for the production of aluminium. Deposits of commercial grade are also reported to occur in British India. In the United States, a

number of occurrences are known, but most of the material contains too much inseparable iron to be suitable for high-grade ceramic products.

Market Conditions and Prices:

Nepheline syenite continues to be used chiefly in the glass trade, where it is preferred to straight feldspar because of its higher content of alumina. Most Canadian glass companies and also several large American plants now use the material. Some feldspar grinding plants in the United States use the syenite for blending with their granular glass spar. In the glass batch, 3 tons of syenite will replace 4 tons of feldspar, on the basis of relative alumina content, and the higher content of alkalis reduces the temperature of melting, with resultant saving of fuel and longer tank life. Research has been proceeding steadily on applications for nepheline syenite in other branches of ceramics and it has been found of advantage, owing to its higher fluxing action, as a body ingredient in a variety of products, including pottery, semivitreous ware, sanitary and electrical porcelain, floor and wall tile, and structural clay products, and also 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 the various types of ware made from it.

Work has been proceeding in the Bureau of Mines, Ottawa, on the removal of the small content of corundum present in some sections of the Blue Mountain deposit, and it was found that a combination of jigging and flotation at 28-mesh was effective in reducing the corundum content to 0.134 per cent. A treatment unit, employing this method, which would provide also for the recovery of a corundum by-product, was placed in semi-commercial operation at the Rochester mill of American Nepheline Corporation during 1943.

The fine dust product resulting from the processing of Lakefield syenite has been found of service as a substitute for pumice for grinding and polishing and in the cleanser, enamelware, and heavy clay industries.

Glass-grade nepheline syenite for sale in Canada remained at the 1942 price of \$11.75 per ton, bulk, in carload lots, f.o.b. Lakefield, and ground, 200-mesh, ceramic grade was quoted at \$16.50. Grade B (dust) sold for \$13.00 l.c.l. American prices also remained unchanged at \$12.00 for glass grade and \$15.50 for ceramic grade, all bulk, in carload lots, f.o.b. Rochester, New York.

Tariff:

Crude nepheline syenite enters the United States free of duty, provided that total imports of crude and ground material do not exceed 50,000 long tons in any calendar year. Ground material pays 15 per cent ad valorem.

Prepared by Hugh S. Spence,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, March, 1944.

## PHOSPHATE IN 1943

### Ores Mined and Producing Localities:

All of the phosphate produced in Canada consists of apatite, a common associate of phlogopite mica occurring in the Precambrian crystalline pyroxenites of adjacent sections of southwestern Quebec and eastern Ontario. Since about 1900, the mining of straight apatite has been on a limited scale and a large part of the mineral sold has been by-product material from mica mines. Since the commencement of the present war, there has been a slight revival of interest in the production of apatite and several of the larger old mines, mainly in Quebec, have produced small tonnages. The largest total annual output from these recent operations has been only 2,487 tons (in 1941), but this exceeded the production in any other year since 1900.

For many years, Electric Reduction Company, Buckingham, Quebec, has purchased most of the apatite produced, for use in the production of elemental phosphorus and various phosphorus compounds. Canadian Refractories Ltd., Kilmar, Quebec, also are in the market for small tonnages.

About 70 per cent of the 1943 production came from Quebec, most of it from the old Brazeau mine in Bowman township, operated by Robert Bigelow, of Buckingham. The remainder came from Ontario, where Canadian Phosphate Mining Company, Ltd., 125 Holland Avenue, Ottawa, working the old MacLaren mine in Bedford township, near Westport, was the chief operator. Late in 1943, this company was taken over by Ontario Phosphate Company, Ltd., Temple Bldg., Toronto.

Sedimentary phosphate rock occurs in Canada in beds of Carboniferous and Permo-Jurassic age along the Rocky Mountains divide, notably in the Crowsnest area. The rock, however, is rather low-grade and is not considered to be of present economic interest. An attempt to develop the deposits in the Crowsnest-Michel area was made about ten years ago by Consolidated Mining and Smelting Company, as a source of phosphate for its Trail fertilizer plant, but the project was abandoned in favour of higher-grade rock obtained from Garrison, Montana. Eastern Canadian plants using phosphate for fertilizer or other purposes employ mainly Florida rock.

No form of beneficiation of Canadian apatite has ever been employed other than picking and cobbing, and the shipping product has consisted of picked crude lump, sometimes mixed with screened mine and cobbing fines. The average grade is comparatively low and often erratic, commonly ranging from about 60 to 70 per cent tricalcic phosphate. The usual impurities are calcite, iron sulphide, pyroxene, mica, and other silicate minerals. Though not directly objectionable for furnace treatment, such impurities condemn phosphate for fertilizer use by the acid process and would require to be removed. Tests made by the Bureau of Mines, Ottawa, have indicated that a satisfactory grade of product for almost any industrial use can be made by flotation. Apatite, however, has no advantages over sedimentary phosphate for most purposes, and as phosphate rock is likely to remain in abundant supply, it is highly doubtful whether the expense of beneficiation treatment would be warranted. In this connection, it should be noted that although Canadian apatite reserves, doubtless, are substantial, the deposits tend to be erratic and pockety, and are incapable of supplying more than a small fraction of domestic requirements for phosphate, which amount to about 250,000 tons annually. Total production since the inception of mining in 1870 is estimated at about 350,000 tons.

### Production and Trade:

Production of apatite in 1943 was 1,435 tons valued at \$19,460, compared with 1,264 tons valued at \$17,431 in 1942. All of the output was used in Canada, mainly for the manufacture of phosphorus. Grade ranged from 60 to 70 per cent. Purchase price basis remained at \$16 per short ton for 80 per cent material, with a penalty or premium of 20 cents per unit below or above that figure. The average price of

imported Florida phosphate, laid down, during the year was about \$17.50 per long ton for 73 per cent grade. Imports of phosphate rock totalled 260,846 tons valued at \$1,085,080, compared with 271,372 tons valued at \$1,053,229 in 1942. The material comprised both Florida phosphate, used mainly by eastern consumers, and Montana rock taken by fertilizer plants in British Columbia.

World production of phosphate is about 11 million long tons annually. By far the greater part of it consists of sedimentary rock, but the Russian output of apatite, produced as concentrate from nepheline-apatite rock, has amounted to about 1,000,000 tons a year. With the exception of Russia, European countries are deficient in phosphate deposits. Sweden produced 6,267 tons of apatite in 1939, and the Brazilian Government has begun the production of superphosphate from domestic apatite. In the United States, apatite and ilmenite are recovered as concentrates from the treatment of nelsonite in Virginia, and some by-product mineral also has been produced from magnetite-apatite ore in New York State.

The United States is the leading producer of sedimentary phosphate, its output in 1941 and 1942 being more than 4½ million tons. Estimates for 1943 indicate a record high of nearly 5 million tons. The chief producing States are Florida, Tennessee, Montana, and Idaho.

Total world reserves of phosphate have been estimated to be in excess of 26 billion tons, of which about half is in the United States, one-third in Russia, and one-eighth in North Africa, with the remainder scattered over Oceania, South America, and Asia.

#### Market Conditions and Prices:

Phosphate is used chiefly for the manufacture of superphosphate fertilizers. It is used also in the manufacture of phosphoric acid and its derivatives; phosphorus; ferrophosphorus; in stock and poultry feeds; as fertilizer filler; as a calcined phosphate addition in pig iron blast furnaces; and for direct application to soils. Phosphate usually contains fluorine, which is objectionable for certain of its uses, particularly for stock feeds and food products generally. Removal of fluorine can be effected by sintering, and there was a large increase in the production of defluorinated phosphate in the United States in 1943, sales being estimated at about 45,000 tons.

The list of various phosphorus salts and compounds used in industry has been steadily growing and there has been an increase also in commercial applications for standard products. Trisodium phosphate is used extensively as a detergent in laundering and in cleansers generally; for the prevention of scale or scum in boiler-feed and washing waters; and in the tanning, photographic, sugar, and other industries. Sodium pyrophosphate and tetraphosphate are employed as scum and scale preventives, and for deflocculating and lowering the viscosity of oil drilling muds. Sodium metaphosphate (trade name "calgon") is a powerful "wetting" agent, and is proving of value in flotation practice, for the treatment of boiler-feed water, and for the softening of laundry and washing waters generally. A number of alkyl compounds, including tri-butyl, tri-ethyl, and trimethyl phosphates, are now on the market. Alkaline earth phosphates serve as binders in refractories, and natural phosphate is a constituent in some glass batches and in various other ceramic products. Excess fluorine in potable waters is the cause of "mottled" teeth, and its removal is accomplished by filtering through a bed of sintered, defluorinated phosphate. New phosphorus compounds recently placed on sale include aluminium and barium metaphosphates, and calcium and magnesium pyrophosphates, for all of which a field of usefulness in ceramics is indicated, chiefly for glass, porcelain, and enamels. Calcium pyrophosphate might also serve as an enriching medium for food products.

Tariff:

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  $7\frac{1}{2}$  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 United States Government on exports of either crude phosphate rock or superphosphate. Superphosphate intended for blending with other fertilizer ingredients, however, enters Canada free under all tariffs.

Prepared by Hugh S. Spence,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, March, 1944.



## PYRITES IN 1943

### Ores Mined and Producing Localities:

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, Limited, with mine and concentrator at Arntfield, twelve miles west of Noranda, Quebec, operated until August, 1943, when operation ceased permanently, the ore reserves being exhausted. The products consisted of a copper concentrate, which was shipped for treatment to the Noranda smelter, and of a high-grade iron pyrites concentrate, which was shipped partly to chemical plants in the United States, and partly to Three Rivers, Quebec, for use by St. Lawrence Paper Mills Company.

The company is opening up a new property at Moulton Hill, Ascot Township, 4 miles from Sherbrooke. This property is being developed underground and it is expected to have a 250-ton concentrator in operation by June 15, 1944. The sulphide ore is composed of copper, lead, and zinc sulphides, with appreciable values in gold and silver. The mill will produce copper, lead, and zinc concentrate for shipment to the United States. A pyrites concentrates may also be produced.

In British Columbia, part of the large output of pyrites from the Britannia mine at Britannia Beach was consigned to the acid plant of Nichols Chemical Company at Barnet, British Columbia, and part was exported to plants in the United States. A considerable tonnage of pyrites from operations in previous years has accumulated at Britannia Beach for disposal when market conditions are more favourable.

The property of Northern Pyrites Limited, at Ecstall River, about 60 miles south of Prince Rupert, remained idle in 1943. Exploitation of the orebodies with estimated reserves of 5,000,000 tons of 45 per cent sulphur, awaits an improvement in market conditions.

### Production and Trade:

No separate records are available showing the quantity of pyrites produced in Canada. The estimated sulphur recovered from all sources (sulphur in pyrites, and sulphur recovered from smelter gases) in 1943 was 261,372 tons valued at \$1,758,538, compared with 303,714 tons valued at \$1,994,891 in 1942.

Trade figures are not available for publication owing to the war.

### Market and Prices:

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 Canadian demand.

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.

Prepared by A. Buisson,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, March, 1944.



## SALT IN 1943

### Source of Supply:

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

### Producing and Prospective Localities:

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

In Nova Scotia, Malagash salt Company produced about 12 per cent less salt than in 1942. The demand from customers exceeded 100,000 tons. The salt beds occur in strata of the Windsor Series and operations have extended to a vertical depth of 1,128 feet and reach out horizontally for 1,300 feet north and south ~~of~~ 1,400 feet east <sup>and</sup> and west. In addition to the two main white seams of salt there are parallel zones of reddish coloured salt.

At Nappan, near Amherst, Cumberland county, Nova Scotia, a well was drilled in 1931 by Imperial Oil, Limited in a search for oil and gas. The hole reached a total depth of 4,134 feet and bottomed in anhydrite. The hole penetrated 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, for a length of 20 feet, and this was followed by many other salt horizons interbedded in gypsum, anhydrite, and sand. At 2,990 feet, there followed a thickness of 500 feet of salt. The geological structures in this area were worked out in detail by Imperial Oil, Limited.

To obtain further information on this structure the Nova Scotia Department of Mines undertook a drilling campaign in 1943. No. 1 hole, drilled one mile west of Amherst, intersected 26 feet of salt between 779 feet and 805 feet. No. 2 hole drilled 650 feet north of No. 1 intersected salt at 888 feet and was stopped in salt at 1,114 feet, giving 226 feet of salt. The results of the drilling gave ample evidence of huge deposits of salt in this district.

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. It was the second drill hole to strike salt on that 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 was being approached. Six drill holes have penetrated the salt so that a deposit over  $1\frac{1}{2}$  miles wide and 4 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.

In Manitoba, the plant of Neepawa Salt Company, subsidiary of Canadian Industries, Limited, Neepawa, operated continuously, and the company has a new plant, installed in 1941, utilizing vacuum evaporation with modern equipment to produce all grades of salt. The brine is obtained from wells 1,500 feet deep.

At Waterways, Alberta, Industrial Minerals, Limited, controlled by Dominion Tar and Chemical Company of Montreal, operated continuously. The company is in a position to place all grades of salt on the market. To provide for contingencies, a second production well was drilled in 1941 and was made ready for production when needed.

#### Production and Trade:

The production of salt in 1943 was 699,858 tons valued at \$4,040,918, compared with 653,672 tons valued at \$3,844,187 in 1942.

Exports of salt in 1943 were 8,061 tons valued at \$118,174, compared with 9,326 tons valued at \$128,832 in 1942.

Imports of salt in 1943 were 84,788 tons valued at \$589,108, compared with 69,244 tons valued at \$440,848 in 1942.

No salt deposits in the United States are known to be nearer than about 200 miles from the Atlantic coast, so that such industries as fish curing and others in coastal areas usually find it easier to use salt imported mainly from the West Indies (26,000 tons imported in 1941).

#### Market and Prices:

The market for salt in Canada is steadily increasing. Domestic production is sold principally to the dairy, meat curing, and canning industries; to fisheries; to highway and transport departments for use as a soil stabilizer; to the chemical industries; and as table salt.

The use of salt in soil stabilization for the foundations of highways and for a surface veneer for gravel roads has shown marked increase in recent years. It has been used extensively also in the development of soil-stabilized bases for runways at Canadian air fields. Sand piled each fall at regular intervals along main highways remains loose and free-flowing even in the coldest weather, when mixed with salt, thus allowing easy distribution on the icy roadway.

According to Canadian Chemistry and Process Industries (Toronto), prices for the several grades of salt were as follows in 1943:

specially purified (99.9 per cent NaCl) from January to July, and 94 cents per 100-pound lot from July to the end of the year; salt in 280-pound barrels f.o.b. plant, \$3.53 per barrel; industrial fine, in bulk car lots f.o.b. plant, \$6.53 per ton; and industrial coarse \$10.63 per ton.

Prepared by A. Buisson,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, March, 1944.

## SAND AND GRAVEL IN 1943

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 1943 amounted to 26,425,694 tons valued at \$9,065,533, compared with 26,349,907 tons valued at \$9,005,414 for 1942. Following are the output and value by provinces for these two years:

Name	1942		1943	
	Quantity tons	Value \$	Quantity tons	Value \$
Nova Scotia	775,795	371,970	760,902	338,261
New Brunswick	923,020	540,541	715,481	404,761
Quebec	11,026,249	2,485,853	12,615,625	2,955,730
Ontario	8,420,358	3,433,986	7,573,187	3,331,739
Manitoba	1,443,001	427,150	1,256,371	413,680
Saskatchewan	679,979	435,798	976,197	534,420
Alberta	481,644	218,914	661,697	316,766
British Columbia	2,599,861	1,091,202	1,866,234	770,176
<b>Total</b>	<b>26,349,907</b>	<b>9,005,414</b>	<b>26,425,694</b>	<b>9,065,533</b>

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 upon 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.

Prices of sand, gravel, and crushed stone in the four largest cities in Canada were as follows, at the end of 1942 and 1943. Prices per ton or cubic yard, as indicated below, are for carlots, f.o.b. cars:

	<u>Montreal</u>		<u>Toronto</u>		<u>Winnipeg</u>		<u>Vancouver</u>	
	per ton		per ton		per cu.yd.		per cu.yd.	
	<u>1942</u>	<u>1943</u>	<u>1942</u>	<u>1943</u>	<u>1942</u>	<u>1943</u>	<u>1942</u>	<u>1943</u>
	\$	\$	\$	\$	\$	\$	\$	\$
Sand.....	1.15	1.15	1.00	1.01	1.00	1.00	1.00	1.00
Gravel.....	1.10	1.10	1.56	1.55	1.00	1.00	1.00	1.00
Crushed Stone	.93	.98	1.67	1.67	-	-	1.10	1.10

Prepared by R. H. Picher,  
 In the Bureau of Mines,  
 Department of Mines and Resources,  
 Ottawa, Canada, May, 1944.

## SILICA IN 1943

### Ores Mined and Producing Localities:

The materials produced are quartz, quartzite, sandstones, silica sand, and silex or flint.

Quartz is one of the most common and useful of minerals. It usually occurs in massive form without crystal faces, and varies in texture from coarse to fine-grained. It is generally white and opaque to semi-translucent. Quartz also occurs as crystals, the supply of which is mainly obtained from Brazil. When flawless, transparent, and possessing the necessary piezoelectric properties quartz crystal has great strategic importance. They are then cut and ground for lenses, prisms, etc. As the uses of quartz crystals are distinct from those of the ordinary forms of industrial silica, no further elaboration is here needed.

Quartzite is a firm, compact rock, made up chiefly of grains of quartz sand united by a siliceous cement. It is, in general, a metamorphosed sandstone.

Sandstone is a rock composed essentially of grains of quartz, bonded together by some substance acting as a cementing material. Only sandstone of great purity can be used when the silica content is the prime essential for its employment in industry.

Silica sand is disintegrated quartz, obtained when rocks have been subjected to mechanical disintegration and chemical decomposition. In Florida, some of the beach sands contain more than 99 per cent silica.

Silex or flint is a dark gray or dark brown cryptocrystalline variety of silica, with an almost vitreous lustre and no visible structure. It breaks with a conchoidal fracture and is very brittle. Silex is the washed sand or pure quartz, crushed and ground and then either air- or water-floated to recover the fine flour.

Quartz is mined in Quebec and Ontario; quartzite is quarried in Nova Scotia, Quebec, Ontario, Manitoba, and British Columbia; Sandstone is quarried in Quebec and Ontario; silica sand is obtained from Nova Scotia, Quebec, and Manitoba; and silex or flint is prepared in Quebec.

### Important Developments and Producing Localities:

In Nova Scotia the deposit of silica sand near River Denys, Inverness county, was not operated during 1943. The sand is of good quality and is suitable for a number of uses, especially in steel foundries.

In Quebec, Ottawa Silica and Sandstone Company operated its plant intermittently. It produces sand of different grades for steel foundries, the glass industry, and for sand blasting, etc. The plant of Canadian Kaolin Silica Products, Ltd., at Lac Remi, was destroyed by fire in April, 1940, and no steps have been taken to erect a new plant. This company formerly supplied a large part of the Canadian production of silica sand.

Canada China Clay and Silica Company, Limited, with plants near St. Remi d'Amherst, obtains its silica sand from the property of Canadian Kaolin Silica Products, Ltd. The company also produces China clay.

Canadian Flint and Spar Company, Limited, which operates a grinding plant at Buckingham, produced a small tonnage of high-grade quartz sand, which was sold for abrasive and ceramic uses.

Canadian Carborundum Company, Limited 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 ferrosilicon of several grades and metallic silicon in electric furnaces at Beauharnois. It used sandstone from Melochville, Quebec, and 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 and the

ferrosilicon are marketed in Canada and abroad.

In Ontario, Kingston Silica Mines, Limited, R.R.No.1, Kingston, quarried from 50 to 60 tons of rock a day from a deposit of sandstone near Joyceville on Highway No. 15, eleven miles north of Kingston.. The sandstone is used to supply silica for the manufacture of cement. The sandstone is loosely compacted and breaks down readily to a sand of a uniform grade suitable for use in steel foundries and for sand blasting.

#### Production and Trade:

The production of quartz and silica sand in 1943 was 1,750,744 tons valued at \$1,692,302, compared with 1,738,174 tons valued at \$1,538,162 in 1942. Silica brick produced in 1943 were 4,165 M valued at \$295,505, compared with 4,273 M valued at \$263,006 in 1942.

Imports of the various grades of silica amounted to 521,821 tons valued at \$1,978,671, compared with 552,580 tons valued at \$1,559,830 in 1942. These imports included 509,043 tons of silica sand valued at \$1,011,117, compared with 540,904 tons valued at \$1,011,476 in 1942.

Exports consisted of 68,555 tons of quartzite valued at \$124,345, compared with 82,570 tons valued at \$147,172 in 1942.

#### Market and Prices:

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 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, in order to take advantage of these markets.

West of Winnipeg the needs for silica are met almost entirely by imported material. The use of Canadian sand for sand blasting is increasing.

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. In special cases it can be prepared from a friable quartz and from vein quartz.

Silex for use in the ceramic industry must be 150 mesh or finer, whereas in the paint industry, air-floated material 250 mesh or finer is required.

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 ferrosilicon and silica brick depend upon the market for the finished products.

Quartz, quartzite, or sandstone, in sizes from  $\frac{1}{2}$  inch to 6 inches is used in the manufacture of ferrosilicon 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.

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

Prepared by A. Buisson,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, May, 1944.

## SODIUM CARBONATE (NATURAL) IN 1943

### Source of Supply:

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; and the product is marketed in Vancouver for use in the manufacture of soap.

### Production and Trade:

Production in 1943 was 427 tons valued at \$3,629 compared with 256 tons valued at \$2,048 in 1942.

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

### Market and Prices:

Sodium carbonate, or "soda ash", has many industrial uses, such as in the manufacture of glass and soap, in the purification of oils and of bauxite for the production of aluminium, and in the flotation of minerals. Owing to technical advances, the use of soda ash in the glass industry continued to grow. The next largest use of sodium carbonate is in the production of sodium hydroxide or caustic soda. An interesting new use for sodium carbonate is in the manufacture of "synthetic salt cake" (anhydrous sodium sulphate). Considerable quantities of soda ash are also consumed in the smelting of iron ores.

Most of the major consuming industries are requiring more soda ash to cope with higher operating schedules. New munition plants and increased requirements of the aluminium industry, because of vastly expanded production and utilization of low-grade ores, are contributing to the increased consumption of soda ash.

The total Canadian consumption of "soda ash" in 1941 (1942 and 1943 not available), totalled 82,000 tons. The consumption of "soda ash" by the chemicals and allied industries in 1941 (1942-1943 not available), totalled 29,138.5 tons valued at \$838,851 compared with 19,361 tons valued at \$553,707 in 1940. The consumption in 1940 was distributed as follows: acids, alkalis, and salts, 10,840 tons; soaps and washing compounds, 5,820 tons; boiler compounds, 1,450 tons; and miscellaneous chemical industries, 1,251 tons. The treatment of metallic minerals by flotation in Canada in 1941 required about 4,000 tons of soda ash.

#### Consumption of Soda Ash in Specified Canadian Industries

	1940		1941	
	Tons	\$	Tons	\$
Chemical & Allied Prod. (acids, salts, explosives, soaps, etc.)	19,361	553,507	29,138	838,851
Manufacture of Non-met. Min. (includes coke & gas, petroleum & glass)	29,559	746,685	44,157	1,084,869
Pulp and Paper Industry.....	2,817	93,294	3,311	105,855
Dyeing, cleaning, etc. ....	420	24,438	573	31,017
Textiles.....	262	9,951	240	8,992
Sugar Refinery.....	117	5,206	113	4,924

(As published by the Dominion Bureau of Statistics)

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 and in the United States.

The price of "soda ash" in 1943 as given by the Canadian Chemistry and Process Industries remained at \$2.00 per bag of 100 lbs. throughout the year.

PREPARED BY ARTHUR BUISSON,  
IN THE BUREAU OF MINES,  
DEPARTMENT OF MINES AND RESOURCES,  
OTTAWA, MARCH, 1944.

SODIUM SULPHATE (NATURAL) IN 1943  
(Glauber's Salt and Salt Cake)

Source of Supply and Producing Localities:

Sodium sulphate occurs as crystals or in the form of highly concentrated brines in many lakes throughout Western Canada. Hydrated sodium sulphate, known as Glauber's salt, and anhydrous sodium sulphate, known to the trade as "salt cake", are produced in Canada.

Production in 1943 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, with plants at Bishopric and Hardene; Horseshoe Lake Mining Company, Ormiston, Midwest Chemical Company, Palo; and Sybouts Sodium Sulphate Company, Gladmar; all of which are in Saskatchewan. Small tonnages were also produced from several other properties.

Natural Sodium Products' plant at Bishopric operated throughout the year and has a capacity of about 500 tons daily. The company also operates the deposit at Alsask Lake where its 250-ton plant went into operation in the spring of 1942. Midwest Chemicals Limited, at the central portion of Whiteshore Lake, operated throughout the year. Horseshoe Lake Mining Company operated its plant at Ormiston. Sybouts Sodium Sulphate Company operated its dehydrating plant at Sybouts Lake, 9 miles south of Gladmar. D.C. Hart of Regina has been experimenting on methods of dehydrating and of obtaining a product suitable to the textile trade. He has a test plant at a lake in the vicinity of Horizon and has secured a patent for his method of treating the natural sodium sulphate crystals.

No production is reported from British Columbia. Sodium sulphate is the chief salt in a number of deposits in that province, and several of them have been prospected to determine their extent.

A discovery made in New Brunswick during 1937 may yet prove 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 were obtained, show the presence of a bed of glauberite ( $\text{Na}_2\text{SO}_4\text{CaSO}_4$ ) from 60 to 100 feet thick, mostly overlying the rock salt; the sodium sulphate content of this bed ranges from 25 per cent to 30 per cent. Glauberite and sodium chloride are present in other holes drilled in 1939, thus further extending the salts basin. Many millions of tons of sodium sulphate seem to be indicated in this deposit, the boundaries of which have not yet been fully determined. The Bureau of Mines, Ottawa, did much research work on the material recovered in these cores, and indicated a method of recovery of the sodium sulphate. Further detailed work is required to determine the commercial possibilities of the deposit.

Investigations of the sodium sulphate deposits in Western Canada was started by the Bureau of Mines, Ottawa, in 1921, and over 120,000,000 tons of hydrous salts was proved in the few deposits examined in detail

Production and Trade:

The production of natural sodium sulphate in 1943 amounted to 87,297 tons valued at \$854,152, compared with 131,258 tons valued at \$1,079,692 in 1942. The decrease is attributed to the shortage of labour. 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.

Complete figures for the world production of salt cake are not available, and it is difficult to compare the returns from different countries as the production comes from both chemical plants and natural deposits. Germany, prior to the war, was probably the largest producer of total salt cake and Canada was among the first ten 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 have shown a marked increase since the commencement of the war.

#### Market Conditions and Prices:

The industry in Western Canada appears to be well established and steady progress is being made. The material is shipped to the Pacific coast in Canada and the United States; east to Ontario, Quebec, and the Maritimes; and south to the middle western States and to Louisiana.

Glauber's salt is used widely in the chemical industries, and the demand is increasing. Sodium sulphate is used extensively in the pulp and paper (70,100 tons in 1942), glass, dye, and textile industries and to a smaller extent for medicinal purposes and for tanning. It is also used extensively in the smelting of nickel-copper ores for the separation of these two metals.

Markets for the products from these deposits are likely to expand, as supplies from Europe are no longer available and as the by-product material from the manufacture of hydrochloric acid is decreasing in volume each year owing to the manufacture of hydrochloric acid synthetically.

The price for natural anhydrous sodium sulphate from the deposits in Western Canada ranged from \$9.00 to \$10.00 per short ton f.o.b. plant. The delivered price is considerably higher, owing to the high freight rates to the consuming plants, which are mostly in Eastern Canada.

Prepared by A. Buisson,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, February, 1944.

## SULPHUR IN 1943

### Source of Supply:

Deposits of native 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 prior to 1925 this gas was a total waste as no facilities were available for the recovery from it of sulphur, or sulphur 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.

International Nickel Company of Canada erected in 1930 at Copper Cliff, Ontario, a sulphuric acid plant employing the contact process in the manufacture of acid from converter gas, for the recovery of portions of its smelter gases. The plant has been in operation since 1925 at the Coniston smelter of the same company. A plant using the contact process was erected in 1929 at Tadanac (Trail) British Columbia, by Consolidated Mining and Smelting Company. At the plant of International Nickel Company, high-grade sulphuric acid is produced and is marketed in several industries, and at the Trail plant, the acid made is used chiefly for the manufacture of fertilizers. 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 British Columbia, part of the large output of pyrites from the Britannia mine at Britannia Beach was consigned to the acid plant of Nichols Chemical Company at Barnet, British Columbia, and part was exported to plants in the United States. A considerable tonnage of pyrites from previous years' operations has accumulated at Britannia Beach and is awaiting more favourable market conditions.

In Quebec, Aldermac Copper Corporation, with a mine and concentrator 12 miles west of Noranda, discontinued operation in August 1943 and the plant is being dismantled. It produced a copper concentrate and a high-grade pyrites concentrate from massive sulphide ores. The former was shipped to the Noranda smelter for treatment, while part of the latter was exported to chemical plants in the United States and part of it was shipped to Three Rivers, Quebec, for use by St. Lawrence Paper Mills Company in its Freeman flash-roasting plant. At the plant of Noranda Mines, Ltd. pyrites concentrate, a by-product of the milling of copper-gold ores, was marketed for the manufacture of acid.

### Production and Trade:

Canada's production of sulphur, including elemental sulphur and the sulphur content of sulphuric acid and of pyrites, was 261,372 tons valued at \$1,758,538, compared with 303,714 tons valued at \$1,994,891 in 1942. Canadian trade figures are not available for publication owing to the war.

World production of elemental sulphur in 1942 is estimated by the U.S. Bureau of Mines at over 4,300,000 long tons.

The United States is the main source of the world production of crude sulphur. The output in 1942 amounted to 3,460,700 long tons, chiefly from the states of Texas and Louisiana.

### Market and Prices:

Sulphur is used in Canada chiefly 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.

With the construction of new sulphuric plants in Canada and the United States, the consumption of sulphur was increased in 1941 and was further increased in 1942 and 1943.

Sulphur is one of the essential raw materials for war - such as, in the form of sulphuric acid for making explosives. The rayon industry consumes large quantities of sulphur. The expansion of the pulp and paper industry has also created increased demand for sulphur.

The consumption of sulphur in certain Canadian industries in 1940, as given by the Dominion Bureau of Statistics, was as follows:-

	<u>Short Tons</u>
Acids, alkalis and salts industries	22,595
Insecticides industry	1,168
Miscellaneous chemical products industry	1,919
Pulp & Paper industry	211,466

The consumption of sulphuric acid, 66° Bé, by industries in 1940 was:

	<u>Short Tons</u>		<u>Short Tons</u>
Acids, alkalis and salts	9,890	Coke and Gas	30,740
Explosives	35,735	Petroleum refining	14,000
Fertilizers	177,075	Others	7,490
Iron and Steel products	8,375		
		Total	<u>283,305</u>

The sulphuric acid producers are:

Canadian Industries, Ltd., with plants at Copper Cliff and Hamilton, Ontario; and New Westminster, British Columbia.

Consolidated Mining & Smelting Co. of Canada, with plant at Trail, British Columbia.

Dominion Steel & Coal Corp., Ltd., with plant at Sydney, Nova Scotia.

Nichols Chemical Co., Ltd., with plants at Sulphide, Ontario and Barnet, British Columbia.

According to "Metal and Mineral Markets", New York, the price of sulphur in 1943 remained unchanged at \$16 a long ton, f.o.b. mines. The prices at consumers' plants in Canada vary from \$20 to \$32 according to location, the difference being due to transportation costs. The average for the Dominion in 1943 was about \$27.

Prepared by A. Buisson,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, March, 1944.

## TALC AND SOAPSTONE IN 1943

### Ores Mined and Producing Localities:

Annual production of ground talc in Canada in the five-year period 1939-1943, inclusive, ranged from 16,000 to 32,000 tons, these figures including also material classed in statistical records as soapstone, part of which was ground in mills other than those of primary producers. All of the output came from Ontario and Quebec.

Most of the material from Ontario consists of white, foliated talc, which occurs as veins in crystalline dolomitic limestone of the Madoc area, Hastings county, where an established talc-industry has existed for the past forty years. Total output from the Madoc area to the end of 1943 is about 400,000 tons. Since 1937, Canada Talc Limited, operating the Conley and Henderson mines, has been the only important producer. W.C. Spry and Company in recent years has been milling a small tonnage of finely schistose, cream-coloured talc in the plant of Canada Slate Products, about a mile north of Madoc. The crude rock is trucked in from a deposit near Ompah, in Frontenac county, 65 miles distant.

The talc from Madoc is very low in iron, and has a good white colour, but contains considerable carbonates. Tests recently conducted by the Bureau of Mines, Ottawa, have shown that the carbonate content can be reduced by flotation to below the tolerance demanded for even the most exacting uses, including the manufacture of steatite insulators. A paper entitled "Canadian Talc for Use in Steatite Insulators", giving the results of the above tests, was published in the Bulletin of the American Ceramic Society (vol. 22, No. 8, August, 1943). As yet, however, no commercial use has been made of ~~the~~ beneficiation in the production of talc in Canada.

In Quebec, the talc produced is also of foliated type, but it occurs in bands in highly-metamorphosed basic rocks, mainly serpentine and pyroxenite, and is often associated with bodies of soapstone, an impure talcose rock. It contains much iron, present mainly in chlorite, and varies rather widely in carbonate content. It yields a slightly off-colour, grey powder, and is used chiefly in the rubber, paper, and roofing trades. The entire production is obtained from the Eastern Townships, mainly from the Thetford Mines area, and there are also a mine and mill at Highwater close to the Vermont boundary. All of Canada's output of sawn soapstone blocks, sold chiefly for use in the alkali recovery furnaces of domestic kraft mills, and also of talc crayons, comes from the Thetford Mines area. Some of the sawing dust from these operations is sold to domestic roofing firms, and a large tonnage of quarry and sawing waste is shipped to the grinding plant of Pulverized Products, Limited, 4820 Fourth Avenue, Rosemount, Montreal.

Broughton Soapstone and Quarry Company, with mines and mill near Leeds station, in Broughton township, is the principal operator in Quebec, and produces ground talc, sawn soapstone blocks and bricks, and talc crayons. Charles Fortin, of Robertson, and L.C. Pharo, of Thetford Mines, produce sawn soapstone in Thetford and Leeds townships, respectively. Baker Mining and Milling Company, 4010 St. Catherine Street West, Montreal, operates a mine and mill near Highwater in Brome county and produces only ground talc. During the year, this plant was engaged also in part-time custom grinding of serpentine and magnesia products from operations at Kilmar and Wakefield, Quebec.

In recent years, there have been small sales of custom-ground, pale yellow serpentine, found in mining magnesite in the Kilmar district, Quebec, and classed as a talc substitute. The ground product is stated to be fibrous, resembling the tremolitic talc of the Gouverneur district, New York, and to be well adapted for use in paint.

In British Columbia, the production of talc near McGillivray, on the Pacific Great Eastern railway, and at Kapoor, near Victoria, was discontinued in 1935. The material was shipped to Vancouver for grinding and local use in roofing products. Some ground soapstone is prepared in a small mill in Vancouver by George W. Richmond, 3239 West King Edward Avenue, from crude imported from the State of Washington. This plant also grinds mica, slag, etc., for local roofing use and also for

export to Tacoma, Washington.

Owing to the critical need for additional sources of massive, steatitic talc (see below), investigation was undertaken during the year by Wartime Metals Corporation, a Crown company, of an occurrence of such material near Red Earth Creek, in Kootenay National Park, British Columbia. The talc is dominantly black, or mottled grey and black, due to the presence of finely divided graphite, but burns white, and occurs as a bedded deposit in dolomitic limestone. Quality is impaired by bedding partings and pressure checks, and by the presence of considerable pyrite and carbonate inclusions. Underground work was conducted from a 40-foot tunnel following the bedding, on the site of an abandoned working made in 1927-1930, and a raise and winze were driven in a search for a workable body of clean, unflawed material. Total thickness of talc cut in this work was 40 to 50 feet. As a result of these operations, about 8 tons of crude block talc was selected and stockpiled, but it was decided that the recovery was too low to justify further work and the mine was closed in March, 1944. Some test blocks of the material were shipped to a lava talc plant in the United States for sawing and firing tests, but only one of the pieces gave satisfactory performance. Similar tests undertaken by the Bureau of Mines, Ottawa, showed that the development of firing cracks was very pronounced. Samples of yellow steatite from a deposit at the base of Mt. Whympet, several miles south of the above occurrence, were also forwarded to the United States for test, but the material proved to be too badly flawed to be usable.

#### Production and Trade:

Total value of talc and soapstone produced in Canada in 1943 was \$244,599. This comprised ground material, made by primary producers, sawn soapstone blocks and bricks and talc crayons, and waste sold to other firms for grinding. In 1942, total production was reported as 29,868 tons valued at \$310,824. The production in Ontario, which consists entirely of ground material, is classed for statistical purposes as talc, and that from Quebec, which includes both ground and sawn stone as well as grinding waste, is classed as soapstone, although the ground product is marketed as talc. In statistical records, also, the output from Quebec is not classified by products, and includes ground material made only by mine operators.

The production of ground talc in Ontario in 1943 was 12,182 tons valued at \$134,550, a decline of 21 per cent in quantity and 19 per cent in value from the 1942 figures. Average unit value of products was \$11.20 per ton. The estimated production of ground talc in Quebec in 1943 was 12,099 tons valued at \$127,343, compared with 12,538 tons valued at \$131,420 in 1942. Average unit value of products was \$10.52 per ton. Estimated total production of ground material marketed as talc in 1943 was 24,281 tons valued at \$261,893, having an average unit value of \$10.78 per ton.

Sales of sawn soapstone furnace blocks, all from Quebec, totalled 1,293 tons valued at \$35,439, and of talc crayons, 99 tons valued at \$19,357. These figures compare with 1,482 tons of soapstone blocks valued at \$37,318, and 93 tons of crayons valued at \$16,929, sold in 1942. Soapstone blocks continued to sell at \$24 to \$27 per ton, equivalent to about \$2.25 per cubic foot.

Exports of talc totalled 11,364 tons valued at \$146,516 in 1943, compared with 16,055 tons valued at \$214,033 in 1942. Imports were 6,450 tons valued at \$130,813, compared with 5,441 tons valued at \$114,852 in 1942.

Prior to the war, the world production of talc, including ground material, cut soapstone, steatite, and pyrophyllite (a mineral closely resembling talc and used for many similar industrial purposes) amounted to about half a million tons a year, more than half of which was produced in the United States. Manchuria, with an output of about

100,000 tons, was the second largest producer, followed by France and Italy, each with about 50,000 tons; Norway, British India, Canada, and Germany (including Austria).

Sales in the United States in 1943 totalled 412,868 tons valued at \$5,121,414, an increase of 6 per cent in quantity and 8 per cent in value over 1942. These figures are exclusive of sales of cut dimension soapstone. Eastern States, notably New York, North Carolina, Vermont, and Georgia, furnished 81 per cent of total sales in 1943. New York production was over double that of any other State. California rose from fourth to third place among the producing States.

#### Market and Prices:

Ground talc has a great variety of uses, but much the greater part of the output is employed in the paint, roofing, paper, rubber, and ceramic industries. It is used also in foundry facings, bleaching fillers for textiles, cosmetics and pharmaceuticals, soaps and cleansers, insecticides, polishes, plastics, and for rice polishing. Talc is also reported to be of value as a fertilizer.

Ceramic uses for talc have shown the most noteworthy increase, and it is now a standard ingredient in floor and wall tile, electrical and other porcelains, porcelain enamels, dinnerware bodies, and refractories. For rubber, talc is employed mainly for the dusting of moulds and finished products. It is of value, also, as a body reinforcing ingredient, to impart toughness and to increase tensile strength, particularly in cable insulation.

Indicating consumption trends for ground talc (including also soapstone and pyrophyllite), United States sales in 1943 were distributed to the following industries: paint, 31 per cent; ceramics, 12 per cent; roofing, 12 per cent; rubber 12 per cent; paper, 8 per cent; insecticides, 6 per cent; cosmetics, 4 per cent; and foundry facings, 3 per cent. As reported in the Annual Census of Manufactures for 1941, Canadian consumption of talc in that year totalled 13,365 tons valued at the works at \$291,729. Distribution, by industries, was as follows: roofing, 35 per cent; paint, 28 per cent; pulp and paper, 9 per cent; rubber, 8 per cent; soaps and cleansers 6 per cent; ceramics, 6 per cent; cosmetics, 4 per cent; electrical products, 3 per cent. No important changes in this distribution are believed to have taken place in the interval.

Following the outbreak of the present war, a substantial demand for Canadian talc developed in the British market, to supply deficiencies caused by the cutting off of imports from France and Italy. In 1943, however, exports to Great Britain decreased materially, owing to lack of cargo space. In October, the British Ministry of Supply issued an order placing "talc, steatite, soapstone and pyrophyllite, whether crude or prepared, or in the form of lumps, granules, powder, slabs, sticks or blocks" under strict Government control. The administration of control regulations was vested in the Chrome Ore, Magnesite and Wolfram Control board, which was empowered to take over all stocks of the above materials in the hands of merchants and importers. It was provided that all further imports and purchases from abroad were to be for Ministry of Supply account, the Control to place all future orders and to negotiate direct with producers in Canada and elsewhere. Canadian producers who had sold through a single representative in the United Kingdom were exempted from this order, as the Control was prepared to deal direct with such importer or agent. All supplies of talc for British consumers were, at the same time, placed under strict allocation control, under licence, and cargo <sup>space</sup> allotment was placed in the hands of the Ministry of War Transport. To provide for sale and distribution to approved consumers, Talc Importers' Association Limited was organized, membership in which was restricted to established importing individuals or firms. Prices were also established by the Control.

(Details of the above regulations were published in the Commercial Intelligence Journal, Department of Trade and Commerce, Ottawa, of November 6, 1943, and copies of the Statutory Rules and Regulations governing the control are available in that Department.)

In the United States, steatite talc, defined as "natural magnosium silicate suitable for use in steatite products and containing not over 1.5 per cent lime, 1.5 per cent ferric oxide, and 4 per cent alumina", and which had come into critical supply, was placed under strict Government control and allocation in October, 1942. The original order (Conservation Order M-239 of the War Production Board) restricted the use of such talc to certain essential needs, including insulators for communications, radio, radar, and underwater sound instruments; sparkplugs for certain war industries; filtering of foods, flavouring extracts, and medicines; and in pharmaceuticals and health supplies. Consequent on an easier supply developing, this order was amended in February, 1943, and again in April, 1943, to release supply for previously restricted uses. Under the last amendment, control of production and grading was established, a system of inventory control based on maximum consumer stocks was provided, and all frozen stocks were released. In the list of materials issued by the Conservation Division of the War Production Board in February, steatite talc was placed in Group I (supply insufficient for war and essential industrial demand), with all other talc (and including also soapstone) in Group III (supply in excess of current essential needs). In April, all talc was placed in Group II (supply sufficient for current war and essential industrial needs), with soapstone in Group III. In July, and through to January, 1944, only Indian block talc was included in Group I, with ground talc and soapstone in Group III. In October announcement was made of the formation of an Advisory Committee of the Talc Industry, composed of representatives of the leading producing companies, to work with the Office of Price Administration in a study of proposed new price regulations.

With the exception of shipments to the United States, exports of talc (including steatite, soapstone, and pyrophyllite) from Canada during the present war have been subject to export permit control. In April, 1944, following the establishment of the British control system, exports to British Empire destinations were exempted from export permit licence.

Steatite, is the mineralogical name given to compact, massive talc having no visible grain, that can be sawn, turned, drilled, and otherwise machined into any desired form. Such material has been widely used for the production of fired shapes, used mainly as electrical insulators. There is now a large demand for steatite for use as grid spacers in high-frequency ship and tank radio transmitters, and for the cores, bushings, resistors, etc., in radio, radar, and other electronic equipment. It is used to an important extent also for carbon black and other gas burner tips. An alternative trade name for steatite is "lava talc". Because of the small amount of natural steatite available, its high cost, and excessive machining and firing losses, the aforementioned articles are now made largely by die-pressing powdered talc. Suitable talc for the purpose is required to be high-grade material, low in lime and iron, and such talc is now commonly termed steatite, or steatitic talc, irrespective of its texture. There is still a limited demand, however, for sawn steatite shapes, and suitable crude is in short supply. The chief sources of supply at present are British India, Sardinia, Maryland, Montana, and California. Specifications call for compact texture, good structural strength, freedom from hair-cracks and parting lines and from gritty impurities, and a low content of lime and iron. In general, grade and suitability are determined by machinability and firing behaviour, followed by tests for electronic performance. Chemical analysis is of secondary importance.

Many grades of ground talc are marketed, and the price range is wide. Value is dependent upon purity (determined by freedom from lime

and gritty or iron-bearing substances, slip, and colour), particle shape, and fineness of grinding, the specifications for which vary in the different consuming industries. Roofing and foundry talcs are the cheapest grades, the trades in these being satisfied with coarser, grey or off-colour material, often soapstone powder or sawing dust, which sells at about \$5 to \$7 a ton f.o.b. rail. Domestic grey talc, suitable for rubber and paper use, sold in 1943 for an average of \$7.50 to \$9 per ton. White talc from the Madoc area was quoted at \$8 to \$10 for the coarser grades, \$12 to \$18 for finer mesh sizes, and \$44 for minus 400-mesh material.

American talcs include high-grade, white Californian material, which sold for \$17.50 to \$43 a ton; fibrous New York "Asbestine", "Tremoline", and "Loomite" grades, which were quoted at \$13 to \$21; and the lower-grade, grey Georgia and Vermont products, which sold for \$8 to \$14; all prices f.o.b. mines. Lava steatite and crayon talc sold for \$100 to \$150 a ton.

#### Tariff:

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 a long ton, and at 35 per cent on material valued at over \$14 a ton. The duty on crude material is one-quarter cent a pound, whereas cut soapstone or talc, in the form of bricks, crayons, blanks, etc., is dutiable at one cent a 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 are dutiable at 20 per cent.

#### PYROPHYLLITE:

Pyrophyllite (hydrous silicate of alumina) closely resembles 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 of talc. Commercial deposits are relatively scarce. Most of the recorded world production comes from North Carolina, where the industry has expanded rapidly in recent years. A large part of the American output goes to the ceramic trade, the remainder being sold for fillers in various products. When fired, pyrophyllite does not flux, as does talc, and it is of value in a wide range of high-grade ceramic products, including refractories.

Important deposits are known in Newfoundland, and are at present owned and operated by Industrial Minerals Company of Newfoundland, Limited, Box 435, St. John's, which in 1942 built a grinding plant with a capacity of 25 tons a day and shipped about 500 tons of ground material to Great Britain. Shipments in 1943 remained at about the same level, and went also to the British market. In Canada, some rather low-grade, sericitic pyrophyllite occurs at Kyuquot Sound on the west coast of Vancouver Island. A small quantity was shipped from these deposits about 30 years ago for use in refractories and cleanser products.

In 1943, pyrophyllite was quoted at \$10 to \$13 a ton, f.o.b. North Carolina mills, for 200-mesh and 325-mesh material, respectively. The material was in easy supply and was placed throughout the year in Group III of the list of materials issued by the Conservation Division of the United States War Production Board.

Prepared by Hugh S. Spence,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, May, 1944.



## VOLCANIC DUST IN 1943.

Volcanic dust (pumicite or pumice dust) is a natural glass or silicate, atomized by volcanic explosions and thrown into the air in great clouds which ultimately settle, forming beds of varying thickness, often hundreds of miles from its source of origin. In many instances the dust has been washed down from higher levels and re-deposited by the agency of waters, in which case the beds are stratified and mixed with foreign substances. It consists of aluminum silicate (80 to 90 per cent) and of oxides and silicates of iron, sodium, magnesium, calcium, etc.

### Source of Supply:

Deposits of volcanic dust are found in Saskatchewan, Alberta, and British Columbia. There has been intermittent production from Waldeck, near Swift Current, and at Rockglen, 125 miles southeast of Swift Current, in Saskatchewan, and from near Williams Lake in British Columbia.

In Saskatchewan, deposits occur also five miles north of Braddock; west of Beverley; and near St. Victor, all of which are grey to buff in colour. As a result of laboratory experiments carried out during 1941 and 1942 by the University of Saskatchewan on samples from several of these deposits, a small shipment was made from Rockglen in 1943. Although a number of deposits of fair size and grade have been found and tested there has been little mining activity in recent years.

In British Columbia there are several deposits, of which the purest known is a snow-white, fine-grained volcanic dust from 25 miles up the Deadman River, north of Kamloops Lake, where some prospecting was carried out in 1943. Extensive beds of compact dust also occur north of Quesnel Lake in the Cariboo district, but there has been no production.

### Production and Trade:

In 1943 about 60 tons were shipped from Rockglen to Medicine Hat for insulation purposes. There had been no shipments since 1934, when production amounted to 31 tons valued at \$620, one ton of which came from Waldeck, Saskatchewan, and 30 tons from Williams Lake, British Columbia.

Imports are grouped with a number of similar products (pumice, pumice stone, lava, and calcareous tufa) the value of which totals approximately \$40,000 annually.

In the United States, shipments of volcanic dust and pumice in 1942 (figure for 1943 not available) were 126,522 tons valued at \$706,199. Twenty-four companies were engaged in the production which came from seven States. The tonnage and value of output were higher than in any past year.

### Market Conditions and Uses:

The war cut off supplies of high quality Italian pumice from Lipari Island near the north coast of Sicily, but suitable material is being produced in California.

In the past, about 60 per cent of the United States output was used as the abrasive base in scouring and cleansing compounds and to a lesser extent for glass bevelling, polishing aluminium, etc., but in 1942, about 43 per cent was used for these purposes and 36 per cent as a concrete admixture and concrete aggregate. Some of the United States volcanic dust was used in the manufacture of fire-proof 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 suitability for such use has been indicated by laboratory and industrial applications, but only on material relatively free from iron. In most of the deposits, however, this iron is in the form of a complex silicate and attempts to remove it by concentration, magnetic separation, leaching, and other methods have been unsuccessful. Volcanic dust of a certain purity has been used in place of feldspar in ceramic bodies whose colour is of secondary importance. Some promising results have been achieved, however, with decolorizers such as selenium and arsenic trioxide. Volcanic dust has possibilities for use as a glaze component, in low-cost glass, and in bricks when mixed with plastic clays.

Prices:

Prices are not quoted, but in the United States sales values for cleansing and scouring were about \$7.50 per ton; for acoustic plaster, \$27., for concrete admixture and aggregate, \$1.25 per ton.

Prepared by V.L. Eardley-Wilmont,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, March, 1944.

## WHITING SUBSTITUTE IN 1943

### Sources of Supply:

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 continental Europe. It may be made from white limestone or white marble, marl, lime, or the waste calcium carbonate sludge resulting from the manufacture of caustic soda.

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 made from chalk 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 subangular rather than rounded. Most of the whiting substitute made in Canada is made from white marble.

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 constituent, 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. Two plants have been built to make whiting substitute from marl, but only one was in operation in 1943. The output of that plant was utilized entirely as a filler for newsprint.

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.

### Production and Trade:

Producers of whiting substitute are: Pulverized Products, Limited, Montreal; Claxton Manufacturing Company, Toronto; White Valley Chemicals, Limited, Toronto; Marlhill Mines, Limited, Marlbank, Ontario; Gypsum Lime and Alabastine, Canada, Limited, Winnipeg; and Beale Quarries, Limited, Van Anda, Texada Island, British Columbia.

No separate record is kept of production of whiting substitute, but it is known that the industry has experienced a steady growth in recent years because improvements in grinding equipment and the maintenance of close technical control have enabled products to be marketed that are very consistent in chemical and physical properties. Many manufacturers now use the domestic products with entire satisfaction in place of imported whiting, and with all European sources of whiting cut off because of the war the domestic industry is largely supplying the Canadian market.

### Market and Prices:

Whiting substitute made in Canada is used mostly in the manufacture of oilcloth, linoleum, in certain kinds of rubber products, in putty, in explosives, and as a filler in newsprint, book, and magazine paper. 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.

Prices per ton, bagged and in carload lots, range from \$8 to \$15 a ton f.o.b. plants.

Prepared by M.F. Goudge,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, June, 1944.



## COAL IN 1943

### Source of Supply:

The production of coal in Canada is confined mainly to the western and eastern provinces. Ontario and Quebec have no commercial coal mines and the production of coal in Manitoba is limited to a small tonnage of lignite.

Nova Scotia produces medium and high volatile bituminous coal from Cape Breton Island, largely in the Sydney area and from the mainland collieries in the Cumberland and Pictou areas. New Brunswick produces at Minto and adjoining area a small portion of the bituminous coal of Eastern Canada. Lignite is produced in Saskatchewan, the main producing areas being the Bienfait and Estevan divisions.

Alberta produces almost all ranks of coal including a small tonnage of semi-anthracitic coal. Coking bituminous coal ranging from high volatile to low volatile is produced in the Crowsnest, Nordegg and Mountain Park fields, and the various mining areas of the foothills such as the Lethbridge and Coalspur areas yield lower rank bituminous coals which are practically non-coking. The coal mined in the central area of the province such as in the Drumheller and Edmonton fields is lower in rank and is classed as sub-bituminous, whereas that mined in the Pakowki is lignite and that in the Tofield, Redcliff, and several other areas is on the border of sub-bituminous and lignite. The Cascade area was the only field producing semi-anthracitic coal.

British Columbia produces bituminous coal of varying types from low to high volatile from Vancouver Island, and from the Crowsnest, Telkwa, and Nicola areas on the mainland, whereas sub-bituminous coal is mined mainly in the Princeton field.

The major portion of the coal produced in Canada was mined in Nova Scotia and Alberta, approximately 34% of the total coming from Nova Scotia, and 43% from Alberta.

### New Developments:

The coal production from Nova Scotia augmented by a relatively small tonnage from New Brunswick provides, in peacetime, not only for the requirements of the railways of the area, the steel industry and the domestic market, but also for much of the fuel requirements of the Province of Quebec and to a lesser degree Ontario. The increasing wartime expansion of industry and transportation, however, almost totally reduced the movement of coal into Quebec and Ontario, from this area.

The development of markets in Ontario for Alberta coal was discontinued in 1942 due to the increased demands in the Western provinces. As a result of this increased demand and to provide a reserve of production to meet emergencies, the Emergency Coal Production Board initiated and financed the opening of six stripping operations in Alberta, and was instrumental in securing the reopening of a large stripping operation in southern British Columbia. Due to an exceptionally mild autumn and winter, however, coal production in Alberta and Saskatchewan was in excess of requirements up to the end of the year.

A major development of the year was the completion of the Elk River Collieries near Fernie B.C. The tipples at this mine is equipped with the most modern types of screening, washing and subsidiary equipment. Another new development was started in the Alberta Crowsnest area near Bellevue.

The Emergency Coal Production Board in co-operation with the Department of Mines, Quebec assisted in the development of small local peat fuel operations in various parts of the Province and provided limited financial assistance for that purpose. As the operations during the year were of an experimental nature the peat fuel produced was insignificant, but it is anticipated that a production of approximately 10,000 tons may be obtained in 1944.

Production and Trade:

The production of coal in Canada in 1943 amounted to 17,878,778 tons valued at \$62,429,662, compared with 18,865,030 tons valued at \$62,897,581 in 1942. The minimum during the past 15 years was 11,739,000 tons in 1932, the largest output being in 1942.

Production of Coal by Provinces\*

<u>Province</u>	<u>1943 Tons</u>	<u>1942 Tons</u>
Nova Scotia	6,086,733	7,204,852
New Brunswick	380,001	435,203
Manitoba	999	1,265
Saskatchewan	1,777,833	1,301,116
Alberta	7,631,803	7,754,053
British Columbia	2,001,409	2,168,541
Canada	<u>17,878,778</u>	<u>18,865,030</u>

Production of Coal in Canada by Kinds

	<u>1943 Tons</u>	<u>1942 Tons</u>
Bituminous	11,971,485	13,616,215
Subbituminous	792,252	733,547
Lignite	5,081,811	4,515,268
Totals	<u>17,845,548</u>	<u>18,865,030</u>

\*Figures are those given in Preliminary Report of Mineral Production, 1943 by Dominion Bureau of Statistics.

The total imports of coal into Canada amounted to 28,852,654 tons compared with 25,609,267 tons in 1942. Anthracite importations amounted to 4,458,519 tons, compared with 4,802,023 tons in 1942. Bituminous coal importations amounted to 24,393,798 tons compared with 20,807,005 tons for 1942.

Coal exports from Canada amounted 1,110,101 tons, compared with 815,585 tons for 1942.

The 1943 Canadian consumption of coal was in excess of 45 million tons in comparison with 29.4 million tons in 1939.

Prepared by E. Swartzman,  
In the Bureau of Mines,  
Dept. of Mines and Resources,  
Ottawa, Canada, March, 1944.

## COKE IN 1943

### Source of Supply:

Coke from Canadian and imported coals was produced to the capacity of the several types of carbonizing equipment located throughout Canada. These plants included seven by-product-coke plants, two beehive plants, three Curran-Knowles installations, seven continuous vertical retort plants, and eight installations of horizontal D retorts.

By-product coke ovens produce most of the coke made in Canada and of the coal consumed for the production of coke in Canada 85 per cent is processed in five by-product coke plants.

The Province of Ontario produces approximately 60 per cent of the coke manufactured in Canada. The principal operations of this Province are reported in the following table together with the rated capacity of the plants:

<u>Company</u>	<u>Location</u>	<u>Annual Rated Capacity</u>
Algoma Steel Corporation	Sault Ste. Marie, Ontario.	1,015,000
Hamilton By-Product Coke Ovens	Hamilton, Ontario.	795,000
Steel Company of Canada	" "	641,000
Consumers' Gas Company	Toronto "	302,000

Two large by-product plants are situated in Eastern Canada, one of which, at Sydney, Nova Scotia, is operated by the Dominion Steel & Coal Corporation, Limited, for the production of blast furnace coke and has an annual capacity of 950,000 tons of coal; the other plant located at Villa LaSalle, in Quebec, is operated by the Montreal Coke and Manufacturing Company, which produced principally metallurgical coke and has an annual capacity of 565,000 tons of coal. The use of Nova Scotia coal at this plant, was discontinued during the year due to the increased consumption of coal in the Maritime Provinces.

Beehive coke is manufactured in two plants in Western Canada situated at Coleman, Alberta, and Michel, British Columbia.

Expansion of the industry has resulted from the completion of the Curran-Knowles plant at Hamilton, Ontario, where the three new batteries have an annual rated capacity of 380,000 tons of coal.

### Production and Trade:

The total production of coke from coal in 1943 was 3,548,700 tons, compared with 3,274,600 tons in 1942. Production by provinces was reported as follows:

<u>Province</u>	<u>1943 Tons</u>	<u>1942 Tons</u>	<u>Per Cent Increases</u>
Eastern Provinces	1,068,310	1,123,570	5.0 (decrease)
Ontario	2,178,300	1,849,330	17.8
Western Provinces	<u>302,090</u>	<u>301,700</u>	<u>0.1</u>
Total for Canada	3,548,700	3,274,600	8.4

Coal processed for the manufacture of coke amounted to 4,838,940 tons, of which 1,316,270 tons<sup>were</sup> of Canadian origin, and 3,522,670 tons were imported. Petroleum coke produced at the oil refineries amounted to 84,575 tons, compared with 73,732 tons in 1942.

The imports of coke for 1943 were 941,066 tons, compared with 719,910 tons in 1942. Exports of coke for 1943 were 48,256 tons, compared with 44,764 tons in 1942.

Prepared by E. J. Burrough,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, March, 1944.



## NATURAL GAS IN 1943

### Sources of Supply:

Natural gas has been found in most of the provinces of Canada. It is produced commercially in abundance in Alberta and Ontario, and in smaller quantities in New Brunswick, Saskatchewan, and Quebec.

In Alberta, most of the production comes from the Turner Valley field, which supplies fuel for the field itself, and feeds the pipe line to the cities and districts of Calgary and Lethbridge. It has been unnecessary to drill gas wells in this field for some years, and production is now largely derived from the petroleum wells, in which the gas plays a vital role in the production of petroleum. The 'gas/oil ratio' of many of these oil wells, particularly in the southern part of the field, where effective measures of conservation began to be applied comparatively late in their life, has risen so much that in some cases the wells have had to be re-classified as gas wells, thus, augmenting the reserve of gas. Production of gas still remained considerably in excess of consumption, although the waste was further reduced about 12 per cent. The experiment in re-cycling of gas, using Foundation well as the input well, was continued throughout the year, the wells drawn upon being mainly Frontier and Prairie. The amount so returned to the limestone, 116,728 m.c.f., was not included in the production. No information is available as to the results achieved in this experiment.

The Edmonton area is supplied from the gas field at Viking about 80 miles southeast of the city, supplemented by the field at Kinsella farther east, discovered in 1929 but first connected by an extension of the pipe line in the fall of 1940. Kinsella is now the principal source; seven wells were drilled and production there was nearly three times the volume of gas produced at Viking. In December six wells were producing at Viking and fourteen at Kinsella.

In December, 34 wells were producing in the Medicine Hat area and 12 in the Redcliff area. Two wells were drilled at Medicine Hat and production increased about 10 per cent. At Vermilion, consumption increased 50 per cent, at Wainwright about two per cent; the former draws its supply from the field of the same name, the latter from Fabyan. Among other producers the more important were Foremost and Brooks.

A small production, 1500 m.c.f., was recorded in the Northwest Territories. In Saskatchewan, the eastern part of the Lloydminster field supplies the town of Lloydminster. In the Kamsack area fifteen shallow wells were drilled, ten of the earlier wells are connected to the town and six more remained unconnected. These wells are mostly around 200 feet in depth and yield from 15 to 250 m.c.f. at a closed-in pressure of 36 lbs. Throughout the province geophysical and geological work was again active with a view to the discovery of both gas and petroleum. Decisive results from a number of deep tests have not yet been obtained.

In Ontario, although no striking new development occurred, a small new area of Guelph gas was brought into production in Zone township. Drilling continued in Haldimand county, where a number of small producers were obtained, particularly in Walpole, Oneida, and North and South Cayuga townships, as well as in Norfolk county, notably in Woodhouse and Townsend townships, and in Welland county, where Bertie township was the main producer. The test in Lake Erie about 5,900 feet off shore from Romney township got gas from the Lower Salina and Upper Guelph in an attempt to extend Tilbury East field. The deep test to the Trenton in Romney township was unsuccessful, as were also several wells in South Norwich and Westminster townships.

In Quebec, natural gas is produced in small quantities at several shallow wells along the St. Lawrence River and is used locally.

In New Brunswick, the Stoney Creek field continued to supply Moncton and Hillsborough and certain localities in Albert and Westmorland counties with natural gas. Six new wells were drilled and one was deepened. Flush production of the new wells amounted to 3,730 m.c.f.

Total production for the year was 674,784 m.c.f., of which 573,145 m.c.f. were sold. The geophysical survey that was in progress in 1942 was continued.

Production:

The total production of natural gas in Canada during 1943 amounted to 43,237,500 M cubic feet valued at \$11,699,894. The production by provinces was as follows:

	<u>1943</u>		<u>1942</u>	
	Amount M.cu.ft.	Value \$	Amount M.cu.ft.	Value \$
New Brunswick	670,000	324,280	610,000	298,900
Ontario	8,005,000	5,200,000	11,000,000	6,600,000
Saskatchewan	111,000	43,179	107,600	32,280
Alberta	34,450,000	6,132,100	31,000,000	5,270,000
Northwest Territories	1,500	335	1,500	330
	<hr/>	<hr/>	<hr/>	<hr/>
	43,237,500	11,699,894	42,719,100	12,201,510
	<hr/>	<hr/>	<hr/>	<hr/>

Prepared by T.G. Madgwick,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, May, 1944.

## OIL SHALE IN 1943

### Deposits and Producing Localities:

There are large deposits of oil shale in different parts of Canada, the 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 been actively developed on a commercial scale.

### Developments:

In 1942, the Mines and Geology Branch, Department of Mines and Resources, Ottawa, drilled some of the oil shale occurrences in New Brunswick to determine their possibilities as a source of oil and lubricants under war conditions. A total of forty-three holes were drilled in oil shale deposits in the Rosevale area and in the vicinity of Taylor Village, New Brunswick; thirty-six holes were also drilled in deposits at Albert Mines, New Brunswick. The conclusion was reached that the over-all grade of the shales in the areas mentioned is too low to be of economic interest even under present conditions.

### Production and Trade:

No production has been reported for a number of years and no oil shale is being imported into Canada.

Experimental plants were erected in 1928-30 near Rosevale, New Brunswick, and New Glasgow, Nova Scotia, to treat local shales but they operated only for short periods. Activity has been confined chiefly to field exploration and to laboratory investigation. Laboratory work by the Bureau of Mines, 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 process 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 were being developed in 1938 on a large scale. The production of these countries in 1938 was; Scotland, 1,551,346 tons; Esthonia, 1,450,885 tons; and Manchuria, approximately 3,000,000 tons. In 1939 South Africa is reported to have produced 3,000,000 gallons of shale oil. In Australia the Federal and New South Wales Governments are reported to be giving considerable assistance to the shale oil industry, the production in 1942 being 1,600,000 gallons of shale oil.

Prepared by A.A. Swinnerton,  
In the Bureau of Mines,  
Department of Mines and Resources,  
Ottawa, Canada, March, 1944.



## PEAT IN 1943

### General Statement:

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 was formed, and on the nature of the vegetation which contributed to its formation. Many species of plants are found in peat bogs, the most abundant being mosses, such as sphagnum and hypnum; marsh and heath plants; grasses, rushes, etc.; marine plants; and sometimes trunks, roots and leaves of trees. Peat is found in every province of the Dominion.

### PEAT FUEL

Small amounts of peat fuel have been produced intermittently in Ontario and Quebec. In 1943 machine-peat fuel was produced in Ontario at Gads Hill near Stratford and at Osgoode near Ottawa, and a small amount of hand-dug peat was used locally at Morewood in Dundas county. The total production of the Province was about 250 tons.

In Quebec there was a marked increase in the production of machine peat fuel in 1943 as a result of the assistance given by the Provincial Department of Mines and The Emergency Coal Production Board. A total of 1570 tons was produced by the following operators: Excel Peat Limited, Ile-aux-Coudres, Charlevoix county; Tourbière, St. Jean, St. Jean Chrysostome, Levis county; Tourbière St. Bernard, St. Bernard, Dorchester county, Tourbière Grondines, Grondines, Portneuf county; Tourbière St. Charles, Bellechasse county; Tourbière Garthby, Garthby, Wolfe county; Quebec Peat Moss Company, St. Bonaventure, Yamaska county; Tourbière Chicoutimi, Chicoutimi county.

Sales of peat fuel in 1943 were 434 tons valued at \$4,467 compared with 172 tons valued at \$1,204 in 1942.

### PEAT MOSS

Peat moss is the dead moss of the Sphagnum plant. It is of importance because of its ability to absorb and hold from 10 to 25 times its own weight of liquids and gases. It is also elastic and has a low heat conductivity, which makes it a good insulating material.

Prior to the war peat moss was obtained from bogs at Isle Verte, Rivière Ouelle, and Waterville in Quebec; at Grand Valley and Clinton in Ontario; at Edmonton West in Alberta; and at New Westminster, in British Columbia. It was used as a bedding litter for animals, as a filler for fertilizers, for insulating and sound proofing material and as a packing material. Most of the operations were on a relatively small scale and the annual production amounted to only a few thousand tons.

When supplies from Europe to this country and the United States were cut off as a result of the war, active attention was given to the development of deposits in Canada, with the result that many plants have since been brought into production in scattered areas throughout the Dominion. The output, which increased from 17,186 tons in 1940 to 63,635 tons valued at \$1,352,183 in 1943, is mostly exported to the United States. In 1943 a total of 33 plants were in operation in Canada. The output in 1942 amounted to 53,506 tons valued at \$1,069,372.

Possibly the demand in the United States will decline in the post-war years and if so, the decline could be largely offset by a marked increase in the present use of peat moss in Canada. To acquaint Canadians with the many uses of peat moss in agriculture, industry, and the home, the Mines and Geology Branch, Department of Mines and Resources, Ottawa, issued a booklet "Peat Moss or Sphagnum Moss" in 1943, copies of which can be obtained from the Secretary, Bureau of Mines, Ottawa.

Production and Recent Developments (Peat Moss)

In New Brunswick, Fafard Peat Moss Company produced horticultural peat and poultry and stable litter from its bog at Shippigan. Western Peat Company, Limited continued the development of its bog at Shippigan.

In Quebec 13 companies, including Excel Peat Company at Ile aux Coudres, and Tourbiere Pointe au Pere at St. Anaclet, whose plants were brought into production in 1943, produced horticultural moss and poultry and stable litter and a small quantity of insulation material, the two largest producers being Premier Peat, Limited at Isle Verte, and Canada Peat Company at Riviere du Loup.

In Ontario, six companies produced horticultural moss, poultry, and stable litter, and fertilizers fillers, the three largest companies being Erie Peat Company, Welland; Canadian Industries, Limited, Erieau, and Canadian Humus Products Registered, Beverley township.

In Manitoba, Winnipeg Supply and Fuel Company and N. McMillan, Lac du Bonnet, produced horticultural moss and poultry litter.

In Alberta Moss-Tex, Limited, Edmonton, produced horticultural moss, poultry and stable litter, and insulation material.

In British Columbia, 11 companies produced horticultural moss, poultry and stable litter, and peat for metallurgical uses, the three largest producers being, Western Peat Company, Limited, Industrial Peat, Limited, and Alouette Peat Products, Limited, all at New Westminster.

Several of the larger bogs, chiefly in the Maritime Provinces, have been acquired for development after the war.

Prepared by:  
H.A. Leverin and A.A. Swinnerton,  
Bureau of Mines,  
Dept. of Mines and Resources,  
Ottawa, Canada, June, 1944.

## PETROLEUM IN 1943

### Source of Supply:

Petroleum is produced in Canada from wells in Alberta, the Northwest Territories, Ontario, and New Brunswick. Exclusive of that from the Northwest Territories, for which no data are available for publication, production showed a decrease of three per cent and failed to reach the 10,000,000 barrels of recent years. By far the greater part of Canada's requirements of crude petroleum and products were imported.

Aside from the Northwest Territories, 95 per cent of the petroleum produced in Canada in 1943 came from the Turner Valley field of Alberta, in which field the Rundle (Madison) Limestone of Palaeozoic age is the source of almost all of the output, an insignificant amount being obtained from sands in the overlying Cretaceous rocks. Production comes from both petroleum and gas wells and is supplemented by natural gasoline derived through the medium of absorption plants treating the gas from these wells.

Until June 1936, except from a few wells along the margin of the gas-cap of Turner Valley field that yielded a heavier petroleum, production was derived almost entirely from gas wells in the form of so-called naphtha, an unstabilized natural gasoline. Since then all development has been diverted towards the western deeper-lying belt of the limestone where the same porous zones yield a liquid-phase petroleum. Here the gravity of the petroleum ranges from 38° API in the lower part adjacent to the edge-water to 45° API near the gas cap.

Efforts to extend development north and south were continued in 1943 and the limit at either end does not appear to be reached, although nothing on the scale attempted at the north end in 1941 and 1942 was repeated. Interest centred largely in the area 9 miles long in the central part of Turner Valley, in which a limited amount of drilling had been done, the results of which were not encouraging. To stimulate the drilling of wells in order to keep up the supply of light petroleum for Western Canada from Turner Valley, which had been declining from its peak reached in February 1942, a company known as Wartime Oils was formed by the Dominion Government under the Oil Controller to finance such drilling. Money is loaned to the operator on the basis of a small royalty and low interest and is to be paid back out of production. Drilling was started in the summer and by the end of the year three wells had been completed and eleven rigs were working. Depending on results, at least twenty-six wells were planned.

The deep hole that was started in 1942 on legal sub-division 2-25-19-3-5 as a cooperative effort by a number of operators to test whether the Devonian limestone underlay the west flank of Turner Valley passed from the Banff shales into Upper Blairmore (?) at 8,795 feet, thus demonstrating its absence in that locality. Production was subsequently obtained from the usual porous zones in the Rundle limestone at 7,662 feet.

The repressuring experiment in the south end of Turner Valley, in which gas mainly from Frontier and Prairie wells has been returned to Foundation well, was continued throughout the year. No information as to results has been published.

At the end of 1943 a total of 214 wells were in production in Turner Valley, 24 of which were completed during the year.

Elsewhere in the Foothills of Alberta, some oil is reported to have been trucked to Calgary from Ram River No. 2 well, but no proper test had been made. The oil was reported to have a gravity of 41.5° API and to be low in sulphur. The test at Jumping Pound, close to the strike of the northward continuation of the north end of Turner reached the top of the Palaeozoic limestone at 11,588 feet and was completed at 12,056 feet. Although porosity in the limestone was good, water was struck and the well has since been abandoned. Farther south, drilling was proceeding at Sullivan Creek, west of Nanton, and at Maxmont a hole is reported to be over 9,700 feet.

Drilling was active again on the southern plains of Alberta and was usually preceded by careful geological and geophysical surveys. Such work is facilitated by the regulations in force in the Province, and at the end of the year it was reported that a total of nearly four million acres were under permit for this purpose. No new sources of oil were discovered, but considerable success was achieved at Taber, where four wells are reported to have become major producers, the old problem of infiltration of water apparently having disappeared at the greater depths. Production from the Taber field was more than double that of 1942, and would have been greater had the market been available.

Production from the Vermilion field increased from 2,500 barrels in May to 17,000 barrels in November. The refinery at Borradaile was closed during part of the year for the erection of new equipment.

In the Pouce Coupe area, the hole spudded in during 1942 came in as a gas well at 2,173 feet.

In Saskatchewan, the drilling of deep holes was continued. The hole at Radville penetrated the Silurian, and those at Ogema and Parry both reached the basement complex; at Dahinda, drilling had entered the Jurassic. All of the holes, except the Radville, which was abandoned, had shows of petroleum that remain to be tested. Besides this deep drilling, much structural drilling and geophysical work was done. Another hole that penetrated sands carrying petroleum was drilled to 3,516 feet near Horsham.

In Ontario, petroleum continues to be produced at Petrolia, Oil Springs, Bothwell, and in the townships of Dawn, Warwick, West Dover, and Mosa.

In Quebec, Continental Petroleum, Limited began drilling on the Galt anticline on Gaspé Peninsula, where the limestone underlying the Devonian sandstone is exposed. At over 2,000 feet the hole was still in the limestone. Failing production at higher horizons it was intended to drill to the Silurian.

In Prince Edward Island, Island Development Company, a subsidiary of Saco-Vacuum and Cities Service companies, following seismic surveys, began drilling in Hillsborough Bay. The well, which was being drilled on a pier, was intended to test Mississippian beds, hitherto not reached beneath the considerable thickness of the overlying Pennsylvanian.

In New Brunswick, further geophysical work was done in the vicinity of the Stoney Creek field. One well was drilled and two were deepened. A slight decline occurred in production.

In Nova Scotia, investigations were proceeding with a view to further test drilling.

The important development started in 1942 in the Northwest Territories and known as the Canol Project was continued throughout 1943 with encouraging results. In 1942, sixteen wells were drilled at Norman Wells on the Mackenzie River, two of which failed to produce petroleum in commercial quantity, and in 1943 fourteen more were completed. In 23 of the total of 30 wells drilled oil in commercial quantities was found. Four of the others were 'wildcat' wells, and three were marginal. Including the original four wells, a total of 27 were productive at the end of the year and a fairly well defined area of over 5,000 acres was regarded as proven. Much of this lies beneath the Mackenzie River, although possibly over half of it can be reached by means of directional drilling. At this point the river, including islands, is three miles wide. Productive wells have been drilled on Bear Island and on the down-stream end of a sand bar called Goose Island.

The productive formation at Norman Wells is a reef limestone that occurs at 1,050 to 1,150 feet in the shallow wells on the right bank of the river and at 1,706 feet in a well on Bear Island. The limestone is amenable to treatment with acid and the initial production of individual wells is up to expectation. Reservoir pressures generally are comparable to the hydrostatic head. The pipe line to connect the field with a refinery under construction at Whitehorse, Yukon Territory,

was nearing completion early in June, 1944.

The throughput of the refinery at Norman Wells was increased in September from 840 barrels to over 1,100 barrels a day. Products were aviation-base gasoline, white motor-gasoline, heavy naphtha, light Diesel fuel, reduced crude, and bottoms. A heavy Diesel fuel is blended from reduced crude, heavy naphtha, and crude petroleum.

	(1) <u>Production by Provinces</u>		(2)	
	<u>1942</u>		<u>1943</u>	
	bbls.	Value \$	bbls.	Value \$
New Brunswick	28,089	39,467	25,000	35,100
Ontario	143,845	306,242	133,000	313,900
Alberta	10,117,073	15,514,665	9,800,000	15,800,000
Northwest Territories	75,789	108,477	89,929	--
<b>Totals</b>	<b>10,364,796</b>	<b>15,968,851</b>	<b>10,047,929</b>	<b>16,149,000</b>

(1) Figures from the Dominion Bureau of Statistics, those for 1943 being preliminary.

(2) Production for Northwest Territories is for first six months only. Total value does not include value of production from N.W.T.

Production in Alberta

<u>Turner Valley</u>	<u>1942</u> bbls.	<u>1943</u> bbls.
Palaeozoic limestone oil wells	9,668,263	8,940,198
Palaeozoic limestone gas wells	27,650	46,465
Shallow oil wells (Cretaceous)	5,806	4,865
Natural gasoline	302,216	461,169
<b>Totals</b>	<b>10,003,935</b>	<b>9,452,697</b>

<u>Other Fields</u>		(2)
Armelgra	--	462
Del Bonita	1,653	1,882
Dina	2,780	200
Lloydminster	477	2,640
Moose Dome	--	2,205
Princess	10,478	340
Red Coulee	10,107	8,928
Taber	29,819	88,735
Tilley	5,718	5,065
Vermilion	63,793	93,258
Wainwright	14,510	18,136
<b>Totals</b>	<b>139,335</b>	<b>221,851</b>

Crude oil produced Mc Murray 10,041 (750-1,000 in October)  
 Totals for Alberta. 10,153,311 9,674,548

(2) Information from Petroleum and Natural Gas Conservation Board, Alberta. It will be noted the figures differ slightly from those supplied by the Dominion Bureau of Statistics.

Prepared by T.G. Madgwick,  
 In the Bureau of Mines,  
 Department of Mines and Resources,  
 Ottawa, Canada, June, 1944.

1. The first part of the report is devoted to a general description of the work done during the year. It includes a list of the projects undertaken and a brief account of the progress made on each.

2. The second part of the report is devoted to a detailed account of the work done on the various projects. It includes a list of the work done on each project and a brief account of the progress made on each.

Project Name	1957	1958
Project A	100,000	120,000
Project B	80,000	90,000
Project C	60,000	70,000
Project D	40,000	50,000
Project E	20,000	30,000
Project F	10,000	15,000
Project G	5,000	8,000
Project H	3,000	4,000
Project I	2,000	3,000
Project J	1,000	2,000

**Other Items**

Item	1957	1958
Item 1	100,000	120,000
Item 2	80,000	90,000
Item 3	60,000	70,000
Item 4	40,000	50,000
Item 5	20,000	30,000
Item 6	10,000	15,000
Item 7	5,000	8,000
Item 8	3,000	4,000
Item 9	2,000	3,000
Item 10	1,000	2,000

**Summary of Results**

The work done during the year has been very satisfactory. It has resulted in a number of important discoveries and has laid the foundation for further work in the future.

Category	1957	1958
Category 1	100,000	120,000
Category 2	80,000	90,000
Category 3	60,000	70,000
Category 4	40,000	50,000
Category 5	20,000	30,000
Category 6	10,000	15,000
Category 7	5,000	8,000
Category 8	3,000	4,000
Category 9	2,000	3,000
Category 10	1,000	2,000

Total 1957: 500,000  
 Total 1958: 600,000

The work done during the year has been very satisfactory. It has resulted in a number of important discoveries and has laid the foundation for further work in the future.