CANADA

DEPARTMENT OF MINES AND RESOURCES

HON. T. A. CRERAR, MINISTER; CHARLES CAMSELL, DEPUTY MINISTER

MINES AND GEOLOGY BRANCH

JOHN MCLEISH, DIRECTOR

BUREAU OF MINES

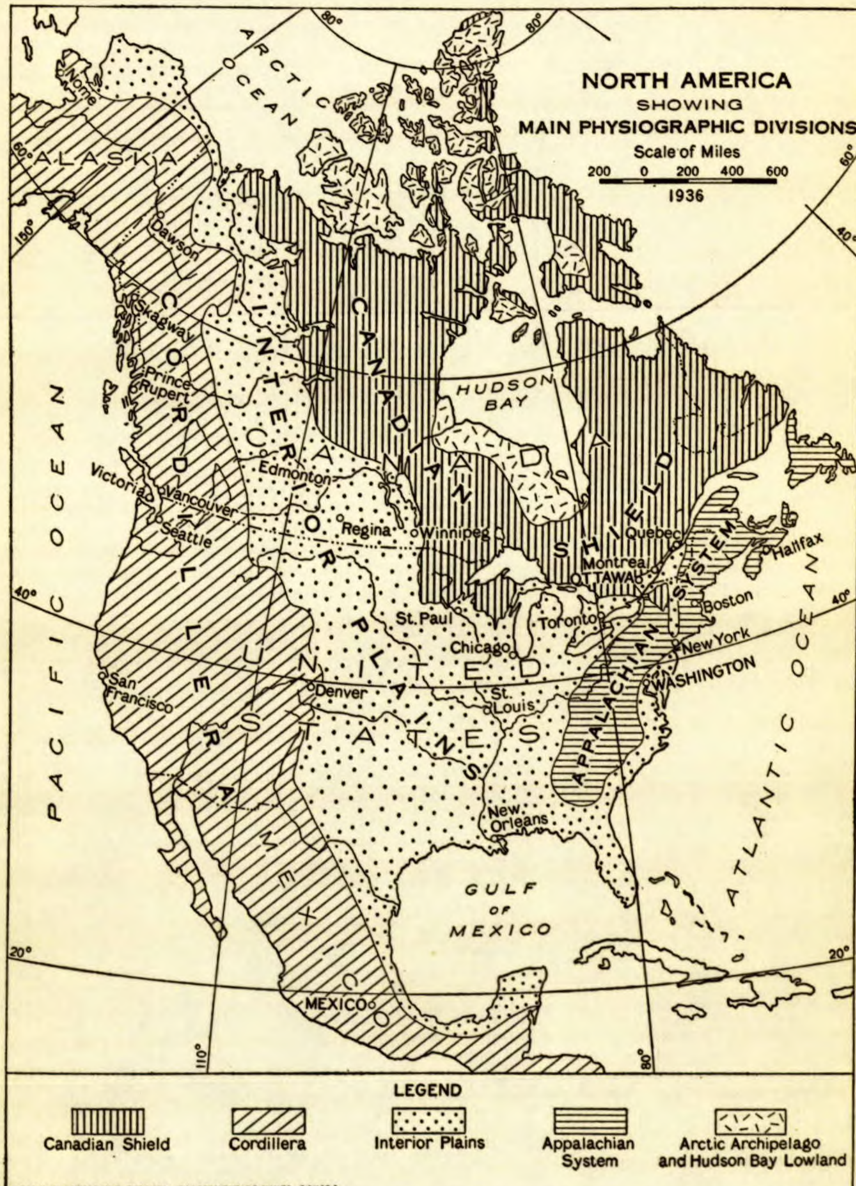
W. B. TIMM, CHIEF

THE CANADIAN MINERAL INDUSTRY IN 1937

Reviews by the Staff of the Bureau of Mines

Price, 25 cents

No. 791



Practically the entire output of metals in Canada is derived from the Canadian Shield and the Cordilleran area, which together occupy a large part of the North American continent, the world's greatest source of metallic minerals. Total value of Canada's mineral production in 1937 (including fuels and non-metallics) was $456,793,260.

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NOTE.—Statistical data relating to production, except where noted otherwise, were obtained from published data by the Dominion Bureau of Statistics. The figures of production for 1937 are preliminary figures and subject to revision. Imports and exports are taken from the "Trade of Canada," as issued by the Dominion Bureau of Statistics, and cover the calendar year. Market quotations are obtained from standard marketing reports issued in Montreal, New York, London, or elsewhere.

I. METALS

ALUMINIUM

Canadian requirements of bauxite, the ore of aluminium, are all met by import, no commercial deposit having as yet been found in Canada. Direct delivery of bauxite from British Guiana, which was discontinued in 1930, was resumed in 1935 when 24,685 tons was imported; in each of the following years imports from British Guiana show marked increases rising to 176,461 short tons in 1937. There are also substantial imports annually from the United States, and occasionally small amounts are re-exported from Great Britain, most of which is used in the abrasive and chemical trades.

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

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

The Aluminium Company of Canada at its two refineries at Arvida and Shawinigan Falls, Quebec, is the only Canadian producer of the metal; most of the output is exported. This company has also two fabricating plants, one at Shawinigan Falls, Que., and the other at Toronto, Ont. A number of other plants, mainly in Ontario and Quebec, manufacture aluminium cooking utensils, automobile parts, and other articles of aluminium.

The world output of aluminium is estimated by *Engineering and Mining Journal* at 523,000 short tons for 1937, a very large increase over 1936 when it was 404,000 short tons. The principal producing countries, in order of output capacity (as given by *Engineering and Mining Journal*) are: United States (138,000), Germany (138,000), Russia (50,000), Canada (50,000), and France (47,000).

Imports of bauxite, alumina, and cryolite were valued at $4,397,523 in 1937 and $2,936,550 in 1936. Imports of metallic aluminium and its products were valued at $2,181,878 in 1937, against $1,589,677 in 1936. The total exports of aluminium and its products were valued at $18,623,-475 in 1937 and $11,498,482 in 1936.

ANTIMONY

The Consolidated Mining and Smelting Company produces an antimonial residue as a by-product of its silver-refining operations at Trail, British Columbia. This residue will be treated in 1938 in the new antimony refinery at Trail, for the production of metallic antimony.

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

Antimony-gold ores are now being mined from the Congress and the Reliance mines in the Bridge River area, British Columbia.

No antimony ore or refined antimony has been produced in Canada since 1917, when shipments of 361 tons of ore valued at $22,000 were made; small experimental shipments were made in 1925, 1926, 1927, and 1931; small amounts of refined antimony as well as antimony ores were, previous to 1917, produced intermittently for a number of years in the Maritime Provinces.

The Bealmore Milling Company has contracted with the Congress and the Reliance Mines for the treatment of their antimony-gold ores, using the adjoining Wayside 150-ton concentrator near Minto, British Columbia. Milling was started in December, and the antimony concentrate produced is to be exported, probably, to Europe.

The refinery at Trail, British Columbia, is expected to be in operation during the first quarter of 1938. It is to have capacity to treat 10 tons a day of residue in the form of silver refinery flue dust; 60 per cent of the charge will be from stocked dust that has been accumulating for a number of years and the remainder from current operations. The production of refined antimony is expected to be 4 tons a day or over 1,400 tons a year, an amount about double our present annual import.

Small deposits of antimony ore are known in several parts of Canada. The present high price for antimony and the difficulties facing the antimony industry in China as a result of war are an incentive to explore for new deposits and to resume development at the deposits already known in Canada.

Canada's requirements of antimony up to the present have been supplied from abroad; in 1937 there were imported 1,176,790 pounds of antimony metal or regulus valued at $136,836, and 53,629 pounds of antimony salts valued at $10,382. The imports of antimony oxide are not given separately in the report "Trade of Canada."

The market for antimony depends upon general industrial activity and especially upon the demand from automobile manufacturers, as it is used largely in alloys for storage-battery plates, bearing and babbitt metals, solder, rubber goods, paints, and fixtures.

The antimony trade of the last few years has shared in the substantial progress toward recovery made by the world's trade. The expansion in the manufacture of munitions of war has also been an important factor in the increased demand for antimony.

The Chinese antimony trade has been these last few years under government control.

The bulk of the production has come in the past from China, although Bolivia and Mexico have been for years important producers of antimony, and during the last few years there has been a noticeable increase in output from Czechoslovakia and Algeria and, to a lesser degree, from several other countries.

The world's production of antimony in 1936 (1937 not yet available), as published by the United States Bureau of Mines, amounted to 31,000 metric tons, approximating the 1929 production, the highest figure of production since the War years.

The New York price of antimony (ordinary brand) in 1937 averaged 13·36 cents a pound, as against 12·24 cents in 1936. The New York domestic price has been fluctuating slightly, while the price for Chinese brand, duty paid, remained constant at 18·25 cents from October to December.

BISMUTH

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

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

In British Columbia, the Consolidated Mining and Smelting Company of Canada completed, in the latter part of 1928, a plant for the electrolytic treatment of bismuth residue resulting from the electrolytic treatment of lead bullion. The operation of the plant is intermittent.

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

The Canadian production of bismuth in 1937 was 5,711 pounds valued at $5,654, as against 364,165 pounds valued at $360,523 in 1936. No metallic bismuth was produced in 1937, though a considerable quantity was sold from stock.

No separate records of exports of bismuth or bismuth salts are available.

The imports in 1937 were: metallic bismuth, 34 pounds valued at $40, and bismuth salts valued at $17,489, as against metallic bismuth 29 pounds valued at $35 and bismuth salts valued at $17,068 in 1936.

Statistics of the world's production are incomplete and are estimated at between 800 and 1,000 tons annually. The United States is the principal producer, but the publication of figures is withheld as most of the production is from the plants of two companies only, the American Smelting and

Refining Company and the U.S. Smelting, Refining and Mining Company. Canada appears to hold second place as a source of supply of bismuth. Other important sources are Germany, Spain, Peru, Mexico, and Japan. Bolivia was for more than half a century the principal source of supply, but in recent years its production has decreased considerably.

Until recently most of the bismuth has been used in the manufacture of pharmaceutical products; a much larger proportion is now used in the making of so-called fusible or low-melting alloys, as for automatic sprinkler nozzles. Fusible bismuth alloys usually include lead, tin, cadmium, mercury, or antimony. An alloy of bismuth, lead, tin, and antimony has been introduced for use in mounting dies and punches.

Although many new applications of bismuth, introduced in the last few years, have increased the demand for this metal, potential supplies from various sources very much exceed present demand.

The price of bismuth at New York in ton lots has remained fixed at $1 a pound from September, 1935, to the end of that year and throughout 1936 and 1937. For several years the United States price has been maintained a little below the European parity, plus duty of 7½ per cent, chargeable upon imports into the United States; this brings the American price roughly equivalent to the London quotation, which has remained at 4 shillings throughout the year. For several years now the price has been well controlled.

CADMIUM

Cadmium is obtained as a by-product in the production of zinc, and in some cases of lead, being present in small amount in most zinc ores and in some lead ores.

Metallic cadmium is produced at Trail, British Columbia, and at Flinflon, Manitoba.

The plant for the recovery of metallic cadmium of the Consolidated Mining and Smelting Company, at Tadanac, British Columbia, started production early in 1928 and has been treating the cadmium residues from the zinc refinery. It has a capacity of 500 tons annually.

The Hudson Bay Mining and Smelting Company at Flinflon, Manitoba, completed a cadmium recovery plant in 1936, having an annual capacity of 180 tons. The residues treated are from the zinc refinery, and consist partly of current precipitate and partly of accumulated material; the procedure being similar to that followed at Trail (Tadanac).

The Canadian production in 1937 was 744,431 pounds valued at $1,220,867 as against 785,916 pounds valued at $699,465 in 1936.

Canadian production of cadmium is believed to be exported chiefly to Europe, small amounts going to the Orient.

The world's production in 1936 (1937 not available), as published by the United States Bureau of Mines, was 3,665 metric tons, as against 3,140 metric tons in 1935. The chief producing countries are: the United States, Canada, Belgium, Germany, Australia (Tasmania), France, Poland, and Norway.

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

The market has been more buoyant these last few years owing to the increased use of cadmium, principally in the manufacture of alloys and compounds and as a plating material. The use of cadmium alloys in automobile bearings has created in recent years a strong demand for the metal, and the future of the alloy for this purpose is said to be dependent upon the ability of the producers to supply the metal at a relatively low price. Cadmium also finds application in the arts, medicine, and dyeing, etc. It is marketed in metallic form 99·5 per cent pure and better, and as a sulphide.

The price of cadmium in New York in 1937 averaged $1.22 as against 97·8 cents in 1936. The maximum price was $1.42½, which ruled from July to November. The American product is protected by a duty of 15 cents per pound.

COBALT

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

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

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

There are no known occurrences of cobalt in Canada, outside of the silver-cobalt camps of northern Ontario, that give promise of commercial importance. A stable high price for silver would probably result in renewal of operations at some of the old silver mines high in cobalt and thus increase the cobalt output.

Production of cobalt in Canada in 1937 was 507,064 pounds valued at $848,247 as against 887,591 pounds valued at $804,676 in 1936.

The imports in 1937 were: cobalt oxide 617 pounds valued at $871, as against 410 pounds valued at $610, in 1936; 300 pounds of cobalt ore valued at $5 was also imported in 1937.

The exports were as follows:

	1936		1937	
	Pounds	Value $	Pounds	Value $
Cobalt contained in ore..	526,200	212,814	92,400	58,712
Cobalt alloys..	43,211	70,372	51,939	84,629
Cobalt metallic..	2,376	2,970	7,576	10,834
Cobalt oxides and salts..	484,541	556,791	597,869	754,965
	1,056,328	$842,947	749,784	$909,140

Mainly owing to the agreement reached in 1935 amongst the principal producers, the price of cobalt has remained fairly constant these last few years. The nominal New York price (as quoted by Metals and Mineral Markets) for cobalt metal imported from Belgium, remained at $2.50 per pound, less 30 per cent, for cash, from January to the end of August, thence at $1.92 per pound for the rest of the year. On yearly requirement contracts quantity discounts brought the price down to $1.25 per pound delivered from January to the end of August and to $1.36 for the rest of the year. The London quotations averaged 8s. 3d. per pound on yearly requirement contracts.

The Cobalt Association comprises leading Canadian, Belgian, Northern Rhodesian and Moroccan producers, the Association of German Cobalt Producers, and the Vuoksenniske Company of Finland. The Cobalt Association now controls probably about 90 per cent of the world's output. The agreement, which was to expire in August 1936, was renewed for five years.

The total world annual output is estimated to approximate 1,500 short tons. The greater part of the world's requirements are now supplied from the extensive deposits of the Belgian Congo and Northern Rhodesia, the remainder being contributed mainly by Canada, India, and French Morocco. Other producing countries, so far, of less importance are Australia, Japan, Germany, and Russia.

The principal uses of cobalt are in the metallurgical and ceramic industries. The metallurgical uses are for high-speed cutting steels, for making stellite (alloys of cobalt, chromium, and usually small quantities of other metals) used for cutting metals at high speed, and for making permanent magnets. Small quantities of cobalt used with other chemicals in nickel-plating solutions are said to produce a bright nickel electro deposit as an undercoating for later chromium plating. The invention of a new cobalt steel, employing 36 per cent cobalt, for use in fine machine operations was reported in 1937, the other metals being cobalt, molybdenum, chromium, with small quantities of carbon and vanadium.

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

COPPER

Canada's supply of copper is obtained from the copper-nickel ores of Sudbury, Ontario; the copper-gold ores of Noranda, and the copper-pyrites ores of Aldermac and Eustis, in Quebec; the copper-zinc ores of Flin Flon and of Sherritt-Gordon in northern Manitoba; the copper-zinc ores of Britannia and the copper ores of Copper Mountain in British Columbia. Some copper is also recovered as concentrates from the lead-zinc-copper ores of Stirling mine, Cape Breton, N.S.

In British Columbia the Britannia mine and 6,000-ton concentrator at Britannia Beach were operated at full capacity, producing copper and zinc concentrates which are exported. The Granby Consolidated Company resumed operations in the summer of 1937 at its Copper Mountain mine and Allenby 3,000-ton concentrator near Princeton; the copper concentrate produced is being exported.

The Flin Flon mine and smelter on the boundary line between Manitoba and Saskatchewan operated at full capacity. The Sherritt-Gordon property was under development throughout the year and milling was resumed in July, 1937, the copper concentrate being smelted at Flin Flon.

In Ontario the production from the mines of the Sudbury district exceeded by far that of any previous year. The No. 5 shaft at the Creighton mine was completed down to 4,050 feet and has facilitated the development of new ore zones and the increasing of the output from this mine. The Garson mine, after being closed for several years, was reopened in the latter part of 1936 and operated at full capacity in 1937. The Levack mine was reopened early in 1937; the sinking of a new 2,000-foot shaft was started in the latter part of 1937, and a complete new surface plant is being built. The Copper Cliff concentrator, the capacity of which had been increased in 1936 from 8,000 to 12,500 tons of ore a day, is being further enlarged to permit the treatment of part of the enlarged mine output. The additions to the smelter at Copper Cliff in the form of new reverberatory furnaces and converters, completed towards the end of 1936, increased the production capacity of the smelter for blister copper and for nickel matte by one-third.

The construction of the Research and Chemical Laboratory at Copper Cliff was completed and placed in operation during the latter part of the year.

The Falconbridge Nickel Mines, Limited deepened its No. 1 shaft to 2,126 feet with bottom level at the 2,100-foot horizon. No. 5 shaft, which has a depth of 1,800 feet, is connected on the 1,200-foot level with No. 1 shaft; several hundred feet of development was done on the 1,750-foot level (bottom level) from No. 5 shaft, and a cross-cut started from No. 1 shaft at the same horizon. During the year the known ore reserves of the mine were much increased. Additions to the surface plant, including enlargement of the concentrator and the smelter which was started during 1936 and completed early in 1937, increased the capacity of the plant to 12,500 tons of nickel-copper matte, all of which is exported.

The Cuniptau copper-nickel property, situated near Timagami, Ontario, was idle in 1937.

In Quebec the Noranda Mines, Limited operated its mine and smelter at normal rate throughout the year; sinking of No. 5 shaft, started early in 1935, was continued in 1937 to a depth of 4,000 feet, and exploration works started on the 3,475-, the 3,725-, and 3,975-foot levels.

The Aldermac mine and 1,000-ton mill resumed operations in January, 1937. The Waite-Amulet mine and 350-ton concentrator also resumed operations in 1937. The Eustis mine in southern Quebec continued in regular operation, exporting its copper concentrate to the United States.

The Normetal (Abana) mine, north of Dupuy station on the Canadian National Railway, started production in 1937, after completing the new 250-ton concentrator; the copper concentrate produced is shipped to Noranda smelter and the zinc concentrate is exported to Belgium.

The refinery of the Ontario Refining Company at Copper Cliff, Ontario, and that of the Canadian Copper Refiners, Limited, at Montreal East, Quebec, were operated at their annual nominal capacities of 120,000 tons and 75,000 tons, respectively. The latter plant, which is being enlarged to the capacity of 80,000 tons, treated the anode copper from Noranda and the blister copper from Flin Flon, and the Copper Cliff plant treated the entire output of blister copper of the International Nickel Company's smelter.

The method of receiving blister copper from the International Nickel Company in molten state, which was tried experimentally in 1936, was perfected during 1937 and four movable holding furnaces mounted on broad-gauge railway trucks are now in operation between the smelter and refinery, transporting the blister output of the smelter a distance of two miles to the refinery's anode furnaces. Although this method of transportation has been in use in the steel industry for some time it is the first time it has been applied to large-scale handling of blister copper.

During 1937 Ontario Refining Company brought into commercial production the melting of copper cathodes in an arc-type electric furnace of 30 tons capacity. This is one of the outstanding developments in the copper refining industry.

The Ontario Refining Company during 1937 put in a machine for double pointing vertically cast copper wire bars. The improved product has been favourably received by copper rolling mills in Canada and abroad.

The exploration and development by Consolidated Mining and Smelting Company of the gold-copper deposits on Doré Lake, Chibougamau area, about 170 miles west of Lake St. John, was discontinued in 1937, but was resumed by the owners, the Consolidated Chibougamau Goldfields.

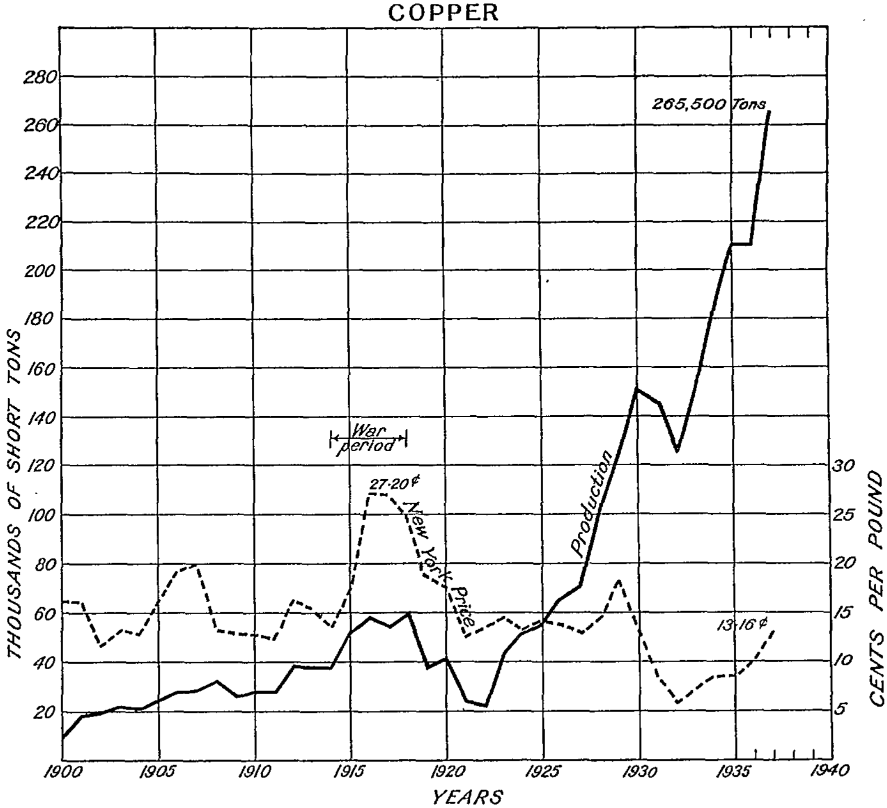
The total Canadian production in 1937 was 265,520·9 tons, valued at $69,049,734, as against 210,013·8 tons valued at $39,514,101 in 1936; of the total production Ontario contributed 61 per cent, Quebec 18 per cent, Manitoba and Saskatchewan 12 per cent, and British Columbia 8 per cent.

Exports were:	Pounds	$
Copper fine in ore, matte, etc.	73,867,600	7,409,381
Copper blister	10,884,300	1,333,073
Copper in ingot, bar, rod, etc.	296,141,300	38,705,380
Copper, old and scrap	5,551,000	549,638
Copper in rod, strip, sheet, plate and tubing.	51,224,800	7,310,329
Copper wire and cable	......	436,834
Copper manufactures	......	410,647
		56,155,282

Imports were:	Pounds	$
Copper in bar, rod, block, pig, ingot, tube, wire and scrap	2,830,572	578,860
Copper manufactures and compounds	....	914,396
		$1,493,256

Owing to the special revenue tariff of 4 cents a pound, sales of Canadian refined copper in the United States had ceased since 1933, but were resumed in 1937; concentrate shipped to the United States, chiefly from British Columbia, but also from Quebec, was treated in bond, the metal recovered being all offered for sale abroad. On account of its excellent quality Canadian refined copper is much in demand by foreign buyers and is finding its way into ever-widening markets. Most Canadian producers have the advantage of producing copper more or less as a by-product in the recovery of gold, silver, nickel, and zinc.

The beginning of 1937 found the world's copper industry in a better condition than at the beginning of any of the four previous years. The progressive improvement from the standpoint of consumption, price, and reduction of excessive stocks noticeable in 1936 continued for the first half of 1937, after which some recession set in.



Copper production and price trends in Canada, 1900-1937.

The world production in 1937 (as estimated by Engineering and Mining Journal) was 2,434,000 short tons, compared with the previous high point of 2,118,000 short tons in 1929. The gradual improvement during recent years is largely owing to increased consumption in Great Britain and Europe, and in Japan.

The greater part of Canadian refined copper goes to Great Britain, where the consumption of new copper in 1936 was at the rate of about 250,000 tons annually, as against 160,000 tons in 1928, the year of greatest consumption before the depression. The increase is attributed mainly to house building, the improvement in the transportation and engineering industries, and to the increasing domestic use of electricity; the electrical industry is by far the biggest consumer of copper in Great Britain.

The United States is by far the largest consumer of copper, the principal industries using copper in that country in 1936, being, in order of importance: the electrical manufacturers (164,000 tons), automobiles (108,000 tons), buildings (71,000 tons), electric refrigerators (15,000 tons), and air conditioning (6,400 tons)—an industry still in its infancy and which is expected to consume large quantities of copper. The total for the year approximated 750,000 tons. In normal times the building industry is as large a consumer of copper and its alloys as is the automobile industry.

The world's consumption of copper in 1936 (1937 not yet available), as given by the Engineering and Mining Journal, New York, was 2,072,200 short tons, as compared with 2,076,800 short tons in 1929, the year of highest production. Canada is now contributing about 15 per cent of the total world production.

The Montreal price of electrolytic domestic copper averaged 13·48 cents per pound in 1937, as against 10·07 cents in 1936. The average monthly price in Montreal in 1937 rose from 12·34 cents in January to 16·60 in March, then gradually decreased to about 9·8 cents in November.

The New York price of domestic electrolytic copper averaged 13·16 cents a pound in 1937, compared with 9·47 cents in 1936. Owing to the 4 cent duty, there is a differential between the foreign and domestic price.

GOLD

The chief source of gold in Canada in 1937 was, as for many years past, the gold quartz mines of Porcupine and Kirkland Lake camps in northern Ontario. The combined output of these two camps was 51·7 per cent of the total production of the Dominion, as against about 53·0 per cent in 1936. With the exception of that obtained as a by-product in the refining of nickel and copper, practically all Ontario's gold comes from gold-quartz mines.

Quebec's chief producer is still the Noranda gold-copper mine, but the relative amount contributed by gold-quartz mines in the northwestern part of the Province is increasing rapidly.

The chief source in British Columbia is gold-quartz mines, of which the Bralorne and the Pioneer in the Bridge River area, and the Silback (Premier) near Stewart are the most important. Next come auriferous base metal ores, notably those of the Britannia and Copper Mountain mines. A relatively small amount is obtained from placers.

Manitoba's gold is derived chiefly from the copper-zinc-gold ores of the Flin Flon and Sherritt-Gordon mines, with a relatively increasing production from gold-quartz mines. That of Saskatchewan is still virtually all from that portion of the Flin Flon mine lying west of the interprovincial boundary.

Yukon's gold output is virtually all from placers and is won chiefly in large-scale dredging operations.

Nova Scotia's output is all from gold-quartz mines.

The inconsiderable amount reported annually from Alberta is placer gold.

Plants for the production of fine gold are operated by: the Royal Mint, at Ottawa; the Hollinger mine at Timmins, Ontario; the Ontario Refining Company, at Copper Cliff, Ontario; Canadian Copper Refiners, at Montreal East, Quebec; and the Consolidated Mining and Smelting Company, at Trail, British Columbia.

During 1937, great activity was manifest in the development of new mines, especially in the old Porcupine and Kirkland Lake (Larder Lake section) areas; and in new areas at Gordon Lake, Yellowknife River, and Outpost Island in the Northwest Territories, and Lake Athabaska in Saskatchewan. Increased production was recorded in all the gold-producing provinces of the Dominion except Alberta and Yukon Territory.

During 1937 there were in operation 134 gold mills with a combined total daily capacity of 45,800 tons. Of this total 17 small plants, mostly in Nova Scotia, were in operation only intermittently. New mills completed and put in operation in 1937 numbered 26, with a combined daily capacity of 2,665 tons. There are 29 new mills with a combined daily capacity of 5,670 tons scheduled to come into production in 1938; six of these plants are already in operation and the balance are under construction. Thus, by the end of 1938 Canada will have at least 163 operating gold mills with a combined daily capacity of 51,500 tons.

In Ontario, two new mills, those on the Raven River and Sand River mines came into production late in 1937, and others on Kerr-Addison, McLeod-Cockshutt, Hard Rock, Tombill, and Moneta will be in operation early in 1938 and five others are expected to start during the year.

In Quebec, the 300-ton mill on Dome's subsidiary, Sigma Mines, came into production early in the year and has since increased its capacity to 500 tons; new mills under construction at the Sladen-Malartic and Pan-Canadian mines are expected to be in operation early in 1938; and the building of at least five others in the Province is planned.

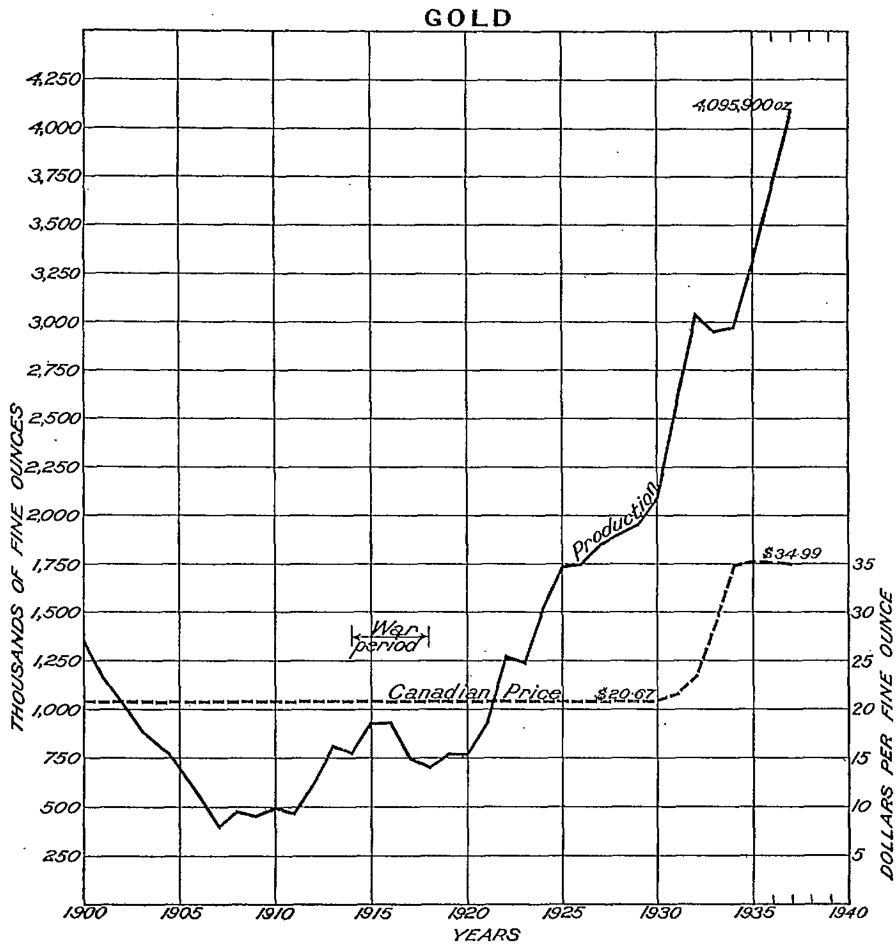
In Manitoba, a new mill brought into production at the Gurney mine, near Cranberry Portage, offset the announcement of the intended suspension of operations at the Central Manitoba mine after ten years of unprofitable production.

In British Columbia a large mill is being built on the Big Missouri mine, in the Portland Canal area. This mill is unique in Canadian metallurgy inasmuch as it is being built entirely underground. A mill has been built on the Whitewater mine in the Taku area, a locality from which no production has been previously recorded. In the southern part of the Province three new mills are being built and two others are planned.

In Saskatchewan a 1,000-ton mill is being built at Goldfields, on the north shore of Athabaska Lake, by the Consolidated Mining and Smelting Company.

In the Northwest Territories a 100-ton mill is being built by the Consolidated Mining and Smelting Company near Yellowknife Bay, Great Slave Lake, and another is planned at Gordon Lake, 50 miles to the northeast.

In Nova Scotia the gold output, though still small, increased about 63 per cent over that of 1936; the Seal Harbour mill, the largest in the Province, operated throughout the year; and an extension of milling facilities is under consideration at Montague Mines.



Gold production and price trends in Canada, 1900-1937.

The gold production of the Dominion in 1937 was 4,095,872 fine ounces, which when valued at $34.99 an ounce, the average price for the year in Canadian funds, amounted to $143,314,561, a gain of $12,000,000 over 1936 and an all-time high record. By provinces the production was as follows:—

Production of Gold in Canada for the Calendar Years 1936 and 1937

—	1936		1937	
	Fine ounces	Value	Fine ounces	Value
		$		$
Nova Scotia	11,960	418,959	19,639	687,169
Quebec	666,905	23,361,683	712,004	24,913,020
Ontario—				
Porcupine	1,023,351	....	1,120,525	....
Kirkland Lake	965,165	....	999,489	....
Other	389,987	....	467,371	....
Total Ontario	2,378,503	83,318,960	2,587,385	90,532,601
Manitoba	139,273	4,878,733	160,395	5,612,221
Saskatchewan	48,981	1,715,804	65,018	2,274,980
Alberta	109	3,818	46	1,609
British Columbia	451,938	15,831,388	503,403	17,614,071
Yukon and N.W.T.	50,359	1,764,076	47,982	1,678,890
Canada	3,748,028	131,293,421	4,095,872	143,314,561

In view of the conditions in the Dominion's gold mining industry at the end of 1937, a further increase in production is practically assured in 1938, though the proportionate increase may not be so great as that of 1937 over 1936.

IRON

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

Bounties on the production of iron ore are offered by the Provinces of Ontario and British Columbia. Ontario, as a result, will be producing iron ore in considerable quantity in 1939.

Algoma Ore Properties, Limited, a subsidiary of the Algoma Steel Corporation, stimulated by the bounty of 2 cents a unit offered by the Ontario Government, is opening up its New Helen mine in the Michipicoten district. The New Helen deposit is estimated to contain some 100,000,000 tons of carbonate ore averaging about 35 per cent iron. To fit it for use in the blast furnace a roasting and sintering plant capable of treating 2,000 tons of ore a day will be built in 1938. The sinter will carry about 50 per cent iron.

In the Sudbury district, the M. A. Hanna Company of Cleveland, Ohio, sampled the old Moose Mountain mine and is reported to have shipped some 60 tons of ore for experimental purposes. The Moose Mountain deposit is estimated to contain at least 33,000,000 tons of proved and probable low-grade siliceous, magnetite ore carrying 35 per cent iron. It was worked in a more or less experimental way for a number of years and an exceptionally high-grade material for blast furnace use was produced by fine crushing the ore, followed by magnetic separation and sintering of the concentrate. It was, however, found impossible to bring costs down so as to make a profit. Under present-day conditions and aided by the Ontario bounty of 2 cents a unit it may now be found possible to work this deposit.

Some interest was also shown during the year, in the possibilities of iron deposits at Atikokan and at Steeprock Lake, west of Port Arthur.

Imports of iron and its products (including iron ore to the value of $4,721,387) in 1937 were valued at $211,002,837 of which $173,864,866 came from the United States and $29,794,323 from Great Britain. Exports were valued at $66,027,238 of which $6,954,215 went to the United States and $14,914,879 to Great Britain.

LEAD

The greater part of the lead produced in Canada has come from the great Sullivan silver-lead-zinc mine at Kimberley, British Columbia. Other important producers in British Columbia 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.

The high-grade silver-lead mines of the Mayo area, Yukon Territory, have been in operation for a number of years. There has been no production from the lead mines of Ontario for a number of years. In Quebec, the production has been derived from the lead-zinc mine in Portneuf County; and in Nova Scotia the production has been from the lead-zinc-copper mine at Stirling, Cape Breton.

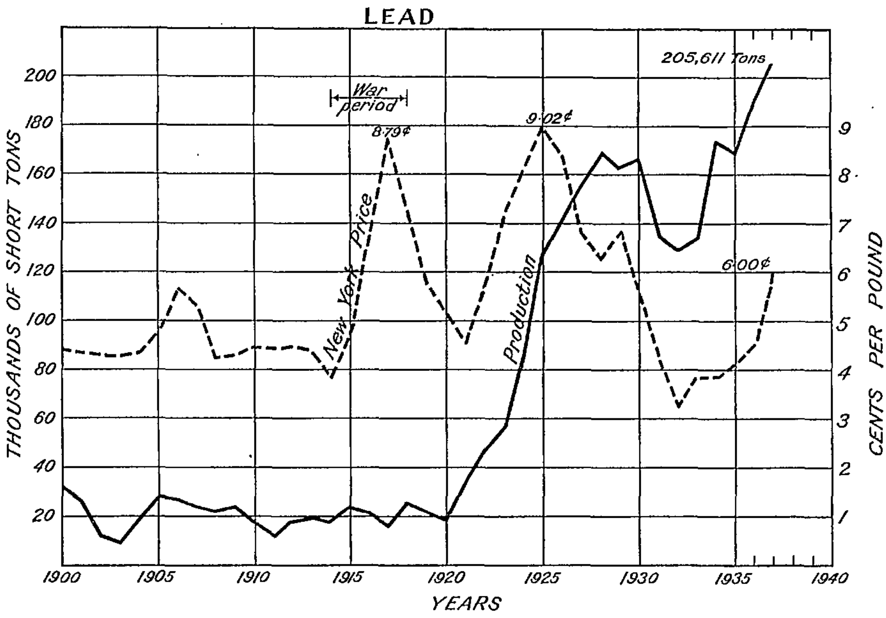
The Sullivan mine situated at Kimberley, British Columbia, and owned and operated by the Consolidated Mining and Smelting Company of Canada, produces the greater part of Canadian lead; the lead and zinc concentrates produced at its 6,500-ton concentrator are shipped by rail 185 miles to the company's smelter and refinery at Tadanac, near Trail, British Columbia. Additional equipment was added to the Kimberley mill during 1937. The Monarch mine, near Field, British Columbia, has been an important producer, exporting to Europe both the lead and zinc concentrates produced; operations in 1937 were confined to development, the equipping for production of the adjoining Kicking Horse property, and the overhauling of the 300-ton concentrator. The Mammoth mine and concentrator at Silverton were in operation throughout the year; the concentrators of the Whitewater at Retallack and the Noble Five at Sandon were worked for part of the year; several other properties in this area (Ainsworth-Slocan) such as the Lucky Jim, McAllister, and Utica, were under active development and occasional shipments were made. With higher lead and zinc prices the above-mentioned properties and several others in British Columbia would become fairly regular producers.

The Treadwell-Yukon Company continued producing with encouraging results from its several small but high-grade silver-lead properties near Mayo, Yukon Territory.

The Tetreault property near Notre-Dame-des-Anges, Quebec, and the Stirling property, at Stirling, Cape Breton, Nova Scotia, were both in operation for part of 1937, the lead and zinc concentrates produced being shipped to Europe.

The lead smelter and electrolytic refinery at Trail, British Columbia, the only one in Canada, with a new capacity rating of 560 tons of refined lead a day, or 205,000 tons a year, was operated at full capacity throughout the year; improvements in 1937 included the reconstruction of the frame building, installation of a centrifuge plant for slimes washing, modified treatment of refinery dross and installation of miscellaneous equipment with consequent increased capacity of the whole plant.

The Canadian production of lead in 1937 was 205,611 tons valued at $21,013,404, as against 191,590 tons valued at $14,993,869 in 1936.



Lead production and price trends in Canada, 1900-1937.

The exports of lead in ore, pig, etc., in 1937 were 184,835 tons valued at $17,840,997, as against 165,373 tons valued at $10,400,851 in 1936; and white lead, 108 tons valued at $17,842 in 1937, compared with 317 tons valued at $43,555 in 1936.

The total imports of lead and lead products in 1937 were valued at $2,532,563, as against $1,787,689 in 1936.

The average price of pig lead at Montreal in 1937 was 5·11 cents a pound, as against 4·64 cents in 1936; the monthly average price dropped from 7·2 cents in March to 3·5 cents in December. The quotations on the London market, converted to Canadian funds, average for the year 5·11 cents as against 3·91 cents in 1936. The average price at New York was 6·00 cents as against 4·71 cents in 1936.

The world production in 1937 as estimated by the Engineering and Mining Journal, New York, was 1,893,000 short tons, compared with a maximum production of 1,933,000 short tons in 1929. Canada contributes about 11 per cent of the world lead production. The principal producing countries are, in order of importance, United States, Mexico, Australia, Canada, Germany, Belgium, India (Burma), and Spain.

The world production of refined lead in 1937, as given by the American Bureau of Metal Statistics, totalled 1,889,800 short tons, of which amount 200,700 short tons or over 11 per cent of the total was produced by Canada.

The world consumption in 1936 (1937 not yet available), as given by the American Bureau of Metal Statistics, was 1,760,000 short tons. The Canadian consumption of lead is probably between 35,000 and 40,000 tons a year. In the United States the principal consumption continues to be in the storage battery, lead pigment, cable covering, building, and ammunition industries.

In the United Kingdom consumption of lead for the last few years has been increasing annually and is much in excess of that for the year 1929; the chief influence continued to be the further advance in building activity. The consumption is estimated at about 400,000 short tons.

MANGANESE

The production of manganese ore in Canada has been small and irregular and has been confined mainly to Nova Scotia and New Brunswick with occasional shipments from British Columbia.

The manganese ores that have been mined in Canada are pyrolusite, manganite, psilomelane, and bog manganese. These, with the exception of the bog manganese, were mostly ores with a high manganese content and fairly free from deleterious constituents. They were usually in small lots and were derived from various localities in Nova Scotia, New Brunswick, and British Columbia.

The production of manganese ore in Canada in 1937 was 85 tons valued at $609, as against 221 tons valued at $1,596 in 1936. There was no production during the previous three years.

The imports of "manganese oxide" in 1937 were 77,226 tons valued at $802,269, as against 64,262 tons valued at $684,175 in 1936.

The manganese ore imported into Canada comes mainly from the Gold Coast, West Africa. Important quantities are also imported from British South Africa and from the United States. The ore is principally used in the making of ferromanganese.

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

The world's production of manganese, as reported by the United States Bureau of Mines, for the year 1935 (complete statistics for 1936 and 1937 not yet available) amounted to 3,920,000 metric tons. The present output is estimated probably to exceed 4,000,000 metric tons.

Russia is by far the largest producer, followed by British India, West Africa (the Gold Coast), the Union of South Africa, Japan, Brazil, Egypt, and Cuba.

The price of manganese ore at North Atlantic ports for 46 to 48 per cent manganese, Brazilian, averaged 37 cents per unit for 1937; for South African ore, 50 to 52 per cent manganese, the price varied from 34 cents up to 50 cents per unit and averaged 43 cents for the year; for chemical grades 80 per cent MnO_2, the price was $45 per ton.

The trade agreement between the United States and Canada signed on November 15, 1935, and proclaimed by the President on December 2, 1935, provided for reduction of the duty on ferromanganese containing not less than 4 per cent carbon imported into the United States. This agreement went into effect January 1, 1936, and is still in force.

The metallurgical industry is the largest consumer of manganese ore; the next in importance is the battery industry; the chemical, ceramic and glass industries consume relatively small quantities.

MERCURY

Occurrences of mercury in the form of cinnabar or sulphide of mercury have been reported from a few localities in British Columbia and from one in Ontario. Mercury, associated in the form of an amalgam with the silver ores of the Cobalt area, Ontario, has been also noted.

With the exception of a small output (138 flasks) of mercury produced between 1895 and 1897 from a property near Savona, Kamloops Lake, British Columbia, and about 12 flasks recovered between 1910 and 1918 in the treatment of the Cobalt camp silver ores, there has been no mercury production in Canada.

The improvement in the price of mercury during the last few years, particularly during 1937, has encouraged further exploration for mercury deposits in Canada. In British Columbia development work was done on claims in the vicinity of Savona, and near Minto, Bridge River area. Three companies have been reported as developing their cinnabar deposits in the Bridge River area: the Manitou Mining Company, the Conardon Mercury Mines, and the Anglo-Western Mercury Mines.

The mercury imports into Canada in 1937 were 394,354 pounds valued at $371,178, as against 78,781 pounds valued at $66,511 in 1936. In addition there were imported mercury salts valued at $9,681 as compared with $4,719 in 1936.

The world production of mercury is approximately 3,000 tons a year. The two chief producing countries are Spain and Italy. The civil war in Spain, the principal producing country (one-third of world production), has created a very serious situation for the principal mercury-consuming countries, which have no producing mines or only small sources of supply.

The Italian output has been just slightly below that of Spain and under the stimulus of present conditions, world shortage and high prices, it is believed that the Italian output is being considerably increased. Other important producers are: the United States, Mexico, and Bolivia.

The average New York price of mercury in 1937, in flasks of 76 pounds, was $90.18. The monthly average price increased from $90.25 in January to $96.65 in June, then gradually decreased to $81.04 in December.

Considerable quantities of mercury are still consumed by the gold mining industry, although the introduction of "corduroy" blankets for the concentration of gold ores has decreased the demand. Substantial quantities are being required in new chemical and metallurgical plants as a catalyser, and for mercury arc rectifiers. It is used in boiler compounds, and in the preparation of drugs and chemicals. Research is being carried on and the prospects for increased consumption in new uses are encouraging.

MOLYBDENUM

The chief ore of molybdenum is molybdenite, a very soft steel-blue coloured sulphide, usually found in pegmatite dykes and along the contacts of limestone and gneiss. Greenish grey pyroxenites are common associated rocks in which other minerals such as pyrite and pyrrhotite occur.

During 1937 there was considerable activity throughout the Dominion in prospecting for molybdenite, attention being confined mainly to properties worked during the World War.

In Ontario the Phoenix Molybdenite Corporation, Limited, the only shipper during the year, intermittently worked the Bagot property, 8 miles southwest of Renfrew. Development was done on the 100-foot level and the 3-compartment shaft was extended to 25 feet below the 200-foot level. Some ore was extracted from a showing to the north of the mill. About 4,700 tons of ore is said to have been mined, about half of which was put through the mill. About 12½ tons of concentrate was shipped. Prospecting, in the form of pits and trenching, was done by the McCoy Molybdenite Company, on a property in the southwest corner of Lyndoch Township, Renfrew County, from which a few tons of ore were shipped in 1917. In the Thunder Bay District, L. C. Anderson of Port Arthur did some prospecting on the Owl Lake property near Schreiber. Four holes, totalling about 1,000 feet, were drilled and although the molybdenite was generally low grade some small sections are said to have assayed one per cent. Surface prospecting revealed four parallel ore zones, in which some high assay values are stated to have been obtained. A few tons of ore were shipped in 1920 from these claims, known at that time as the Jackfish-Pritchard property. The Molydor Mines, Limited, prospected the property two miles north of Loon Station (C.P.R.), 28 miles east of Port Arthur. Pits and cross trenches have indicated the presence of molybdenite over a width of 30 feet and a length of 240 feet. The mineral occurs mainly along the margins of quartz filled fractures that run from pegmatite dykes intruding granite. At the close of the year some ore had been mined and it is intended to ship bulk samples for assay and testing. Camp buildings and equipment have been built on the property and the erection of a 40-ton mill is planned. A small shipment was made from this deposit in 1918.

Activity was resumed at the A. V. Duke deposit at Mace near Cochrane, and the Duke Molybdenite Mining Syndicate was formed in the latter part of 1937. It is stated that pits and trenching have now exposed a mineralized zone of pegmatite and quartz over 2,000 feet in length, from which some high molybdenite assays with some gold have been obtained. More extensive work is proposed during 1938.

Prospecting was carried out during the year by J. B. Gratton on his farm near Searchmont in Gaudette Township, 30 miles north of Sault Ste. Marie. Pits and cross trenching are said to have revealed molybdenite, assaying low in gold, over a width of 12 feet and a length of 100 feet.

In Quebec a small flotation test mill was erected by Kindale Mines, Limited, on the Bain property, Masham Township, 36 miles north of Ottawa. The operations, with H. H. Claudet of Ottawa in charge and with 15 men employed, consisted of camp building, some surface work and the treatment of a small tonnage of ore in the test mill. The LaReine Gold Mines, Limited, extensively prospected its gold property in LaReine Township, Abitibi District. Showings of molybdenite, some of which are said to be rich, were found in quartz veins; several thousand feet of diamond drilling was done; a 3-compartment shaft was sunk to 120 feet and some drifting was done at the 100-foot level; a road to the property was completed; machinery and equipment were installed. No ore was mined, but plans are underway for the erection of a mill.

Assessment work was carried out by the Molybdenite Corporation of Canada, on the LaCorne Township property, 25 miles south of Amos, Abitibi District; at the close of the year diamond drilling was started to test the vein system in depth. A few years ago this property was explored by shafts and underground workings; a mill was erected and some concentrate was shipped.

Prospecting was undertaken by J. H. Lamarche on some new discoveries of molybdenite in the vicinity of Mont Laurier, about 100 miles northwest of Montreal.

In Manitoba prospecting was carried out by several parties along the Manigotagan River to the east of Lake Winnipeg; at Garner Lake, and at the Falcon Lake claims near the Manitoba-Ontario boundary.

In British Columbia a small shipment was sent for testing to the Bureau of Mines, Ottawa, by E. A. Jamieson, from the Martel Gold Mines property at Martel, Ashcroft Mining Division; it assayed 1·5 per cent molybdenite, but, partly because of the small amount sent, the recovery was low and the concentrate somewhat low grade.

H. A. Fraser of Armstrong prospected a molybdenite property near Westwold, 40 miles southeast of Kamloops.

The Consolidated Mining and Smelting Company of Canada investigated several molybdenite properties, including the Molly mine, south of Salmo, Nelson Mining Division, and at Lake La Hache, Clinton Mining Division, apparently without finding commercial ore.

About 13½ tons of concentrate was produced and 12½ tons was shipped, valued at $7,674. Some of this was, however, produced in 1936, when no shipments were made.

Canada imported 212,566 pounds of calcium molybdate in 1937 for use in the manufacture of steel alloys, valued at $70,337; in the previous year the imports were 158,621 pounds, valued at $60,363.

The world production in 1937 of metallic molybdenum was about 60 per cent greater than in 1936, the amount in that year being 9,500 tons. The United States contributed about 90 per cent of the total, thus constituting an all-time record. The Climax Molybdenum Company at Climax, Colorado, continued to be the leading producer with an output of 11,000 tons of contained molybdenum, 50 per cent more than in 1936. An increased output was also maintained by other large United States producers such as the Kennecott Copper Company; the Molybdenum Corporation, from its mines at Questo, New Mexico; and the Arizona Molybdenum Company, the total production of all three in the form of concentrate, being about 2,000 tons of molybdenum content.

Outside the United States the largest production comes from Cananea, in Mexico, which in 1936 had an output of high-grade concentrate of molybdenum sulphide containing 534 tons of the metal. The Knaben mine in Norway increased its output, which now amounts to 700 tons of molybdenite concentrate a year. Several other companies were active in Norway. In Australia, there are several very small producers distributed throughout New South Wales, and one in Queensland. A few tons are also being produced from Peru, Chosen, and Turkey, and from the Azagour district in French Morocco.

Molybdenum is used chiefly to intensify the effects of other alloying metals, particularly nickel, chromium, and vanadium. The extended use of molybdenum in many fields has caused a steady and considerable increase in consumption. The use of carbon-molybdenum steels is increasing, especially for sheeting and piping. Nearly all tungsten tool-steels now have some molybdenum added and in some instances it is actually replacing the tungsten in the high-speed tool-steel industry. For use in hard-wearing and special parts, especially in automobiles, molybdenum steels are gaining favour both on the American continent as well as in Europe. The use of molybdenum in cast iron has increased greatly in recent years. Much molybdenum wire and sheet is used in the radio industry. The chemical applications of the metal continue to grow.

Molybdenum is introduced into steel either as calcium molybdate or as ferromolybdenum, particularly the former; the proportion used being about 4 to 1 on the American continent, but in England this proportion is reversed.

The substantial increase in use of molybdenum in England is of interest. During 1937, 1,000 tons of metallic molybdenum was consumed and contained in over 2,000 tons of concentrate imported, which is double the English 1936 consumption and imports.

The price at New York of 90 per cent molybdenite concentrate is nominally 42 cents per pound of contained molybdenum sulphide. The duty on ore or concentrate into the United States is 35 cents per pound on the metallic molybdenum contained therein. The price in England increased towards the end of the year and now ranges from 31 cents per pound for 65 per cent molybdenite concentrate to 45 cents for 85 per cent concentrate. Calcium molybdate is about 87 cents and ferromolybdenum $1 per pound of contained molybdenum, f.o.b. Montreal.

As in the previous year activity in molybdenite prospecting and mining continued to increase appreciably throughout the world. There were a considerable number of inquiries for Canadian material especially in England. Although most of these call for regular tonnage of a consistent grade of concentrate over fairly long periods, there is nevertheless some demand for small odd shipments of 5 to 10 tons.

NICKEL

Nearly all Canada's nickel is derived from the nickel-copper ores of the Sudbury district, in Ontario, though a small amount is recovered, as a by-product, from the silver-cobalt ores of Cobalt and similar camps in the northern part of the same Province.

Proved ore reserves of the International Nickel Company of Canada, Limited, the chief producing company, are reported as being well over 200,000,000 tons. This Company's chief mines, Frood and Creighton, are the two largest known nickel deposits in the world. The Frood mine, though only partly explored, is known to contain over 125,000,000 tons of ore.

Production during the year was from the Frood, Creighton, and Garson mines of the International Nickel Company and from the Falconbridge mine.

Both the International and Falconbridge companies produced at a high rate throughout the year, the result being an all-time high record for nickel production in Canada.

In Ontario the production of the Sudbury district mines exceeded by far that of any previous year. The No. 5 shaft at the Creighton mine, completed down to the 4,050-foot horizon, has facilitated the development of new ore zones and the increasing of the output from this mine. The Garson mine, after being closed for several years, was reopened in the latter part of 1936 and operated at full capacity in 1937. The Levack mine was reopened early in 1937; the sinking of a new 2,000-foot shaft was started in the latter part of 1937, and a complete new surface plant is being built. The Copper Cliff concentrator, the capacity of which had been enlarged in 1936 from 8,000 to 12,500 tons of ore a day, is being further increased to permit the treatment of part of the enlarged mine output. The additions to the smelter at Copper Cliff in the form of new reverberatory furnaces and converters completed towards the end of 1936, increased the production capacity of the smelter for blister copper and for nickel matte by one-third.

The construction of the Research and Chemical Laboratory at Copper Cliff was completed and placed in operation during the latter part of the year.

The Falconbridge Nickel Mines, Limited, deepened its No. 1 shaft to 2,126 feet with bottom level at the 2,100-foot horizon; No. 5 shaft, which has a depth of 1,800 feet, is connected on the 1,200-foot level with No. 1 shaft; several hundred feet of development was done on the 1,750-foot level (bottom level) from No. 5 shaft, and a cross-cut started from No. 1 shaft at the same horizon. During the year the known ore reserves of the mine were much increased. Additions to the surface plant, including enlargement of the concentrator and the smelter, started during 1936 and completed early in 1937, increased the capacity of the plant to 12,500 tons of nickel-copper matte, all of which is exported.

In the early part of the year, B.C. Nickel Mines, Limited, of Choate, B.C., made some experimental shipments of concentrate to Japan; but at present no work is being done at the mine pending the outcome of negotiations to supply Japanese interests with nickel concentrate for smelting in Japan.

Important new activities in Ontario were the development by Denison Nickel Mines, Limited, of their property near Worthington in the Sudbury district; the incorporation of Kenora Nickel Mines, Limited, as a subsidiary of Coniagas Mines, Limited, to develop the latter's nickel property at Empire Lake in the Kenora District; and the purchase, after diamond drilling, of the Cross nickel property at Shebandowan Lake, west of Port Arthur, in the Thunder Bay District, by the International Nickel Company.

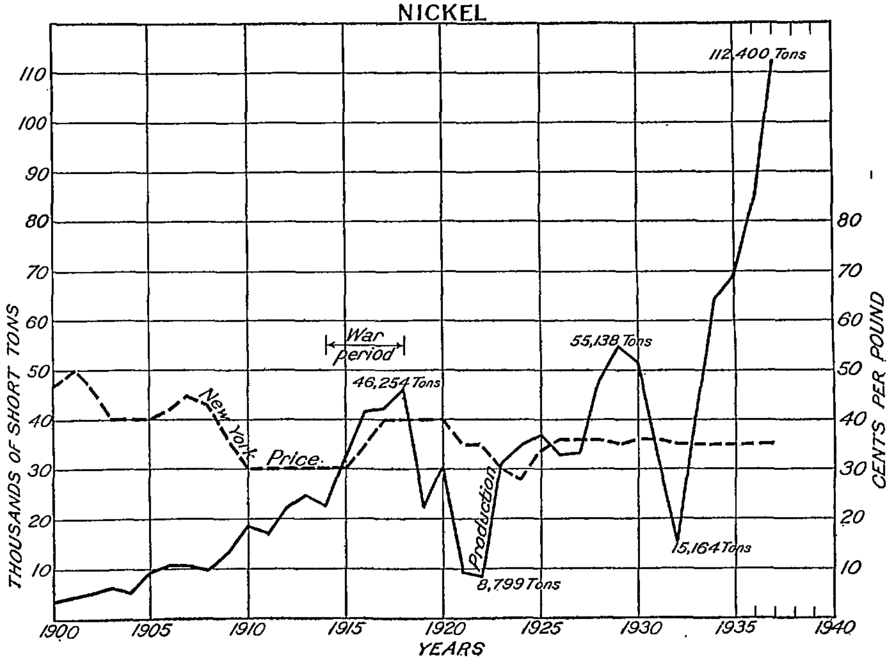
Cuniptau Mines, Limited, now merged in the Ontario Nickel Corporation, was inactive.

Mr. R. C. Stanley, President of the International Nickel Company, in his review of "The Nickel Industry in 1937" gives the following approximate distribution of the world's present consumption of nickel:

World Nickel Consumption

Steels	55%
(Construction steels, stainless steels and other corrosion and heat-resisting steels, and steel castings.)	
Nickel cast iron	5%
Nickel-iron alloys	1%
Nickel-copper alloys and nickel silvers	10%
Nickel brass, bronze and aluminium alloy castings	2%
Heat resistant and electrical resistance alloys	3%
"Monel", malleable nickel, nickel clad, "inconel"	12%
Electrodeposition	10%
Non-metallic materials for the chemical industry	1%
(Nickel salts, ceramic materials, storage battery materials and catalysts.)	
Miscellaneous and unclassified	1%

The Ontario production of nickel in 1937 was 112,395·5 tons valued at $59,507,176, compared with 84,869·7 tons valued at $43,876,525 in 1936. Crude nickel ore was exported from British Columbia for experimental purposes but data are not available for publication.



Nickel production and price trends in Canada, 1900-1937.

The exports of nickel in 1937 were 222,770,000 pounds valued at $58,913,217 compared with 173,637,500 pounds valued at $44,594,296 in 1936. The imports were as follows:

—	1936		1937	
	Quantity	Value	Quantity	Value
	lb.	$	lb.	$
Nickel, nickel silver and German silver in ingots or blocks, n.o.p.......	10,008	2,603	20,061	5,636
Nickel in bars and rods, strips, sheets and plates......................	769,061	300,141	818,946	326,469
Nickel silver and German silver in bars, rods, strips, sheets, plates or anodes..........................	101,585	27,920	97,327	25,785
Nickel chromium in bars, or rods, etc.	52,825	51,170	46,246	45,264
German, Nevada, or nickel silver, manufactures of hot plates	....	126,081	....	178,572
Nickel-plated household hollow-ware.	....	2,212	....	2,115
Nickel kitchenware................	....	1,473	....	1,344
Nickel-plated wares, n.o.p..........	....	665,649	....	887,535
	....	1,177,249	....	1,472,720

PLATINUM GROUP METALS

With the exception of a few ounces of platinum obtained from the black sands of British Columbia, and a small production obtained as an impure residue in the refining of gold at Trail, B.C., all the Canadian platinum and allied metals are obtained from the treatment of the Sudbury nickel-copper matte.

The successful development of the copper-nickel mines near Sudbury has added considerably to the Canadian production of metals of the platinum group, as the ores of these mines usually contain a notable amount of these metals.

The refinery at Acton, England, owned by the International Nickel Company through its subsidiary the Mond Nickel Company, is designed to treat precious metal residues. In order to provide for the large output of platinum metals from the Sudbury mines of the International Nickel Company of Canada, the refinery was enlarged in 1932 and now has an annual capacity of 300,000 ounces of metals of the platinum group.

All the platinum metals obtained from the treatment of the copper-nickel ores of the International Nickel Company, after refining at the Acton plant, are sold by the Mond Nickel Company, Limited, and by its regular distributors throughout the world.

The Falconbridge Nickel Company, which exports its nickel-copper matte to Norway for refining, in 1935 added a precious metal recovery unit to its copper-nickel refinery at Christiansand and is now producing and selling refined gold, silver, platinum, and palladium.

The Canadian production of platinum in 1937 was 139,361 ounces valued at $6,752,041, as against 131,571 ounces valued at $5,320,731 in 1936. The production of palladium and other associated metals of the group was 119,867 ounces valued at $3,181,668, as against 103,671 ounces valued at $2,483,075 in 1936.

The imports of platinum products in 1937 were valued at $310,048, as against $171,145 in 1936. Exports in 1937 were valued at $8,402,555, as against $6,852,597 in 1936; export records do not show the metals of the platinum group present in exported copper-nickel matte.

The price in New York of refined platinum opened the year 1937 at $48 an ounce. This fixed price increased to $68 in February, then gradually dropped to a minimum of $38 in December. The average for the year was $51.77 per ounce.

Since 1934 Canada has been the leader in the world's production of platinum, displacing Russia, which country had previously held first place; the other principal producers, by order of importance, are: Russia, South America (Colombia), and South Africa. Canada also leads the world as producer of palladium. This condition is a corollary of the great increase in the Canadian output of nickel.

The world's production of platinum and allied metals approximated 470,000 ounces in 1937.

The world's consumption of platinum metals for 1936 (1937 not yet available) as estimated by Baker & Company, approximated 400,000 ounces, a remarkable gain over the 1935 figure of 275,000 ounces.

The continuous growth in the consumption of the platinum group of metals is in part due to the improvement in the jewellery trade, which is using increasing quantities of platinum and palladium. The activity in the chemical industry has led to several new developments and to further inquiry for platinum catalysts and laboratory equipment. Industrial uses of the platinum metals continue to advance, particularly in the manufacture of rayon and in the electrical field.

Palladium ranks second in consumption amongst the platinum group; it is the cheapest metal of the group and tends more and more to replace other metals; it is used chiefly in the dental trade, other uses being in the electrical and jewellery industries, and to a much smaller extent in the manufacture of chemical ware; palladium leaf is now finding wide application.

Iridium ranks third, and is employed chiefly as a hardener for platinum, principally in the manufacture of jewellery, in which a 10 per cent iridium alloy is used; and in the electrical industry, in which a 15 per cent alloy is used; it is also used in making fountain pen points; in the musical field investigations have been proceeding for making flutes entirely of iridium and platinum.

The other metals of the platinum group—osmium, rhodium, and ruthenium are as yet consumed in relatively small quantities. Rhodium, which, on account of its brilliance and durability, has been called "the diamond of the metals" is finding increased use as a finish for reflectors and for the protection of silverware from tarnish.

RADIUM AND URANIUM

Canadian production of radium and uranium ore in 1937 continued to be confined to Eldorado Gold Mines, Limited, now in its seventh year of operating the important pitchblende deposits discovered in 1931 at LaBine Point, Great Bear Lake, in the Northwest Territories. Since this original discovery a few other occurrences of the mineral have been reported at scattered localities in the same general region.

The Eldorado mine was in steady operation and production throughout the year. Underground development was continued on the main, or No. 2 vein, by further drifting to the west on the three lowest levels, at 250 feet, 375 feet, and 500 feet, respectively, below the adit. In addition, exploration of the hitherto undeveloped No. 1 parallel vein was started from a cross-cut driven south from the shaft on the 500-foot level, followed by a second cross-cut on the 250-foot level. Both these were driven to prove the assumed downward continuation of the rich ore-shoot in the original surface discovery pit on this vein, and on each level important lengths of pitchblende were found. A cross-cut was driven on the 250-foot level to explore the No. 3 parallel vein exposed on surface to the north, the downward persistence of which to this depth is reported to have been determined. In addition to the above work on LaBine Point proper, a second shaft was sunk during the year in the gulch at the head of LaBine Bay, at a point 4,000 feet northeast of the main workings and on the strike of the No. 1 vein; this shaft was carried to 125 feet. Cross-cutting and drifting is reported to have yielded encouraging results. Conditions on the lowest level, at 590 feet below surface, show persistence of strong and well mineralized breaks to this depth.

A large new bunk-house and cook-house, assay office, addition to store house, electric transmission line to the gulch shaft, and additional tank storage for fuel oil were built. An 8-mile pipe-line around the rapids on Great Bear River has been laid, thus avoiding the costly transport of oil in drums and small river boats from the wells at Norman on the Mackenzie River to the Eldorado mine. New Diesel-powered boats went into service on the Waterways-Fitzgerald and Fort Smith-Fort Norman stretches of the Athabaska, Slave, and Mackenzie Rivers, and a large tank-barge was built and placed on Great Bear Lake to transport oil from storage established at the head of Great Bear River to the mine. Eldorado Company has acquired the transport business of Northern Transportation Company. As a result of this, as well as by the completion of the truck road around the Great Bear River rapids by the Dominion Government in 1937, transport has been speeded up with a corresponding decrease in freight costs.

The total installed power was raised to 834 h.p., all furnished by Diesel equipment. Present mill capacity is around 75 to 80 tons per day. Additional screening, jig, filtering and drying units were installed toward the end of the year. The mine working force now totals 110 men. The company reported 1,062 tons of machinery, equipment, and supplies landed at the property during the open navigation season, and 561 tons of ore shipped out. The latter included 391 tons of pitchblende-silver jig table concentrate and cobbed high-grade pitchblende and silver, and 170 tons of silver-copper flotation concentrate. The two former products are consigned to the radium refinery at Port Hope, Ontario, and the last to the smelter at Tacoma, Washington. A small amount of crude cobalt ore was also shipped.

Consolidated Mining and Smelting Company has done considerable work on a group of claims at Common Lake, adjoining the Eldorado property to the northeast, and drifting from two adit cross-cuts has disclosed both silver and pitchblende. Work was suspended in June, 1936, and has not since been resumed. A few tons of crude pitchblende and silver ore is stated to have been shipped to Trail. Small amounts of pitchblende have also been found in certain portions of the workings of the mine being operated by B.E.A.R. (Bear Exploration and Radium, Limited) at Contact Lake, 10 miles south of LaBine Point, but so far this property has been found to carry mainly silver, cobalt, and nickel. No recent development has been reported on the pitchblende discoveries made several years ago at Beaverlodge and Hardisty Lakes, about 100 miles south of Great Bear Lake. From the Arden group of claims at Beaverlodge Lake, several tons of crude pitchblende ore were mined and shipped in 1934. This ore consisted of an intimate mixture of pitchblende and hematite, occurring in pockets or lenses in a large quartz body; it is thus distinctly different to that at Great Bear Lake, where the pitchblende occurs in definite veins, associated with native silver and cobalt-nickel arsenides. A discovery of pitchblende was also made in 1935 near Goldfields, on Lake Athabaska, in Saskatchewan; the mineral occurs in extremely narrow veinlets. Samples of the vein material have yielded high gold assays and some diamond drilling was reported during the year.

In Ontario, Canada Radium Mines has been conducting underground exploration of pegmatite bodies for some years past at Cheddar, in Cardiff Township, Haliburton County. The pegmatites are stated by the Company to carry radioactive and other minerals. Work was suspended during 1937.

Figures of production, both of ore and refinery products, have not been released by the Eldorado Company for 1937, but there was a substantial increase in all departments over 1936. In 1936, 23,000 tons of ore was milled, with a production of 400 tons of concentrate and crude high-grade; ore shipments comprised 326 tons of pitchblende-silver table concentrate and 40 tons of copper-silver flotation concentrate.

At the Eldorado radium refinery at Port Hope, additions included a large new 4-story, steel-tile construction building to house radium and silver refining operations; this was completed by the end of the year and provides for a normal capacity of 75 tons per month of ore treated, equivalent to about 8 grammes of radium, or more than double the previous output. A new uranium building for the production of crude press-cake is under construction and will be completed early in 1938. A new boiler and power-house, generating 600 h.p., has been built, and a new roast-house, with a capacity of 100 tons per month, is under construction; this will house one Wedge and one Herreshoff roasting furnace for crude ore, and two reverberatory furnaces for chloridizing to recover silver. Products made at present comprise radium bromide; yellow and orange sodium uranate and black uranium oxide, used as colouring agents in the ceramic trade; silver, recovered as silver sulphide; and minor amounts of other uranium salts. The new plant also provides for the recovery of radio-lead, for which industrial use has been found, and of which about one ton is present in 20 tons of ore. Investigations are being conducted by the National Research Council, at Ottawa, into the possibility of recovering polonium and ionium from refinery residues. The plant treated 300 tons of ore in 1937, and employs 55 men. Most of the radium produced is consigned to England for measurement and loading into needles; uranium salts are shipped principally to England and the United States; silver sulphide is consigned to the United States for final refining.

Exports and imports of uranium compounds are not shown separately in trade statistics. Radium imported into Canada for medical and scientific use during the last five years has had the following values: 1933, $8,374; 1934, $211,140; 1935, $150,643; 1936, $109,032; 1937, $6,402. These values, however, represent largely radium imported on a temporary rental basis and also radium of Canadian origin sent to London for loading into needles and shipped back.

SELENIUM

Selenium, although fairly widely distributed, is not abundant in nature; it occurs in association with sulphur, and frequently accompanies the sulphides of heavy metals in the form of selenides; in no case does it occur in quantity large enough to be mined for itself alone. Commercial selenium is recovered from the slime or residue produced in the refining of copper; in Canada it is recovered during the refining of blister copper produced in Manitoba, Ontario, and Quebec.

It was produced for the first time in Canada in 1931 at the copper refinery of the Ontario Refining Company, at Copper Cliff, Ontario; the only other producer in Canada is Canadian Copper Refiners, Ltd., with refinery at Montreal East, Quebec; this Company first started production in November, 1934.

At both properties, it occurs in association with tellurium in the refinery slime of the copper refinery, and considerable quantities are now being produced annually by both companies. The Copper Cliff product is derived from the treatment of the copper-nickel ore of Sudbury district, and that at Montreal East is obtained from the treatment of the gold-copper ore of Noranda, Quebec, and the gold-copper-zinc ore of the Flin Flon mines situated on the boundary line between Manitoba and Saskatchewan.

The production of selenium in 1937 was 399,473 pounds valued at $691,088, as against 350,857 pounds valued at $621,017 in 1936.

Although most of the production is exported, no separate records of exports of this commodity are published; no imports are recorded.

Canada is now in a position to produce selenium in notable quantity and the output is marketed chiefly in Great Britain. The whole production is marketed.

Figures of world production of selenium are not available, as Canada appears to be the only country that publishes annual figures of production. The United States and Canada appear to be the principal sources of supply. Small quantities are produced by several countries including Russia, Japan, and Mexico.

The chief use at present is in the glass and pottery industries, both as a colouring agent, as in ruby glass, and to neutralize the effect of objectionable oxides; the most important development is probably the photoelectric cell or electric eye which is finding many industrial applications; it is being used in alloying stainless steel for screw and bolt stock, developing improved cutting and threading qualities; a large potential market exists in certain rubber-compounding industries, and it is being now used for vulcanizing and fireproofing switchboard cables and to increase the resistance of rubber to abrasion, these applications still being subjects of research; it finds an application in the manufacturing of certain kinds of paint; selenium oxychloride is a powerful solvent of many substances. Selenium is also used for the manufacture of certain dyes, and there are numerous other minor uses. Its application to the production of improved cutting-tool steels and to the vulcanizing of rubber seems to offer the best opportunities for the expansion of the market.

A nominal price for selenium, black powdered, 99·5 per cent pure, of $2 per pound at New York has prevailed for the last few years.

SILVER

In Nova Scotia, a very small quantity of silver is derived from the gold-quartz ores. The production in Quebec is mainly obtained from the treatment of the gold and the gold-copper ores of the Rouyn and adjoining areas in western Quebec. In Ontario, the production is mostly from the silver-cobalt-nickel-arsenical ores of Cobalt, Gowganda, and South Lorrain; from the gold ores of Porcupine, Kirkland Lake, Patricia Portion of Kenora

District and other areas, and from the treatment of the nickel-copper ores of the Sudbury district. In Manitoba, silver is derived from the copper-zinc ores of the Flin Flon and Sherritt-Gordon mines in northern Manitoba, and from gold-silver ores. In British Columbia, which is the leading silver-producing province in the Dominion, the silver is obtained mainly from the treatment of silver-lead-zinc ore from the Sullivan mine in the East Kootenay District. Important contributions are also made from mines on Wallace Mountain, near Beaverdell; from the silver-gold-bearing pyrites of the Premier mine, near Stewart; from the gold-silver ores of the Pioneer and Bralorne mines, Bridge River; and from the low-grade copper ore of Britannia mine, near Vancouver, and of the Granby Company's mine at Copper Mountain near Princeton. The Yukon production is derived from the argentiferous lead ore of the Mayo district.

The rapid expansion of mining in western Quebec has resulted in a noticeable increase in the production of silver, which amounted to 908,432 fine ounces for 1937, as against 724,339 fine ounces in 1936.

The silver mines of Cobalt and adjoining areas in Ontario have in recent years been showing a gradual falling-off in production accentuated by the low price of silver. The increased production of the Sudbury nickel-copper mines has in the last few years partly made up for the gradual decrease from the old Cobalt area. The Ontario production was 4,695,220 fine ounces as against 5,219,366 fine ounces in 1936.

The Flin Flon property, situated on the boundary line of Manitoba and Saskatchewan, was operated at full capacity throughout the year. The Sherritt-Gordon property resumed operations and went into production in 1937. The gold ores of eastern Manitoba also contributed a small quantity of silver. The Manitoba-Saskatchewan production was 1,806,103 fine ounces, as against 1,433,986 fine ounces in 1936.

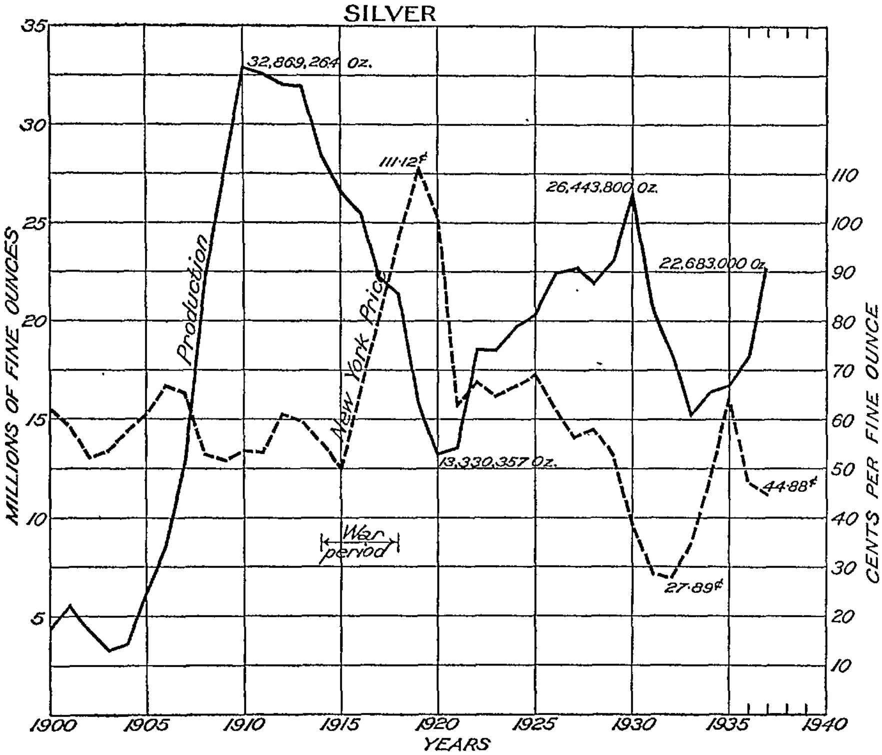
In British Columbia the Sullivan silver-lead-zinc mine and the Premier gold-silver mine were, by far, the principal producers, but contribution was made also by the Beaverdell silver camp, by the Pioneer and Bralorne gold mines, and by various smaller mines in West Kootenay. The British Columbia production was 11,162,689 fine ounces, as against 9,748,715 fine ounces in 1936.

In the Yukon, production was mainly from the Mayo district high-grade silver-lead ore. In the Northwest Territories important discoveries of silver-bearing ores made during the last few years in the vicinity of Echo Bay, and along Camsell River, Great Bear Lake district, have been followed by more intensive exploration and development. The Eldorado 75-ton concentrator started operation early in December, 1933, and is equipped to produce pitchblende as well as silver concentrate and is also making important recovery of native silver. The output for the Northwest Territories and the Yukon was 4,071,987 fine ounces, as against 1,089,137 fine ounces in 1936.

The total Canadian production of silver in 1937 was 22,683,032 fine ounces, valued at $10,180,371, as against 18,334,487 fine ounces, valued at $8,273,804 in 1936.

The exports in 1937 were 5,769,332 fine ounces of silver in ore and concentrate valued at $2,567,412 and 14,620,025 fine ounces of silver bullion valued at $6,556,357; in addition, Canadian silver coins to the value of $1,353,988 were exported.

The imports in 1937 included unmanufactured bullion to the value of $870,388 and manufactures of silver to the value of $422,891.



Silver production and price trends in Canada, 1900-1937.

The world's production of silver in 1937, as estimated by Handy and Harman, was 276,000,000 fine ounces; this compares with 250,818,000 fine ounces in 1936, as given by the American Bureau of Metal Statistics.

The price of silver in New York in 1937 averaged about 44·88 cents a fine ounce, as against 45·09 cents in 1936.

Ratification of the London Agreement of July, 1933, regarding silver was made in March, 1934, by the Canadian Government, and Canada has agreed to purchase or otherwise withdraw from the market 1,671,802 fine ounces of silver (current mine production) each year beginning with the calendar year 1934, the agreement terminated on January 1, 1938, and no effort was made to renew it. The Bank of Canada, acting for the Government of Canada, purchased each year, the stipulated amount.

TELLURIUM

Tellurium has been found native and is also an essential constituent of several minerals, none of which have been found in quantities large enough to constitute commercial ore. Tellurium-bearing minerals also occur in minute quantities in association with other metallic ores, and the element may be recovered as a by-product in the refining of copper or lead, and also when sulphuric acid is manufactured from certain classes of pyrites. The potential possibilities of the recovery and production of tellurium are great, but the present-day demand is small, so that the quantity of refined metal produced is small. Tellurium can be recovered from residues of lead and copper refineries; such ores occur in British Columbia, Saskatchewan, Manitoba, Ontario, and Quebec.

At the present time two electrolytic copper refineries are operating in Canada, both of which have plants for the recovery of tellurium from their refinery sludges, and for the production of refined metal; that of the Ontario Refining Company at Copper Cliff, Ontario, started production in 1934, and that of the Canadian Copper Refineries, Limited, at Montreal East, Quebec, in 1935. The former treats the slime from the refining of the blister copper produced by the International Nickel Company at Copper Cliff, Ontario; 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 & Smelting Company, at the Flin Flon mine situated on the boundary line between Manitoba and Saskatchewan.

There has been no recovery so far in Canada from the sludge of sulphuric acid chambers.

The production in 1937 was 51,622 pounds valued at $89,306, as against 35,591 pounds valued at $62,997 in 1936.

Most of the output was marketed in the United Kingdom and a small amount was sold locally.

Canada and the United States appear to be the main sources of supply.

Metallic tellurium, until quite recently, was of very minor industrial importance; formerly it was used to a very small extent in some radio work; it finds slight application as a colouring agent in the ceramic industry; was used in the photographic arts and also for blackening art-silverware. More recently industrial research has shown that when alloyed with lead the tensile strength and toughness of the lead is increased greatly; the use of small quantities of tellurium as a substitute for tin in the lead used for sheathing electric wire cables is reported to improve their resistance to both heat and corrosion; it has also been used for improving the machining qualities of certain steels. Very finely powdered tellurium may be used as a rubber-compounding material; it is stated that its presence shortens the time of curing, and greatly improves the resisting qualities of the product. These two recently developed uses have increased the commercial demand for the metal. Tellurium is also used in the steel industry, but so far mainly in an experimental way.

A nominal price for tellurium of $2 per pound at New York has prevailed throughout the year.

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TITANIUM

Ilmenite carrying from 18 to 25 per cent of titanium occurs in deposits of considerable size at St. Urbain in Charlevoix County, and at Ivry in Terrebonne County, both in the Province of Quebec. A few thousand tons are shipped annually from the St. Urbain deposits, in part to Niagara Falls, New York, presumably to be used in the manufacture of ferrotitanium, in part to plants of the General Electric Company in the United States. No shipments from the Ivry deposits have been reported for a number of years.

Much the most important use of titanium is for the production of the oxide TiO_2, the demand for which, chiefly for use as a white pigment, has increased with great rapidity during the last few years. The next most important use is in the form of ferrotitanium, as a "scavenger," in the manufacture of steel. Metallic titanium is a constituent of some importance in some stainless steels; in small amounts it is also used as a constituent of certain non-ferrous alloys such as copper-beryllium alloys, copper-titanium, and the "Konel" alloys developed for use in thermionic vacuum tube filaments.

During the year it was announced that a company called Canadian Titanium Pigments, Ltd., in which Canadian Industries, Ltd. has a financial interest, had been formed to manufacture titanium oxide in Canada and for this purpose had acquired a large site at Cap de la Madeleine, near Three Rivers, Quebec. The Canadian market for titanium pigment is believed to be large enough to justify the establishment of a plant in Canada.

New York quotations for ilmenite, 45 to 52 per cent TiO_2, f.o.b. Atlantic seaboard, are $10 to $12 per gross ton, according to grade and impurities. As these quotations have remained unchanged for years they are evidently nominal. The Engineering and Mining Journal Metal and Mineral Markets, under date of December 2, 1937, reports that ilmenite imports into the United States in August, all from British India, amounted to 6,868,640 pounds, valued at $14,939 or about $4.35 a short ton.

British India is much the world's largest producer of ilmenite at the present time.

TUNGSTEN

Occurrences of tungsten-bearing minerals, usually in the form of scheelite, are known in Nova Scotia, New Brunswick, Manitoba, British Columbia, and in the Yukon Territory.

In Nova Scotia development has been carried on in a small way for the past few years at Indian Path mine, near Lunenburg. The Moose River district deposits have not been worked for several years.

In New Brunswick a deposit is known at Burnt Hill Brook, York County, but the property which was worked during the War years, has since been idle.

Some exploratory work was done about 1918 on a scheelite deposit near Falcon Lake in southeastern Manitoba.

In British Columbia the old deposit on Hardscrabble Creek, Cariboo District, was under development during 1936 and 1937 and a small treatment plant was erected by D. D. Fraser of Quesnel.

In the Yukon Territory scheelite sands have been recovered in a very small way from the alluvial deposits of Dublin Gulch, Mayo district.

Tungsten in the form of ferberite, a very rare tungsten mineral, has recently been noted in some of the gold-bearing zones found on Outpost Islands, Great Slave Lake, Northwest Territories.

There has been no production of tungsten in Canada, with the exception of a few hundred tons of concentrate produced between 1912 and 1917.

The imports of chromium metal and tungsten metal for alloying purposes totalled 122,288 pounds valued at $96,900 in 1937, compared with 140,834 pounds valued at $60,382 in 1936. Imports of metallic elements, and tungstic acid for use in the manufacture of metal filaments for electric lamps were valued at $128,781, compared with $86,239 in 1936.

The world production of tungsten ore, in metric tons of concentrate containing 60 per cent WO_3 (as given by the U.S. Bureau of Mines) in 1935 was 22,000 metric tons (data for 1936 and 1937 not yet available).

The principal producing countries are: China, British India (Burma), Federated Malay States, United States, Bolivia, and Portugal.

The principal uses of tungsten are in the manufacture of high-speed tool steels, stellites, electric lights and radio tube filaments; in the preparation of various chemicals, such as pigments and in the tanning of leather.

The price of domestic tungsten ore (scheelite) in New York, per unit of WO_3, rose from $16 in January to a maximum of $30 in September, then dropped gradually to $22 in December.

ZINC

Nearly three-quarters of the zinc produced in Canada comes from the Sullivan silver-lead-zinc mine near Kimberley, British Columbia. The rest is from the Flin Flon copper-zinc mine at Flinflon on the boundary line between Manitoba and Saskatchewan; the Sherritt-Gordon copper-zinc mine, in northern Manitoba; the Britannia copper mine on Howe Sound, and several small lead-zinc properties in West Kootenay District, British Columbia; and from the Tetreault lead-zinc property near Notre-Dame-des-Anges, Portneuf County, Quebec, and the Stirling copper-lead-zinc property in Cape Breton, Nova Scotia.

In British Columbia, the Sullivan mine and the 6,000-ton a day concentrator at Kimberley of the Consolidated Mining and Smelting Company were operated at full capacity throughout the year. The Trail zinc plant of this company had its capacity increased in recent years by various additions and improvements to a total of 400 tons of slab zinc a day, or 145,000 tons a year and was operated close to its full capacity. The Monarch mine, near Field, owned by the Base Metals Mining Corporation carried on extensive development work during the year. The Monarch mill has been idle since December, 1935.

Several relatively small lead-zinc properties in West Kootenay District that had resumed operations in 1935, after several years of idleness, continued working during the year. The Mammoth mine and concentrator at Silverton were in operation throughout the year; the concentrators at the Whitewater at Retallack and the Noble Five at Sandon operated for part of the year; several other properties in this area (Ainsworth-Slocan) such as the Lucky Jim, McAllister, and Utica, were under active development and occasional shipments were made. With higher lead and zinc prices, these and several other properties in British Columbia would become fairly regular producers.

In Manitoba, development of the Flin Flon mine of the Hudson Bay Mining and Smelting Company added considerably to the known ore reserves and the 5,000-ton concentrator and the zinc refinery were operated at full capacity, producing at the annual rate of about 30,000 tons of slab zinc; some improvements and additions are being made to the zinc plant.

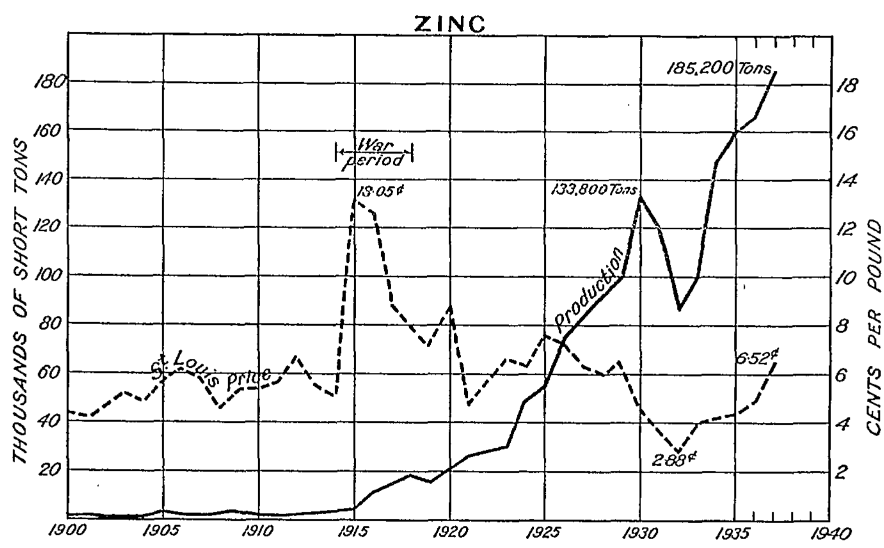
The Sherritt-Gordon copper-zinc mine, situated about 50 miles northeast of Flinflon, which had been idle since May, 1932, was reopened in 1936; operations consisted in exploration and development and in overhauling the surface plant; milling was resumed in the spring of 1937.

In Ontario, the Errington mine of Treadwell-Yukon Company, Limited, in the Sudbury basin, remained idle throughout the year.

In Quebec, at the Waite-Amulet and the Normetal (Abana) mines, operations were resumed after several years of idleness.

In Nova Scotia, at the Stirling copper-lead-zinc property in Cape Breton, after a few years of idleness, operations were resumed early in 1936, and the mine was again in production in 1937.

The Canadian production of zinc in 1937 was 185,209 tons valued at $18,157,894, as against 166,591 tons valued at $11,045,007 in 1936.



Zinc production and price trends in Canada, 1900-1937.

The exports in 1937, chiefly in the form of spelter, were valued at $15,491,186, as against $9,315,034 in 1936.

The imports in 1937 of zinc products of all kinds, including oxide and chemicals, were valued at $2,484,425, as against $1,845,988 in 1936.

The average price of zinc at Montreal for 1937 was 5·59 cents per pound as against 4·15 cents in 1936. The St. Louis price was 6·52 cents as against 4·90 cents in 1936.

The world's production of zinc in 1937, as estimated by the American Bureau of Metal Statistics, was 1,849,400 short tons. The production for 1936 was 1,650,200 short tons.

Canada is the third largest producer of slab zinc, displacing Poland in 1934, and is now contributing about 10 per cent of the world's total. The two largest producers of slab zinc are the United States and Belgium.

The principal producing countries, according to the origin of the ore, are as follows: United States, Canada, Australia, Germany, Poland, Russia, and Mexico.

The world consumption in 1936 (1937 not yet available), as given by the United States Bureau of Mines, was 1,529,100 metric tons, an increase of 13 per cent over 1935.

The galvanizing industry consumes the greater proportion of both primary and secondary zincs; other important uses are: brass and castings industry, paint pigments, radio and flash light batteries, and for making zinc oxides.

II. INDUSTRIAL MINERALS

ARSENIOUS OXIDE

Arsenic is obtained in Canada 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 the O'Brien mines in Quebec. Other mines such as the Bralorne and the Hedley in British Columbia export arsenical gold concentrate to the United States, but no payment is made for the contained arsenic.

Deposits containing arsenopyrite associated with gold are known to occur in various parts of Canada. Some of these are being worked for gold in the Provinces of British Columbia, Ontario, Quebec, and Nova Scotia. These, in the aggregate, could supply considerable amounts of concentrate suitable for the production of arsenic were it profitable to do so.

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

The O'Brien Gold Mines, Limited put in operation in 1935 a baghouse to extract arsenic from the fumes of a small roasting plant used in the recovery of gold from an arsenical concentrate made at its gold mine in Cadillac Township, Quebec.

The Beattie Gold Mines, Limited also put in operation in November, 1937, a baghouse to extract arsenic from the fumes of its large new roasting plant used in the recovery of gold from the arsenical flotation concentrate produced at its gold mine in Duparquet Township, Quebec.

Production of arsenious oxide in Canada in 1937 was 1,389,426 pounds valued at $41,032, as against 1,365,606 pounds valued at $42,491 in 1936.

Exports of arsenic in 1937 were 735,000 pounds valued at $26,938, as against 688,400 pounds valued at $25,004 in 1936.

Imports were: arsenious oxide 7,604 pounds valued at $462 as against 529 pounds valued at $90 in 1936; and other compounds of arsenic valued at $33,115, as against $40,638 in 1936.

Though world consumption of white arsenic has fluctuated considerably during the last ten years the quoted price has remained at 3½ cents a pound; and when consideration is given to the fact that most of it is obtained as a by-product of metal recovery, through necessity rather than choice, and that the potential supply from this source is far in excess of any probable demand, there seems little likelihood of any sustained increase in price. For instance, it is estimated that 40,000 tons of white arsenic, roughly equivalent to the world's total consumption, is extracted annually from roaster gases at the Boliden mine, in Sweden, alone. Only a small fraction of this amount is refined for sale and appears in production returns. The remainder, in the form of crude arsenic, was at first mixed with cement, cast into blocks, and sunk in the sea; but this method of disposal proving too expensive, it has, since early in 1931, been placed in huge storehouses built for the purpose, in the hope that through research a use for it may ultimately be found.

The chief uses of arsenic are in insecticides, weed killers, sheep and cattle dip, wood preservatives, and in the manufacture of glass; minor uses are in pigments, tannery supplies, and pharmaceutical preparations.

ASBESTOS

Canadian chrysotile asbestos is produced only in the Eastern Townships, Quebec. Fibrous minerals similar in structure to asbestos, but lacking the fineness and elasticity of chrysotile, have been reported from other localities in Canada; the qualities and quantities of the material so far discovered are such that no commercial developments have followed; such materials are occasionally used for making mineral fillers.

Increase in demand has caused the opening of several dormant properties. Exploration and development on the properties of the older operating companies have disclosed reserves of ore sufficient for many years to come. The application of block-caving methods in the King mine of the Asbestos Corporation, introduced in 1934, continued to show remarkable reduction in mining costs, as well as improvements in mill feed and in working conditions.

The production in 1937 was 410,026 tons valued at $14,505,791 as against 301,287 tons valued at $9,958,183 for 1936. The 1937 output showed an increase of 36 per cent in quantity and 45·6 per cent in value, the highest ever recorded.

World production in 1936 (1937 not yet available) was approximately 549,000 short tons. The principal producing countries in the order of their importance were Canada, Russia, Southern Rhodesia, Union of South Africa, and Cyprus.

Most of the Canadian chrysotile asbestos fibre is exported; in 1937 the exports were: asbestos, 196,511 tons valued at $10,972,852; asbestos sand and waste, 194,530 tons valued at $3,242,457; and manufactures of asbestos valued at $330,061. In 1936 the exports were: asbestos 136,547 tons, valued at $7,391,517; asbestos sand and waste, 157,678 tons, valued at $2,567,343; and manufactures of asbestos valued at $175,038.

By far the greater part of the asbestos produced in Canada is exported to the United States; other countries importing considerable amounts of Canadian asbestos are Japan, Belgium, Germany, France, and the United Kingdom.

The only imports in 1937 were 76 tons of asbestos packing valued at $65,963; brake and clutch linings valued at $365,033; other products not specifically designated, valued at $718,061.

The end of the long decline in production was reached about the middle of the year 1933; a decided improvement in business was noted, particularly during the last quarter of that year. This improvement has continued throughout the last four years. Since the principal uses of asbestos are for the manufacture of automobile brake linings, of building materials, and of heat insulators, the production of asbestos will follow closely the trends in the automobile and construction industries.

The price of crude No. 1 fibre was advanced from $550 per ton in January to $750 per ton in December; the demand for this grade of fibre exceeded the supply. For the first eleven months of the year crude No. 2 prices ranged from $200 to $225 a ton; spinning fibres from $90 to $170; magnesia and compressed sheet fibre, $100 to $110; on the other grades the prices were fairly steady, ranging from a minimum of $11 a ton for shorts to a maximum of $75 a ton for high-grade shingle stock.

BARITE

The year saw no change in the Canadian barite situation and there was no production of the mineral. Canadian barite production, never large, has been negligible for a number of years. A number of deposits are known, many of them large enough to supply a moderate tonnage of ore, but competition of cheaper foreign barite, high freight rates, and the necessity for concentration to remove impurities in the case of certain of the deposits, have combined to discourage operations. Most of the comparatively small output within recent times has come from occurrences in the Lake Ainslie district, Cape Breton, Nova Scotia, and was consumed locally. Other deposits in the same Province are in Colchester, Hants, and Pictou Counties, but no mining has been done for many years. Barite also occurs in Quebec, northern Ontario, and British Columbia. The northern Ontario deposits have attracted the most attention in recent years, and a few small shipments of both crude and milled ore have been made. A renewed attempt to reopen an idle mine in Langmuir Township, in the Porcupine district, was made a few years ago, and the mill was reconditioned, but the operation ceased without attaining commercial production.

Imports of powdered barite in 1937 totalled 2,078 tons, valued at $32,869, compared with 1,658 tons, valued at $26,554 in 1936. Of the 1937 imports, 1,319 tons came from Germany, 426 tons from the United States, 246 tons from Great Britain, 87 tons from Italy. Barite enters Canada free under the British preferential tariff; imports from other countries pay 25 per cent ad valorem.

Prices of barite, as taken from trade journals, remained steady during 1937. American crude sold at around $7 per short ton, f.o.b. Missouri mines (soft ore) and $7 per long ton f.o.b. Georgia mines (hard, crystalline ore). Water-ground and floated, bleached barite was quoted at $23 per short ton f.o.b. Missouri mills. Canadian quotations on imported ground material were $33.50 per ton for No. 1 white grade and $20 to $28 per ton for off-colour grades. Natural barium carbonate, or witherite, which shares the market for this salt with the artificial, precipitated product, sold in Canada and the United States at $42 to $44 per short ton; most of the supply of this mineral is derived from Great Britain.

Most of the interest in domestic barite in recent years has been prompted by the possibility of exporting the material to Trinidad for use in oil-drilling, the mineral being used for weighting the drilling mud; so far, this project has not materialized. There being no manufactures of lithopone or barium chemicals industry in Canada, no demand exists at present for crude ore; domestic requirements for powdered barite are met chiefly by imports from Germany and the United States.

At one time ground barite was extensively used as a filler or loading material in a variety of products, such as rubber, paper, oilcloth, plastics, textiles, etc., but this use has been steadily declining and has now become comparatively secondary; it is now chiefly used as a pigment or extender in paints, and in oil-drilling muds. Crushed, granular barite is used in certain grades of glass, particularly the moulded forms. About 75 per cent of the barite now used on the American continent is employed in the manufactures of lithopone and barium chemicals. Small amounts are used as a flux in brass and iron founding, and for the manufacture of barium metal and alloys. Of the total barite used in the United States in 1936, including both domestic production and imports, 28 per cent represented ground material, 55 per cent was used for lithopone manufacture, and 17 per cent for barium chemicals.

Barite for the paint trade is usually required to be soft and of a good white colour; if the crude ore is iron-stained it is often subjected to an acid-bleaching process. For use in glass, barite must have low iron content. For many filler or loading uses, colour is not so important and off-colour ore may be used; the same applies to barite used in oil-well drilling and in the manufacture of lithopone and barium chemicals. The principal barium chemical made is precipitated barium sulphate, or blanc fixe; this is a finer and whiter material than can be made by grinding the natural mineral. Precipitated barium carbonate is added to clay for the manufacture of bricks to prevent scumming or efflorescence, and is used for making barium peroxide for the production of hydrogen peroxide.

BENTONITE

Bentonite is the name originally given to a peculiar clay resulting from the alteration (hydration) in place of the glassy substance of volcanic dust or ash beds. The principal clay constituent is usually the mineral montmorillonite, a hydrous silicate of alumina, which is generally mixed with varying amounts of gritty impurities such as fine grains of quartz, mica, or hornblende. The particles of clay material are of exceedingly fine size and often possess colloidal character. More recently, the term bentonite has been extended to include a rather broad class of clays that are in general petrographically similar to the typical bentonite but differ considerably from it in their physical properties. Many such clays come within the activable bleaching clay group, now being utilized more and more extensively in the activated or acid-treated form for the bleaching of mineral, vegetable, and animal oils. Some of these activable clays bear little superficial resemblance to the original colloidal bentonite and would hardly be recognized as bentonite; they do not swell noticeably when wetted, or form gels, and settle rapidly from thin water dispersions, in which respects they show a notable dissimilarity from the colloidal material. Only activation and decolorizing tests can determine the general suitability of such clays for bleaching and their relative efficiency. Broadly speaking, the typical colloidal bentonites are most widely distributed over the northern (plains) section of the American continent, including the Prairie Provinces of Canada, whereas the activable varieties are most prevalent in the southern and southwestern regions.

Occurrences of clay of bentonitic character are numerous in the Prairie Provinces, some of the deposits probably being thick enough to possess economic importance. Several extensive beds also exist in the Princeton-Merritt area in British Columbia. Only a few of the known occurrences, notably deposits at Princeton, B.C., Edson, Alberta, and Morden, Manitoba, have as yet received any attention as possible sources of production. The Princeton beds are thick (maximum about 9 feet), and are probably the most important known reserves: in recent years, a few carloads annually have been mined and the material shipped to Vancouver for grinding. This has been utilized mainly in oil and gasoline refining and as a concrete admixture. In 1937, some small shipments were reported from the Drumheller district, Alberta, to the Turner Valley oil field, for use in drilling.

Several scattered deposits in the Morden district, in southern Manitoba, have attracted some attention during the past two or three years from Winnipeg interests, and several carloads have been shipped to that city: the clay, after grinding, was utilized in foundry work. Tests of the Morden clay, conducted by the National Research Council, at Ottawa, indicate that the material, after activation, possesses high bleaching power, and some small-scale experimental work along commercial activation lines was carried out in a Winnipeg plant in 1937. During the year, the Morden Bentonite Company, 211 Brock Building, Toronto, was formed, and has an agreement to purchase all of the clay produced from the original O'Day claims near Morden, except what may be used for local sale in Manitoba. Initial plans call for the erection of a drying and grinding plant at Morden, and sale of the crude, ground material to supplant imported German and Utah bleaching clays. It is claimed, on the basis of tests made, that 1½ tons of crude Morden bentonite is the equivalent in bleaching power of 1 ton of standard activated clay, such as Filtrol. Delivered cost at eastern consumption points is estimated at around $20 per ton, of which $8.50 represents freight charges, as compared with a selling price of $65 to $75 per ton for the imported clays now used.

Production of bentonite in 1937 amounted to 163 tons, valued at $1,971, most of it from the Morden district, in Manitoba; the production in 1936 was 120 tons valued at $180, all of which was derived from British Columbia.

Bentonite, both crude and activated, is often marketed and distributed under a variety of trade names (e.g. Aquagel, Volclay, Filtrol, Revivo) which tend to conceal its identity, and it may even be sold as "common clay": it is thus difficult to obtain accurate figures of the amounts imported and consumed in Canada, even users of the material often not being aware of its bentonite nature.

Prices of powdered natural bentonite, as reported by Canadian users, vary from $23 to $43 per ton laid down at plant. A leading American producer in 1936 quoted $10.80 per ton for minus 200-mesh material, f.o.b. Wyoming, with a $10.50 freight rate per ton to Montreal. Dried coarsely crushed material was priced at $7.50 per ton. The price of activated bentonite, carload lots, averages around $65 to $75 per ton, delivered to points in Eastern Canada.

Canadian bentonite deposits are probably adequate to fill domestic requirements for this class of clay, the principal consumption of which in this country is in the decolorizing and clarifying of mineral lubricating oils, gasoline, and vegetable and animal oils, as well as in the foundry industry, where it is used as an ingredient of core washes and to rejuvenate spent moulding sands. A small quantity is also employed in the manufacture of asphalt emulsions, insecticides and detergents; as a bonding agent in certain cements; as a concrete admixture, and for a variety of other minor uses. Some is used in oil-well drilling, where, as an ingredient of the drilling mud, it serves to control its viscosity and to seal wall-pores.

A recently developed use for bentonite that may prove of considerable importance is for cutting off the flow of ground water through earthworks, pervious gravels, walls of irrigation or drainage ditches, seamy rock in mines and other excavations, around dam abutments, etc. The bentonite may be used in dry, powdered form or be grouted in the form of a bentonite-water slurry. A further promising use is in clarifying turbid water and sewage. Probably more than half the colloidal bentonite produced in the United States is utilized as an ingredient of moulding sands and foundry facings; it is used both to make up synthetic sand-clay mixtures and to rejuvenate spent sand. Oil-drilling muds also consume important quantities. Other uses are as a detergent in laundry work; as a plasticizer and bonding agent in ceramic bodies, plasters, cements and insulating materials; as a suspending agent in enamels, horticultural sprays and insecticides; in emulsifying asphalts; to improve the workability of concrete mixtures and prevent segregation; in cosmetics and pharmaceutical products; and in clarifying such liquids as wine and honey. Much of the clay used for decolorizing (bleaching) has undergone activation, by treatment with sulphuric acid. So far, little serious interest has been shown in developing a domestic bentonite industry, and most of the powdered clay used is imported from the United States. Activated clay is obtained wholly from American or German firms specializing in the production of this class of material.

BERYL

The mineral beryl, a silicate of aluminium and beryllium, with 12 to 14 per cent beryllium oxide, is the only important known source of the element beryllium. Its occurrence is confined to pegmatite dykes where it usually is found in the form of disseminated crystals. A large part of the beryl sold represents by-product material from the working of pegmatites for their feldspar or mica content. Beryl-pegmatites are known in a number of countries, and small tonnages have been produced in various states in the United States, in India, South Africa, Brazil, Argentina, Madagascar, Scandinavia, France, Portugal, Spain, and Russia. The total amount so produced and sold annually in recent years has been only a few hundred tons, but it is believed that the known reserves are capable of meeting considerably increased demand.

Known deposits of beryl of possible commercial importance in Canada include an occurrence in Lyndoch Township, Renfrew County, in Ontario, and several scattered occurrences in the Pointe du Bois district, in southeastern Manitoba. The first-named probably offers the best chances for development: it has been worked intermittently on a small scale since 1926 by various operators, including T. B. Caldwell, of Perth, Ontario, Madawaska Minerals, Limited, Renfrew Minerals, Limited, and Canadian Beryllium Mines and Alloys, Limited. The last-named company was incorporated in 1937 to take over the assets of Renfrew Minerals, Limited and intends to go into the field of manufacturing beryllium alloys and chemicals: head office of the company is at 901 Royal Bank Building, Toronto. Mining was conducted during 1937 and at the end of the year the company reported about 40 tons of cobbed beryl crystals stock-piled. Small shipments of feldspar have been made from the property, and there has been a recovery of a few tons of mixed rock containing columbite and certain rare-element minerals, principally euxenite. Analysis of the Lyndoch beryl has shown from 13·4 to 14·4 per cent of beryllium oxide. The beryl occurs as scattered crystals, sometimes of large size, in localized shoots or zones in a large pegmatite body. During the year, a second company, International Beryllium Mining Syndicate, 371 Bay Street, Toronto, was formed to prospect and mine for beryl in adjacent sections of Lyndoch Township and in the adjoining Township of Brudenell.

Some of the Manitoba pegmatites carry beryl as scattered crystals, sometimes of large size, and a few rich pockets of small extent have been found in which the beryl, as small crystals, constitutes possibly 50 per cent of the rock. So far, there has been no attempt at production. Occasionally yellow, green, or colourless crystals are found, and a small amount of such material has been cut into gem stones for the local Winnipeg jewellery trade. Late in the year, press notices stated that Winnipeg interests were conducting an examination of various beryl properties held by Winnipeg River Tin Mines, Limited in the Great Falls, Bird River, and Pointe du Bois districts, with a view to possible development.

In November 1937, New York trade journal quotations for beryl, carload lots, ex mine, were $30 per ton for mineral carrying a minimum of 10 per cent BeO, and $35 per ton, minimum 12 per cent BeO. These prices are nominal, and actual sales are by individual contract. American supplies, in addition to those of domestic origin, have been largely drawn from India, but recently shipments have been obtained from Argentina, and small amounts from Union of South Africa and Brazil. No statistics are available of either production or consumption of beryl in the United States, or in the world generally; present American consumption is, however, estimated to be around 300 tons per year, with reasonable prospect of a rise to 500 tons in the near future.

Until a few years ago, beryllium held little commercial interest, owing chiefly to the exceedingly high cost of extraction of the pure metal. This cost has now been reduced to a point that enables it to be used in industry and the production of beryllium alloys, chiefly copper-beryllium and nickel-beryllium, is expanding rapidly. Beryllium imparts high tensile strength to copper, and tools made of the above alloys have the valuable properties of hardness and toughness approaching that of steel and of being non-sparking. For many purposes, where wear and corrosion resistance or high fatigue values, combined with good electrical conductivity, are essential, beryllium-copper, with about 2·25 per cent beryllium, fills an important requirement. The price of the alloy now stands at $1 to $1.50 per pound in standard commercial shapes and sizes, as sheet, plates, rods, and wire. Many forms of tools made of beryllium-copper are now on the market, and it is also used for firing-pins for fire-arms, precision bearings, bushings, valve parts, moulding dies, wire cloth for special uses, and for many other purposes.

Despite the publicity given to the possible field for beryllium in alloys with the light metals aluminium and magnesium for use in aircraft engines and parts, commercial developments along such lines have, so far, been unimportant. Its addition to silver, in order to prevent tarnish, has also not proved to effect the anticipated improvement under all conditions. Alloys with nickel, nickel-iron, and nickel-chrome-iron are more promising; they are very strong, non-magnetic, heat- and corrosion-resistant, and find a use in springs of various kinds. Although metallic beryllium was made and marketed in the first instance, there is now little demand for the straight metal and the various alloys are made direct.

Initial development of the beryllium industry took place in Germany, but there are now two concerns established in the United States manufacturing beryllium alloys: these are Beryllium Corporation of Pennsylvania (formerly Beryllium Corporation of America), Temple, Pa., and Brush Beryllium Company, Cleveland, Ohio. The latter also makes a number of beryllium chemicals, including the high-refractory oxide. A third, more recent entrant into the alloy field is Westaco Chlorine Products Company, Charleston, West Virginia. In recent years, a comparatively large proportion of the beryl utilized in the United States has gone into the production of the super-refractory oxide and other compounds. Beryllium salts are used in certain kinds of glass, and also in lithopone, to increase light-fastness.

BITUMINOUS SAND

Deposits of bituminous sand occur along Athabaska River between the 23rd and 26th base lines, in the northern part of the Province of Alberta; exposures may be seen along both sides of the Athabaska River and its tributaries. Small shipments of bituminous sand have been made from the following locations: Sec. 32, Tp. 88, R. 8; Sec. 14, Tp. 89, R.9; Sec. 8, Tp. 89, R. 9; Sec. 24, Tp. 95, R. 11; and Sec. 1, Tp. 97, R. 11. Between the years 1927 and 1930 about 2,000 tons had been shipped for laboratory investigations and about 3,000 tons for the construction of demonstration pavements and road surfaces.

During 1937 the International Bitumen Company processed a small amount of bituminous sand at its plant at Bitumont, Alberta, with production of fuel oils and asphalt. Abasand Oils, Limited continued construction work on separation, distillation and refining units on Horse River near McMurray. Actual production is expected during 1938.

The Department of Mines[1] has conducted a comprehensive investigation of these deposits of natural asphalt. In addition to field exploration during fifteen field seasons, extensive laboratory studies of the bituminous sand and of bitumen separated from it have been made. Various industrial applications for the separated bitumen, as for example, in the manufacture

1 Now Department of Mines and Resources.

of paints and varnishes and in the manufacture of certain rubber goods, are also being investigated. Results obtained have directed attention to the extent and potential economic importance of the deposits. Products that may be derived include motor fuels and other liquid hydrocarbons as well as certain solid and semi-solid bitumens.

A large market for petroleum products exists in the Provinces of Alberta, Saskatchewan, and Manitoba. The extent to which this market can be supplied from the processing of bituminous sand will depend on ability to meet competition from other fields and on production and transportation costs. Production costs have not yet been definitely determined but apparently will be low. Transportation costs will apparently be governed to a considerable extent by tonnage of freight offered by producing companies.

CEMENT

The chief raw materials used in the manufacture of cement are limestone and clay. The chief product is Portland cement, for the production of which there are nine operating plants having an aggregate rated daily capacity of about 34,000 barrels.

The large excess of capacity over production is due to the fact that plants were built to take care of an anticipated demand, which has as yet not completely materialized.

In the east the plants operate throughout the year at a percentage of rated capacity, whereas in the west plants operate to capacity only part of the year. If business justified such a course all plants could operate to capacity throughout the year because most are now equipped with stock houses sufficient to take care of the natural contraction of sales during the winter season.

During 1937 the Canada Cement Company operated plants at Hull and Montreal East, in Quebec; Port Colborne and Belleville, in Ontario; Fort Whyte, in Manitoba; and Exshaw, in Alberta.

Other operators were the St. Mary's Cement Company, at St. Mary's, Ontario; the British Columbia Cement Company, at Bamberton, B.C., and the Coast Cement Company at Vancouver, B.C.

The Canadian production (sales) of Portland cement in 1937 was 6,168,971 barrels valued at $9,095,867, as against 4,508,718 barrels valued at $6,908,192 in 1936.

Exports in 1937 were 72,568 barrels valued at $82,978, as against 68,-929 barrels valued at $56,909 in 1936.

The imports of Portland cement and hydraulic lime in 1937 were 61,082 barrels valued at $134,113, as against 39,867 barrels valued at $107,180 in 1936; in addition certain unspecified cement products valued at $45,744 were imported in 1937.

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

	1936	1937
Quebec	$1.41	$1.37
Ontario	1.48	1.38
Manitoba	2.28	2.27
Alberta	1.95	1.99
British Columbia	1.85	1.81

The cement industry benefited from the general improvement in the building industry in 1937, this being the best year since the depression low of 1933. Based upon the permits issued, the total volume of construction in 1937 was only 39 per cent of that in 1929, the peak year, and as the consumption of cement is largely dependent on the building industry, it may be concluded that the cement industry is as yet much below normal.

CHROMITE

Practically all the chromite ever mined in Canada has been derived from the Coleraine area in the Eastern Townships, Quebec. Fairly heavy shipments were made from this area during the Great War period. Since 1923 to the present only a few small intermittent shipments have been made. The Asbestos Corporation of Canada has been mining these last two years some chrome ore at one of its properties in the Thetford asbestos field, in southern Quebec.

In Ontario, the Obonga Lake property situated 26 miles south of Collins, a station on the Canadian National Railway and in the Thunder Bay District, has been under development these last few years by the Chromium Mining and Smelting Corporation. Various experimental shipments have been made from the property to test plants, and to the Company's own smelter in Sault Ste. Marie, where a large modern electric smelting plant is in operation for the production of ferrochrome and ferrosilicon. The ferrochrome produced to date has been mainly from imported chrome ore.

In British Columbia exploration and development work has been done at several properties and occasional experimental shipments have been made, but there have been no reports of recent activities in connection with any of the British Columbia properties.

Production of chromite in Quebec in 1937 was valued at $43,250, as against $13,578 in 1936. The production figures for Ontario are not available for publication.

Imports of chromium ore into Canada are not separately recorded. In 1937 imports of chromium products included 2,958,505 pounds of sodium bichromate valued at $175,431; 136,454 pounds of potassium bichromate valued at $11,603; chrome firebrick to the value of $103,287; nickel-chromium bars and rods, containing more than 10 per cent chromium, 46,246 pounds valued at $45,264; and chromium metal and tungsten metal and scrap alloys of these two metals, 122,288 pounds valued at $96,900.

The world's present annual production of chromite is estimated at 900,000 metric tons. In 1935, the latest year for which complete statistics are available, the production, as reported by the United States Bureau of Mines, was 794,000 metric tons.

Russia is the largest producer of chromite, followed closely by the Union of South Africa, Southern Rhodesia, and Turkey. Other important sources of supply are Cuba, New Caledonia, and Yugoslavia.

The New York price for chrome ore, per long ton, c.i.f Atlantic ports, varied from $18.50 in January to $23 in November, averaging for the year about $21 for 45 to 47 per cent Cr_2O_3 ore; and from $20 in January to $27 for the last quarter of 1937, averaging for the year about $24.50 for 48 to 50 per cent ore. The price for 97 to 98 per cent metallic chromium averaged 85 cents per pound for the year. The price for ferrochrome, 4 to 6 per cent carbon and 66 to 70 per cent chromium was 10 cents per pound of contained chromium.

The growing use of chromium alloy steels and of various corrosion and abrasion-resistant chromium-bearing alloys has been chief cause of the increased demand for chromite in recent years. Other important uses are for refractory materials and for metal for electro-plating.

DIATOMITE

The International Diatomite Industries, Limited continuously operated the deposits at New Annan, south of Tatamagouche, in northeastern Nova Scotia, where the material is calcined and pulverized. Small shipments were made by the Canadian Multi-Cell, Limited, Martin Siding, by the Muskoka Diatomite, Limited, Gravenhurst, and by John Tynan, Novar, all in the Muskoka area, Ontario. Fairey and Company and P. G. Lepitich each shipped about two car lots from the Quesnel area in central British Columbia.

The bulk of the output was produced, as in former years, by the International Diatomite Industries, Ltd., Tatamagouche, Nova Scotia. The Company's calcination plant at New Annan operated most of the year, but its output was slightly less than that of 1936. The calcined diatomite is treated in a small mill at Tatamagouche station, 12 miles to the north. About 15 per cent of the output was sold in Canada, mainly as a sugar filter-aid, which is a very carefully prepared product. Other outlets for the Nova Scotia diatomite were as a filler in various trades, for insulation, and as a metal polish base.

In the Muskoka region of Ontario, the Muskoka Diatomite, Ltd., Toronto, excavated about a thousand tons of crude material from its deposit south of Gravenhurst. Trial runs were made in the mill erected at the edge of the property and a few tons of prepared product were shipped to various users for testing, the results of which were said to have been satisfactory. When certain changes in the mill have been made the company expects to run the plant at full capacity. About a car lot of diatomite was shipped from stock by the Canadian Multi-Cell Ltd., Toronto, deposit at Martin Siding, south of Huntsville. Farther north, J. Tynan shipped a few tons made by burning some diatomaceous peat from a deposit near Novar.

In the Cariboo District of central British Columbia, Fairey and Company, Vancouver, mined about 100 tons and shipped two car lots from lot 6182 in the east bank of Fraser River, 3 miles north of Quesnel. About 15 miles farther south P. G. Lepitich, Alexandria, shipped two car lots of crude diatomite from lot 8015 on Narcosli Creek on the west side of the Fraser River. This is the first shipment from these extensive deposits south of Quesnel. The material from the Cariboo was used in the crude form for insulation and air-floated for concrete admixture. The Western Non-Metallics, who shipped a few tons from lot 1122 in 1936, has been reorganized as the B.C. Silica Products, Ltd., Granville Island, Vancouver.

In the United States during 1936 there were 19 producers, the total sales for that year being estimated at 120,000 short tons.

The Canadian production in 1937 was 643 tons valued at $18,606 as against 615 tons valued at $13,650 in 1936. There are no export records available, but from private information it is known that about 45 per cent of this total production was exported to England and about 20 per cent to the United States; sales within Canada in 1937 amounted to 450 tons as against 241 tons in 1936.

The imports in 1937 were approximately 3,800 tons, almost all from California, U.S.A., against 2,852 tons in 1936.

There was a general increase of about 33 per cent in the consumption of diatomite used in the home industries during the year but the demand for insulation and concrete admixtures slightly increased owing to improvement in the building and allied industries.

Approximately 80 per cent of the diatomite now being consumed in Canada is in the form of filter-aids, about 15 per cent is used for insulation, and the remainder is absorbed as a filler, concrete admixture, silver polish base, and in chemicals. One or two companies are manufacturing diatomite insulation bricks and stove pads. Amongst the recent applications, the use of diatomite in the paint and varnish industry has demonstrated its advantages as a flattening agent and as an extender.

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

There is a fair demand in England, but mainly for a pure white high quality diatomite and it is being used largely as a filler for composite floorings and hard rubber products.

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

FELDSPAR

With the exception of a few thousand tons mined since 1934 in Manitoba, all of Canada's feldspar production has come from mines in Ontario and Quebec. Pegmatite dykes, the main source of commercial feldspar, are distributed widely throughout the Precambrian rocks of Eastern and Northern Canada, and the potential reserves of the mineral are very great. Development possibilities, however, in view of the comparatively low unit value of the mineral, hinge upon the two important factors of run-of-mine freedom from iron-bearing impurities and cost of transportation to grinding plant. Mechanical (magnetic) methods of cleaning spar to the grade of purity demanded by the trade, although now practised by certain producers in the United States, have not as yet been adopted at any feldspar mine or mill in this country, sole dependence being placed on cobbing and hand-picking. Deposits where this last-named practice will achieve a production of less than one ton of merchantable spar to around two tons of waste may be regarded as on the borderline of profitable operation. (These remarks apply to operations for straight feldspar: magnetic cleaning of nepheline syenite rock, a feldspar substitute, is now practised in Canada, as noted below.) Truck transport has done much to extend the limit of road haul from mine to rail or mill, and distances up to 25 miles are now possible.

Feldspar production has tended to be regional: that is, when one major operator has started in a district, others have followed suit, with the development of a sometimes considerable local industry. This has brought about a succession of periodic switches in productive centres, the period of activity in which has depended on the rapidity with which the local deposits became depleted. In the earlier days of the industry, the most important of such centres of production was the Verona district, in Frontenac County, Ontario, with a number of mines, most of them now inactive. Later, the Hybla, Mattawa, Sudbury, Parry Sound, and Bathurst districts in Ontario, and the Buckingham district, in Quebec, all, in turn, became prominent. At the present time, most of the production is derived from the two last areas. For the three years 1933-36, a single mine in the Pointe du Bois district, southeastern Manitoba, was in production, with a reported total output to the end of 1936 of around 7,000 tons: this mine was idle in 1937.

Little occurred during the year in the way of changes in the domestic industry or important new discoveries, and production continued to be drawn in the main from established mines. In 1936, a small tonnage was shipped for the first time from a deposit in Lyndoch Township, Renfrew County, Ontario; the pegmatite also carries considerable amounts of beryl, and it is hoped that it may prove possible to win beryl and feldspar simultaneously. Most of the Ontario production in 1937 continued to come from the large quarry of Bathurst Feldspar Mines, in Bathurst Township, Lanark County; a small tonnage was also reported from operations in the Verona district, Frontenac County; in Renfrew and Hastings Counties; in Burwash Township, Sudbury District; in McKellar Township, Parry Sound District; and in Nipissing District. In Quebec, the entire output came from about half a dozen established mines contiguous to the Lièvre River, north of Buckingham, in Papineau County. This district supplies all of the small tonnage of dental spar produced.

The feldspar production in 1937 was 21,330 tons, valued at $178,160, as against 17,846 tons, valued at $154,475 in 1936, an increase of 20 per cent in quantity and 15 per cent in value.

Exports of feldspar in 1937 amounted to 27,462 tons valued at $197,000 compared with 14,133 tons valued at $94,537 in 1936. Most of the Ontario and Quebec exports are consigned to grinding plants at Rochester, N.Y.; all of the former Manitoba production was shipped to a mill at Warroad, Minnesota. A small amount of specially selected, high-grade "dental" spar is exported for use in the manufacture of artificial teeth. Crude feldspar entering the United States pays a duty of 35 cents per long ton; ground spar pays 30 per cent ad valorem.

The imports of ground spar, all from the United States, were 1,356 tons valued at $22,937 in 1937 compared with 718 tons valued at $13,955 in

1936. Imports of crude feldspar were 439 tons valued at $2,197 as against 23 tons valued at $285 in 1936. Crude feldspar enters Canada duty-free; ground spar from the United States pays 20 per cent ad valorem.

The two domestic mills grinding for the ceramic trade, that of Frontenac Floor and Wall Tile Company, at Kingston, Ontario, and of Canadian Flint and Spar Company, at Buckingham, Quebec, were in steady operation throughout the year, as was also the grinding unit of the Bon Ami Company, at Montreal East. The first-named draws its supply from the Bathurst district, Ontario, and the second from mines along the Lièvre River, Quebec. The Bon Ami Company requires a light-coloured spar and in 1937 imported most of its requirements from New Hampshire.

Prices remained at the level of the previous year, with No. 1 ceramic grade quoted at $5.50, f.o.b. rail or mill. Ground spar sold at $16 per ton, ex mill.

The modern trend towards supplanting hand methods (cobbing and picking) by mechanical means in the production of minerals is making itself increasingly felt in the feldspar industry. Magnetic separation is now employed on a considerable scale in the United States and may eventually become standard practice as deposits of clean spar become exhausted. Flotation methods, investigated for some years past in Germany, are also attracting the attention of American producers for making a clean feldspar product from mixed quarry-run feldspar-quartz rock or from dump material formerly discarded as waste. The successful commercial development of such methods would permit recovery of important tonnages of spar from the waste-piles of many of the larger mines, as well as assuring consumers of a cleaner and more uniform product. It might also ultimately lead to the production of feldspar from rocks other than pegmatite, e.g. granite, syenite, gneiss, particularly where such rock contains other minerals of industrial value, such as garnet, cyanite, sillimanite, mica, etc. A recent report of the U.S. Bureau of Mines states that a plant for this purpose is expected to come into operation in 1938. Technical research on feldspar is also receiving increasing attention, directed toward a further understanding of its properties and function for ceramic uses generally and more particularly in the glass industry, which now consumes a very large proportion (over half) of the total spar used. Much work is also being done on improved methods of analysis of feldspars.

As indicating present consumption trends, an official survey of the feldspar industry in the United States showed that sales of ground spar in 1936 were distributed as follows to the various consuming industries: glass, 51 per cent; pottery, 32 per cent; enamel and sanitary ware, 10 per cent; brick and tile, 2·6 per cent; electrical insulators and other porcelain, 2 per cent; the remainder being divided between other ceramic uses, scouring preparations and abrasive wheels. In the same year, total grinding capacity of American mills was estimated to be over half a million tons, or more than double the volume of sales.

Nepheline Syenite

Nepheline syenite is an igneous rock consisting of a mixture of the feldspathoid mineral nepheline (or nephelite), a silicate of alumina and soda, and varying amounts of soda and potash feldspars. Being used in the ceramic trade (at present mainly in the glass industry) as a substitute for straight feldspar, it is included here under the latter mineral.

Interest in the material as an industrial mineral or rock is of recent date, the first production being in 1936, when Canadian Nepheline, Limited opened a quarry at Blue Mountain, in Methuen Township, Peterborough County, about 27 miles northeast of Lakefield, and erected a mill at Lakefield to crush and process the rock for market. This operation met with conspicuous success from its inception, and has run steadily ever since, with demand in excess of capacity. Originally designed to produce 20 tons a day of finished product, the plant was stepped up during 1937 by the addition of a second magnetic separator and additional crushing equipment to an output of around 45 tons per day. Quarry plant was also extended by the provision of crushing equipment to reduce crude rock to 4 inches before shipment. Processing of the quarry-run rock is necessary to remove the small amount of iron-bearing minerals present, principally magnetite. Crushing to 20 mesh suffices to free the objectionable impurities, the finished product being a granular material of the mesh size desired by the glass trade, to which the entire output at present goes. A large part of the production is exported to the United States, the remainder being taken by domestic glass works. The material is of particular interest to the glass industry owing to its higher content of alumina (about 24 per cent), as compared with straight feldspar (about 20 per cent) 1,500 pounds of syenite replacing 2,000 pounds of spar. Research indicates that the syenite may have useful application in other branches of ceramics, such as semi-vitreous ware and porcelain enamels, and these uses may considerably extend its industrial field. Operations of Canadian Nepheline, Limited were further extended in 1937 by the formation of a subsidiary, American Nepheline Corporation: during the year this Company erected a large crushing and processing plant at Rochester, N.Y., and in 1938 will be in a position to make quarry-run rock from the Blue Mountain deposit and prepare it for the American trade; capacity of this plant will be about 200 tons of head-feed per 24 hours.

Other deposits of nepheline syenite occur to the north of the above area, and there has been active prospecting of this region during the last two years. In 1937, a second company, Gooderham-Nepheline, commenced operations on a property in Glamorgan Township, Haliburton County, and shipped several hundred tons of crude rock to the mill of United Feldspar Corporation at Spruce Pine, North Carolina, for processing; a small tonnage was also shipped to the mill of the same Company at West Paris, Maine. From the Vardy property, in Dungannon Township, Hastings County, the Golding-Keene Company shipped about 1,500 tons of syenite to its mill at Keene, New Hampshire. A few tons were also shipped from the Morrison property in the same township to the mill of Genesee Feldspar Company at Rochester, N.Y.

Production of nepheline syenite in 1937 was valued at $121,481, compared with a value of $37,426 in 1936. These figures cover both crude rock and processed material.

Crude syenite enters the United States duty-free; processed material pays the same duty as ground feldspar, namely, 30 per cent ad valorem.

FLUORSPAR

Few important occurrences of fluorspar are known in Canada, and practically the whole of the domestic requirements for the metallurgical and ceramic industries is imported. The only localities where the mineral occurs in important amount are the Madoc district, in Hastings County, Ontario, and near Grand Forks, British Columbia. During the war period, active mining was conducted on a number of properties in the Madoc area, with the production of considerable tonnages; in recent years, however, output has been very small and practically all the mines have been idle. In 1937, plans were made by a recently incorporated company, Canadian Fluorspar, Limited, to reopen the old Keene mine, one of the more important War-time producers in the Madoc district, but operations were suspended before the workings had been completely dewatered.

The Rock Candy mine of the Consolidated Mining and Smelting Company, near Grand Forks, B.C., represents by far the largest known deposit of fluorspar in Canada. It was operated intermittently between 1918 and 1929, but has been idle since the latter year, when nearly 18,000 tons was produced; the total output is estimated at around 70,000 tons of crude fluorspar, from which about 30,000 tons of concentrate was produced. Some of this material was exported, but most of it was utilized by the above Company for the production of hydrofluosilicic acid, used in the electrolytic purification of lead at its Trail smelter. Following the erection of the Company's large fertilizer plant at Trail, recovery of by-product fluorine from the phosphate rock used has obviated the necessity of employing fluorspar as a source of fluorine. At present, the whole of such recovery is consumed in the lead refinery, but the company is considering other outlets, such as in the manufacture of sodium fluosilicate, used in the ceramic and glass industries, for laundry purposes, and as an insecticide; lead and zinc fluosilicates, also of value as grasshopper poisons; and ammonium fluosilicate, used as a detergent.

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

In 1937, the small Canadian production of 150 tons, valued at $2,550, was all recovered by a single operator from small surface workings or waste dumps in the Madoc area, Ontario. In 1936, the production was 75 tons, valued at $900. The material is mostly of gravel grade.

Imports of fluorspar into Canada in 1937 totalled 11,444 tons valued at $168,082, compared with 11,194 tons valued at $95,268 in 1936. The material came from the United States (4,059 tons), Newfoundland (2,638 tons), United Kingdom (1,790 tons), Germany (1,626 tons), and Spain (1,331 tons).

Prices of fluorspar, as reported in trade journals, showed slight advances in 1937. In the United States, gravel spar rose from $18 to $19 in January to $20 to $21 in December; No. 2 lump advanced from $20 to $21; ground, 95 to 98 per cent CaF_2 grade, remained steady at $35 to $37, all per net ton, f.o.b. mines Kentucky and Illinois. Canadian quotations rose from $33 to $37 per ton, delivered, in the same period, with grade not specified.

By far the largest use of fluorspar is in the metallurgical industries, chiefly as a flux in the production of basic, open-hearth steel ("fluxing gravel" grade); some is also similarly used in the melting of electric furnace steels, ferro-alloys, non-ferrous metals, and in general foundry work ("foundry lump" grade). The glass and pottery trades consume important amounts of ground fluorspar, and a considerable tonnage ("acid lump" grade) is consumed in the manufacture of hydrofluoric acid, used largely for the production of synthetic cryolite, a material employed in the electrolytic bath in the extraction of aluminium from bauxite and also, to a smaller extent, in glass and other ceramic products, insecticides, etc. Smaller miscellaneous uses for fluorspar include Portland cement manufacture, bonding of emery wheels, and in the making of carbon electrodes, calcium carbide and cyanamid. A new demand that shows promise of important expansion is in the manufacture of an organic refrigerating medium known as "Freon," or "F-12."

Clear, glassy, crystal fluorspar finds employment in various types of optical instrument, such as spectroscopes and microscopes, for correcting colour and spherical aberration of lenses, and similar, coloured fluorspar is sometimes used in jewellery, though the softness of the mineral is a drawback for such purpose. Fluorspar of optical quality is exceedingly rare and commands high prices. Fine crystals were formerly obtained from the Keene mine, near Madoc, Ontario, when this property was operated during the War; the discovery in Siberia of exceptionally large crystals, measuring 4 to 6 inches across, has recently been announced.

GARNET

Commercial garnet belongs to a group of complex silicate minerals of which almandite, the brownish red iron-aluminium silicate, is generally considered the hardest and the best as an abrasive. Garnet, crushed and suitably graded as to size, is used for making abrasive-coated papers and cloths for rather clearly defined special uses in certain manufacturing industries, particularly in the woodworking and shoe leather trades. About 175 tons of prepared garnet, now used yearly in Canada, is being imported as graded grains, there being no Canadian production. Attempts in the past to produce commercial garnet have failed, owing to the existing market being small, to competition from high-quality United States material, and because garnet possessing abrasive efficiency equal to that obtainable in the United States has not as yet been found in sufficient quantity.

During 1937 activity was reported by a few companies. The Damigo Mining Syndicate, Toronto, mined 400 tons of garnet rock and sent 5 tons to Industrial Minerals Laboratories of the Bureau of Mines for concentration tests. It was this property in Ashby Township, 20 miles east of

Bancroft, Ontario, from which 1,250 tons of rough garnet concentrate was shipped in 1923, so far the only commercial shipment of this mineral from Canada. The Canada Garnet Company in 1937 took over the property and assets of the Labelle Mining Inc., in Joly Township, 2 miles southwest of Labelle, Quebec, installing mining equipment and beginning the erection of a concentrator at the close of the year. A small amount of garnet rock was shipped for testing to the Bureau of Mines laboratories by the International Garnet Syndicate, Montreal, from its property, which adjoins that of the Canada Garnet Company. Some prospecting was carried out during the year by A. G. Chew on a garnet deposit northwest of River Valley, near North Bay, Ontario.

About 90 per cent of the world garnet consumption comes from United States, its output in 1936 being only 3,820 short tons. Outside of the North American continent, England is by far the largest individual user, with an estimated annual consumption of less than 800 tons of graded garnet. The quality of this abrasive is gauged by the United States product, so that Canadian garnet must be at least equal in every way to that standard before it can successfully compete. Prices of the best quality concentrate are $85 to $90 a ton.

GRANITE

(Building, Ornamental, and Crushed)

The stone quarried in this industry consists of granite and other related crystalline igneous rocks used for building, decorative, ornamental, or constructional purposes. Producing properties are situated in the Provinces of Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba, and British Columbia.

A large proportion of the granite produced in Canada is used for foundations for highways, for permanent ballasting of railway road beds, for heavy aggregate in large concrete structures, for filling breakwaters and for bridge piers. Owing to heavy curtailment of operations of this nature during the last few years the production of granite for such uses has been seriously affected. The improvement shown in these branches of the industry during the past few years leads one to believe that, although production is still far below the record years, the recovery may be steady.

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

The Province of Quebec furnishes most of the granite for building, the Stanstead, St. Samuel, Lake St. John, and Rivière-à-Pierre districts being the biggest producers of this class of stone. The low ebb of building construction during the past few years has seriously affected this part of the industry.

Prospecting for granite deposits suitable for both building and ornamental use has been active in the Province of Manitoba; no new quarries have as yet been developed although some promising localities are being investigated.

Granite for monumental use is produced in the Maritime Provinces as well as in Quebec, Ontario, Manitoba, and British Columbia, and this material finds a small but steadily increasing market. At the same time there is still an appreciable amount of foreign stone, principally black, being imported for this use, and a quarry of similar material in Canada of equal grade should find a ready market for its product. One company producing black granite near Lake St. John, Quebec, has recently greatly extended its operations and added to its plant by the erection of gang saws and other equipment, and its product has been employed in a number of public buildings and as monumental dies in the Province. There are other deposits of " black granite " at several localities in the Maritime Provinces, Quebec, Ontario, and Manitoba that give promise of yielding stone of good quality, but until these are developed their commercial value will be unknown.

With the large extent of country in Canada underlain by granite, the prospects of finding deposits of stone suitable for the several uses are decidedly promising.

Granite is employed for building construction mainly in the larger buildings such as public and semi-public structures and institutions.

The Canadian production of granite for 1937 was 979,538 tons valued at $1,698,412, as against 941,743 tons valued at $1,319,313 in 1936.

Our exports were 1,234 tons valued at $11,408 (granite and marble unwrought), as against 1,156 tons valued at $8,788 in the previous year.

The imports of granite were valued at $114,935 in 1937, compared with imports valued at $100,122 in 1936.

Small amounts of granite were imported during the year from the United States and Europe for monumental use, but prospecting for similar stone in Canada is active and it is possible that in time the importation will be replaced by Canadian material. Like many other products, the demand for a certain class of stone for monumental use varies, so that a variety of stone that enjoys a steady market for a number of years may in time be completely superseded by an altogether different one. At present the so-called "black granite" and the "grey" seem to be in most demand for monuments.

In the building trade the tendency has been to employ coloured granites to a greater extent than heretofore in the form of thin polished slabs for trim for buildings in which the main colour scheme needs some contrast to relieve it.

The upward turn in the building industry is reflected by an improvement in the granite industry, and the coming year should, therefore, show a continued improvement in the use of dimension stone.

Canadian granites are suitable for all the purposes for which granite is used, and with consistent advertising to enable the Canadian products to become better and more widely known, there is no reason why this industry should not have a promising future.

GRAPHITE

In 1937, as for a number of years past, the entire graphite production continued to come from a single operator, the Black Donald Graphite Company, with mine and mill at Whitefish Lake, 22 miles west of Calabogie, in Renfrew County, Ontario. This is the only concern that has successfully weathered the various vicissitudes that have attended attempts at graphite production in Canada, and now has a record of about 28 years operation. The deposit is of exceptional size and richness, and although the graphite flakes are too small to be suitable for crucible use, the products made are well adapted for lubricants and foundry facings. In recent years, the highest grade has been successfully employed in pencil manufacture, being exported to the United States and there reduced to the requisite degree of fineness in a new type of impact pulverizer using high-pressure dry steam. All other graphite mines and mills established at various times in Ontario and Quebec have been inactive for many years and the plants have in most cases been dismantled.

Samples of graphite ore, some of them high-grade, from newly discovered deposits are occasionally brought to the attention of the Bureau of Mines, but in view of the many adverse factors to profitable operation of graphite deposits on the North American continent at the present time, little encouragement can reasonably be given to the investment of capital in such enterprises. The situation in this country is essentially similar to that in the United States, where, despite the fact that large known reserves of graphite exist in a number of States, attempts over an extended period to mine and process the graphite for domestic consumption have led to a succession of failures, and that Country has for a number of years past relied almost entirely on foreign graphite to fill its requirements for flake and crystalline (plumbago) grades. These are obtained mainly from Madagascar and Ceylon, respectively, countries that can lay down graphite on this continent at prices that render domestic production difficult, if not impossible. American supplies of amorphous graphite are derived mainly from Mexico and Chosen (Korea), where ample material is available. The economic considerations affecting graphite mining in the United States apply even more strongly to Canada, where climatic conditions impose added production difficulties, and where the hard, unweathered character of the graphite renders milling and refining more costly. In addition, many makers of crucibles in the United States have developed a preference for Madagascar flake graphite, claiming that it is superior to either the American or Canadian product.

The production of Canadian graphite in 1937 was valued at $125,776, compared with $88,812 in 1936; an increase of over 41 per cent; tonnage figures are not available.

Graphite exports, including both natural and artificial, for 1937 totalled 2,948 tons valued at $133,262, compared with 3,384 tons valued at $138,454 in 1936. Total graphite imports including ground, unground and manufactures of, but exclusive of crucibles, were valued at $177,166 in 1937 and $131,913 in 1936.

According to a report received by the Bureau, flake graphite prices continued throughout 1937 on the abnormally low levels obtaining over the previous five years, owing to keen competition among Madagascar producers; demand was sluggish throughout the year. Ceylon crystalline plumbago was in fairly active demand until the end of the year, when the general business slump in the United States reduced sales to a minimum; prices remained low during the first six months with a slight advance at mid-year on grades that had been sold out at mines or export points. The following figures, taken from trade journals, indicate the general price level for the various commercial grades at the end of the year, all f.o.b. New York; Ceylon lump 7 cents per pound, Ceylon chip 5½ cents, Ceylon dust 3½ cents; Madagascar No. 1 flake 9½ to 17 cents per pound, No. 2 flake 7 cents, ground 3 cents; crude amorphous $12 to $23 per ton according to grade, ground 3 cents per pound.

There were no important changes during the year in the world graphite industry. Following the general progress of industrial recovery, total production and consumption in 1937 will probably show a still further increase over the improvement registered in 1936. As far as the American continent is concerned, Madagascar and Ceylon continue to dominate the field as sources of flake graphite and crystalline plumbago, respectively, for the crucible trade, and of lower grade dusts for foundry work. Mexico and Chosen furnish most of the amorphous graphite used in pencils, dry batteries and commutator brushes. Artificial graphite, made in the electric furnace, is now being used more and more extensively in dry battery manufacture and is also employed in liquid lubricants and electrodes; the product is competing to an increasing extent with the better grades of natural amorphous graphite. A recent estimate of the consumption of natural graphite in the United States, by industries, shows roughly 20 per cent in crucibles, 40 per cent in general foundry work, 15 per cent in pencils and crayons, 15 per cent in lubricants, and 10 per cent in paints, stove polish and miscellaneous uses. The amount of graphite used in crucibles, once the largest outlet for high-grade flakes, has shown a large decrease in recent years, owing to the longer life of pots resulting from improved methods of manufacture, notably the addition to the mixtures of refractory silicon carbide. A recent technical development is the use of colloidal graphite for protecting metal surfaces, whereby the graphite in suspension is made to adhere to the metal by attraction; after heating, the metal-graphite bond is said to be so strong that the surface will resist corrosion and abrasion to a high degree.

GRINDSTONES, PULPSTONES, AND SCYTHESTONES

Grindstones. Although no actual quarrying was carried out during the year by the Read Stone Company, Sackville, N.B., stones were made up from material quarried in previous years. Most of the grindstones came from near Stonehaven on the Bay of Chaleur, N.B., and a few from Quarry Island, Pictou County, N.S. The output was about 33 per cent less than in 1936. The Wallace Sandstones Quarries, Wallace, Cumberland County, N.S., produced about 42 tons of stones; the first production of grindstones from this quarry. The total grindstone sales amounted to 293 tons valued at $14,507, against 360 tons ($15,325) in 1936.

Pulpstones. The J. A. and C. H. McDonald Company, Vancouver, continued to work the quarry on the northwest end of Gabriola Island, near Nanaimo, Vancouver Island, B.C., the output being the same as that of the previous year.

Scythestones. The output of these stones, which are quarried by the Read Stone Company, Stonehaven, and G. A. Smith, Shediac, N.B., amounted to 74 tons valued at $4,147, against 129 tons ($4,872) in 1936.

The production of all grades of stone in 1937 was 455 tons valued at $23,525; in the previous year the production was 576 tons valued at $24,697. The exports of these stones in 1937 were valued at $135 as against a valuation of $1,688 in the previous year. The imports, which consisted chiefly of pulpstones, were valued at $185,358, as against $136,335 in the previous year.

Canadian grindstones are valued at $50 per ton, and pulpstones at $57 per ton at the quarries.

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

There is a demand for good pulpstones, particularly for use in the large magazine grinders, but as deposits containing thick beds of the proper quality sandstone are very scarce in Canada, only about 1 per cent of the stones used in Canadian pulp mills is being produced in the Dominion.

The artificial pulpstones made of silicon carbide segments and also more recently of fused alumina segments are gradually but surely replacing the natural stone. Approximately 300 of these stones are now in use in Canadian mills.

GYPSUM

The materials produced are the hydrous calcium sulphate, commonly known as gypsum, the partly dehydrated material known as plaster of Paris or wall plaster, and the anhydrous calcium sulphate known as anhydrite. Gypsum is marketed in the crude lump form, ground as "land plaster" and "terra alba", or ground and calcined as plaster of Paris and wall plaster. Each year an increasing proportion of the calcined material enters into the manufacture of wall-board, gypsum blocks, insulating material, acoustic plaster, etc. Anhydrite is used mainly as a fertilizer for the peanut crop in the Atlantic seaboard states of the southern United States.

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

The several large companies operating in Canada increased their production in 1937 and although their sales during the year were still below those of the peak years, a decided improvement was shown over 1936.

In Nova Scotia, the National Gypsum Company of Buffalo, N.Y., throughout the year maintained its shipments from its Cheticamp and Dingwall properties to London, England. An interesting feature was the shipment of 2,500 tons of anhydrite from Dingwall to the Imperial Chemical

Industries in England. This is the first big shipment of anhydrite from Canada for purposes other than use on peanut plantations in the United States.

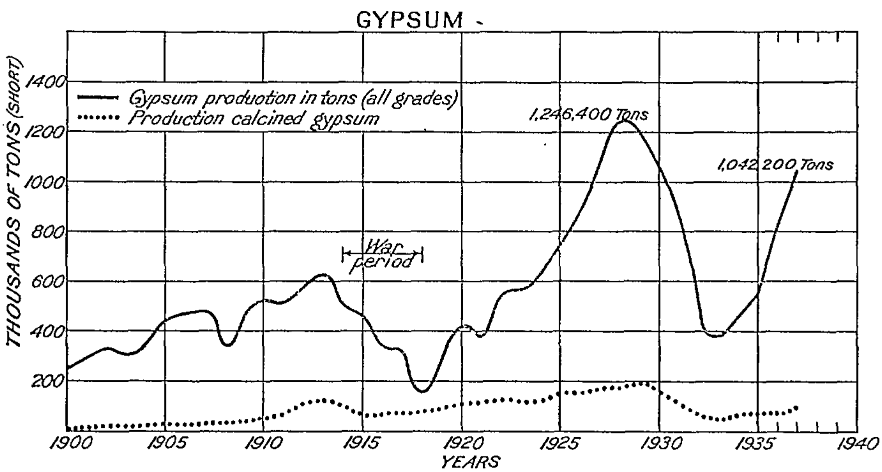
A new company, the St. Andrews (N.S.) Gypsum Company, Limited, was incorporated under Nova Scotia charter on July 26, 1937, with the hope that its property at Boulardarie, N.S., will be developed and put on a producing basis during 1938.

Extensive deposits are known in northern Ontario that in years to come may be called upon to supply material to the northern parts of Ontario and Quebec.

Deposits in northern Alberta, although distant from markets and railway, are of good grade. Several deposits are known in British Columbia, in addition to those already being worked, and may be operated when conditions warrant.

The Summit Lime Works of Lethbridge, Alta., continued the manufacture of hardwall plaster, obtaining the raw gypsum from its deposit at Bull River in British Columbia.

The plants of the Gypsum, Lime and Alabastine, Canada, Limited, at New Westminster, British Columbia, and Calgary, Alberta, were supplied with raw material from the Company's deposit at Falkland, B.C.



Gypsum production in Canada, 1900-1937.

The use of anhydrite in England for the manufacture of sulphuric acid, ammonium sulphate, and special plasters is rapidly increasing, and the shipment of 2,500 tons of anhydrite during the past year, marks the entry of Canada into this market. Canada is fortunate in having extensive deposits favourably situated for commercial exploitation, the material from which has been proved by tests carried out by the Department of Mines and Resources to be of excellent grade. Previous to 1937 the small production of anhydrite in Canada was exported, principally as a fertilizer for the peanut crop, but when conditions warrant, it may well be that an industry will be started in this country in which our anhydrite may be used for the manufacture of special plasters, similar to the material now being marketed in England.

The production of gypsum in 1937 was 1,042,239 tons valued at $1,536,587 as against 833,822 tons valued at $1,278,971 in 1936.

The exports amounted to 842,425 tons valued at $990,263 as against 651,129 tons valued at $775,290 in 1936.

The imports were 1,769 tons valued at $40,642 compared with 1,170 tons valued at $29,359 in 1936.

The upward trend in the building industry, an industry that usually lags from six months to a year behind any general improvement of business conditions, has not developed as fast as might be expected from the general business improvement in Canada. The gypsum industry, which is entirely dependent on the building industry, has therefore not shown so rapid a rate of increase as some of the other industries, nevertheless the improvement in the past four years has been definite and steady each year, that in 1937 being quite marked.

The production curve of gypsum in Canada shows a comparatively steady increase until 1907, when the depression in the United States led to the falling-off of gypsum shipments. Increased production is again manifest up to the War years, but the greatest decline in the curve does not take place until the United States entered the War in 1917. From 1919, with the exception of a slight falling-off in 1921, the rise is rapid, until 1929, when an all-time peak production was recorded. With the start of the depression in the latter part of 1929 the fall in production of gypsum in Canada was rapid and reached its lowest in 1933, after which the upward swing again commenced. Probably the production curve for calcined gypsum gives a truer picture of the gypsum industry in Canada, because this represents the greater part of the total production that is consumed in the country. This rises steadily until the War years when the drop was rapid, reaching its lowest point in 1915 just after the War started, and it remained almost stationary for several years. The rise from 1919 to 1929 was gradual but steady, falling off again gradually as the result of the depression became more manifest. The upward trend for the past four years is small but definite.

The use of gypsum products in the building grades has made rapid progress in past years because of their lightness, durability, fire-resisting, insulating and acoustic properties; and tiles, wall-boards, blocks, and special insulating and acoustic plasters have been developed. With the larger proportion of the crude gypsum quarried in Canada being shipped to the United States for the manufacture of gypsum products, industrial conditions in that country have an important bearing on the industry.

IRON OXIDES (MINERAL PIGMENTS)

Ochreous iron oxide, sold uncalcined and used chiefly in the purification of illuminating gas, constitutes the major production of the minerals classed under this title. The calcined form of ochreous iron oxide is also produced for use 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 also produced in both the raw and calcined state, for use as pigments in paint manufacture.

The major part of the production has for many years come from the vicinity of Three Rivers, Quebec, at Red Mill and Pointe du Lac. Two other deposits, one in Marchand Township, Labelle County, and the other near Almaville, Lake St. John District, have been under development recently. The deposits in Marchand Township, near Lacoste, is being equipped with a mill and may be in commercial production during 1938.

Other deposits in Quebec, worked in the past, are near Ste. Anne de Beaupré, and at Les Forges, near Three Rivers. In Lynch Township, Labelle County, and at St. Raymond, in Portneuf County, are other deposits, which at one time had been worked.

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

There were no important developments during 1937. The industry is a comparatively small one, and the quantity produced varies but little from year to year. The present producing localities have met the requirements of the domestic pigment trade for the cheaper grades for many years past. Other prospective deposits could be drawn upon in Quebec and Ontario, if the market demand warranted their development. In Nova Scotia, various beds of ochres and umbers have been worked in the past to a small extent, and in Alberta and Saskatchewan several deposits of ochre are known, some of which have commercial possibilities, but owing to their present inaccessibility and to the limited market, have had little development. For similar reasons, large deposits of ochre that have been reported from the vicinity of Grand Rapids and Cedar Lake in northern Manitoba have not yet been developed. In Saskatchewan, several deposits of ochres and iron oxides await development.

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 1937 totalled 6,197 tons valued at $83,640, as compared with 5,854 tons valued at $69,629 in the previous year. The production during the past ten years has averaged practically 6,000 tons per year.

Our exports of mineral pigments are stated to have been 1,755 tons valued at $105,240 in 1937, as against 1,572 tons valued at $92,011 in 1936. Imports of all kinds of ochres, siennas, and umbers totalled 1,623 tons and were valued at $56,084 in 1937; in the previous year the total combined weights amounted to 1,506 tons valued at $49,750. In addition there were imported prepared oxides, fillers, and related products, some of which were probably not ochres, valued at $844,149 as against a valuation of $721,614 in 1936.

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

KAOLIN (CHINA CLAY) AND BALL CLAY

China clay has been produced commercially in Canada only from the vicinity of St. Remi d'Amherst, Papineau County, Quebec.

A group of open pits and mines was operated for several years prior to 1923. The property remained idle until 1937 when, under new management, a shaft was sunk into the kaolinized quartzite deposit to a depth of 200 feet. A mill is being installed for the production of washed china clay and washed silica.

In 1931, a nearby property was developed, mainly for the production of silica, but a small amount of china clay has also been produced.

Deposits of high-grade, white-burning clays occur on Mattagami, Abitibi, and Missinaibi Rivers in northern Ontario. Some of these clays may be classed as ball clays and others as china clays. For several years a number of these have attracted attention, but as yet no production has resulted.

An undeveloped deposit of white-burning clay occurs on Punk Island, Lake Winnipeg, Manitoba.

Ball clays of high bond strength occur in extensive deposits in southern Saskatchewan, about 60 miles south of Moose Jaw. Shipments have been made from the vicinity of Readlyn and Willows to potteries in Ontario and the United States.

Near Williams Lake, British Columbia, is a deposit referred to in the "Report of the Minister of Mines of British Columbia for 1926" as consisting of "silicate of alumina." This material, if not a true kaolin, is similar to it. Some trial shipments were sent to Vancouver where the material was used as a fireclay.

No production of china clay has been reported for the years 1936 and 1937.

The exports of clays, chiefly ball clays, in 1937 are reported to have been 1,320 cwt., valued at $3,111; in the previous year the exports were 3,297 cwt., valued at $2,600. The imports of china clay were 1,103,891 cwt., valued at $445,073; in the previous year the imports were 833,807 cwt., valued at $342,654.

There is a large steady demand for various grades of china clay in Canada, for use in the manufacture of paper and rubber as well as in the ceramic industry.

Ball clays are used in the ceramic industry as a bonding clay in the manufacture of porcelain and similar compounded bodies. While the market in Canada is not large, it is growing and there are also good prospects of developing a profitable export market in the United States.

LIME

Owing almost entirely to increased demand for chemical and metallurgical uses, the lime industry in 1937 achieved the second highest production of all time. Well over 80 per cent of the total lime production is now used chemically and the old conception of lime as being primarily a structural material is no longer true.

Lime is marketed in the form of quicklime and in the hydrated state, the latter being a specially prepared slaked lime in the form of fine powder and marketed in 50-pound, multi-wall paper bags. Quicklime, which comprises about 80 per cent of the total sales, is marketed in the lump, pebble, crushed, and pulverized forms. Lump lime and pebble lime are sold either in bulk or 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.

Lime is manufactured in every province except Prince Edward Island, though the Saskatchewan production is intermittent and very small. Fifty-four plants were in operation during 1937. Both high-calcium and dolomitic limes are produced in Nova Scotia, New Brunswick, Ontario, and Manitoba, but only high-calcium lime is made in Quebec, Alberta, and British Columbia. Ontario is the leading lime-producing province and supplies about one-half of the total output, and Quebec comes next with slightly more than one-third of the total production.

Consequent upon the increased demand for lime, additional equipment was installed by several lime producers, and investigations were made with a view to building new lime plants in several localities. Among the deposits investigated was the high-calcium limestone deposit at Coral Rapids on the Temiskaming and Northern Ontario Railway, 98 miles north of Cochrane, Ontario.

Companies incorporated during 1937 to engage in the manufacture or marketing of lime include:

Industrial Lime Products, Limited, Vancouver.
Adhesive Lime Limited, Montreal.
Adhesive Lime Manufacturing Company, Limited, Montreal.

The two last-named companies are engaging in the manufacture of a patented hydrated lime for use in the construction industry.

A development that is providing a large new market for Canadian lime is the use of calcium carbonate filler in place of imported clay in newsprint and magazine paper. The manufacture of this new filler from high-calcium quicklime was begun in Canada in 1937.

Aged lime putty and lime mortar for use in construction has been marketed in Canada for a number of years but a greatly increased interest has been taken lately in these products and preparations are being made to market them in a number of cities.

Lime production in 1937 amounted to 463,903 tons of quicklime valued at $3,436,326; and 82,768 tons of hydrated lime valued at $572,174, which represents a substantial increase over the 1936 production of 391,499 tons of quicklime valued at $2,789,972 and 76,902 tons of hydrated lime valued at $545,998.

Exports of lime amounted to 10,373 tons valued at $85,489 as compared with 11,666 tons valued at $97,574 in 1936. Imports, which are all from the United States, amounted to 5,661 tons valued at $41,417, as compared with 1,495 tons valued at $18,070 in 1936, according to data supplied by the United States Bureau of Mines.

Prices of lime vary over a wide range owing to differences in quality of the lime and to the geographical location of the plants. In general, however, during 1937 there was a tendency toward firmer prices for lime in most parts of the Dominion, largely due to the rising costs of manufacture.

The outlook for the lime industry is promising because of the increasing number of uses for lime, and because of the increase in lime-using industries in Canada. The feasibility of recovering the carbon dioxide gas resulting from the calcination of lime, now allowed to go to waste in most commercial lime plants, is engaging the attention of lime manufacturers. According to the January 1938 issue of Mining and Metallurgy (page 59) a lime company in Australia is producing both liquid and solid carbon dioxide as by-products. In the process the kiln gases are passed through absorption towers where they come in contact with a solution of potassium carbonate, with which the carbon dioxide unites to form potassium bicarbonate. When the latter is heated to 80° C. it decomposes and sets the carbon dioxide free and the potassium carbonate is returned to the absorption tower. This method is quite in contrast to the more common method of calcining the limestone in that the carbon dioxide is not contaminated with fuel gases.

LIMESTONE (GENERAL)

Limestone, which, on account of the great variety and importance of its industrial uses is the most useful of all rocks, is quarried in all provinces of Canada except Prince Edward Island and Saskatchewan, and the current production for all purposes, including the manufacture of lime and cement, constitutes about 87 per cent of the total Canadian stone production. The greater part of the production comes from Ontario and Quebec.

It is marketed in a variety of forms ranging from large squared blocks of dimension stone for use in construction, to extremely fine dust used chiefly as a mineral filler. The bulk of the output, however, is crushed and screened for use as road metal, concrete aggregate, railroad ballast, and as flux in metallurgical plants. Large quantities are also marketed in the crude or broken state for use in chemical and metallurgical industries.

A number of new limestone quarries were opened in 1937, and several quarries that had been idle for some time were reopened. International Lime Corporation, Limited, Vancouver, began shipment of chemical limestone to the United States from Nelson Island at the mouth of Jervis Inlet, about 70 miles northwest of Vancouver. The Consolidated Mining and Smelting Company of Canada, Limited began underground mining of limestone for use as flux from its property near Procter, British Columbia.

The Canadian rock wool industry, which utilizes shaly dolomite in the manufacture of its various products, expanded considerably in 1937 and further expansion is in prospect for the present year. Shipments of Canadian rock wool were made to England and Sweden.

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

The 1937 production of limestone for general use, exclusive of that used for building stone, lime, and cement, is estimated at 5,190,000 tons valued at $3,990,000, compared with a production of 3,704,451 tons valued at $2,894,859 in 1936. The production for all purposes in 1937 is estimated at 7,700,000 tons. The increased production was largely from quarries in Ontario and Quebec and was due in large part to an increased demand for limestone for road construction, railway ballast, and for use in chemical and metallurgical industries.

Exports and imports of limestone are not separately recorded. Exports are comparatively small and consist chiefly of limestone for use in sugar refineries and in agriculture in the United States. Imports, however, are comparatively large and consist of limestone from the United States and Newfoundland for use as blast furnace flux, and from the United States for use in pulp mills in northern Ontario. These imports are not because of a lack of suitable limestone in Canada, but because the foreign limestone can be obtained more cheaply at certain consuming centres than can the domestic limestone.

LIMESTONE (STRUCTURAL)

The principal quarries from which limestone in blocks of large dimensions for building purposes is obtained are in Quebec, Ontario, and Manitoba. In Quebec there are three quarries at St. Marc des Carrieres producing grey limestone, and at Montreal several quarries producing a limestone of similar colour. In Ontario a large quarry near Queenston in the Niagara Peninsula produces silver-grey limestone together with small quantities of buff and of variegated buff-and-grey; and at Longford Mills buff, silver-grey, and brown limestone for use both as marble and building stone is produced. The Manitoba quarries, three in number, are at Garson near Tyndall and yield mottled grey, mottled buff, and mottled variegated limestone. In addition limestone quarries producing small quantities of building stone (chiefly rubble) for local use are worked near Quebec city and Hull in the Province of Quebec; and at Ottawa, Kingston, Erin, and Wiarton in Ontario.

Some of the quarry companies market stone in all stages of manufacture from the mill block to elaborately carved material. Other companies 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.

Longford Quarries, Limited is now marketing a brown limestone from its quarry at Longford Mills, Ontario, in addition to the buff and grey varieties previously mentioned. A portable crushing plant was added to the equipment at this quarry to crush waste stone for road metal and for other uses.

The production of limestone for building purposes in 1937 shows a substantial increase over the production of 26,997 tons valued at $249,013 in the previous year, though only incomplete data are as yet available. This increase was largely from quarries in Ontario and Quebec, there being little change in the production of the Manitoba quarries as compared with that in 1936. The above data on production refer only to stone marketed either in mill blocks or in the finished state by the quarry companies, and the value of the work done on the stone by cut-stone contractors is not included.

Exports of building limestone are very small and are not separately recorded. Imports of all varieties of building stone, excepting marble and granite, during 1937, were valued at $43,272 as compared with imports valued at $33,124 in 1936.

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

LITHIUM MINERALS

The principal commercial lithium ores are amblygonite, a fluophosphate of lithium and aluminium; spodumene, a silicate of these two elements; and lepidolite, or lithia mica, also a silicate. The lithia content of these minerals, as mined, commonly ranges from around 8 to 9 per cent for amblygonite, 4 to 7 per cent for spodumene, and 3 to 5 per cent for lepidolite. The minerals triphylite and lithiophilite, respectively phosphates of lithium with either iron or manganese and carrying theoretical contents of lithia as high as 8 to 9 per cent, are also classed as lithium ores; they, however, are rarely met in commercial quantities and, in addition, have often lost a large proportion of their original lithia by natural leaching.

All the above minerals are known to occur in Canada, but there has as yet been only a small production, mainly of lepidolite and spodumene. The important deposits are all in Manitoba, chiefly in the Pointe du Bois region, in the southeastern part of the Province, where a number of lithium-bearing pegmatites have been located. The first discoveries were made in 1925, and intermittent mining and development have been undertaken at various times, most of it conducted on the Silver Leaf property (the original discovery), on the south side of Winnipeg River, and on the Buck claims at Bernic Lake, between Winnipeg and Bird Rivers. From the Silver Leaf mine, a couple of trial cars of lepidolite and spodumene were shipped between 1925 and 1928, but little further work has been done.

At Bernic Lake, a number of outcrops of lithium minerals were found in 1930 during prospecting for tin, and about 100 tons of spodumene and 50 tons of amblygonite were mined and stock-piled. The Lithium Corporation of Canada, 403 Avenue Building, Winnipeg, which controls the deposits, reports having conducted diamond drilling of the property during 1936, in order to determine the thickness of a number of pegmatite dykes located on surface. Indications point to these dykes having the character of comparatively thin, flat-dipping sills, carrying local zones rich in amblygonite, spodumene and lithiophilite. The company reports that some further mining was conducted in the winter of 1936-37 on the Buck claim, 600 tons of rock being raised, which yielded 50 tons of clean, cobbed amblygonite and 30 tons of mixed rock containing about 50 per cent amblygonite, as well as small amounts of spodumene and triphylite. A shipment of 32 tons of amblygonite, averaging 7·9 per cent Li_2O, was made to the Maywood Chemical Company, Maywood, N.J., in 1937, and a slightly lesser quantity was hauled out to rail at Pointe du Bois before the spring breakup. Lithium Corporation also reports having acquired control of lithium deposits at Cat Lake, north of the Bird River, where important amounts of spodumene occur.

Some interest has been shown in deposits of spodumene on the Kobar claims, at Wekusko Lake, near Mile 81 on the Hudson Bay Railway, in northern Manitoba, from which a shipment of rock was sent to the Ore Dressing Division of the Bureau of Mines in 1936 for concentration tests. The material was treated by the new decrepitation method developed by the United States Bureau of Mines for the separation of spodumene from admixed minerals and yielded a concentrate with 6·13 per cent Li_2O content, with a recovery of 90·44 per cent.

During the year, a discovery of spodumene was reported near Falcon Lake, 85 miles east of Winnipeg, and 1½ miles from a siding of the Greater Winnipeg Water District Railway. The deposit is stated to carry rich concentrations of spodumene, and on account of closeness to both highway and railroad, to offer much lower production and delivery costs than other known Manitoba deposits, most of which have considerable transportation obstacles to overcome.

Most of the present world supply of lithium minerals is drawn from deposits in the United States, Southwest Africa, and France. In the United States, there has long been an important production of spodumene, and of smaller amounts of both amblygonite and lepidolite, from deposits in the Black Hills, in South Dakota; lepidolite has also been mined extensively in California and New Mexico. The newly discovered spodumene deposits in North Carolina are regarded as one of the world's largest potential sources of supply of lithium: development of the deposits has already begun. Total production of lithium ores in the United States in 1936 was 1,239 tons. Production in Southwest Africa is increasing, the output for the first nine months of 1937 being reported as 1,100 tons, of which 990 tons was lepidolite and 110 tons amblygonite: the material was consigned to England, France, and Germany. Portugal was formerly an important producer, but output has declined severely since 1933, when 870 tons were shipped. Germany has obtained supplies from the tin-bearing greisen rock of the Erzgebirge, in Saxony, the mineral used being the lithium mica zinnwaldite.

Trade journal quotations for lithium minerals in the United States at the end of 1937 were as follows: amblygonite, 8 to 9 per cent Li_2O, $35 per ton; lepidolite, $20 to $25; spodumene, 6 per cent Li_2O, $30 per ton, all f.o.b. mines.

Up to the present, the sole outlet for lithium minerals has been for the production of lithium chemicals and metal, with lepidolite used also as a constituent of the batch in certain types of glass. The treatment of lithium ores is in the hands of a few important concerns, with plants in England, France, Germany, and the United States, respectively. The present interest in ceramic outlets for spodumene shows promise of a substantial increase in demand for this mineral and may provide the needed encouragement for development of the important deposits existing in Manitoba.

Lithium minerals serve as the raw material for the manufacture of lithium chemicals and lithium metal and alloys. Lepidolite, which contains relatively low percentages of lithium, is also used as an ingredient of certain glasses, particularly those of the heat-resistant (Pyrex) variety. The lithium chemicals trade is a comparatively small industry, and the world consumption of lithium salts has shown little expansion over a period of years. Some interest is currently being shown in the use of lithium chloride as a drying agent in air-conditioning, the compound being one of the most hygroscopic inorganic compounds known: the growing application of air-conditioning may lead to an increased demand for lithium minerals for the manufacture of this salt. In this connection, a method recently devised by the United States Bureau of Mines for recovering the lithium of spodumene in the form of the chloride by volatilization from a charge of the mineral with calcium chloride and limestone, may have important application. The development of a new refrigerant employing lithium nitrate and ammonia has also recently been announced. A recent development is the perfection of a process for making lithium fluoride in the form of single crystals having valuable optical properties.

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

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

MAGNESITE

No magnesite, within the strict meaning of the term, is produced in Canada at the present time, but deposits of magnesitic dolomite consisting of an intimate mixture of magnesite and dolomite are quarried at Kilmar and Harrington East, in Argenteuil County, Quebec, and are processed for use as refractory materials. For many uses these magnesitic dolomite products have proved more suitable than those made from magnesite. Products at present marketed include caustic-calcined magnesitic dolomite, dead-burned or grain material, bricks and shapes (both burned and unburned), finely ground refractory cements, and, in combination with chrome, the dead-burned material is used as an ingredient in certain other types of refractories. Caustic-calcined magnesitic dolomite is used for fettling the bottoms of basic open-hearth furnaces, and for the construction of floors and the making of floor tile.

The Quebec deposits are the only deposits of magnesitic dolomite, or of magnesite of commercial grade, known in the eastern part of North America, and consequently are favourably situated to supply the large markets for refractory products in Eastern Canada and the Eastern United States.

Magnesia products made in Canada from imported magnesite include fused magnesia (artificial periclase), optical periclase, and "85 per cent magnesia" pipe covering.

Important developments in the magnesitic-dolomite industry during 1937 included the change-over from open pit quarrying to underground mining by Canadian Refractories, Limited, and also the installation of a modern, high-temperature tunnel kiln by the same Company for the making of basic brick. Further progress was made in the development of new refractory products, particularly those having a higher lime-content than heretofore, and several of these products were placed on the market. Production of chemically-bonded unburned bricks and shapes for lining cement kilns, lime kilns, and metallurgical furnaces was greatly increased, and licences were issued to several companies outside Canada to manufacture certain refractory products developed by Canadian Refractories, Limited. Export markets for magnesitic dolomite products have also widened to include Australia and South Africa as well as Great Britain and the United States.

Large deposits of magnesite containing considerable silica and alumina occur in British Columbia, near Marysville, which is between Cranbrook and Kimberley. These deposits have been acquired by Consolidated Mining and Smelting Company of Canada, Limited and some development and experimental work 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 the present time.

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

Brucite (hydrated magnesium oxide) is found in small quantity as an alteration product of serpentine in the asbestos-producing districts of the Eastern Townships of Quebec, and small quantities obtained in connection with the quarrying of asbestos have been exported to the United States. A deposit of Precambrian dolomite containing crystals of brucite and pyroaurite disseminated through it has recently been found near Mattawa, Ontario.

Magnesitic dolomite products having a value of $677,207 were marketed in 1937. This represents a decrease of $91,535 from the value of the 1936 production. Exports of magnesitic dolomite products are recorded as 2,028 tons valued at $49,401 as compared with 2,928 tons valued at $71,183 in the previous year, and imports of magnesite brick, caustic and dead-burned magnesite, crude and ground magnesite were valued at $724,338 as compared with the 1936 valuation of $626,351 on the same products.

Recent trends in the making of magnesia refractories have been toward incorporating a greater proportion of lime, with the proviso that a suitable ratio must be maintained between the acidic and basic constituents so that no chemically active lime remains in the product. This development has now been carried to the point where, with the presence of certain stabilizing agents, it is possible to make highly effective refractories from dolomite and silica, or even from calcium limestone and silica. These new products, on account of the low cost of the raw materials, can be made much more cheaply than can the corresponding magnesitic products and their development bids fair to have a major effect on the production of refractories made from magnesite and magnesitic dolomite.

Competing with magnesite as sources of magnesia products are dolomite, brucite, and sea water. Dolomite, in addition to its newly discovered possibilities for the making of refractories, has long been the principal source of basic magnesium carbonate, pure magnesium oxide, and magnesium carbonate, and processes have been worked out for the production of magnesium metal from this mineral. Brucite is being quarried in the United States for the manufacture of refractories. The extraction of magnesia from sea water has now reached the commercial stage in California and England, the material so obtained is now marketed in various forms for industrial and pharmaceutical uses, and is also being converted into refractory products.

Interest in magnesite deposits has been greatly stimulated by the world-wide demand for magnesium metal. Although until two years ago almost the entire production of magnesium was from magnesium chloride brine and from the waste water of potash deposits, magnesite is now an important source of this light metal.

MAGNESIUM SULPHATE

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

Columbia and experimental shipments from one of the lakes in Saskatchewan. In 1933 a small experimental plant was erected at Ashcroft, B.C., to treat the crude salts recovered from deposits at Basque, B.C.

Epsom Refineries, Limited, the company operating this deposit, has remodelled and enlarged its plant at Ashcroft, the productive capacity being approximately 10 tons per day. Its product is marketed, principally, in the tanning and medicinal industries.

The production in 1937 was 727 tons valued at $14,456, as against 654 tons valued at $13,712 in 1936.

The imports in 1937 were 1,678 tons valued at $33,116, as against 1,790 tons valued at $37,928 in the previous year.

MARBLE

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

In Quebec, four varieties of clouded grey marble, some of which are tinted and lined with green, and also black marble, are quarried at Phillipsburg. This quarry was formerly worked by Wallace Sandstone Quarries, Limited, but late in 1937 it was purchased by Missisquoi Stone and Marble Company, Limited, under which name the quarry will be operated in future. Trenton limestone quarried for building stone at St. Marc des Carrieres, takes a good polish and yields a brown marble, and some is so used. White dolomitic marble is quarried and crushed by White Grit Company at Portage du Fort, Pontiac County, and by Canada Marble and Lime Company at L'Annonciation, Labelle County, for the making of terrazzo chips, stucco dash, poultry grit, artificial stone, and for chemical uses. A small quantity of dry red marble is quarried, chiefly for use as tombstones, at Cap St. Martin near Montreal.

In Ontario, black marble is quarried at St. Albert, near Ottawa, by Silvertone Black Marble Quarries, Limited. At Longford, near Orillia, Longford Quarries, Limited is producing buff and silver grey marbles, and in 1938 will be marketing a brown marble; the stone from this quarry is also used for building and for sculpture. At Bancroft, Hastings County, a number of handsomely coloured marbles are available, the most striking of which, known as Bancroft Laurentian, is a clouded-grey breccia with a rich chocolate-coloured bond. The Bancroft Quarries, producing marble in block form, are operated by Rock Construction Company, Limited, Toronto. In 1937 a new company, American Marble Company, Limited, Toronto, commenced production of terrazzo chips at Bancroft and is marketing red, black, buff, green, and white chips; the crushing and screening plant has a capacity of 50 tons per day. White marble is quarried at Marmora by Bonter Marble and Calcium Company, Limited, and at Haliburton by Bolender Brothers for terrazzo chips, poultry grit, stucco dash, and artificial stone. In 1937, Bonter Marble & Calcium Company also began the production of white marble in block form. Buff, red, white, green, and black marbles are quarried near Eldorado, Hastings County, by Karl Stocklosar, Madoc, for use as terrazzo.

In Manitoba, a number of highly coloured marbles are available, but at the present time there is only a very small production for use as terrazzo chips and as building rubble.

In Alberta, deposits of calcareous tufa near Calgary are quarried for terrazzo chips, and in 1937 equipment was installed by E. J. Couch, Calgary, to quarry this tufa in block form for sawing into slabs.

In British Columbia there are many deposits of marble but there is only a small production at the present time. Canadian Marble and Granite Works, Limited operates a quarry at La Blanche station on the Lardeau branch of the Canadian Pacific Railway, where a bluish grey marble for the making of monuments is obtained. Small quantities of white marble are quarried near Victoria and on Texada Island for the production of terrazzo, poultry grit, and marble sand.

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

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

The production of marble during 1937 amounted to 20,965 tons valued at $86,248, compared with the production of 22,866 tons valued at $169,698 in 1936.

Exports of marble are recorded with exports of granite and the exports of the two during 1937 amounted to 1,234 tons valued at $11,408, as compared with exports of 1,156 tons valued at $8,788 in 1936. Imports of marble during 1937 had a value of $89,263, against a value of $67,361 in 1936. Current imports of marble are largely in the form of unpolished slabs and in the form of sawn stock for tombstones—the finishing being done in the marble mills throughout Canada. Most of the imports of marble blocks are from the United States, France, Italy, Belgium, and Great Britain, though practically all of that coming from Great Britain originates in other European countries. Within recent years imports of black marble have practically ceased as the Canadian market is now being supplied from domestic quarries, principally from the recently opened marble quarry at St. Albert.

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

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

MICA

The production of sheet mica in Canada is almost wholly of the phlogopite, or amber mica, variety. It is derived almost entirely from adjacent sections of Ontario and Quebec, within an area extending roughly from Kingston, on Lake Ontario, northeastward into Hull and Papineau Counties, Que. The mica-bearing series (pyroxenites) is probably continuous throughout this entire region, but is hidden for some distance south of the Ottawa River by a belt of later sedimentary rocks. In Quebec, the pyroxenites extend also for some distance both west and east of the main productive area, into Pontiac and Argenteuil Counties, respectively, but production from these districts has been comparatively small. A few scattered amber mica occurrences are also known in the Province as far east as Quebec city, but very little mining has been conducted on them.

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

Mica mining in Canada has been at a low ebb for a number of years past, production being restricted to a few major operators working old, established mines. This has been in marked contrast to the situation in the earlier days of the industry, when considerable contributions were made to the total output by farmers and others who worked small mines on their properties during the off-season. The demand for phlogopite mica, which had shown an encouraging upward trend in 1936, continued active during the year, particularly for knife-trimmed larger sizes, and this interest led to a revival of small-scale mining on a number of scattered properties, most of them in Quebec. Some operations, mostly prospecting, were also reported on muscovite deposits in the Saguenay region, on the lower St. Lawrence, Quebec, and a small production of this class of mica came from a deposit in Ryerson Township, near Burk's Falls, Parry Sound District, Ontario. The improved demand also led to a reopening of trimming and splitting shops in Quebec Province, including that of the Loughborough Mining Company (General Electric Company) at Sorel; some of these worked on stocks on hand from previous years. While some of the dealers engaged in trimming and splitting operate central establishments, there was also a considerable amount of farming out of the work in the smaller rural communities, the labour being performed mostly by girls working at home. A small amount of sheet black mica (biotite or lepidomelane) was produced during the year from a deposit in Faraday Township, near Bancroft, Ontario, operated some years ago as a source of grinding scrap for a mill at Bancroft. The mica occurs in very large crystals and considerable quantities are available: it is, however, of poor splitting quality, and having a high iron content, it would presumably be a poor electric insulator. The property is understood to be owned by S. Orser, Verona, Ontario.

Reference has been made in recent reviews (1935 and 1936) to an unusual kind of deposit of fine flake muscovite, or sericite, at Baker Inlet, near Prince Rupert, B.C., the material of which on account of its extremely friable nature and ease of grinding, should prove eminently suitable for the production of mica powder. The deposit is controlled by P. M. Ray, 23 Besner Block, Prince Rupert, who reports further development during the year. About 100 tons of crude material has been mined to date, of which 70 tons was shipped to Vancouver for grinding and use in roofing during 1937. The ground product is stated to have sold for $55.50 per ton, f.o.b. Vancouver. Small trial shipments have also been made to the United States. On account of the friability and small particle size of the crude material, it breaks down to a fine powder with little destruction of the natural flakes; these are relatively thicker and heavier than those produced by grinding sheet mica, and use of this mica in roofing manufacture is stated to cut dust loss of powder materially. A report on tests made in the Ore Dressing Laboratories of the Bureau of Mines upon a shipment of crude mica from this occurrence has been published (Report No. 748, Investigation No. 606), and copies may be obtained by application to the Director, Bureau of Mines, Ottawa.

A small shipment of scrap mica imported from India was ground in Vancouver for local use in roofing manufacture. Small tonnages of scrap phlogopite, as well as a proportion of small-sized sheet mica, continued to be recovered during the year from the waste dumps of old mines.

The following figures show the production of the five leading mica products in 1936 and 1937:—

—	1936		1937	
	Pounds	Value	Pounds	Value
		$		$
Knife-trimmed	113,169	48,086	206,757	69,432
Thumb-trimmed	35,289	3,233	172,744	11,656
Splittings	24,376	9,780	72,500	32,495
Rough-cobbed	10,940	2,615	93,699	9,058
Scrap	1,417,783	10,842	1,252,887	9,370
	1,601,557	74,556	1,798,587	132,011

Exports of mica of all classes in 1937 were valued at $171,770 as compared with $87,300 in 1936. Imports of splittings in 1937 were valued at $83,596 as compared with $77,822 in 1936.

Sheet mica is marketed in various classes, depending on the amount of preparation the mine-run material receives. Formerly, much of the Canadian output was sold in the semi-rough form, termed "thumb-trimmed," but owing to stricter trade requirements this practice has now been largely supplanted by knife-trimming, which provides a much higher-grade of product. Scrap mica, representing the waste from mining or trimming, is sold to grinding mills for the production of mica powder, used extensively in the roofing and rubber trades. Most of the scrap so sold is consigned to mills in the United States.

Canada shares the world market for amber mica with Madagascar, the two countries constituting the principal known sources of this variety. The depression in the Canadian industry in recent years has been largely attributable to the competition of more-cheaply produced Madagascar mica, this being especially pronounced in the case of splittings, a product in which labour costs are particularly vital. The abundant supply of cheap, skilled native labour, both in India (the main world source of muscovite mica) and Madagascar, has reduced the making of all classes of splittings to small proportions on the American continent. There appears, however, to have been some increase in the Canadian production of splittings in 1937. The better grades of Canadian amber mica are considered superior in point of heat-resistance to much of the Madagascar product, and the improvement in trimming practice has resulted in a revived interest by the British trade in Canadian supplies of sheet mica for heaters, as well as for use in heavy-duty spark-plugs for aeroplanes. The recent general improved demand for mica is largely attributable to increased consumption for armaments.

The mica-grinding plant at the Blackburn mine in Templeton Township, Quebec, continued in operation throughout the year and improved business over 1936 was reported: most of the powder produced goes to the roofing and rubber trades.

Price averages improved slightly over 1936; dealers' quotations at the close of the year were as under:—

Knife-Trimmed Sheet

	Per Pound
1 x 3 inches..	$0.50
2 x 3 "	0.75
2 x 4 "	1.00
3 x 5 "	1.75
4 x 8 "	2.25
5 x 8 "	3.00

Splittings

	Per Pound
1 x 1 inches..	$0.45
1 x 2 "	0.50

Ground mica: 20 mesh, $25 per ton; 60 mesh, $30; 120 mesh, $45; all prices f.o.b. Ottawa, in ton lots.

Mica is a comparatively insignificant mineral from the point of view of tonnage production. It is, however, a vital key mineral in industry, particularly in all forms of electrical equipment, in which no substitute for it has ever been found. Although the muscovite variety fills by far the largest share of the world demand, amber mica is essential for certain purposes, more especially where high heat-resistance is demanded. Although already drawn on extensively, Canadian reserves of amber mica are held still adequate to furnish important supplies and any material price advance would probably result in a revival of mining and increased production.

Fine flake or powdered mica has become an important industrial product, particularly in the United States where a number of plants are engaged in its manufacture both by wet and dry systems of grinding. New uses for the material announced in 1937 include its combination with resin varnishes as a lining or coating for foodstuff cans, and as a base in cleanser compounds. Large amounts of wet-ground muscovite mica are consumed in wallpaper manufacture: up to the present, most, if not all, of the supply of this product has been furnished by a single company in the United States, but in 1937 a plant for its manufacture was established in England. A method of separating flake mica from crushed rock or sand by means of the frictional electricity induced in the flakes during their passage down inclined glass plates has recently been announced by the United States Bureau of Mines.

Vermiculite. Four plants now exist in Canada for the expanding by heat-processing of the hydrated variety of mica known as vermiculite. This mineral expands tremendously when heated, yielding an exceedingly light-weight product, which is finding wide application for heat- and sound-insulation. Three of the plants, owned by Gypsum, Lime and Alabastine, Canada, Limited, are situated at Calgary, Alta., Winnipeg, Man., and Paris, Ont.; the fourth was built in 1937 by the W. E. Phillips Company at Oshawa, Ont., the expanded product being marketed by Dominion Insulation, Limited, 57 Bloor Street West, Toronto. All these plants draw their supply of crude vermiculite from a deposit at Libby, Montana. No occurrences of this class of mica are known in Canada, though there have been unconfirmed reports of discoveries in British Columbia.

MOULDING SAND (NATURAL BONDED)

Every province except New Brunswick and Prince Edward Island has been producing steadily or intermittently some grade of natural bonded moulding sand at least since 1916, when the compilation of statistics of production was started. There was a small production from New Brunswick from two deposits; one deposit was operated in 1918 and the other in 1921 and 1922. Before statistics were kept, there was a small production in Prince Edward Island of a grade suitable only for light-weight castings. By far the greatest part of the production has always taken place in Ontario in the Niagara Peninsula, from Niagara to and around Hamilton. Occasionally new deposits have been opened up, most of these being in Ontario and the western provinces.

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

The Canadian production in 1936 was 16,725 tons, valued at $16,951. The 1937 figures are not yet available. The production of late years has fallen off to a considerable extent. The average yearly production from 1930 to 1936 inclusive is only 19 per cent of the tonnage and 21 per cent of the value of corresponding figures from 1920 to 1929 inclusive.

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

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

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

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

PHOSPHATE

The only important recorded occurrences of phosphate rock in Canada are the Precambrian apatite deposits of the Ottawa-Kingston region, in Ontario and Quebec, and the rather low-grade sedimentary phosphate of the Crowsnest district just west of the boundary between southern Alberta and British Columbia. A belt of such sedimentary rock extends along the Rocky Mountains divide for a considerable distance north of the International Boundary, being probably, in part at least, a northerly extension of the richer phosphatic beds of Montana and Idaho. Prospecting has picked up phosphate horizons at various points as far north as Jasper, Alberta, but nowhere have the deposits given promise of being rich or extensive enough to work.

The production of apatite has been almost negligible for many years, with the single exception of 1932, when there was a small revival of mining along Lièvre River in Quebec, with a reported output of 1,316 tons. The apatite occurs in mica-bearing pyroxenites, and most of the small output of the last twenty years has been by-product material won during mining for mica (phlogopite). The apatite is sold mostly to the Electric Reduction Company, at Buckingham, Quebec, for the production of phosphorus or phosphorus products. This Company reported purchases of about 700 tons of apatite in 1936, most of which was mined from the old High Rock phosphate mine on Lièvre River, Que., the remainder coming from mica mines in the Templeton-Gatineau district, Quebec. In 1937, purchases totalled only about 100 tons, all accumulated stock-pile material from the Blackburn mine in Templeton Township, Quebec: grade averaged 82 per cent, with a value of $8.90 per ton. Sales of apatite are usually based on 80 per cent tricalcic phosphate content, with a spread of around 10 cents per unit above or below this figure.

The Crowsnest sedimentary phosphate was discovered some years ago as the result of extensive prospecting by the Consolidated Mining and Smelting Company for phosphate rock to supply its new fertilizer plant at

Trail, B.C. Mining was conducted at two localities in the Crowsnest-Michel area, and several experimental shipments totalling nearly 5,000 tons were made to Trail. The rock, however, is of rather low grade and did not prove amenable to concentration; the Company, therefore, discontinued operations and at present draws its supplies mainly from Garrison, Montana. In 1937, the Company reported a production of 48,873 tons of phosphate at its Montana mine by its subsidiary, Montana Phosphate Products Company, with shipments to Trail of 47,621 tons. Eastern Canadian plants using phosphate rock for fertilizer and other purposes obtain their supplies mainly from Florida or Tennessee; there have also been some imports from Morocco in recent years. The laid-down price of Florida rock at eastern points in 1937 was about $8.50 per ton.

Reported production (sales) of phosphate in 1937 totalled 100 tons valued at $900 as against 525 tons valued at $4,927 in 1936.

Imports of phosphate rock into Canada in 1937 totalled 113,971 tons, valued at $453,599, as against 83,474 tons, valued at $298,179 in 1936; practically the entire amount came from the United States. Canada also imported 100,726 tons of superphosphate valued at $952,775 in 1937, compared with 96,067 tons valued at $867,666 in 1936.

The Quebec and Ontario apatite deposits were once of considerable importance and were actively mined as a source of fertilizer phosphate, but the industry became unprofitable upon the discovery of the immense sedimentary phosphate deposits of the southern United States about 1890. By flotation a relatively higher grade prosphate could probably be produced from apatite than from sedimentary rock, but such a product would appear to have little superiority for fertilizer and other purposes and could hardly compete on a price basis owing to very much higher mining costs. It seems doubtful, therefore, that any revival of active mining for the mineral in Canada can be expected. Enormous tonnages of apatite are now being produced by concentration from low-grade ores of the Murmansk region, in Russia, this being the principal world source of the mineral; small amounts are also similarly recovered in Virginia, U.S.A.

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

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

PYRITES

In 1937 by-product pyrites was produced in the treatment of copper-pyrites ores at the Eustis mine and at the Aldermac mine in Quebec, and at the Britannia mine in British Columbia.

There have been no important new developments during the year. The Freeman flash-roasting plant in the mill of the St. Lawrence Paper Mills Company, Limited, at Three Rivers, Quebec, was in operation during most of the year. This unit at present is supplying all the sulphur dioxide and much of the steam required for the operation of the sulphite plant, in which four standard newsprint machines are in operation; the plant utilizes flotation concentrate produced at the Eustis mine, near Sherbrooke, Quebec.

There is no general market in Canada for lump pyrites and none is produced. Although the Freeman process of flash roasting, especially designed for treatment of by-product flotation fines recovered in 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 care for any demand that may arise in the immediate future. Canada exported a considerable tonnage of pyrites to the United States and to Japan; these shipments were made both from Quebec and from British Columbia.

No separate records are available showing the quantity of pyrites produced annually in Canada. In Canada there does not appear to be any standard price for sulphur in pyrites; most contracts are probably based on a price of 5 cents (or slightly better) per unit of sulphur (22·4 pounds) per ton, f.o.b. cars at point of production.

The exports of pyrites (sulphur content) in 1937 were 46,317 tons valued at $251,834 compared with 52,192 tons valued at $284,718 in 1936.

SALT

Common salt (sodium chloride) is obtained in two forms, in solution in a brine from which the salt is extracted by evaporation, and in lump or solid form by direct mining.

During the year 1937 salt was produced in southern Ontario; at Malagash, Nova Scotia; and Neepawa, Manitoba. Ontario salt is obtained from brine wells, as is also the salt produced in Manitoba, and the Malagash salt is recovered by mining rock salt, as well as by recovery by evaporation from brines produced by leaching of salt from the waste material in the mine.

There were no new developments in the Ontario field during the year. The Walker Salt Corporation at Port Franks, Ontario, ceased operations and most of the plant has been dismantled.

The Canadian Industries, Limited, in June 1937, commenced the erection of a caustic soda-chlorine plant at Shawinigan Falls, Quebec, to meet the expanding demands for bleached sulphate pulp and rayon pulp. The plant will take a year to complete and salt will be shipped from Sandwich, Ontario.

In Nova Scotia, the Malagash Salt Company showed a substantial increase over 1936, the output for the present year establishing a record for this Province to date. Special investigations were carried out by the Provincial Department of Mines to study the subsurface geology of Malagash in detail, with the hope of indicating extensions laterally of the salt body.

The Neepawa Salt Company of Neepawa, Manitoba, now part of the Canadian Industries, Limited, replaced the wooden grainers by three metal-lined grainers, each 93 feet by 11 feet. These are operated alternately, only two being in use at any one time. A copper-lined steam-driven centrifuge has been installed and the salt is put through this machine directly from the grainers, after which it is bagged for shipment.

Exploratory drilling was carried on in the vicinity of Thunder Hill on the Saskatchewan-Manitoba boundary southwest of Swan River. This work had not yet been completed when shut down for the winter.

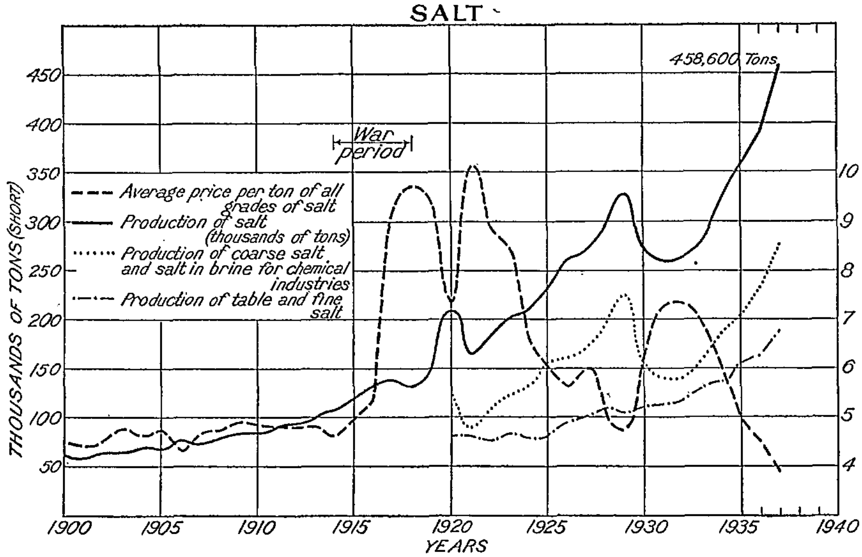
Some interest was shown during the latter part of the year in the salt springs on the west shore of Lake Winnipegosis, Manitoba. A new company, the Northern Salt Syndicate, is planning to erect a small plant on some springs near the mouth of the Red Deer River where it runs into Lake Winnipegosis.

At McMurray, Alberta, Industrial Minerals, Limited, in December, 1937, completed the erection of a plant for the production of salt from brines obtained from rock salt deposits. A production well was drilled and fitted for operation. Open pans are being employed for the evaporation of the brine and a number of grades of salt will be produced.

The extent of the salt basin in New Brunswick, south of Moncton, was further determined when the New Brunswick Gas and Oilfields, Limited, in drilling for oil at Weldon, N.B., encountered nearly 900 feet of salt formation consisting of beds of rock salt interbanded with narrow beds of anhydrite or silt. The top of the salt was at a depth of 1,740 feet below the collar of the hole. So far, these salt beds have remained unexploited, but it is probable that this district will become a producer when conditions warrant.

Near Amherst, Cumberland County, Nova Scotia, a well put down by Imperial Oil, Limited, in a search for oil and gas, encountered 3,200 feet of alternating beds of salt, anhydrite, dolomite, limestone, and shale, the salt constituting 45 per cent of the whole. Salt was met at a depth of 920 feet from the surface, and one of the salt beds, which had a thickness of over 480 feet, contained over 90 per cent sodium chloride in the crude sample. The apparent great thickness of the salt may possibly be due to the steep dip of the beds.

The production of salt in 1937 was 459,027 tons valued at $1,799,465, as against 391,316 tons valued at $1,773,144 in 1936.



Salt production and price trends in Canada, 1900-1937.

The exports of salt from Canada in 1937 were 9,329 tons valued at $61,522 compared with 5,549 tons valued at $46,601 in 1936. The imports of salt were 116,459 tons valued at $466,190 as against 108,924 tons valued at $460,998 in 1936. The greater portion of this salt comes in free of duty for use in the fisheries on the Atlantic and Pacific coasts.

The production, except for small exports, is sold in Canada, principally to the dairy, meat curing, canning, fisheries, and chemical industries, and as table salt for household use. The production during 1937 showed a 17 per cent increase in volume over the preceding year, and taken over a period of years the market for salt in Canada is steadily increasing and the industry is in a sound condition. The production for 1937 marks an all-time record, appreciably exceeding the former high record of 1936.

A large tonnage of salt is still imported duty free, for use in the fisheries, because for many years the only producing district was in Ontario, which is unfavourably situated with respect to the markets offered by the Atlantic and Pacific coast fisheries. The production from Malagash has materially aided the fishing industry in the Maritime Provinces, and although the demand for salt for this use has been curtailed in recent years, it is gradually improving. Until, however, a deposit on or near the west coast of Canada is found and exploited, the Pacific coast fisheries will be dependent largely on imported salt.

Soil stabilization with salt and clay for the foundations of highways and for a surface veneer for gravel roads is now firmly established and the use of salt for this purpose is steadily increasing.

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

SILICA

The materials produced in this industry are quartz for smelter flux and ferrosilicon; quartzite for ferrosilicon and silica brick; silica sand for the manufacture of glass, carborundum, sodium silicate, etc., also for sandblasting, roofing, and for use in the steel foundries; silex, the finely pulverized silica used in ceramics and the paint industry.

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

Silica sand is generally prepared from a friable sandstone by crushing, washing, drying and screening to recover different grades of material according to the industry for which it is required. For example, for the manufacture of glass the material should range between 20 and 100 mesh. Silica sand is also prepared from a friable quartz and from vein quartz.

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

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

Although the deposit of silica sand near River Denys, Inverness County, Nova Scotia, was not operated during the past year, it has a good quality of sand suitable for a number of uses, and its product should find a ready market in the Maritime Provinces, especially in the steel foundries.

The Ottawa Silica and Sandstone Company, Templeton, Quebec, is producing sand of different grades for steel foundries, the glass industry, and for sandblasting, etc.

The Canadian Kaolin Silica Products, Limited, from its property at Lac Remi, Quebec, is making regular shipments of silica sand to the glass companies and others in the Montreal district. Construction has been started on extensive additions to the mill with a view to increasing the capacity of output.

The Canadian China Clay Company, St. Remi, Quebec, has done considerable development work during the year on its china clay property at St. Remi. Shaft sinking has been in progress, and a number of buildings were erected with a view to bringing the property into production during 1938. This company will probably produce silica as a by-product from the washing operations in the production of china clay.

The St. Lawrence Alloys Company, Limited is producing ferrosilicon of several grades in electric furnaces at Beauharnois, Quebec, and is using sandstone from Melocheville, Quebec. The sandstone is crushed and screened to pass 3 inches and be retained on $\frac{5}{8}$ inch, and is trucked the 2 miles from the quarry to the plant.

In the use of silica as a flux, smelters endeavour to obtain their material from the nearest possible source, and in many cases prefer a siliceous ore containing small values in the precious metals. For the manufacture of ferrosilicon and silica brick, the market for the finished product limits the quantity of silica required, and as both these industries showed an improvement, the consumption of silica for these uses increased accordingly.

The demand for high-grade silica sand remained steady and though appreciable quantities of Belgian sand are still brought into Montreal as ballast at a comparatively low cost, Canadian producers are steadily improving their position and each year sees an increasing use of their products. Silica sand for use in the manufacture of glass and silicate of soda has to be of a high degree of purity and uniformity; and if Canadian producers hope to supply this market fully, they will have to adhere rigidly to strict specifications and be able to guarantee regularity of shipments.

The use of Canadian sand for sandblasting is increasing and the prospects are promising for a still further use of Canadian material.

The production of quartz and silica sand in 1937 was 1,369,639 tons valued at $1,126,278, compared with 1,046,649 tons valued at $597,781 in 1936. There were 3,744 M silica brick produced in 1937 at a value of $181,126; in the previous year the production was 2,393 M valued at $97,285. No exports of silica or silica products were recorded during the year. The tonnage of the various grades of silica imported during 1937 amounted to 218,927 tons with a value of $516,316, compared with 148,900 tons valued at $378,296 in 1936. The imports of silica brick in 1937 were valued at $539,253, compared with $261,974 in 1936.

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, on the whole, is a comparatively low-priced commodity, and therefore the location of a deposit with respect to markets is of great importance. The larger markets for silica are in the Provinces of Quebec and Ontario, and any new deposits being opened up should be within economic reach of either Toronto or Montreal.

SODIUM CARBONATE (NATURAL)

Deposits of natural sodium carbonate in the form of "natron" (sodium carbonate with 10 molecules of water) and also as brine, occur in a number of "lakes" throughout the central part of the Province of British Columbia, chiefly in the Clinton Mining Division, around 70 Mile House, and in the neighbourhood of Kamloops. Since 1921 there has been a small intermittent production from several of these deposits, the product being marketed in Vancouver, B.C., for use in soap manufacture.

During the past year the only shipments made were from Anita Lake, 3 miles west of 70 Mile House in the Clinton Mining Division.

Production in 1937 was 286 tons valued at $2,288, as against 192 tons valued at $1,677 in 1936.

SODIUM SULPHATE (NATURAL)

(Glauber's Salt and Salt Cake)

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

Production was all from the Province of Saskatchewan, the principal producers being the Natural Sodium Products, Limited, Dunkirk, Sask.; Horseshoe Lake Mining Company, Ormiston, Sask.; the Midwest Chemical Company, Palo, Sask.; and the Sodium Corporation, Alsask, Sask., with small tonnages from several other properties.

The Natural Sodium Products, Limited, at Dunkirk, Sask., has erected an oil refinery adjacent to its plant at Frederick Lake, from which it obtains sufficient fuel oil for operating the kilns together with a surplus for use when additional kilns are installed. A power line is under construction from the National Light and Power Company at Moose Jaw. Extensive additions being made to the plant will greatly increase its capacity.

The Horseshoe Lake Mining Company at Ormiston, Sask., was purchased by the International Nickel Company in the early part of 1937, and extensive alterations were made in the operation of the plant, which were completed in July. Diesel power was substituted for electricity on both the excavator and the haulage locomotive and two small direct-fired rotary dryers were installed for experimental purposes.

The Sodium Corporation at Alsask, Sask., produced a small tonnage during the early part of the year but has since been idle.

At the central part of Whiteshore Lake, the Midwest Chemical Company produced steadily throughout the year, using direct rotary dryers working on harvested intermittent crystals. The capacity of the plant has been greatly increased. The shipping point is at Palo, Sask., a station on the Canadian National Railway, 3 miles north of the plant.

The Oban Salt Company, a subsidiary of the Eastcrest Holding and Development Company, with head office at Calgary, Alta., made a small shipment early in the year of high-grade anhydrous sodium sulphate from its plant at Oban, Sask., but since then it has been closed down pending completion of arrangements for increasing the capacity of the plant to 50 tons per day.

Muskiki Sulphates, Limited, holding leases on Muskiki Lake, 60 miles east of Saskatoon, Sask., is erecting a plant which it hopes to operate during 1938.

Experimental work carried on during the past year at a number of other properties in Saskatchewan has not, so far, resulted in commercial production.

Activity has been marked in this industry, and it is encouraging to note the progress made in the past few years. The investigation of sodium sulphate deposits was started by the Mines Branch in 1921 and over 120,000,000 tons of hydrous salts was proved in the few deposits examined in detail. In 1921 none of this material was used commercially but by 1937 the revenue derived by Canadian railways from this industry exceeded $800,000. At the present time the operating plants are capable of producing over 600 tons of dried salts per day. The development of these sodium sulphate deposits has been one of the major factors that has made possible the erection of the plant for separating nickel from copper, at Copper Cliff, Ontario, by the Orford process.

The production of natural sodium sulphate in 1937 amounted to 79,884 tons valued at $618,028, as against 75,598 tons valued at $552,681 in 1936.

Although there were small shipments from the deposits in Western Canada to the United States, the figures are not shown in the customs reports. The imports of sodium sulphate during 1937 including Glauber's salt, salt cake, and the acid sodium sulphate (nitre cake) amounted to 16,953 tons valued at $175,318; in 1936 the imports were 13,598 tons valued at $153,924.

The production of natural sodium sulphate from the deposits of Western Canada again increased sharply during the past year, and a new all-time high for this industry was established. The demand both from the pulp mills and the metallurgical industry at Copper Cliff has also increased during the year owing to revived activity in both these industries. In addition there has been an increase in the export to the United States.

The producers in Western Canada have always endeavoured to improve the quality of their product so as to compete in markets demanding a product of high purity, and the results have been gratifying during the past few years.

The product from these western deposits should find a rapidly extending market, as the by-product material from the manufacture of hydrochloric acid is each year decreasing in volume owing to the manufacture of hydrochloric acid synthetically. With improved methods of refining, the better quality of the product and reduced cost of production, the western sodium sulphate industry should look forward to the future with confidence, providing other deposits nearer the main markets are not developed.

SULPHUR

Deposits of elemental sulphur of commercial grade have not been found in Canada. Sulphur occurs in combination with copper, lead, zinc, nickel, or iron in many base metal sulphide ore-bodies in various parts of Canada. As noted in the article on pyrites, a small quantity of sulphur is utilized annually from that contained in by-product concentrate. In addition, wherever sulphide ores are treated to recover the valuable metal content, bi-product sulphur dioxide gar is a waste product that has a potential value as a source of sulphur for industrial use.

In practice waste sulphur dioxide gas can be used directly for the manufacture of sulphuric acid, for the production of liquid sulphur dioxide, or for the production of elemental sulphur; two plants in Canada (at Tadanac, British Columbia, and at Copper Cliff, Ontario) are now manufacturing sulphuric acid from waste gas. At present no plant in Canada is producing liquid sulphur dioxide from waste gas, although this has been done experimentally. Much research has also been directed towards the development of processes for the production of elemental sulphur from the waste gas or from the original sulphide ore, and a number of patents have been issued or are pending. A plant producing 80 tons of sulphur per day from waste gases is operating at Trail, B.C.; two other firms are engaged in research on this problem.

The Dominion Bureau of Statistics reports the equivalent amount of sulphur recovered from all sources as 130,913 tons, an increase of about 7 per cent over the previous year; Canada imports sulphur from the States of Texas and Louisiana; the imports in all forms were 225,684 tons valued at $3,669,082 in 1937, as against 168,774 tons valued at $2,802,282 in the previous year.

According to trade journals sulphur was quoted at $18 per long ton, f.o.b. cars at the mines; the prices at consumers' plants in Canada vary according to location, reaching a maximum of about $37, the difference being due to transportation costs. The largest single sulphur-consuming industry in Canada is that which produces sulphite pulp used both for making artificial silk and for newsprint; other important consuming industries include the sulphuric acid and explosive groups, rubber manufacture, and fertilizer production. Metallurgical industries treating sulphide ores of copper, nickel, lead, or zinc necessarily produce large quantities of sulphur dioxide gas from roasting or oxidizing operations; until recently all this gas was wasted. Some years ago plants were erected, first at Copper Cliff, Ont., and later at Tadanac, B.C., equipped with absorption apparatus to recover portions of these waste gases. At Copper Cliff the gas is used for the manufacture of high-grade sulphuric acid, the capacity of the units installed being about 150 tons per day of fuming acid; this acid finds a market in numerous industries. In British Columbia the acid made is used chiefly for the manufacture of fertilizers, but a small proportion is used elsewhere in the plant as required.

TALC AND SOAPSTONE

As for many years past, the great bulk of the Canadian production of talc continued to come from the Madoc district, Hastings County, Ontario, where the mines and mills of G. H. Gillespie and Company and Canada Talc Company have long been in steady operation. In November, Canada Talc Company took over the holdings of G. H. Gillespie and Company, and will henceforth operate both properties.

The talc of the Madoc area is of the foliated variety, has a good white colour, and occurs as a series of vertical veins or bands in white, crystalline dolomite. Each of the above companies has operated its own mill at or near its mine, and most of the mill output is marketed in three grades, according to purity and fineness. The products go principally to the textile, cosmetic, rubber, paper, and roofing trades, and are marketed chiefly in Canada and the United States; some of the output is exported to Great Britain. In recent years, the total annual production of talc from the Madoc area has averaged around 12,000 to 15,000 tons, divided about equally between the two above-named operators.

A few years ago, tests were made in the Ore Dressing and Metallurgical Division of the Mines Branch to determine whether the rather considerable proportion of dolomite in the Madoc talc could be removed satisfactorily. It was found that flotation resulted in lowering the lime content of the crude talc to below 0·5 per cent; however, no process for improving the quality of their products by such means has as yet been adopted at either of the Madoc mills. A report on the above tests has been published (Investigation No. 469, Mines Branch Report No. 736), and copies may be obtained by application to the Director, Bureau of Mines. In this connection, a successful process for separating talc from talc-magnesite by flotation has been developed by the U.S. Bureau of Mines, and a plant has recently been erected at one of the larger Vermont mills. Purification of talc from the tremolite-talc of the Gouverneur district, in New York State, by similar means has also been satisfactorily accomplished by the U.S. Bureau of Mines. Flotation should be applicable with advantage for the beneficiation of Madoc dolomite-talc: the pure talc possesses fine white colour and good slip, and removal of dolomite from the finished mill products might enable it to compete successfully in the higher-priced field with imported talcs used for cosmetic and other purposes.

In Eastern Canada, the only other production of talc is from a soapstone quarry near Broughton, in the Eastern Townships, Quebec. Crude lump talc from a band cutting the soapstone body, as well as soapstone waste, is shipped to a Montreal grinding plant, and the dust from the sawing benches at the quarry is disposed of to the roofing trade. In addition, some soapstone waste is ground in a small mill on the property. Samples of the talc, analysed in the Bureau of Mines laboratories, proved to have a very low lime content, and the material might accordingly have value for ceramic use. Waste rock and sawdust are similarly disposed of by other soapstone operators in the same district.

The Broughton Soapstone Quarry Company, which operates the deposit mentioned above, was in intermittent production throughout the year, supplying sawn blocks and bricks for the pulp-mill trade. Shipment is made as far west as Dryden, in western Ontario, but the bulk of the output has found employment in Quebec mills. In addition to furnace stone, the company has fashioned soapstone monuments, stoves, mantels, slabs and other interior trim, as well as a variety of turned ornamental objects and crayons. This concern was the pioneer Canadian producer of soapstone, and has been operating in the Broughton district since 1922. With co-operation of the ceramic laboratories of the Bureau, the company has investigated the possibility of preparing synthetic bricks of soapstone powder bonded with silicate of soda for pulp-mill use, but they were reported unsatisfactory under working tests. Since about 1935, soapstone operations have been conducted in the same district by the following: L. C. Pharo, Thetford Mines, and Charles Fortier, Robertson, both working in Thetford Township, and Louis Cyr, St. Pierre de Broughton, in Leeds Township. All of the above were in intermittent operation during 1937.

The soapstone of the Thetford district occurs as a persistent band or belt traversing the hilly terrain north of the valley of the Quebec Central railway, and outcrops are frequent along the flanks and upper levels of the ridges. The stone varies from fairly coarse-grained rock to fissile talc schist; it averages 180 pounds to the cubic foot. The schist variety is the purer stone, and yields a fine grade of off-colour talc powder; it is, however, prone to spall in cutting and handling, for which reason the granular stone is preferred for sawn shapes.

A recent development that has considerably reduced the demand for soapstone for pulp-mill use is the introduction of a new type of water-cooled alkali-recovery furnace; this is of steel construction, only the base being built of soapstone blocks. Such furnaces have already been installed in a number of Canadian and American mills, and it is stated that their use is likely to become general. As a result, domestic soapstone sales have fallen off considerably, and increased competition has reduced prices of cut stone to $2 per cubic foot, only half the figure formerly obtained.

Numerous enquiries reached the Bureau during the year regarding Canadian talc resources, and interest in the mineral seems to be growing: there were, however, no new developments of consequence. Further work was reported on a deposit in Potton Township, Brome County, Que., near Highwater, on which a mill is projected by Baker Mining and Milling Company of Montreal. In Ontario, surface prospecting is stated to have disclosed a large talc body in Cashel Township, Hastings County, north of Madoc, on claims owned by L. S. Reeves of Madoc; it was reported at the end of the year that this occurrence was to be developed by a new company, Madoc Talc and Milling Company, Ltd. of Trenton, Ont. A deposit of soapstone, consisting of veins of pyrallolite (altered pyroxene) in crystalline limestone, was worked during the year by J. Bell, of Almonte, in Pakenham Township, Lanark County, Ont., the material being considered suitable for the production of turned or carved ornamental shapes.

In British Columbia a small, intermittent production of ground grey talc is utilized chiefly in the roofing trade. The material has been obtained from near McGillivray Falls (Anderson Lake), on the P.G.E. Railway and from Wolf Creek, near Sooke, on Vancouver Island. The Anderson Lake material was shipped in the crude form to Vancouver for grinding, and that from Sooke was ground in a small plant at the mine. In 1937, neither mine was in operation, local roofing requirements being filled by soapstone waste imported from Washington State and ground in a small custom-grinding plant in Vancouver.

The production of ground talc in 1937 was 12,457 tons valued at $123,301, compared with 14,508 tons valued at $144,500 in 1936. The 1937 output of cut soapstone was valued at $40,513, as against $32,770 in 1936. In previous years, the entire output of soapstone bricks and blocks had found domestic sale, but 1937 saw a shipment totalling 1,000 cubic feet of 12- by 12- by 6-inch blocks to Australia, for pulp-mill use. The exports of talc in 1937 were 8,698 tons valued at $85,953, compared with 10,222 tons valued at $102,071 in 1936. The 1937 imports of ground talc were 3,184 tons valued at $48,079, compared with 2,936 tons valued at $43,185, in 1936.

The United States tariff on ground talc or soapstone valued at not over $12.50 per ton is 25 per cent; valued at over $12.50 per ton, 35 per cent. Crude mineral pays $\frac{1}{4}$ cent per pound. Cut soapstone or talc, in the form of bricks, blocks, crayons, blanks, etc., is dutiable at 1 cent per pound. Talc, ground or unground, enters Canada under the British preferential tariff of 15 per cent, and the intermediate tariff of 25 per cent.

Canadian talc prices remained unchanged from the previous year, at $17.50 per ton for superfine grade, $11.50 for No. 1 grade, and $9 for No. 2 grade, all f.o.b. Madoc mills. Superfine, imported Italian talc, cosmetic grade, sold at $80 to $100 per ton, eastern points. American talcs were quoted at the end of the year as follows: Georgia white, $8 per ton; grey, $6; New York tremolite, fibrous, $12 to $15; Vermont grey, $9 to $9.50, all f.o.b. mills.

Little of importance in connection with new or improved industrial outlets for talc was recorded during the year. The paint, rubber, roofing and paper trades continue to take the bulk of the output: a considerable tonnage of Canadian talc is stated to be used also as a textile filler. Interest continues to develop in ceramic uses for talc, and research has shown it to have value in whiteware bodies, electrical porcelain, saggers, etc.

Pyrophyllite. Pyrophyllite, a hydrous silicate of alumina closely resembling talc in appearance and certain physical properties, but of less common occurrence, is becoming industrially important for many of the same uses as talc; it does not flux when fired, however, as does talc and has been shown to have value for the manufacture of high-grade, refractory ceramic products and cements. The mineral is now produced commercially in North Carolina, and extensive deposits are stated to occur in Newfoundland. Some material from the latter source was shipped to Canada in 1935 for grinding and sale. The only recorded occurrence of pyrophyllite in Canada appears to be at Kyuquot Sound, on the west coast of Vancouver Island; some work was done on the deposit around 1910. There was a report in 1937 of plans for further development, but these do not appear to have materialized.

VOLCANIC DUST

Volcanic dusts (pumice dust) are found in Saskatchewan, Alberta, and British Columbia. The material is used mainly as the abrasive base in scouring and cleaning compounds and a very small amount in acoustic plaster and concrete admixture. There has been intermittent production from near Swift Current, Saskatchewan, and from near Williams Lake in British Columbia. The total production in 1934 was 31 tons valued at $320. Imports are not separately recorded but are grouped with a number of similar products—pumice, pumice stone, lava, and calcareous tufa. Imports of these products in 1937 were valued at $26,238 as compared with $21,275 in 1936.

It is of some interest to note that in the United States annual shipments of volcanic dust and pumice are now over 70,000 tons ($300,000), there being about 20 companies actively engaged in production.

WHITING SUBSTITUTE

Whiting substitute as made in Canada consists of white limestone, or white marble, pulverized to a fineness of minus 200 mesh, and for some uses to a fineness of minus 325 mesh. It is, as the name implies, used as a substitute for whiting made from chalk, and finds its principal use in the manufacture of oilcloth, linoleum, certain types of rubber products, putty, and explosives. In lesser quantity it is used in the manufacture of moulded articles, cleaning compounds and polishes, as a ceramic glaze, and for a number of other purposes. At present all whiting substitute produced in Canada is made from pure marble or limestone containing only a small percentage of magnesium carbonate, though in the past whiting substitute made from white dolomite was marketed for use in the making of putty.

The chief differences between the Canadian material and chalk whiting are that the former has a lower capacity for absorbing oil and the individual particles are inclined to be sub-angular rather than rounded. Whiting substitute made from a magnesian limestone or dolomite is not suitable for certain uses, particularly in the rubber industry, whereas a whiting substitute nearly free from magnesium carbonate is suitable for all uses.

Whiting substitute is manufactured by Pulverized Products, Limited, Montreal, and by Gypsum, Lime and Alabastine, Canada, Limited, at Winnipeg. A finely pulverized limestone product approximating whiting substitute in colour and fineness is produced by F. J. Beale at Vananda, Texada Island, British Columbia.

During 1937 the manufacture of precipitated chalk for use as a filler in newsprint was begun in Canada. This product, which is replacing clay as a filler in both newsprint and magazine paper, is made by introducing carbon dioxide gas into milk-of-lime made from high-calcium quicklime. It is characterized by freedom from impurities and by the extreme fineness of the individual particles. Increased production of this commodity is planned for 1938.

Two companies continued their investigations into the possibility of producing whiting substitute from marl deposits in Hastings and

Peterborough Counties, Ontario, during the year under review, but there has been no commercial production from either deposit.

By-product precipitated chalk, made from the waste sludge resulting from the manufacture of caustic soda from soda ash and lime, is classified as a whiting substitute, but its usefulness is restricted by the fact that it almost invariably contains a small quantity of free alkali. The raw materials for the manufacture of by-product precipitated chalk are available in Canada but it is not being made in this country.

No separate record is kept by the Dominion Bureau of Statistics of the production, imports and exports of whiting substitute, but the industry has experienced a steady growth in recent years because the maintenance of close technical control has enabled a product to be marketed that is very consistent in both chemical and physical properties, and many manufacturers are now using the Canadian product in place of imported chalk whiting with entire satisfaction. There is little or no export of whiting substitute from Canada, but there is a considerable quantity of specially processed whiting substitute imported from the United States. Imports of chalk whiting in 1937 amounted to 11,992 tons valued at $126,015, as compared with imports of 12,498 tons valued at $121,017 in 1936.

III. FUELS

COAL

The Provinces of Nova Scotia and New Brunswick, and Yukon Territory, produce only bituminous coal. Coal produced in the Province of British Columbia is almost all bituminous, except for a small quantity classified as lignitic. Alberta production includes bituminous, sub-bituminous, and lignitic coals, and the Provinces of Saskatchewan and Manitoba produce only lignitic coal.

Developments in Nova Scotia during the last few years include changes and improvements to the washing and screening plant of the Dominion Steel and Coal Corporation. These changes permit of a wider range of preparation of coal for special purposes. A program of consolidation of the various collieries operated by this Company has also been under way, the objective being increased production at a decreased cost, by the construction of cross-measure tunnels, cutting the coal seams at depths sufficient to allow the complete extraction of the coal in the submarine area. An experimental washery employing a high gravity organic liquid is to be installed by the Dominion Steel and Coal Corporation at Sydney, and a Vissac coal washer was built by the Cumberland Railway and Coal Company, Limited, at its Springhill collieries.

Mechanization of coal mines throughout Canada has made further progress during the year, and the special preparation of coal to meet the demand of specialized requirements of the market has made advances.

The plant for the carbonizing and briquetting of Saskatchewan lignite at Taylorton, Saskatchewan, has been purchased and reconditioned by the Dominion Briquette and Chemicals Company, Limited, and briquettes are being manufactured with a maximum output of 225 tons per day. Production figures are incomplete, but an estimate made by the Dominion Fuel Board indicates a total sale of 8,160 tons of briquettes from September 13, the date the plant started production, to November 29. The briquettes are marketed in Manitoba and Saskatchewan.

A briquetting plant has been in operation during the year at the Brazeau Collieries, Limited in Alberta, where the bituminous coal fines are briquetted with an asphalt binder and returned to the mine-run coal, which is sold for railway use.

A coal-cleaning plant has been in operation at the collieries of the Cadomin Coal Company, Limited, and a coal cleaning plant is under consideration by the Mountain Park Coals, Limited with a view to the special preparation of a low ash coal for the manufacture of coke, and for steam-raising purposes.

On October 26, the surface workings at the Michel Mines of the Crow's Nest Pass Coal Company, Limited, in British Columbia, were completely destroyed by fire. Operations were interrupted for a short while only, and construction of a new modern bank-head, complete with coal cleaning equipment, was proceeded with immediately.

The production of coal in Canada in 1937 amounted to 15,775,432 tons valued at $48,662,559 and was the greatest since 1929; this represents an increase of 3·6 per cent over the output for 1936; Nova Scotia contributed over 46 per cent of the total, Alberta over 35 per cent, British Columbia about 10 per cent, Saskatchewan about 7 per cent, and the rest was derived from New Brunswick, Manitoba, and Yukon. Nova Scotia with 7,227,768 tons showed an increase of 8·9 per cent over the output of 1936.

The imports of coal into Canada during the year totalled 16,004,452 tons, compared with 13,735,040 tons in 1936.

Anthracite importations consisted of 3,559,133 tons, 56 per cent of which was from the United States and 32 per cent from Great Britain; the remainder being from Germany, Russia, Belgium, and Morocco.

Bituminous importations consisted of 12,443,825 tons, mainly from the United States.

Exports of Canadian coal in 1937 amounted to 355,268 tons compared with 411,574 tons in 1936. The 1937 total included 345,426 tons of bituminous coal and 9,842 tons of lignite coal.

There was an increase in the amount of Canadian coal moved under Federal Government assistance. It is estimated that 2,641,195 tons were moved in this way in 1937, compared with 2,352,034 tons in 1936. Under these subventions, within certain limits, the difference between the laid down cost of Canadian coal and imported coal is paid by the Dominion Government, usually in the form of assistance in paying the freight.

The total amount of coal moved under subvention since 1928 when this assistance came into effect is 14,205,637 tons, at a cost to the Government of $13,457,085. The administration of this Government assistance is carried out by the Dominion Fuel Board.

The Government assistance to the coal mining industry, as rendered by the Fuel Research Laboratories of the Canadian Bureau of Mines, Department of Mines and Resources, was continued during the year. Research work on coal preparation, storage properties and general characteristics of coal seams was carried out with a view to the increased use of these coals in Canadian plants to displace the imported product. Research work on the amenability of various Canadian coals to hydrogenation was studied throughout the year, in order that, when such a process becomes economic, information will be available as to the suitability of various Canadian coals for this purpose.

With continued assistance in the transportation of Canadian coal from the mine to the market, it is hoped that the improvement in the coal mining situation shown during the last two years will be continued in 1938.

COKE

Coke was produced from coal in all provinces except Prince Edward Island and Saskatchewan in 25 plants which included two beehive, eight by-product, six vertical retort, and nine horizontal retort plants. Petroleum coke was produced at petroleum refineries located in Nova Scotia, Quebec, Ontario, Saskatchewan, and Alberta. Pitch coke was produced by distillation in Manitoba.

In Cape Breton, Nova Scotia, the Dominion Steel and Coal Corporation produced considerable coke from its ovens for its own use and as a domestic fuel for the Maritime Provinces. A substantial increase in production was effected to take care of the demands of the steel industry.

In Quebec the Montreal Coke and Manufacturing Company operated its coke ovens continuously, using about 35 per cent Nova Scotia coal, the remainder being imported coal. The Quebec Power Company with a vertical retort plant used Canadian coal only, and marketed about 68 per cent of its coke for domestic consumption, the remainder being used at the plant for the manufacture of gas and for operation.

In Ontario from the coke ovens at Hamilton, comprising those of the Hamilton By-Product Coke Ovens, Limited and the Steel Company of Canada, and those at Sault Ste. Marie, increased quantities of coke were marketed for use as domestic fuel. The Consumers' Gas Company of Toronto employing both vertical and horizontal retort type plants distributed for domestic consumption approximately 41 per cent of its total coke manufactured, the remainder being used for the manufacture of gas and in operation of the plants.

In Manitoba the Winnipeg Electric Company, which formerly used only United States coal, is using all Canadian coal in its ovens at Winnipeg for the manufacture of domestic coke. The construction, during the year, of a blending plant allows for the use of coal from more than one source.

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

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

The total production of coke from coal in 1937 was reported as 2,569,833 tons. The production in the eastern provinces (Nova Scotia, New Brunswick, and Quebec) in 1937 was 853,379 tons; in Ontario, production was 1,501,765 tons; while in Manitoba, Alberta, and British Columbia, the production was 214,689 tons. The amount of coal used for making coke was 3,577,342 tons, 32·5 per cent of which amount was Canadian coal. In addition to the coke made from coal a relatively small amount of petroleum coke is produced at the oil refineries (64,706 tons in 1936, the 1937 figures not available). About 4 per cent of this petroleum coke is consumed by the refineries themselves.

The exports in 1937 were: coke from coal 36,959 short tons, and petroleum coke 16,967 tons.

The imports were: coke from coal 417,760 tons, and petroleum coke 119,291 tons.

There has been a steady improvement in the coke situation during the last few years, owing to increased demand in the domestic market.

NATURAL GAS

Natural gas has been found in almost all the provinces of Canada, but the principal fields producing in commercial quantity are in Alberta, Ontario, and New Brunswick. Comparatively small quantities are produced in Saskatchewan, Manitoba, Quebec, and in the Northwest Territories.

The principal producing fields in Alberta are: Turner Valley, which supplies the cities of Calgary and Lethbridge and intermediate points; Viking, which supplies the Edmonton area; Medicine Hat, which supplies Medicine Hat and Redcliff; Fabyan, supplying the town of Wainwright; and Brooks, supplying the town of the same name.

In Ontario the greater part of the production comes from the south-western part of the Province, to the north of Lake Erie. The principal fields are: Tilbury, Haldimand, Dawn, DeClute, Brownsville, Dover, Norfolk, Welland, and Onondaga. A network of pipe-lines transmits the gas to nearby towns and cities for distribution, so that practically all the centres of population in that area are served.

In New Brunswick the only field of importance is at Stony Creek, which supplies the city of Moncton and the town of Hillsborough. In Saskatchewan, Lloydminster is being served with natural gas from a well near the town. Natural gas is obtained from a number of small wells along the St. Lawrence River in Quebec, but efforts to develop a large commercial supply have not yet been successful. The gas is used locally in private dwellings.

An outstanding event in Alberta during the current year was the bringing-in of a large gas well on the Battleview structure, thus opening up a new area for development. The open flow was estimated to be about 50,000,000 cubic feet per day and the gas carries some naphtha. The depth was 1,893 feet. In Grande Prairie district a strong flow of gas was reported from a shallow well. Repressuring of the Bow Island field with purified gas from Turner Valley has been continued. In August, after seven years' operation, the pressure was 541 pounds per square inch compared with 235 pounds in 1930. The Arco No. 1 well in south Turner Valley was abandoned when salt water was struck at 8,988 feet. This is believed to be the greatest depth reached by a drill anywhere in the British Empire.

The important development in Ontario during 1937 has been the relatively large production obtained from new wells in the Brownsville field. At the end of the year fifty-one wells were producing in this field, compared with fourteen at the end of 1936. Three of the new wells were estimated to be capable of producing 62,000,000 cubic feet of gas per day. A purification plant was built and started operation in March 1937, the purified gas being turned into the trunk-line of the Southern Ontario Pipe Line Company at Ingersoll. The capacity of the plant was rated at 5,000,000 cubic feet of gas per day. The field has been extended mainly to the west, and does not appear to extend very far into the neighbouring Township of Bayham in Elgin County. Some fine new producing wells have been brought in during the year in the DeClute field, extending the field to the shore of Lake Erie. Development continued in the Eden and Chatham field, and some additional production was obtained.

Some drilling was done in New Brunswick, Saskatchewan, and Manitoba, but no new field was discovered. A new well, drilled south of Lloydminster in Saskatchewan, reported a large flow of gas and indicates an extension of the field southward.

The total production of gas in 1937 was 29,599,198 M cubic feet, compared with 28,113,348 M cubic feet in 1936.

Some natural gas is exported from Canada by the Range Oil and Gas Company of Calgary. The Company owns a well in southern Alberta and exports intermittently to a company operating a distributing system in the State of Montana, which uses the gas principally for its peak load and as a standby.

Some mixed artificial and natural gas is imported into Ontario from Buffalo, N.Y., and is distributed in the Welland area.

In 1936 the amount imported was 118,056 M cubic feet valued at $75,985, and in 1937, 114,275 M cubic feet valued at $74,799 was imported.

The use of natural gas is steadily increasing, and most distributing companies report a larger number of customers for the current year. The development of a crude oil field in south Turner Valley will likely result in some conservation measures being taken to reduce the amount of natural gas used to produce naphtha from the wells. The greater part of this gas was burned in open flares in the field as surplus gas, and has not appeared in statistical reports of production for the Province of Alberta.

OIL SHALE

The principal known occurrences of oil shales in Canada are in Pictou and Antigonish Counties, Nova Scotia, and in Albert and Westmorland Counties, New Brunswick.

No oil shale is being mined in Canada at the present time, and none is imported.

No important changes have taken place during 1937. The Maritime Eduction Company of Rosevale, New Brunswick, went into bankruptcy during 1930, and title to the plant and mining lease became vested in the National Funding Company. The oil shale property at Albert Mines has also been acquired by this Company.

The plant of the Torbanite Products, Limited, at New Glasgow, Nova Scotia, which was badly damaged by fire in October, 1930, still remains idle. The Canadian Torbanite and Oil Products, Limited, a subsidiary of the Oil and Nitrates, Limited, built a small experimental plant at McLellan Brook, about 5 miles from New Glasgow, at which some experimental work was conducted during 1929 and 1930, since when the plant has been idle.

Until quite recently, activity has been chiefly confined to field exploration and laboratory investigations. Laboratory work by the Department of Mines and Resources has included:

1. Determination of petroleum content of representative samples from various localities.

2. Determination of important factors affecting the recovery of crude petroleum by destructive distillation and the character of the petroleum recovered.

3. Investigation of the processes designed for the distillation of oil shales.

The Department of Mines and Resources, Ottawa, has published several reports on the oil shale industry, the more recent of which include the following:

"Report on Oil Shale from Pictou, N.S., and Port Daniel, Bonaventure County, Quebec" (Mines Branch Report No. 725, Investigations of Fuels and Fuel Testing, 1930-31, pp. 136-148.

"A World Survey of Recent Oil Shale Developments (1932)" by A. A. Swinnerton (Mines Branch Memorandum Series No. 53).

"Pritchard Process for the Distillation of Oil Shale" (Mines Branch Report No. 689, Investigations of Fuels, 1926, pp. 106-120).

"Canadian Shale Oil and Bitumen from Bituminous Sands as Sources of Gasoline," etc. (Mines Branch Report No. 689, Investigations of Fuels, 1926, pp. 121-132).

"Preliminary Report on the Investigation of Oil Shales," which includes New Brunswick shale (Mines Branch report No. 590, Investigations of Fuels and Fuel Testing, 1921, pp. 239-252).

"Analyses of Canadian Crude Oils, Naphthas, Shale Oil, and Bitumen" (Mines Branch Report No. 765, 1936).

For a good many years the large-scale production of oil shale was limited to Scotland, but in recent years Esthonia and Manchuria have been seriously developing their deposits; the production being as follows:

Scotland (1936)	1,409,415 long tons
Esthonia (1936)	754,306 " "
Manchuria (1935)	3,383,000 " "

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

PEAT

I. FUEL

Of late years, small amounts of peat fuel have been produced from Quebec and Ontario bogs, the average annual amount between 1932 and 1936 being 1,788 tons. These bogs are located at St. Arsene, Que., and near Morewood and Gad's Hill, in Ontario. At the Morewood bogs the peat is spaded into blocks and stacked by hand, whereas at the other bogs it is put through macerators before being placed on the drying racks.

During 1937 three additional bogs were operated on a small scale, one at Linwood, one at St. Anne's, and one near Galt, all in Ontario. Another important development during the year was the opening of the East Luther bog near Grand Valley by Industrial Compounds, Limited. Equipment installed included an excavating unit, mounted on a scow. This unit is furnished with a 100-horsepower Diesel engine, which operates a suction pump having a specially designed intake head, capable of handling 1,400 gallons of peat pulp per minute. The pulp is piped to a settling tank having a peat-flow regulator, the wet solids being then piped to a series of level drying beds. Products made in 1937 consisted mainly of peat fuel and fertilizer filler.

In all, eight bogs were operated during 1937, as against four the previous year.

Producers' sales of peat during 1937 were reported as about 1,050 tons valued at $5,775; the peat was distributed largely as a domestic fuel in the adjoining districts.

Imports and exports of peat are not separately recorded in trade reports.

II. MOSS

Ten bogs were operated for the production of peat moss for use as insulation material, packing, litter, or fertilizer. Three are in Quebec at Isle Verte, Riviere Ouelle, and Waterville; three in Ontario, at Clinton, Grand Valley, and Vars; and one each at Cowan in Manitoba; Melfort in Saskatchewan; Edmonton West in Alberta, and New Westminster in British Columbia. The shell-marl peat bog at Westover, Ontario, was not operated during the year.

Moss insulation is being produced at six points; Isle Verte, Vars, Clinton, Cowan, Melfort, and Edmonton West, the fabricating plants at Isle Verte and Edmonton West producing products known to the trade as "Spagmos" and "Mosstex"; loose material is being produced at the other points.

Packing moss is turned out at Waterville and New Westminster, at the former as loose material, and at the latter in the form of "Westpeco" sawn boards. Litter or humus is produced at Isle Verte, Riviere Ouelle, and New Westminster, and fertilizer filler at Isle Verte and Grand Valley.

No data are available covering the production of peat moss. Imports of peat moss during 1937 were 336 tons, and cleaned, sized and ground mosses and grasses amounted to 965 tons. The average annual imports during the five-year period 1932-1936 were 487 tons. Imports of peat moss into the United States from Canada averaged 1,513 tons annually between 1932 and 1936.

PETROLEUM

Petroleum is produced in Canada in the Provinces of Alberta, Ontario, New Brunswick, and the Northwest Territories. The product varies from a very volatile naphtha to semi-solid bitumen.

The largest production comes from Alberta, and Turner Valley is the main producing field in the Province. This field is about 40 miles southwest of the city of Calgary. Other regularly producing fields are at Red Coulee, near the town of Coutts on the International Boundary between Alberta and the State of Montana, and at Wainwright and Ribstone about 160 miles east of the city of Edmonton. Crude petroleum has also been found at Taber, Skiff, Del Bonita, and Moose Mountain. In Ontario, crude oil is found in commercial quantities only in the southwestern part of the Province. The principal producing fields are at Petrolia, Oil Springs, Bothwell, and in the Townships of Dawn, Onondaga, and Mosa. In New Brunswick some production is obtained from the Stony Creek field, about 9 miles southeast of the city of Moncton. In the Northwest Territories a small production is obtained along the Mackenzie River at Fort Norman, and some bitumen from deposits near McMurray.

The important development in 1937 was the greatly increased production from Turner Valley, which has become, to an even greater extent than formerly, the major producing field in the country. In June, 1936, before Turner Valley Royalties well was brought in, the production from this field was slightly in excess of 3,000 barrels per day. By the end of 1937, the potential output of the field was 26,800 barrels per day, of which only about 40 per cent was being produced for lack of storage and handling facilities. During the year, 25 producing wells were drilled into the Palaeozoic limestone at the south end of the field, proving an extension to the field of an area about 3 miles long and $\frac{3}{4}$ mile wide. The new production is a light crude oil of about 46 degrees A.P.I. gravity, very different from the naphtha formerly produced from the limestone. An important factor in the development has been the successful use of hydrochloric acid for increasing and maintaining the yield from the new wells.

There would appear to be good prospects of extending the Turner Valley field to the southward, as well as delimiting more clearly its area to the west and north. Other localities that appear to be favourable for future development are at Taber and at Moose Mountain. In both of these places, wells have been brought in during the year that yielded crude oil, and active drilling is being carried on. Additional drilling is also being done at Wainwright and Ribstone, and at Sage Creek in British Columbia.

The production of crude petroleum in Canada during 1937 is reported by the Dominion Bureau of Statistics at 2,928,268 barrels, being an increase of 98·5 per cent over that of 1936.

Production of Petroleum in Canada

(Barrels of 35 Imp. gallons = 42 U.S. gallons)

	1936	1937
Alberta	1,312,368	2,783,824
Ontario	165,495	164,990
New Brunswick	17,112	18,083
Northwest Territories	5,399	11,371
Total	1,500,374	2,978,268

The production from Alberta is classified by the Provincial Department of Lands and Mines as shown below:

Production of Petroleum in Alberta

(Barrels of 35 Imp. gallons = 42 U.S. gallons)

Turner Valley, limestone*	2,756,632
Turner Valley, shallow crude	10,589
Red Coulee, light crude	13,790
Wainwright, heavy crude	13,559
Miscellaneous	2,338
Total	2,796,908

*Includes both naphtha and light crude.

The exports of petroleum and its products in 1937 were valued at $1,295,457, compared with $1,440,961 in 1936; the exports included 4,300,115 gallons of gasoline and naphtha valued at $400,800.

The imports of petroleum and asphalt and their products in 1937 were valued at $59,012,412, compared with $49,727,188 in 1936. The imports included 38,916,629 barrels of crude petroleum, of which 72·2 per cent was from the United States, 10·3 per cent from Venezuela, 10·1 per cent from Colombia, and 7·4 per cent from Peru. The gasoline and naphtha imports amounted to 72,478,101 Imperial gallons, valued at $5,388,134; the greater part was from the United States, which supplied 74·4 per cent, and 24·5 per cent came from Peru, 1·0 per cent from Roumania, and the remaining small amount from Alaska and Great Britain.

Exports and imports being of varied character are shown in the following table:

Exports:	Quantity Gal.	Value $
Oil, petroleum crude	—	—
Oil, coal and kerosene, refined	890,309	93,039
Oil, gasoline and naphtha	4,300,115	400,800
Oil, fuel	11,048,568	474,628
Oil, mineral	1,174,183	319,280
Wax, mineral	2,249 cwt.	7,710
		$1,295,457
Imports:		
Petroleum	1,362,082,028	46,701,769
Kerosene, fuel and illuminating oil	28,235,652	1,037,692
Lubricating oil	15,407,215	3,422,361
Gasoline and other oils	72,628,966	5,456,556
Asphaltum and other petroleum products	—	2,394,034
		$59,012,412

The total retail sales of gasoline in Canada for the year 1937 has been estimated, from the returns received from the gasoline tax departments of the provincial governments, to be 721,900,000 Imperial gallons.

The increased production of crude oil from Alberta has caused some changes in marketing conditions, particularly during the latter part of the year. Almost all the refineries in Alberta and Saskatchewan are now operating on Turner Valley crude, and importation of crude oil to these provinces from other fields has practically ceased. Efforts are being made to introduce this crude into Winnipeg refineries also and, possibly, into Ontario. Coincident with this changeover, some companies are taking the opportunity to improve and modernize their refineries in order to reduce subsequent operating costs. The retail price of gasoline and other petroleum products has been materially reduced in Alberta and, to some extent, in Saskatchewan, owing to the lower cost of crude oil.

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