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 1936

Reviews by the Staff of the Bureau of Mines

Price, 25 cents **No. 786**

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 1936

Reviews by the Staff of the Bureau of Mines

Price, 25 cents **No. 786**

CONTENTS

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 1936 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 New York, London, or elsewhere.

ALUMINIUM

Canadian requirements of bauxite, the ore of aluminium, are imported as no commercial deposits have been found in Canada. Resumption of direct importations of bauxite ore from British Guiana, discontinued in 1930, occurred in 1935 when 49,369,600 pounds were brought into Canada. The 1936 imports from British Guiana were 152,865,500 pounds. Trade returns also show imports from the United Kingdom and the United States, a substantial part of the latter being used in the abrasive and chemical trades and not in the production of aluminium.

When bauxite is used for the production of aluminous abrasives it is usually calcined in the country of origin. On the other hand, bauxite for the chemical trade and bauxite from British Guiana used for the production of aluminium is only washed and dried before being shipped. At Arvida, Que., it is first concentrated by standard methods to remove impurities and is then calcined to remove the chemically combined water.

Canadian requirements of cryolite, necessary in the production of aluminium, are 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 used for many industrial purposes. Research work has resulted in the development of many new alloys and in widening their uses in industry. Among the recent applications are structural shapes and sheet metal for railway cars, automobiles, skips and cages for the mining industry; roofing sheets, shipping barrels, tanks, industrial equipment of many kinds, and aluminium paints for preserving wood and steel surfaces such as 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 oxide surfaces to reduce wear are in general use in the construction of automobile and airplane engines.

The Aluminum Company of Canada, with its two smelters located at Arvida and Shawinigan Falls, Quebec, is the only Canadian producer of aluminium and most of its output is exported. This company has also two fabricating plants, one being also at Shawinigan Falls, Que., and the other at Toronto, Ont. In addition there are a number of other plants located mainly in Ontario and Quebec which manufacture aluminium cooking utensils, powder, automobile parts, and other articles of aluminium.

The world output of aluminium is estimated at 358,727 metric tons for 1936, reflecting a very large increase over 1935 when it was 257,985 metric tons. Large gains in output were reported for the major aluminium producing countries, the most outstanding being the United States and Germany. Hungary started producing during the year, being the fourth new country since 1932 to smelt aluminium.

Imports of bauxite, alumina and cryolite were valued at $2,936,550 in 1936 and $2,927,174 in 1935. Imports of metallic aluminium and its products were valued at $1,589,677 in 1936 against $1,212,354 in 1935. The total exports of aluminium and its products were valued at $11,498,482 in 1936 and $10,760,692 in 1935.

ANTIMONY

The Consolidated Mining and Smelting Company of Canada produces an antimonial residue as a by-product of its silver-refining operations at Trail, British Columbia. Some of this is used in the company's refining processes and the rest is allowed to accumulate at the smelter. Experimental work with this product has been carried on for several years.

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.

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.

Canada's requirements of antimony are supplied from abroad; in 1936 there were imported 1,279,535 pounds of antimony metal or regulus valued at $109,656, and 45,722 pounds of antimony salts valued at $7,189, as compared with 926,959 pounds of antimony metal or regulus valued at $113,072, and 48,628 pounds of antimony salts valued at $7,947 in 1935. The imports of antimony oxide are not given separately in the Trade of Canada reports.

Antimony is dependent for its market 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 two years has shared in the substantial progress towards recovery made by the world's trade. The demand for war munitions has also been an important factor in the increased demand for antimony.

Although Bolivia and Mexico have been for years important producers of antimony, the bulk of the production has come, in the past, from China; but, 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 1934 (1935 and 1936 not yet available), as published by the United States Bureau of Mines, amounted to 21,400 metric tons, as compared with 31,600 metric tons in 1929, the highest figure of production since the War years.

The New York price of antimony (Chinese brand) in 1936 averaged 12·24 cents a pound, as against 13·61 cents in 1935. While the New York domestic price has been fluctuating slightly, the price for Chinese brand, duty paid, remained constant at 12·5 cents from September to December.

The Chinese antimony trade has been these last few years under Government-sponsored control.

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.

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

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

The Canadian production of bismuth in 1936 was 364,165 pounds valued at $360,523, as against 13,797 pounds valued at $13,245 in 1935.

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

The imports in 1936 were: metallic bismuth 29 pounds valued at $35 and bismuth salts valued at $17,068, as against metallic bismuth 2,048 pounds valued at $1,675 and bismuth salts valued at $11,613 in 1935.

Statistics of the world's production are very incomplete. A fair estimate would put it at about 800 tons annually. The output for 1936 was probably between 800 and 1,000 tons. 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 a half century the principal source of supply, but in recent years its production has decreased considerably.

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

Until recent years 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. An alloy of bismuth, lead, tin, and antimony, under the copyrighted name of Cerromatrix, has been introduced for use in mounting dies and punches.

While 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.

Bismuth used in the manufacture of Canadian medicinal and pharmaceutical preparations in 1934 (1935 and 1936 not available) was as follows: bismuth metal 31,365 pounds valued at $31,500, and bismuth salts 11,554 pounds valued at $18,735.

The price of bismuth at New York in ton lots remained fixed at $1 a pound from September, 1935, to the end of that year and throughout 1936. 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 amounts in most zinc ores and in some lead ores.

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

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

The Hudson Bay Mining and Smelting Company at Flinflon, Manitoba, completed the erection of a cadmium recovery plant in 1936. The plant, with an annual capacity of 180 tons of cadmium, is treating cadmium residues obtained from the zinc refinery. The product treated consists partly of current precipitate and partly of accumulated stock, similar to the procedure followed at Trail (Tadanac).

The Canadian production in 1936 was 785,916 pounds valued at $699,465, as against 580,530 pounds valued at $441,203 in 1935.

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

The world's production in 1936 is estimated at 3,500 tons, as against 2,800 tons in 1935, 2,300 tons in 1934, and 1,000 tons in 1932. The chief producing countries are: the United States, Canada, Australia (Tasmania), France, Poland, and Norway.

The possibilities of increased world production of cadmium are great. 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 use of cadmium for plating metal for rust-proofing, and to the rapidly increasing use in the production of bearing alloys for the motor industry. The market activity in 1936 was sustained primarily by the automobile industry and the plating industry. Amongst the new alloys that are being introduced are a cadmium-silver-copper bearing metal, a cadmium-nickel bearing metal, and a copper-lead-cadmium bearing metal. With the price of cadmium raised from 55 cents to $1 per pound it appears questionable whether the use of the metal can be maintained by the bearing manufacturers. A cadmium-copper alloy containing about 1·0 per cent of cadmium is being introduced for high voltage transmission lines, for tramway and railway trolley wires, for overhead telephone and telegraph lines and other similar uses. 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 1936 averaged 97·79 cents as against 70·49 cents in 1935. 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 Lorraine 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. A certain amount of 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, Ltd., 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 1936 was 881,995 pounds valued at $801,857, as against 681,419 pounds valued at $512,705 in 1935.

The imports in 1936 were: cobalt oxide 410 pounds valued at $610, as against 160 pounds valued at $173 in 1935.

The exports were as follows:—

	1935		1936	
	Pounds	Value $	Pounds	Value $
Cobalt contained in ore	419,300	124,679	526,200	212,814
Cobalt alloys	26,405	44,462	43,211	70,372
Cobalt metallic	1,803	2,253	2,376	2,970
Cobalt oxides and salts	378,274	370,160	484,541	556,791
	825,782	541,554	1,056,328	842,947

Mainly owing to the agreement reached in 1935 amongst the principal producers, the price of cobalt has remained fairly constant these last two years. The nominal New York price (as quoted by Metals and Mineral Markets) remained, throughout the year, at $2.50 per pound, less 30 per cent for cash, for cobalt metal imported from Belgium. On yearly requirement contracts quantity discounts brought the price down to $1.25 per pound delivered. The London quotations were 5s. 3d. per pound on yearly requirement contracts.

In the autumn of 1935 the Cobalt Association, comprising leading Canadian, Belgian, Northern Rhodesian, and Moroccan producers, were further strengthened by the inclusion of the Association of German Cobalt Producers and in 1936 by the Vuoksenniske Company of Finland. The Cobalt Association now controls probably about 90 per cent of the world's output.

The total world annual output is estimated to have reached approximately 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, but of less importance, are Australia, Japan, Germany, and Russia.

The most important metallurgical uses of cobalt are for high-speed cutting steels, stellite, permanent magnets, etc. It is also used in the enamel industry and for the manufacture of pigments.

A new high-speed cutting alloy, under the trade name of Crobalt, has been introduced in the United States; its major ingredients are tungsten, cobalt, and chromium; the alloy is said to have remarkable properties and is cheap enough to permit the entire cutting tool to be made of the alloy, thus avoiding tedious and costly welding of tips to steel shanks.

COPPER

The copper-nickel mines of Sudbury, Ontario, are the largest source of supply of copper in Canada, contributing about 70 per cent of the total output. Quebec contributes 15 per cent, which is obtained mainly from the Noranda gold-copper ores, with a small contribution from the Eustis copper-pyrites mine. The Flin Flon copper-zinc mine, situated on the boundary of Manitoba and Saskatchewan, contributes 10 per cent of the total, and the balance (5 per cent) is derived from the Britannia mine in British Columbia.

In British Columbia the Britannia mine gradually increased operations from one-third to about full capacity of the concentrator, producing copper and zinc concentrates which are exported. Operations at Anyox were permanently discontinued in August, 1935. Preparations are being made to resume operations at Copper Mountain, near Princeton.

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 during the last half of 1936 and milling operations are expected to be resumed in 1937 after the necessary power has been provided.

In Ontario the production of the Sudbury district mines exceeded that of any previous year. The new No. 5 vertical shaft at the Creighton mine was completed to the 4,050-foot horizon and several new levels started; two new flotation units and other changes at the Copper Cliff concentrator, completed in the autumn of 1936, increased the capacity from 8,000 to 12,000 tons of ore per day; two new reverberatory furnaces and seven converters were installed during the year, thus greatly increasing the rated capacity of the smelter for blister copper and for nickel matte; the Coniston smelter was operated at full capacity treating mainly Creighton ore for the production of monel metal matte.

The Falconbridge Nickel Mines, Ltd. further extended its new 5-compartment No. 5 shaft to a depth of 1,800 feet; the 1,200-foot level has been connected with No. 1 shaft, 2,500 feet to the west, and about 8,000 feet of drifting was done along the ore zone east and west from No. 5 shaft; additions have been made to the concentrator and the smelter was enlarged, including extension to the blast furnace and the installation of a third converter, thus increasing the capacity to 12,500 tons of nickel-copper matte, all of which is exported.

The Cuniptau, a new copper-nickel property, situated near Timagami, Ontario, has been under development intermittently since 1934; a smelting plant, erected and operated for a short time in 1935, was partly remodelled and again put into operation during 1936.

In Quebec the Noranda mine and smelter were operated at normal rate throughout the year; sinking of the new No. 5 shaft started early in 1935 was completed in 1936 to its objective of 3,000 feet and will be deepened to 4,000 feet by 1937. The Aldermac mine, which was closed in the fall of 1934 pending refinancing for the enlargement of the mill and the erection of a new sulphur plant, resumed operations in January, 1937. The Eustis mine, in southern Quebec, continued in regular operation, exporting its copper concentrate to the United States.

The refinery of the Ontario Refining Company at Copper Cliff, Ontario, and that of the Canadian Copper Refiners, Ltd., at Montreal East, Quebec, were both operated at their annual nominal capacities of 120,000 tons and 75,000 tons, respectively; the latter plant treats the anode copper from Noranda and the blister copper from Flin Flon.

The International Nickel Company has started the construction of a research laboratory at Copper Cliff to help toward the development of new uses for copper.

The exploration and development by Consolidated Mining and Smelting Company of the gold-copper showings on Doré Lake—Chibougamau area, about 170 miles west of lake St. John, and by the Opemiska Copper Mines, Ltd., near Opemiska lake, about 50 miles west of Doré lake, were continued in 1936.

The total Canadian production in 1936 was 420,922,720 pounds valued at \$39,507,869, as against 418,997,700 pounds valued at \$32,311,960 in

1935; of the total production Ontario contributed 68 per cent, Quebec 16 per cent, Manitoba and Saskatchewan 10 per cent, and British Columbia 5 per cent.

	Pounds	$
Exports were—		
Copper fine in ore, matte, etc.	45,519,600	2,971,042
Copper blister	....	....
Copper in ingot, bar, rod, etc.	310,860,400	27,460,714
Copper old and scrap	8,108,700	535,753
Copper in rod, strip, sheet, plate and tubing	48,152,900	4,769,923
Copper wire and cable	....	469,789
Copper manufactures	....	294,433
		36,501,654
Imports were—		
Copper in bar, rod, block, pig, ingot, tube, wire and scrap	1,953,899	328,776
Copper manufactures and compounds		624,967
		953,743

Owing to the special revenue tariff of 4 cents a pound, sales of Canadian refined copper in the United States have ceased since 1933; concentrate shipped to the United States, chiefly from British Columbia, but also from Quebec, was treated in bond, the metal recovered from it being all offered for sale in other countries. 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. Canadian producers in most cases have the advantage of producing copper more or less as a by-product in the recovery of gold and silver, nickel, or zinc.

The beginning of 1936 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 1935 continued throughout 1936.

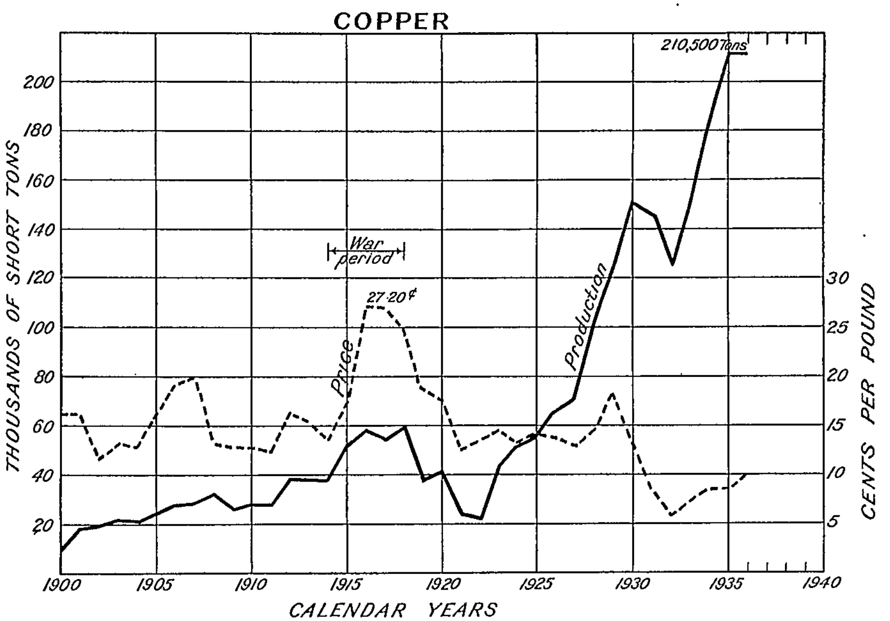
The steady growth of the demand for copper during 1936 has brought about a situation in which consumption has caught up to production and will probably soon exceed it.

The world's consumption during the depression reached its lowest point of 980,000 tons in 1932, as compared with the high point of 1,880,000 tons in 1929. The tide turned in 1933, and the consumption has since gradually increased to about 1,790,000 tons in 1936.

This improvement has been due in a large measure to increased consumption in Great Britain and Europe, and in Japan.

As the greater part of Canadian refined copper goes to Great Britain, it is interesting to note that the consumption of new copper in the United Kingdom 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 the expansion in house building, the improvement in the transportation and engineering industries, and to the continued increased use of electricity in the homes; the electrical industry is by far the most important consumer of copper in Great Britain.

As the United States is by far the largest consumer of copper, it is of interest to note the principal industries using copper in that country. They are by order of importance; the electrical manufacturers (159,000 tons), motor vehicles (94,000 tons), building (74,000 tons), electric refrigerators (23,000 tons), and air conditioning (5,000 tons); this latter is a new industry still in its infancy and is expected to consume large quantities of copper. The oil burner industry has increased its consumption from 125 tons in 1928 to about 3,000 tons in 1936, and a further increase is anticipated for 1937. The industrial uses above given absorb about 50 per cent of the total consumption. For the first 10 months of 1936 the United States total consumption averaged about 60,000 tons a month, but this rate was greatly exceeded during November and December, and the total for the year will approximate 750,000 tons. In normal times the building industry is as large a consumer of copper and its alloys as is the automobile industry, and the outlook for a considerable increase in volume of building in 1937 is said to be very bright.



Copper production and price trends in Canada, calendar years 1900-1936.

The world's production of copper in 1936 is estimated at 1,800,000 tons, as compared with 1,603,000 tons in 1935, and 2,118,200 tons in 1929, the year of highest production. Canada is now contributing about 12 per cent of the total world's production.

The Montreal price of electrolytic domestic copper averaged 10·07 cents per pound in 1936, as against 8·49 cents in 1935. The average monthly price in Montreal in 1936 rose from 9·28 cents in January to 11·55 in December.

The New York price of domestic electrolytic copper averaged 9·47 cents a pound in 1936, compared with 8·65 cents in 1935. Owing to the 4-cent duty, there is a differential between the foreign and domestic price.

The copper restriction agreement signed in New York in 1935, which has been participated in by all the world's principal producers, has six salient clauses, the principal being a curtailment in output in countries outside the United States which are producers and also exporters, at the rate of 240,000 tons per annum, to be made effective from June 1, 1935. Canada was to maintain her current output of refined copper and to store any increase of mine output in the form of matte or blister. The agreement terminates on July 1, 1938. The recent decision of foreign producers to increase production quotas from 85 per cent to 105 per cent of standard capacity, the fifth advance in a short time, indicates that foreign demand is growing to the point where both output and price may be increased. This high percentage (105 per cent) does not represent the full potential output of producers in the agreement, and at any time unrestricted production may be authorized to check the upward movement in prices. Thus the time is drawing near when capacity operations will be achieved by the low-cost producers.

GOLD

The chief source of gold in Canada in 1936 was, as for many years past, the gold quartz mines of Porcupine and Kirkland Lake camps in northern Ontario. During 1936, the combined output of these two camps was approximately 53 per cent of the total production of the Dominion, as against about 58 per cent for 1935, the decrease in the *relative* amount contributed in 1936 being due entirely to a greater rate of increase in production in other parts of the country.

With the exception of a comparatively small amount obtained as a by-product in nickel-copper refineries, practically all Ontario's gold comes from gold-quartz mines.

Quebec's output still comes chiefly from 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 Pioneer and Bralorne in the Bridge River area and the Premier in the Portland Canal area are the most important. Smaller amounts are obtained from base metal ores, notably those of the Britannia mine, and from placers.

Manitoba's gold is derived chiefly from the copper-zinc-gold ores of the Flin Flon mine; 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 by large-scale dredging.

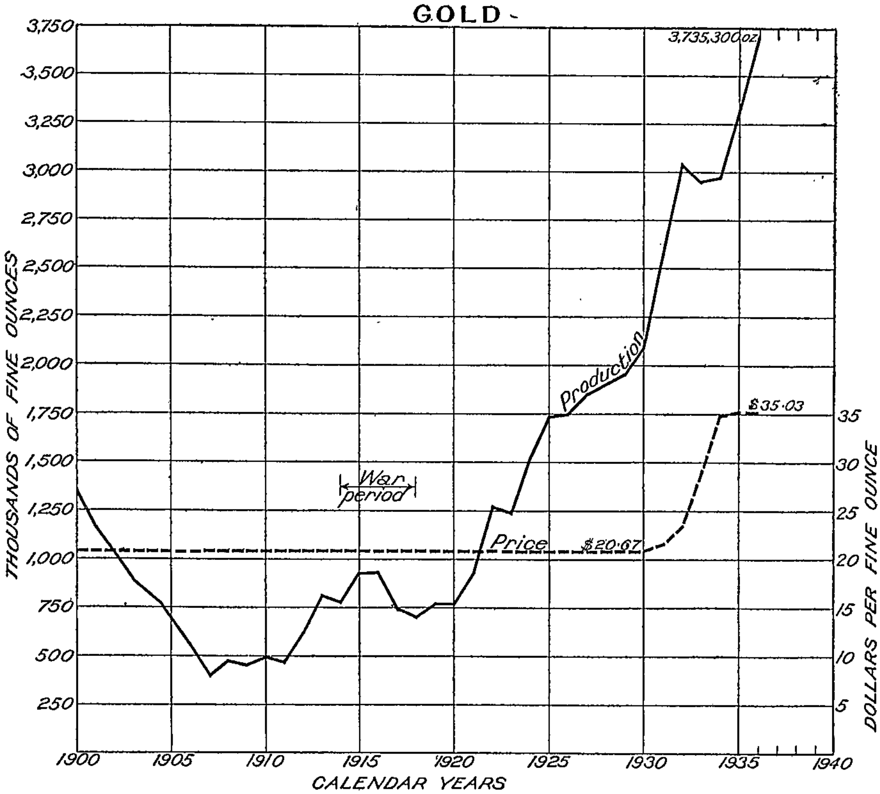
Nova Scotia's output is all from gold-quartz mines.

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.

The year 1936 was characterized by intense activity in the gold-mining industry, resulting in steadily increasing production in practically all parts of the Dominion. Developments in Ontario and Quebec were especially noteworthy, particularly in the Porcupine, Little Long Lac, and Red Lake fields, in Ontario, and in the fields of northwestern Quebec.

Among mines in Ontario first reporting production in 1936 are included Pamour and Ross (Hollinger) in the Porcupine belt, Omega in the Kirkland Lake belt; and Argosy, Red Lake Gold Shore, Hudson Patricia, Algold, Elora, Sturgeon River Gold and Red Crest in northwestern Ontario.



Gold production and price trends in Canada, calendar years 1900-1936.

Among probable important new producers expected to be in production in 1937 are MacLeod-Cockshutt, Hardrock, and Bankfield in the Little Long Lac area. Several small producers are in operation in the old Lake of the Woods district and discoveries made near Arden in Frontenac county caused increased activity in southeastern Ontario.

In Quebec, there were interesting developments in Cadillac and neighbouring townships, and in the Lamaque-Sigma area. On the O'Brien-Cadillac mine an extremely high-grade ore shoot of large but still undetermined extent was discovered during the year. On Dome Mines' subsidiary, Sigma, continued favourable developments resulted in a decision to build a 300-ton mill. It is expected that this will be in operation in 1937. The Shawkey, Thompson-Cadillac, and Stadacona mills came into operation during the year, as did also McIntyre's new mill at Mud Lake.

In Manitoba, though there were no new developments of outstanding importance in 1936, gold mining continued to make satisfactory headway. During the year Gunnar Gold and Laguna mines made their first appearance on the list of producers.

In British Columbia, also, though there were no specially outstanding developments, gratifying progress was made and it is anticipated that production for the year will be substantially larger than in 1935. There was an increase of over 40 per cent in the quantity of placer gold produced in 1936 compared with 1935. The placer output in 1936 was the greatest in volume for the last 25 years and the greatest in value for the last 35 years. Lode gold production showed an increase of about 13 per cent over that of 1935.

In Nova Scotia there was sustained activity in the gold fields. A new 200-ton mill, the largest in the province, was put into operation at Goldboro by Seal Harbour Gold Mines, Ltd., during the year.

In Saskatchewan development work was carried on steadily throughout the year on gold properties in the vicinity of Goldfields on the north shore of lake Athabaska. Development work was also carried on at the Flin Flon gold mine at Douglas lake near the town of Flinflon.

In the Northwest Territories prospecting and the development of gold prospects was very active in the Yellowknife and Great Slave Lake mining divisions, with, it is reported, promising results.

Production of Gold in Canada for the Calendar Years 1935 and 1936

—	1935		1936	
	Fine ounces	Value	Fine ounces	Value
		$		$
Nova Scotia	9,376	329,942	11,902	416,927
Quebec	470,552	16,558,725	666,139	23,334,849
Ontario—				
Porcupine	968,546	34,083,134	1,019,037	35,696,866
Kirkland Lake	948,044	33,361,668	964,262	33,778,098
Other	303,746	10,688,822	386,117	13,525,678
Total Ontario	2,220,336	78,133,624	2,369,416	83,000,642
Manitoba	142,613	5,018,551	139,288	4,879,259
Saskatchewan	14,323	504,026	48,981	1,715,804
Alberta	150	5,279	109	3,818
British Columbia	391,633	13,781,565	449,126	15,732,884
Yukon and Northwest Territories	35,907	1,263,567	50,344	1,763,550
CANADA	3,284,890	115,595,279	3,735,305	130,847,733

In 1935 the estimated average price of a troy ounce of fine gold in Canadian funds was $35.19 and in 1936 the corresponding price was $35.03.

IRON

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

The production of pig iron in Canada in 1936 was 678,672 long tons as against 599,875 long tons in 1935.

Imports of iron and its products (including iron ore to the value of $2,633,925) in 1936 were valued at $135,359,104, of which $108,428,041 came from the United States and $21,687,639 from Great Britain. Exports were valued at $52,303,878, of which $6,078,135 went to the United States and $12,736,360 to Great Britain.

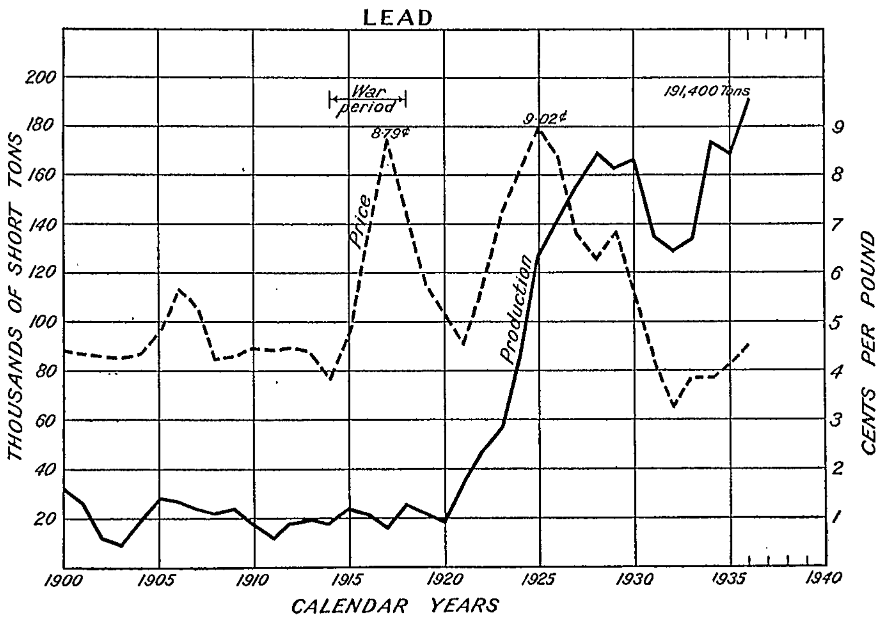
Bounties on the production of pig iron from domestic ore are offered by three Canadian provinces—Ontario, Quebec, and British Columbia—but have not produced the hoped-for result, viz., the establishment of a domestic iron-mining industry, as there are no known large bodies of domestic ore of suitable grade available to Canadian furnaces. There are, however, two large partly developed, but unequipped deposits of low-grade ore in Ontario. The Algoma Steel Corporation's New Helen mine in the Michipicoten district has proved reserves variously estimated at 60,000,000 to 80,000,000 tons of iron carbonate rather high in sulphur that requires roasting to fit it for use in the blast furnace. A similar ore was formerly worked by the same company at Magpie mine, also in the Michipicoten district, but this is not at present profitable. In the Sudbury district, Moose Mountain, Ltd. has developed some 33,000,000 tons of proved and probable ore consisting of low-grade siliceous magnetite carrying in its natural state about 35 per cent of iron. For a time—in the past—an attempt was made to work the Moose Mountain ore by a process of magnetic separation and sintering, but in spite of the exceptionally high grade of the finished product it was found impossible to bring costs down to the point where a profit could be made in competition with available natural ores of foreign origin.

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 district and in other parts of the province.

In the Yukon Territory, high-grade silver-lead mines have been operated in the Mayo area. In Ontario, former production came from the Galetta lead-zinc mine, which has been idle for several years. In Quebec, the production has been derived from lead-zinc mines near Notre-Dame-des-Anges, Portneuf county, and in Nova Scotia, from a copper-lead-zinc mine at Stirling, Cape Breton.

In British Columbia the Sullivan mine, with its 6,000-ton concentrator, produces the greater part of the Canadian lead. The Monarch mine, near Field, has been an important contributor, exporting to Europe both the lead and zinc concentrates produced; milling was suspended at this property in December, 1935, and development work only carried on during 1936. Several properties in British Columbia, mainly in the Kootenay district, which had resumed operations in 1935 after several years of idleness, were again in operation during the year 1936. Amongst these were the Mammoth near Silverton, the Noble Five and Rambler near Sandon, and the Whitewater near Kaslo; all operate their own concentrating plants.



Lead production and price trends in Canada, calendar years 1900-1936.

In the Yukon Territory, the Treadwell Yukon Company continued producing from its small but high-grade silver-lead properties near Mayo.

In Quebec, the Tetreault property near Notre-Dame-des-Anges was restarted in June, 1935, after several years of idleness, and the company shipped lead and zinc concentrates to Europe.

In Nova Scotia, the Stirling property in Cape Breton resumed production early in 1936.

The lead smelter and electrolytic lead refinery at Trail, B.C., the only one in Canada, has a capacity of 525 tons of refined lead a day, or 190,000 tons a year.

The Canadian production of lead in 1936 was 382,754,774 pounds valued at $14,976,045, as against 339,105,079 pounds valued at $10,624,772 in 1935.

The exports of lead in ore, pig, etc., in 1936 were 330,746,400 pounds valued at $10,400,851, as against 294,218,600 pounds valued at $7,161,424 in 1935; and white lead, 634,200 pounds valued at $43,555 in 1936, compared with 217,100 pounds valued at $14,068 in 1935.

The total imports of lead and lead products in 1936 were valued at $1,787,689, as against $1,568,043 in 1935.

Canada contributed in 1936 about 11 per cent of the world's lead production. In 1935, world production, as reported by the Engineering and Mining Journal, was 1,565,679 short tons; the production for 1936 was increased to 1,688,800 short tons. The principal producing countries are, in order of importance, United States, Australia, Mexico, Canada, Germany, Burma (India), and Spain.

There has been a noticeable improvement in consumption since 1932. In the United States the principal consuming industries continue to be the storage battery industry and the lead pigment industry; the cable industry, which in 1929 and 1930 consumed more than any other, is still occupying a low position; the outlook for increased consumption of lead in 1937 is quite encouraging, owing to the general trade improvement, to the increase in building, and to the demand for armaments.

In the United Kingdom consumption of lead for the last four 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 for 1936 is estimated at about 400,000 short tons.

In Canada the consumption of lead in certain specified manufacturing industries amounted in 1934 to about 23,350 tons, in 1930 it was 31,600 tons; data are not yet available for 1935 and 1936.

The average price of pig lead at Montreal in 1936 was 4·64 cents a pound, as against 3·9 cents in 1935; the monthly average price dropped from 4·36 cents in January to 4·09 cents in June, then increased gradually to 6·25 in December. The quotations on the London market, converted to Canadian funds, average for the year 3·87 cents as against 3·15 cents in 1935. The average price at New York was 4·71 cents as against 4·065 cents in 1935.

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 which have been mined in eastern 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 1936 was 221 tons valued at $1,316, as against 100 tons valued at $800 in 1935. There was no production during the previous three years.

The imports of "manganese oxide" in 1936 were 64,262 tons valued at $684,175, as against 36,780 tons valued at $353,414 in 1935.

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 decreased from 3,573,000 metric tons in 1929 to 1,300,000 metric tons in 1932. A noticeable improvement started during the last half of 1933 and continued throughout the last three years. The world's production, as reported by the United States Bureau of Mines, for the year 1934 (complete statistics for 1935 and 1936 not yet available) amounted to 2,861,000 metric tons. The present output is estimated probably to exceed 3,500,000 metric tons.

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

The price of manganese ore at North Atlantic ports for 46 to 48 per cent manganese, Brazilian, remained fixed at 24 cents per unit for the whole of 1936; for chemical grades 80 per cent MnO_2, the price throughout the year was $40 to $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. According to the agreement that went into effect January 1, 1936, the new duty on the manganese content, will be as follows:—

Three-eighth cent per pound plus 1¼ times the lowest rate of ordinary customs duty provided for manganese ore containing in excess of 10 percentum of metallic manganese the product of any foreign country except Cuba, at the time such ferromanganese is entered or withdrawn from warehouse, or consumption; but not more than 1⅞ cents per pound.

With the duty on manganese in ore reduced to ½ cent per pound by virtue of the Brazilian agreement, the new duty on ferromanganese will be 1 cent per pound of contained manganese in lieu of 1⅞ cents under the Tariff Act of 1930. As with other trade agreements, the reduction in duty will apply to all countries except as noted above.

In addition to reducing the compensatory duty on ferromanganese, the Canadian agreement at least halves the protective increment on the smelting operation.

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.

MOLYBDENUM

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

Ontario. The Phoenix Molybdenite Corporation, Toronto, continued operating its property in Bagot township, 8 miles southwest of Renfrew. The shaft was continued to 200 feet in depth from which point cross-cuts were driven to explore the ore found in the early part of the year by diamond drilling. The 25-ton mill was completed and a few tons of concentrate was produced.

Prospecting was carried out on the Joiner property, 2 miles northeast of Wilberforce in Cardiff township, Haliburton county. Over 3,000 feet of trenching was done. Owing, however, to the low average molybdenum content further work has been discontinued. Other prospecting in the same region included work on a molybdenite property at the west end of Baptiste lake.

Quebec. Prospecting was continued on the Bain property in Masham township, about 36 miles north of Ottawa. Drifting was conducted at the bottom of the 25-foot shaft that was sunk during the previous year. Some work was done on molybdenite showings on the west side of Meach lake, 15 miles northwest of Ottawa, in concession IX, Eardley township.

Several hundred tons of ore was mined and a few tons of concentrate was produced by the Phoenix Molybdenite Corporation, near Renfrew, but no sale was made during the year.

In 1936 Canada imported 158,621 pounds of calcium molybdate valued at $60,363, for use in the manufacture of steel alloys; in the previous year the imports were 74,994 pounds valued at $26,192.

The world total production in 1936 was about 9,500 tons of metallic molybdenum. The United States contributed 8,593 tons, which is almost 3,000 tons greater than in 1935, and constituted an all-time record. The Climax Molybdenum Company at Climax, Colorado, continued to be the leading producer contributing nearly 89 per cent of the total domestic output, while a substantial output was maintained by the Molybdenum Corporation of America, near Questa, New Mexico, and the Arizona Molybdenum Corporation in Pinal county, Arizona.

The largest production outside the United States comes from Cananea in Mexico, which in 1936 had an output of high-grade molybdenum sulphide concentrate containing 534 tons of the metal. The Knaben mine in Norway increased its output, which amounted to about 745 tons of molybdenite concentrate. Several other companies were active in Norway. Production was also maintained from the Azagour district in French Morocco and in 1935 amounted to 150 tons of 85 per cent MoS_2 concentrate. 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.

Molybdenum is chiefly used to intensify the effects of other alloying metals, particularly nickel, chromium, and vanadium. The extended use of molybdenum in many fields has caused a considerable increase in consumption. In several industries, such as oil-refining and in steam plants, molybdenum steels are replacing other materials, and in some instances are replacing tungsten in the high-speed tool steel industry. For use in hard-wearing and special parts, especially in automobiles, molybdenum steels are gaining favour on the American continent as well as in Europe. The application of molybdenum in cast iron has greatly increased since it was first thus employed in 1929 and in the United States over 10 per cent of the molybdenum consumed is used for this purpose. A considerable amount of molybdenum wire and sheet is used in the radio industry. Amongst the newer uses are molybdenum pigments and the production of certain deposits on metals, thus replacing to some extent electrolytic methods. 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.

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. Calcium molybdate is about 87 cents and ferromolybdenum $1 per pound of contained molybdenum, f.o.b. Montreal.

Activity in molybdenite prospecting and mining increased appreciably throughout the world during the year. There were a considerable number of inquiries for Canadian material, but these, however, call for regular tonnage of a consistent grade of concentrate over fairly long periods.

NICKEL

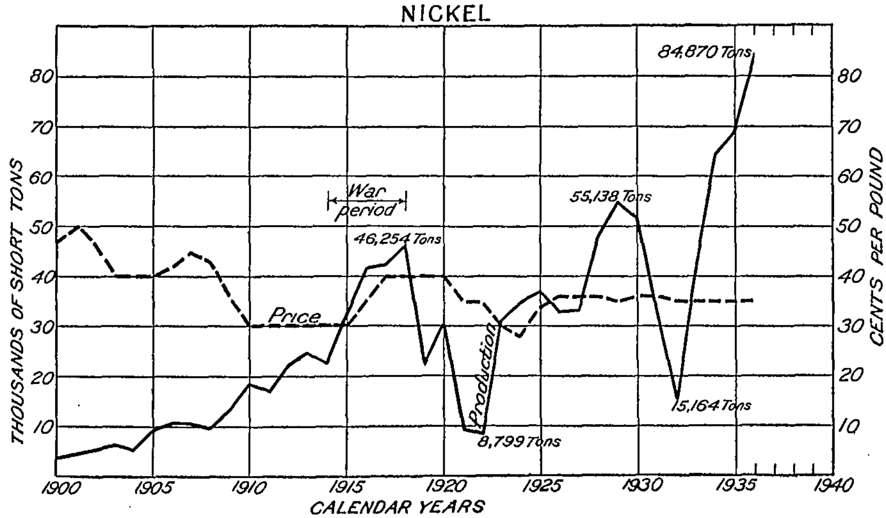
Nearly all Canada's nickel is derived from the nickel-copper ores of the Sudbury district, in Ontario; though a small amount also is recovered, as a by-product, from the silver-cobalt ores of Cobalt and similar camps in the northern part of the same province.

Proved ore reserves of the International Nickel Company of Canada, Ltd., the chief producing company, alone amount to well over 200,000,000 tons. This company's chief mines, Frood and Creighton—from which most of the production at present comes—are the two largest known nickel deposits in the world. The Frood mine alone, though only partly explored, is known to contain over 125,000,000 tons of ore.

The plans for expansion announced by both the International and Falconbridge nickel companies in 1935 were carried to completion, or virtual completion, in 1936. In the case of International Nickel these include smelter additions to increase smelting capacity by about 30 per cent; increase in concentrator capacity from 8,000 to 12,000 tons of ore a day; the building of a new research laboratory at Copper Cliff; and increasing the capacity of the Clydach (Wales) refinery by about 40 per cent. Expansion of refining facilities at Port Colborne by about 43 per cent was also undertaken during the year, as well as the rebuilding of the Whitehead Metal Products' plant which was destroyed by fire. The big new vertical shaft at Creighton mine begun in January, 1935, reached its objective, 4,075 feet below the surface, in August, 1936. A total expenditure of some $12,000,000 is involved in the expansion plans carried out by International Nickel at its various Ontario plants during the year.

Plant expansion of Falconbridge Nickel Mines, Ltd., in 1936, will increase productive capacity by about 25 per cent. Plant extensions at the smelter will make possible the treatment of 1,250 tons or more of ore a day. Seven levels have been opened from the new No. 5 shaft, about which all mining operations will be centred, commencing early in the new year. According to a recent statement by the president, developments at Falconbridge in 1936 have been more than up to expectations.

B.C. Nickel Mines, Ltd. carried on development work steadily throughout 1936 on their property near Choate, B.C., with a view to putting in sight reserves of 2,000,000 tons of ore of an average grade of 1·25 per cent nickel. Particular attention was paid to developing the Pride of Emory ore-body, the largest opened to date. Shipments of 1,500 tons of picked ore averaging 4 per cent nickel were forwarded to smelting interests in Japan, presumably for use in metallurgical tests during the year.



Nickel production and price trends in Canada, calendar years 1900-1936.

Cuniptau Mines, Ltd. made some small shipments of nickel-copper matte from its 25-ton plant near Goward, in the Temagami Forest Reserve during the year. The company is reported also to have optioned the old Alexo nickel mine near Porquis Junction and to have dewatered it for examination.

Interesting and possibly important discoveries of nickel-copper deposits, apparently similar in composition to those of Sudbury, were made during the year, one near Dryberry lake about 40 miles southeast of Kenora in the Lake of the Woods district; another at Dinty lake, about 23 miles northeast of lake Athabaska, in northern Saskatchewan.

Nickel production in Canada in 1936 was 169,737,864 pounds valued at $43,878,413, as against 138,516,240 pounds valued at $35,345,103 in 1935.

Some interesting remarks made by the president at the annual meeting of the shareholders of the International Nickel Company held in Toronto early in 1936 are worth quoting: "Unquestionably a small percentage of your nickel output, in common with other metals, enters into the manufacture of armament, and a war would temporarily increase demand for supplies of this character. Such a demand would be temporary only and might be followed by a disastrous interruption of your company's well established efforts in the great fields of peacetime industry. . . . war demand is neither desirable nor profitable for the nickel industry."

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 Frood copper-nickel mine near Sudbury has added considerably to the Canadian production of metals of the platinum group, as the ores of this mine contain a notable amount of these metals.

The Acton refinery located 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 refining capacity for the large output of platinum metals from the Frood mine, this refinery was enlarged in 1932 to a capacity of 300,000 ounces a year of platinum group metals.

The Canadian production of platinum in 1936 was 131,571 ounces valued at $5,320,731, as against 105,374 ounces valued at $3,445,730 in 1935. The production of palladium and other associated metals of the group was 103,671 ounces, valued at $2,480,075 in 1936, as against 84,772 ounces, valued at $1,962,937 in 1935.

The imports of platinum products in 1936 were valued at $171,145, as against $77,898 in 1935. Exports in 1936 were valued at $6,852,597, as against $5,081,518 in 1935; export records do not show the metals of the platinum group present in exported copper-nickel matte.

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 the largest producer of palladium. This condition is a corollary of the great increase in the Canadian output of nickel.

The price in New York of refined platinum opened the year 1936 at $38 an ounce. This fixed price gradually dropped to $32 in May, then increased to $70 in September, to drop again to $48 in November, at which price it remained to the end of 1936. The average for the year was $42.93 per ounce.

All the platinum metals produced from the treatment of the copper-nickel ores of the International Nickel Company are, after refining at the Acton plant, London, England, sold by the Mond Nickel Co., Ltd., 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 world's production of platinum and allied metals, as given by the United States Bureau of Mines, approximated 414,000 ounces in 1934, the latest year for which complete figures are available. The 1936 production will probably approximate 500,000 ounces, as the Canadian production alone will show an increase of about 45,000 ounces over that of 1935.

The world's consumption of platinum metals for 1936, as estimated by Baker and Company, will approximate 400,000 ounces, a remarkable gain over the 1935 figures of 275,000 ounces.

The continuous improvement 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 rayon manufacturing industry 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, while other uses are 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

The entire production of radium and uranium ore in 1936 consisted of pitchblende mined by Eldorado Gold Mines, Ltd., from its mine at LaBine Point, Great Bear Lake, N.W.T. While a few other occurrences of pitchblende have been reported at several scattered localities in the same general region, none of these has so far shown evidence of being of any serious economic importance.

The Eldorado mine was in active production throughout the year, and underground development of the main, or No. 2, ore-body was carried to 500 feet below the adit level, or a total depth of 590 feet below surface. From this point, it is intended to carry cross-cuts to the No. 1 and No. 3 parallel veins, opening up of which is expected materially to add to present known ore reserves. During the year, stoping was conducted east and west of the shaft on the 250-foot and 375-foot levels, where important widths of high-grade pitchblende and silver were reported to have been found. Most of the ore for the mill was drawn during the year from these levels, as well as from the 125-foot workings. The working force was raised from 65 men in 1935 to 93 in October 1936. A new electric hoist was installed on the adit level, and the power installation was increased by the addition of a 275 h.p. Diesel engine. The company reports a total of 1,200 tons of machinery, equipment, and supplies landed at the property during the navigation season, and 367 tons of concentrates shipped out by water. Milling was continued throughout the year, at an average of 75 to 80 tons daily. Products shipped include picked high-grade pitchblende and silver, and jig table and flotation concentrates. Fuel oil and gasoline are obtained from wells near Norman, at the mouth of Great Bear river, on the Mackenzie. Freight rates to the field, which have already been materially cut, are expected to be still further reduced by the completion during the year of a portage road around the Great Bear River rapids, a project undertaken by the Federal government.

Consolidated Mining and Smelting Company, which for some years has been conducting underground exploration of pitchblende-silver showings on claims adjoining Eldorado, closed down its operations in June. Bear Exploration and Radium (B.E.A.R.) proceeded with development of its mine at Contact lake, ten miles south of LaBine Point, but so far the property has been found to carry principally silver-cobalt-nickel mineralization, with only minor amounts of pitchblende.

Northwest Territories. Nothing further of importance developed during the year in connexion with other known occurrences or new discoveries of radium minerals in northwestern Canada. After a small amount of further prospecting during the winter of 1935-36 by Hottah Lake Gold and Radium Mines, Ltd., of the Arden group of claims at Beaverlodge lake, about 100 miles south of LaBine Point, work was abandoned and the property has since lain idle. Rich pitchblende was discovered at this point in 1934, and a few tons of ore were taken from surface pits.

The occurrence appears to be in the form of pockets or lenses in a large quartz body, the pitchblende being associated with massive hematite; it is thus of distinctly different type to that at Great Bear Lake, where the ore occurs in definite veins, associated with native silver and cobalt-nickel arsenides. No further work was done during 1936 either on the Watt-Kerr claims, on Hottah lake, or on the Murphy claims at Hardisty lake, on both of which groups narrow veinlets of pitchblende have been discovered, as reported in last year's review. It is stated that another similar pitchblende discovery was made during the year about 8 miles northwest of the Arden group, at the southeast end of Hottah lake; a selected small sample from this occurrence analysed in the Bureau of Mines laboratories yielded 22·32 per cent U_3O_8.

The above region lies inland. Water transport is available from Great Bear lake, via the Camsell river, but only for small, light-draught boats, and any development would have to depend mainly on aerial freighting.

Saskatchewan. As noted in last year's review, several small showings of pitchblende were discovered in 1935 on claims of Mineral Belt Locators' Syndicate, near the townsite of Goldfields, on the north shore of lake Athabaska. Although carrying high-grade pitchblende, the veins appear to be very narrow and hardly suggest the presence of commercial ore-bodies. No further work was done on these occurrences during 1936.

Ontario. Canada Radium Mines continued development during the year on its property at Cheddar, 7 miles south of Wilberforce, in Cardiff township, Hastings county, where pegmatite dykes, stated to carry unspecified radioactive minerals, occur. It was reported during the summer that a mill was to be erected on the property.

Figures of production, both of ore and refinery products, have not been released by the Eldorado Company for 1936, but there was a substantial increase in all departments over 1935. Most of the ore, comprising high-grade crude and concentrates, was shipped out by water, via the Mackenzie river, during the open navigation season, but a proportion was flown 300 miles from the mine to Fort Rae, on Great Slave lake, and thence transported by boat to railhead at Waterways, Alta. Consignments were also flown out the entire distance (800 miles) from mine to rail during the winter months.

The Eldorado refinery at Port Hope, Ont., treated 242 tons of ore during the year, for the production of radium and uranium salts, principally orange and yellow sodium uranate. In addition, an important recovery of silver, in the form of silver sulphide, is made from native metal intimately associated with the pitchblende. Refinery capacity underwent further expansion during the year, and in October was reported to be on a scale of 2 grammes of radium per month; the company has announced plans for stepping up production still further in 1937. On November 16, the company reported recovery of its first ounce (28·35 grammes) of radium. All of the radium produced is consigned to England for measurement and loading into needles; most of the output of uranium salts is shipped to England and the United States.

Exports and imports of uranium compounds are not recorded separately in trade statistics. Radium imported into Canada for medical and scientific use during the last five years has had the following values: 1932, \$45,108; 1933, \$8,374; 1934, \$211,140; 1935, \$150,643; 1936, \$109,032. These values, however, particularly for the period 1934 to 1936, represent largely both radium imported on a temporary rental basis and also Canadian radium sent to London for loading into needles and shipped back.

SELENIUM

Selenium, although fairly widely distributed, is not very 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 of selenium 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 of the gold-copper-zinc ore of Flin Flon, Manitoba.

The production of selenium in 1936 was 350,535 pounds valued at $620,447, as against 366,425 pounds valued at $703,536 in 1935.

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 but the output is restricted to a narrow market, chiefly in Great Britain. The whole production is marketed.

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 photo-electric 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, at present inactive, 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 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 mines (now idle) 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 719,959 fine ounces for 1936.

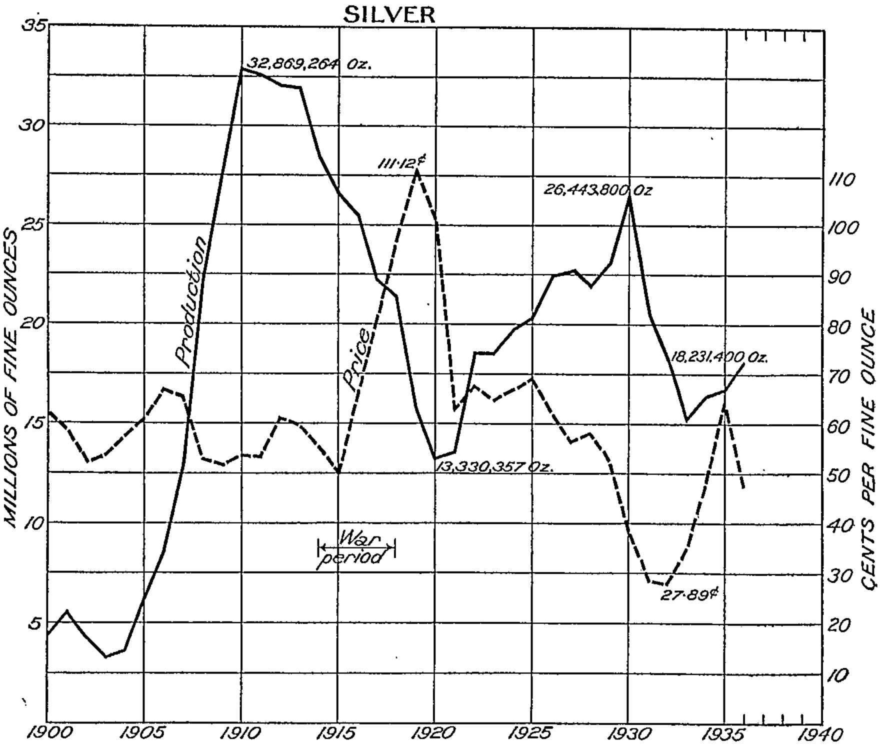
The silver mines of Cobalt and adjoining areas in Ontario have in recent years been showing a gradual falling-off in production accentuated by the low price of silver. The improvement in the price of silver in 1934 and in 1935 stimulated production for a short time particularly by lessees, who are operating several of the old former producing properties. The increased production of the Sudbury nickel-copper mines added noticeably to the Ontario silver production. The Ontario production was 5,205,109 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 remained idle in 1936 but it is expected to be in production in 1937. The gold ores of eastern Manitoba also contributed a small quantity of silver. The Manitoba-Saskatchewan production in 1936 was 1,433,988 ounces.

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 gold mine, and by various smaller mines in West Kootenay. The British Columbia production was 9,710,979 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 an important recovery of native silver; the output was greatly in excess of that for 1935. The Bear Exploration and Radium, Ltd. (B.E.A.R.) installed a 25-ton concentrator in 1935, but made no shipments in 1936. Consolidated Mining and Smelting Company proceeded with development at greater depth. El Bonanza did further underground exploration work. The production from the Yukon and Northwest Territories amounted to 1,053,733 ounces in 1936.

The total Canadian production of silver in 1936 was 18,231,419 fine ounces, valued at $8,227,840, as against 16,618,558 fine ounces, valued at $10,767,148 in 1935.



Silver production and price trends in Canada, calendar years 1900-1936.

The exports in 1936 were 3,347,167 ounces of silver in ore and concentrate valued at $1,494,237 and 12,783,708 ounces of silver bullion valued at $5,789,310; in addition Canadian silver coins to the value of $65,446 were exported.

The imports in 1936 included unmanufactured bullion to the value of $2,389,842 and manufactures of silver to the value of $158,747.

The world's production of silver is estimated at 246,350,000 ounces.

The price of silver in New York in 1936 averaged about 45·1 cents a fine ounce, as against 64·3 cents in 1935.

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 terminating on January 1, 1938, or when the Government of India shall have disposed of 175,000,000 fine ounces, and is conditional on similar undertakings being entered into by Australia, the United States, Mexico, and Peru, covering an aggregate of 35,000,000 fine ounces annually. The Bank of Canada, acting for the Government of Canada, purchased the stipulated amount in 1936.

TELLURIUM

Tellurium has been found native and is also an essential constituent of several minerals, but none of these minerals has been found in quantity 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, Manitoba, Ontario, and Quebec.

At the present time two electrolytic copper refineries are operating in Canada, both of which have recently installed plants for the recovery of tellurium from their refinery sludges, and for the production of refined metal; one of these refineries, that of the Ontario Refining Company, at Copper Cliff, Ontario, started production in March, 1934, and the other, that of the Canadian Copper Refiners, Ltd., at Montreal East, Quebec, started production in 1935. The former refinery 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 produced by Noranda Mines, Ltd., at Noranda, Quebec, and the blister copper produced by Hudson Bay Mining and Smelting Company, at Flinflon, Manitoba.

There has been no recovery so far in Canada from sulphuric acid chamber sludges.

The production in 1936 was 52,724 pounds valued at $93,322, as against 16,425 pounds valued at $32,850 in 1935.

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

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 art and also for blackening art-silverware; in a hydrocarbon compound, diethyl telluride, it found some use as an anti-knock compound in gasoline. 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.

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

TITANIUM

Ilmenite, carrying from 18 to 25 per cent titanium, is known to occur at several places in the province of Quebec and small shipments have been made from time to time from deposits at St. Urbain in Charlevoix county and at Ivry in Terrebonne county.

The chief shipments from the St. Urbain area have been from the General Electric Company's mine, chiefly to the same company's manufacturing plants in the United States. Other shipments from St. Urbain have gone to Niagara Falls, N.Y., presumably to be used in the production of ferrotitanium in the plant of the Titanium Alloy Manufacturing Company.

The chief use of titanium is in the manufacture of pigments, a use that has grown rapidly during the last few years. The next most important is in the manufacture of ferrotitanium. It is also used as a minor constituent in a number of special alloys.

In 1927, a company, called Titanium (Canada), Ltd., acquired the Ivry deposits with a view to manufacturing titanium white from Canadian ilmenite, but the project failed to materialize; in 1935 it was reported that E. I. du Pont de Nemours and Co., Inc., of Wilmington, Delaware, U.S.A. had acquired an ilmenite property at St. Urbain, Que., and in May, 1936, St. Lawrence Alloys, Ltd. had under consideration the manufacture of ferrotitanium at Beauharnois, Que. In so far as is known, however, no active steps have yet been taken for the production of titanium products in Canada.

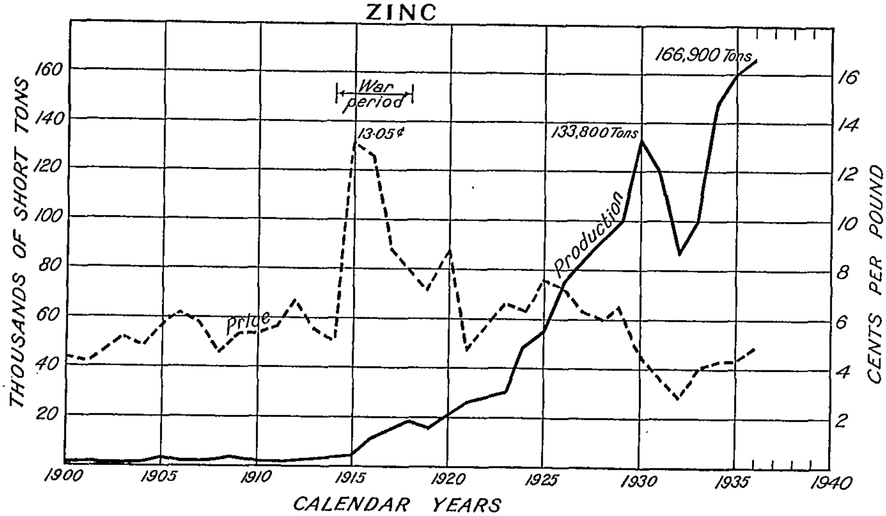
ZINC

Nearly three-quarters of the zinc produced in Canada comes from the Sullivan silver-lead-zinc mine near Kimberley, British Columbia. The rest of the production is from the Flin Flon copper-zinc mine at Flinflon, Manitoba; the Britannia copper mine on Howe Sound, and several small properties in West Kootenay district, British Columbia; and from the Tetreault lead-zinc property near Notre-Dame-des-Anges, Portneuf county, Quebec.

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. 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 the West Kootenay district, which had resumed operations in 1935 after several years of idleness, continued in operation during the year 1936. The principal amongst these are the Mammoth near Silverton, the Noble Five and the Rambles near Sandon, and the Whitewater near Kaslo.

In Manitoba, development at 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 34,000 tons of slab zinc.



Zinc production and price trends in Canada, calendar years 1900-1936.

The Sherritt-Gordon copper-zinc mine, situated about 50 miles northeast of Flinflon, which has been idle since May, 1932, was reopened in 1936; operations consisted in exploration and development and in overhauling the surface plant. Milling is expected to be 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, the Waite-Amulet and the Normetal (Abana) mines remained idle, awaiting more favourable market conditions.

In Nova Scotia, the Stirling copper-lead-zinc property in Cape Breton, after a few years of idleness resumed operations early in 1936.

The Canadian production of metallic zinc in 1936 was 333,857,460 pounds valued at $11,067,375, as against 320,649,859 pounds valued at $9,936,908 in 1935.

The exports in 1936, chiefly in the form of spelter, were valued at $9,315,034, as against $8,211,142 in 1935.

The imports in 1936 of zinc products of all kinds including oxide and chemicals, were valued at $1,845,988, as against $1,730,889 in 1935.

The world's production of zinc in 1935, as given by the Engineering and Mining Journal, was 1,487,383 tons. The production for 1936 is estimated at 1,631,000 tons.

Canada is 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 average price of zinc at Montreal for 1936 was 4·15 cents per pound as against 3·99 cents in 1935. The St. Louis price was 4·90 cents as against 4·33 cents in 1935.

The world consumption in 1935, as given by the United States Bureau of Mines, was 1,351,100 metric tons, an increase of 17 per cent over 1934; the consumption in 1936 was much in excess of that for 1935, and a further increase is anticipated for 1937.

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 flashlight batteries, and for making zinc oxides.

ARSENIOUS OXIDE

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

In the autumn of 1935, O'Brien Gold Mines, Ltd. put in operation a baghouse to extract arsenic from the fume 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 mine in Quebec, and the Bralorne gold mine in British Columbia, both ship arsenical gold concentrate to the Tacoma smelter in the United States, but no payment is made for the contained arsenic.

Besides those mentioned above, deposits containing arsenopyrite associated with gold are known to occur and some are being worked for gold in the provinces of British Columbia, Ontario, Quebec, and Nova Scotia. These, in the aggregate, could no doubt supply considerable amounts of concentrate suitable for the production of arsenic were it profitable to do so.

Production of arsenious oxide in Canada in 1936 was 1,365,606 pounds valued at $42,491, as against 2,558,789 pounds valued at $75,326 in 1935.

Exports of arsenic in 1936 were 688,400 pounds valued at $25,004, as against 2,230,600 pounds valued at $69,866 in 1935.

Imports were: arsenious oxide 529 pounds valued at $90, as against 11,759 pounds valued at $546 in 1935; and other compounds of arsenic valued at $40,638, as against $38,236 in 1935.

Though world consumption of white arsenic has fluctuated considerably during the last ten years the quoted price has remained at approximately $3\frac{1}{2}$ 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 asbestos, which is of the chrysotile or serpentine variety, is all obtained from the Eastern Townships, Quebec. Fibrous minerals similar in structure to asbestos but whose fibres lack 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.

Since the beginning of the year several dormant properties are reported to have been reopened. Explorations and developments on the properties of the 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 has resulted in remarkable reductions in mining costs, in improved mill feed, and in improved working conditions.

The production in 1936 was 301,287 tons valued at $9,958,183, as against 210,467 tons valued at $7,054,614 for 1935. The 1936 output showed an increase of 46 per cent in quantity and 44 per cent in value.

World production in 1934 (1935 and 1936 not yet available) was approximately 281,793 metric 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 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. In 1935 the exports were: asbestos, 100,186 tons valued at $5,300,176; asbestos sand and waste, 100,025 tons valued at $1,585,481; and manufactures of asbestos valued at $175,452.

By far the greatest 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 1936 were 84 tons of asbestos packing valued at $60,978; brake and clutch linings, valued at $321,163; other products not specifically designated, valued at $506,646.

Apparently 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 three 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 trend in the automobile and construction industries.

The price of crude No. 1 fibre was advanced from $500 per ton in February to $550 per ton in March, at which figure it has remained up to the end of September; the demand for this grade of fibre exceeded the supply. For the first nine months of the year crude No. 2 prices ranged from $200 to $225 a ton; spinning fibres from $90 to $150; magnesia and compressed sheet fibre, $90 to $110; on the other grades the prices were fairly constant, ranging from a minimum of $11 a ton for shorts to a maximum of $75 a ton for high-grade shingle stock.

BARITE

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 cheap 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 is consumed locally. Other deposits in the same province are in Colchester, Hants, and Pictou counties, but no mining has been done on these 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 start up an idle mine in Langmuir township, in the Porcupine district, was made a few years ago, and the existent mill was reconditioned, but the operation closed down without attaining commercial production. Most of the interest in 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 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.

Imports of powdered barite in 1936 totalled 1,658 tons valued at $26,554, compared with 2,139 tons valued at $33,739 in 1935.

BENTONITE

Bentonite is the name given to a peculiar type of clay resulting from the alteration in place of volcanic dust beds. This clay consists of exceedingly fine particles, and possesses colloidal character. Occurrences of clay of bentonitic type 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 received any attention as possible sources of production. The Princeton beds are quite thick, 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. It is utilized mainly in oil and gasoline refining and as a concrete admixture. Several scattered deposits in the Morden district, in Manitoba, have attracted some attention during the past two or three years from Winnipeg interests, and one carload is stated to have been shipped to that city during 1936. 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.

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 types of cement; as a concrete admixture, and for a variety of other minor uses. Much of the clay used for decolorizing (bleaching) purposes 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 firms specializing in the production of this class of material.

No production of bentonite was reported in 1936. Forty-one tons, valued at $781, were produced in 1935.

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. The price of activated bentonite, carload lots, averaged in 1936 around $65 to $75 per ton, delivered eastern Canadian points.

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, 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. 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.

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 south-eastern Manitoba. The first-named probably offers the best chances for development: it has been worked on a small scale at various times and has yielded a few tons of beryl crystals from small surface pits. During 1936, the property was operated for both feldspar and beryl by Renfrew Minerals, Ltd., 901 Royal Bank Building, Toronto, who report a recovery of about 20 tons of hand-picked beryl. 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.

In October, 1936, 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.

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 1936, two companies, namely, Abasand Oils, Ltd. and the International Bitumen Company, Ltd., have been actively engaged in development work. As a result it is anticipated that commercial production of liquid and solid hydrocarbons from the bituminous sand will begin in 1937.

The Department of Mines[1] 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 bitumen separated from it have been made. Various industrial applications for the separated bitumen, as for example, in the manufacture 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. Representatives of private capital have recently completed further studies with a view to commercial development. 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 production and transportation costs. The former 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 40,000 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 materialized. In the east the plants operate throughout the year at a percentage of rated capacity, while 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 plants are now equipped with stock houses sufficient to take care of the natural contraction of sales during the winter season.

During 1936 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. Marys, 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 1936 was 4,508,718 barrels valued at $6,911,416, as against 3,648,086 barrels valued at $5,580,043 in 1935.

Exports in 1936 were 68,929 barrels valued at $56,909, as against 55,607 barrels valued at $44,365 in 1935.

The imports of Portland cement and hydraulic lime in 1936 were 39,867 barrels valued at $107,180, as against 17,738 barrels valued at $60,079 in 1935; in addition certain unspecified cement products valued at $7,141 were imported in 1936.

[1]Now Department of Mines and Resources.

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

	1934	1935	1936
Quebec	$1.42	$1.41	$1.41
Ontario	1.41	1.41	1.48
Manitoba	2.10	2.27	2.28
Alberta	1.99	1.99	1.95
British Columbia	1.90	1.87	1.85

CHROMITE

Until 1923 practically all the chromite mined in Canada came from the Coleraine area in the Eastern Townships, Quebec; but since then the only production from this source has been a few small intermittent shipments.

The Obonga Lake chromite deposit, in Thunder Bay district, northwestern Ontario, has been under development these last few years and small shipments were made from this property in 1935 and 1936.

The Asbestos Corporation has been mining some chromite ore from one of its properties in the Thetford asbestos field, in southern Quebec.

The Chromium Mining and Smelting Corporation, Ltd. carried on development work on the Obonga Lake chromite deposit situated 26 miles south of Collins, a station on the Canadian National railway. The company according to press reports built a 100-ton concentrator at its Obonga mine in 1936. It also erected and put in operation a modern electric smelting plant at Sault Ste. Marie, for the production of ferrochrome and ferrosilicon. Operations to date appear to have been largely of an experimental nature.

Some five or six years ago considerable work of an investigatory nature was done on chromite deposits in British Columbia, but there have been no reports of recent activity in connexion with these.

Production of chromite in Canada in 1936 was 545 tons valued at $8,508, as against 1,144 tons valued at $14,947 in 1935. The 1936 figures of Ontario production are not available for publication.

Imports of chromium ore into Canada are not separately recorded. In 1936 imports of chromium products included: 2,959,488 pounds of sodium bichromate valued at $178,167; 139,735 pounds of potassium bichromate valued at $11,556; chrome firebrick to the value of $68,082; nickel-chromium bars and rods, containing more than 10 per cent chromium, 52,825 pounds valued at $51,170; and chromium metal and tungsten metal and scrap alloys of these two metals, 140,834 pounds valued at $60,382.

The world's present annual production of chromite is estimated at 700,000 metric tons. In 1934, the latest year for which complete statistics are available, the production, as reported by the United States Bureau of Mines, was 619,000 metric tons.

The New York price for chrome ore, per long ton, c.i.f. Atlantic ports, averaged about $16.50 for 45 to 47 per cent Cr_2O_3 ore and about $19 for 48 to 50 per cent ore. The price for 97 to 98 per cent metallic chromium was 93 cents per pound for the first quarter and 85 cents for the remainder of 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 the chief cause of the increased demand for chromite in recent years. Other important uses are for refractory materials and for metal for electroplating.

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. Some shipments were made by the Canadian Multi-Cell, Ltd., Martin Siding, and by the Diatomite Refiners Company, Novar, both in the Muskoka area, Ontario.

The Western Non-Metallics, Ltd., Vancouver, shipped a car lot from the deposit at Quesnel, British Columbia, formerly owned by the B.C. Refractories, Ltd.

The bulk of the output was produced, as in former years, by the International Diatomite Industries, Ltd., Tatamagouche, Nova Scotia. The decrease in production below that of 1935 was due to a substantial decrease in the use of diatomite in battery boxes, for which purpose the bulk of the Nova Scotia diatomite was formerly employed. The company's New Annan calcination plant operated most of the year. 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, a carefully prepared product, which had never before successfully competed with the imported filter-aids. Other outlets for the Nova Scotia diatomite were as a filler in various trades, for insulation purposes, and as a metal polish base.

Continued prospecting in southern New Brunswick by Mr. W. M. Campbell, of West Saint John, New Brunswick, revealed more diatomite ponds, some of which contain muds capable of producing high quality calcined diatomite.

In the Muskoka region of Ontario, several companies were active during the year. The Canadian Multi-Cell, Ltd., Toronto, operated continuously for a little over a month and produced a consistent grade of diatomite in its plant, situated close to the railway at Martin Siding, near Huntsville. Several car lots of prepared diatomite were sold for filtration, filler, and insulation purposes. The plant is at present closed down, pending adjustments to the filter unit, but the company expect to continue operations in the spring of 1937. The mill of the Diatomite Refiners Company, Toronto (late Dominion Diatomite Company), near Novar, was burnt down early in 1935; the treatment plant was, however, rebuilt and a few tons of diatomite was burned in small open kilns. A small amount of diatomite peat was dug and air-dried by J. Tynan and E. R. Cox from a deposit one mile north of Novar, about a ton of which was burned in a small kiln. The Muskoka Diatomite, Ltd., Toronto, erected a treatment plant on its property south of

Gravenhurst and production is expected as soon as the mill is completed. A drainage system of the swamp was carried out during the year.

Deposits on lot 1122 of the B.C. Refractories (Fairey and Cunliffe, Vancouver) were not operated, but a car lot of diatomite was shipped by the Western Non-Metallics, Ltd., who leased this claim. The latter company also continued prospecting the Burnaby Lake deposit situated close to Vancouver city, and a small amount of the diatomite mud was put through an experimental plant erected in Vancouver.

In the United States during 1936 there were 19 producers, most of which showed an increase, indicating a slight increase over 1935, the total sales for that year being estimated at 110,000 short tons.

The Canadian production in 1936 was 670 tons valued at $14,750, as against 823 tons valued at $33,140 in 1935. 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 1936 amounted to 241 tons as against 246 tons in 1935.

The imports in 1936 were approximately 2,725 tons almost all from California, U.S.A., against 2,550 tons in 1935.

There was no change in the consumption of Canadian diatomite used in the home industries during the year but the demand as a filter-aid, both for sugar and for use in cleaning establishments slightly increased. Approximately 87 per cent of the diatomite now being consumed in Canada is in the form of filter-aids, about 10 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, one of these using mainly diatomite imported or purchased in 1933.

General improvement in business throughout the country, especially in the building and allied industries, should cause an increased demand, particularly for concrete admixture and insulation material.

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 properly prepared diatomite of the highest quality can now be successfully marketed on a scale sufficiently large to warrant the operation of a property and the erection of a plant.

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 widely distributed 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 purity of rock and cost of transportation to grinding plant. Mechanical methods of cleaning spar to the grade of purity demanded by the trade, while 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 dependance being placed on cobbing and hand-picking. Deposits where such methods 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. 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, Ont., with a number of mines, all 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 past three years, a single mine in the Pointe du Bois district, southeastern Manitoba, has been in production, with a reported total output to the end of 1936 of around 7,000 tons.

Little occurred during the year in the way of changes in the industry or important new discoveries, and production continued to be drawn in the main from established mines. A small tonnage was shipped for the first time from a deposit in Lyndoch township, Renfrew county, Ont.; the pegmatite also carries considerable amounts of beryl, and it is hoped that it may prove possible to win beryl and feldspar simultaneously. A new deposit of high-grade spar was opened on the old High Rock phosphate property, in West Portland township, Que., and in the three months August to November, 600 tons was produced.

The new operation of Canadian Nepheline, Ltd., at Lakefield, Ont., noted in last year's review, came into active production during the year, producing about 20 tons per day of crushed nepheline syenite, a material that has found high favour in the glass industry as a substitute for straight feldspar. The rock consists of a mixture of nepheline and potash and soda feldspars, having a considerably higher alumina content than feldspar. It contains a small amount of iron-bearing impurities, in the form of magnetite grains and flakes of muscovite and biotite micas, which have to be removed by magnetic separation to make a marketable product. Extensive deposits of the syenite occur in the nearby township of Methuen, Peterborough county, as well as in the Bancroft area, Hastings county, farther east. There was some active prospecting of certain of the known nepheline-bearing areas in the region during the year by Canadian Flint and Spar Company and several deposits having commercial possibilities were reported. Canadian Nepheline, Ltd. reports an exceedingly favourable reception for its product by the glass trade, both in Canada and the United

States, with demand much in excess of plant capacity. At the end of the year, it was decided to step up production by the installation of a second magnetic unit. Outside of the glass trade, the product has been found to be valuable for a variety of ceramic uses and it seems likely that it may come into progressively increased demand in place of feldspar.

The feldspar production in 1936 was 17,895 tons valued at $147,891, as against 17,742 tons valued at $144,330 in 1935.

Exports of feldspar in 1936 amounted to 14,133 tons valued at $94,537, compared with 9,959 tons valued at $59,893 in 1935. Most of the Ontario and Quebec exports are consigned to grinding plants at Rochester, N.Y., while all of the Manitoba production is shipped to a mill at Warroad, Minnesota. A small amount of specially selected, high-grade spar is exported for use in the manufacture of artificial teeth.

The imports of ground spar were 718 tons valued at $13,955 in 1936 and 608 tons valued at $10,995 in 1935. Imports of crude feldspar were 23 tons valued at $285, as compared with 1 cwt. valued at $5 in 1935.

The two domestic mills grinding for the ceramic trade, that of Frontenac Floor and Wall Tile Company, at Kingston, Ont., and of Canadian Flint and Spar Company, at Buckingham, Que., were in steady operation throughout the year, as was also the grinding unit of the Bon Ami Company, at Montreal East.

Price levels showed a slightly downward trend, with No. 1 ceramic grade quoted at $5.50, f.o.b. rail or mill. Ground spar remained steady at $16 per ton, ex mill.

FLUORSPAR

Few important occurrences of fluorspar are known in Canada, and practically the whole of the domestic requirements of 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. 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 has been operated intermittently since 1918, the last occasion being in 1929, when nearly 18,000 tons were produced; the total output is estimated at around 50,000 tons.

In 1936, the small recorded tonnage of 75 tons, valued at $900 was all recovered from small surface workings and waste dumps in the Madoc area. In the previous year the production was 75 tons valued at $900.

Imports of fluorspar into Canada in 1936 were 11,194 tons valued at $95,268, compared with 11,591 tons valued at $92,775 in 1935. The material came chiefly from Great Britain (2,229 tons), United States (2,335 tons), Spain (2,031 tons), Newfoundland (3,555 tons), and Germany (1,044 tons).

GARNET

Garnet, crushed, screened, and suitably sized, is used for making abrasive-coated papers and cloths for rather clearly defined special uses in certain manufacturing industries. About 140 tons of prepared garnet now used in Canada is being imported as graded grains, there being no Canadian production. Attempts to produce suitable garnet grains in Canada have been made, but no commercial development has followed, partly because the existing market is a very small one and partly because suitable and accessible material has not been located in sufficient quantity. Several small lots of garnet from various localities were sent during the year to the Bureau of Mines ore testing laboratories for concentration and abrasive tests, but none was found to be quite so satisfactory as the standard garnet at present in use.

GRANITE

(Building, Monumental, and Crushed)

The stone quarried in this industry consists of granite and other related crystalline igneous rocks used for building, decorative, monumental, or construction 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 these purposes has been seriously affected. The improvement shown in these branches of the industry during the past two years leads one to believe that, while production is still far below the record years, the recovery may be steady.

In December, 1935, W. T. Dauphinee, who operates a granite dressing shed at Shelburne, Nova Scotia, opened up a new "black granite" quarry 6 miles west of Shelburne, and monumental dies from this deposit are being marketed throughout the province. G. W. Horne operated throughout the year, in a small way, his "black granite" quarry at West Erinville, Guysborough county, N.S., producing monumental dies for the Maritime market.

The province of Quebec furnishes most of the granite for building, the Stanstead, Scotstown, and St. Sebastien 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.

Further work was done on the quarry of grey granite in Manitoba, 100 miles directly east of Winnipeg on the Winnipeg-Kenora highway. Stone from this quarry was supplied for the Dominion Government office building on Main street, Winnipeg, in 1935.

Granite for monumental purposes 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 would find a ready market for its product. There are deposits of "black granite" at several localities in the Maritime Provinces, Quebec, and Ontario which 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 1936 was 855,805 tons valued at $1,173,866, as against 326,354 tons valued at $1,126,287 in 1935.

Our exports were 1,156 tons valued at $8,788 (granite and marble unwrought), as against 1,255 tons valued at $10,301 in the previous year.

The imports of granite were valued at $100,122 in 1936, compared with imports valued at $99,136 in 1935.

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

Graphite production in 1936 continued to be confined to a single operator, the Black Donald Graphite Company, with mine and mill at Whitefish lake, 22 miles west of Calabogie, in Renfrew county, Ont. This is the only concern that has successfully weathered the various vicissitudes which have attended attempts at graphite production in Canada, and now has a record of about 27 years' operation. The deposit is of exceptional size and richness, and while 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 against the chance of 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. Despite the fact that United States possesses large known reserves of flake graphite, attempts over an extended period to mine and process the ores 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 which 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 ore 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 1936 was valued at $92,820, compared with $79,781 in 1935. Of this latter value, 1·6 per cent ($1,281) represents old stocks from an inactive Quebec producer; the remaining amount relates wholly to Black Donald operations.

Graphite exports for 1936 totalled 3,384 tons valued at $138,454, compared with 3,548 tons valued at $145,772 in 1935. Total graphite imports including crucibles were valued at $131,913 in 1936 and $137,477 in 1935.

There were no important changes during the year in the general world graphite industry. Following the general progress of industrial recovery, total production and consumption in 1936 will probably show a further increase. 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 used extensively in dry battery manufacture and 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. 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 so strong that the surface will resist corrosion and abrasion to a high degree.

GRINDSTONES, PULPSTONES, AND SCYTHESTONES

Grindstones. The Read Stone Company, Sackville, N.B., was the only producer in 1936. Most of the stones came from the vicinity of Stonehaven in the bay of Chaleur, N.B., and a few from Quarry island, Pictou county, N.S.

Pulpstones. The J. A. and C. H. McDonald Company, Vancouver, continued to work the new quarry on the northwest end of Gabriola island, near Nanaimo, Vancouver island, B.C.

Scythestones. The output of these stones, which are quarried by the Read Stone Company, Stonehaven, and by G. A. Smith, Shediac, N.B., was less than in 1935.

The production of all grades of stones in 1936 was 576 tons valued at $24,697; in the previous year the production was 708 tons valued at $34,010. The exports of these stones in 1936 were valued at $1,688 as against a valuation of $184 in the previous year. The imports, which consisted chiefly of pulpstones, were valued at $136,335, as against $144,223 in the previous year.

Canadian grindstones are quoted at $44 per ton, and pulpstones at $57 per ton.

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 shears 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.

GYPSUM

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

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. An increasing proportion of the calcined material each year 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 South Atlantic states.

The several large companies operating in Canada carried on under reduced production in 1936, maintaining, however, their endeavours to reduce operating costs and improve their products, so that, while their sales during the year are still below those of normal years, a decided improvement was shown over 1935.

In Nova Scotia, work was completed during the year on reopening the McAskill property, two miles east of Little Narrows on the south side of St. Patrick channel, Victoria county, Cape Breton Island. This property which was operated a number of years ago, has been acquired by New York interests under the name of the Victoria Gypsum Company. An up-to-date handling plant was erected at a cost of nearly $1,000,000 and the company is now in a position to handle large contracts for crude gypsum to both English and United States markets. One boatload has already been shipped to England. The plant has a capacity of from 200 to 400 tons per hour of material crushed to 2-inch to facilitate handling.

The Atlantic Gypsum Products Corporation, Ltd., of Boston, Massachusetts, U.S.A., with quarries at Walton, Cheticamp, and Aspy Bay, Nova Scotia, was purchased during the year by the National Gypsum Co., Buffalo, N.Y. Boatload shipments of crude gypsum from its Cheticamp property to London, England, were continued throughout the year, an increase being shown over the previous year.

Gypsum, Lime, and Alabastine, Canada, Ltd., of Paris, Ont., have sold out their minority interest in Gyproc Products, Ltd., of Rochester, Kent, England, and this company is now completely controlled by English capital.

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. There are also several known deposits in British Columbia, in addition to those already being worked, that may be operated when conditions warrant.

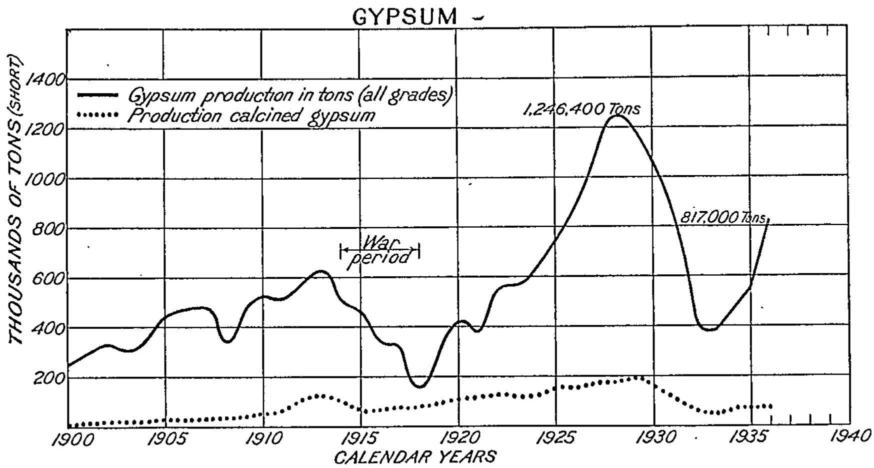
The Summit Lime Works of Lethbridge, Alta., has erected a one-kettle calcining plant at Lethbridge and is preparing hardwall plaster for the western trade. The crude gypsum rock is obtained from the deposit at Bull River in British Columbia.

The use of anhydrite in England for the manufacture of sulphuric acid, ammonium sulphate, and special plasters is rapidly increasing. Canada is fortunate in having extensive deposits of this material favourably situated for commercial exploitation, samples from which have been proved by tests carried out by the Bureau of Mines to be of excellent grade. At present the small production of anhydrite in Canada is exported principally as a fertilizer for the peanut crop, but when conditions are favourable Canadian anhydrite may be used for the manufacture of special plasters, similar to the material now being marketed in England. Extensive research work is now being carried on in the United States with a view to determining whether anhydrite can be partly if not wholly substituted for gypsum as a retarder in cement.

The production of gypsum in 1936 was 816,999 tons valued at $1,265,488, as against 541,864 tons valued at $932,203 in 1935.

The exports amounted to 651,129 tons valued at $775,290 as against 440,058 tons valued at $546,412 in 1935.

The imports were 1,170 tons valued at $29,359, compared with 2,006 tons valued at $35,718 in 1935.



Gypsum production in Canada, calendar years 1900-1936.

The general upward trend of business in Canada during 1936 was not nearly so marked in the building industry, an industry which usually lags from six months to a year behind any general improvements of business conditions. The gypsum industry, which is entirely dependent on the building industry, has not shown so rapid a rate of increase as some of the other industries, nevertheless the improvement in the past three years has been definite and steady each year, that in 1936 being quite marked.

The fact that a large percentage of the Canadian production is shipped in the crude form to the United States has a great influence on the Canadian gypsum industry, since the amount shipped is entirely dependent on the status of the building industry of the United States.

The production curve of gypsum in Canada shows a comparatively steady increase until 1907 when the depression started in the United States with a consequent falling-off of gypsum shipments. Increased production is again manifest up to the war years, but it is interesting to note that the greatest depression 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, until 1929, the rise is rapid, when an all-time peak production was recorded. With the start of the depression in the last months of 1929, the fall in production of gypsum in Canada was rapid and it is only in the last three years that the upward swing has again commenced. Probably the production curve for calcined gypsum gives a truer picture of the gypsum industry in Canada, since 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 remaining almost stationary for several years. The rise from 1919 to 1929 was gradual but steady, but fell off again gradually after the latter year as the results of the depression became more manifest. The upward trend for the last three years is small but definite.

The use of gypsum products in the building trades has made rapid progress in past years because of its 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 ores 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. Other deposits in Quebec worked in the past are located near Ste. Anne de Beaupre and Les Forges. The deposit near Ste. Anne de Beaupre was exhausted in 1930, while the deposit near Les Forges has not been used for several years past.

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 1936. 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. Should the demand increase, there are other prospective deposits which could be drawn upon; two of these are located in Saguenay county, Quebec, in the townships of Iberville and Bergeronnes respectively, and were investigated and sampled in 1929-1930 by the Quebec Bureau of Mines. A deposit in Lynch township, Quebec, has been a producer in the past.

There are numerous occurrences of ochres and iron oxides in Quebec and Ontario, and some of these might be utilized, should the market demand warrant their development.

In Nova Scotia there are various beds of ochres and umbers which have been worked in the past to a small extent. In Alberta and British Columbia, there are several known deposits of ochre, some of which have commercial possibilities, but owing to their present inaccessibility and also to the limited market they have had little development. In northern Manitoba, large deposits of ochre have been reported from the vicinity of Grand Rapids and Cedar Lake, but these also, for similar reasons, have not been developed. In Saskatchewan, there are several known deposits of ochres and iron oxides that as yet have not been developed commercially.

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 1936, totalled 5,854 tons valued at $69,629, as compared with 5,516 tons valued at $77,075 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 1,572 tons valued at $92,011 in 1936, as against 1,925 tons valued at $108,032 in 1935. Imports of all kinds of ochres, siennas, and umbers totalled 1,506 tons and were valued at $49,750 in 1936; in the previous year the total combined weights amounted to 1,555 tons valued at $54,661. In addition there were imported prepared oxides, fillers, and related products, some of which were probably not ochres, valued at $721,614 as against a valuation of $623,698 in 1935.

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 near St. Remi d'Amherst. A group of open pits and mines was operated for several years, but these workings were closed in 1923 and have not been reopened since. A nearby property is now being worked from which both china clay and silica are produced. The china clay, an air-separated product, is used mainly by the paper trade.

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. Recent developments at two points in this area will probably result in a small production of clay in the near future.

A 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 made to Vancouver were used as a fireclay.

The production of china clay in 1935 was 170 tons valued at $1,520. No production has as yet been reported for 1936.

The exports in 1936, chiefly ball clays, are reported to have been 3,297 cwt. valued at $2,600; in the previous year the exports were 5,591 cwt. valued at $2,595. The imports of china clay were 833,807 cwt. valued at $342,654; in the previous year the imports were 708,890 cwt. valued at $287,997.

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

Lime is marketed as quicklime and in the hydrated state, the latter product being a specially prepared slaked lime in the form of fine powder sold in 50-pound, multi-wall paper bags. Quicklime, which comprises about 80 per cent of the total sales, is marketed in lump, pebble, crushed, and pulverized forms. In the lump and pebble forms, quicklime is sold either in bulk or packed in barrels. Crushed quicklime (1 inch and under) and pulverized quicklime (ground to minus 20 mesh, and in some plants to minus 50 mesh) are sold in multi-wall airtight paper bags.

Lime is manufactured in every province except Prince Edward Island, though production in Saskatchewan is intermittent and small. Fifty-six plants were in operation during 1935. 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 produces more than half of the total output, and Quebec about a third.

The placing of pulverized quicklime on the market by a number of Canadian companies is a development worthy of note. It finds a market in the chemical and metallurgical industries and also competes with hydrated lime for plastering because when slaked it yields a highly plastic putty that does not require more ageing than does putty made from hydrated lime. Sales have increased rapidly, particularly in western Canada where highly plastic hydrated lime is not cheaply available. Producers report that pulverized lime packed in airtight bags will keep from 4 to 6 months without air-slaking, as against 2 to 3 weeks for lump lime.

During 1936 a lime kiln was built in the Red Lake district, Ontario, to supply lime to the gold mills in that district, and a new company—International Lime Corporation, Ltd., 609 Hall Building, Vancouver, B.C., was formed to engage in the production of lime from deposits of limestone on Nelson island. Three draw kilns were added to the plant of Gypsum, Lime and Alabastine, Canada, Ltd., at Beachville, Ont., and one draw kiln was added to the plant of Innerkip Lime and Stone Company, Ltd., at Beachville, Ont.

Localities where lime may be produced in the future are numerous because of the abundance of suitable limestone in most parts of Canada.

Conditions in the lime industry showed further improvement over those of 1935 owing largely to increased demand in the chemical and metallurgical industries. The establishment of new lime-using industries and the general increase in industrial activity augurs well for future production. There was also an increase in the volume of trade with the United States.

Lime production in 1936 amounted to 394,258 tons of quicklime valued at $2,728,736, and 79,006 tons of hydrated lime valued at $543,176, which represents a substantial increase over the 1935 production of 342,047 tons of quicklime valued at $2,425,422 and 63,372 tons of hydrated lime valued at $500,369. Exports of lime amounted to 11,666 tons valued at $97,574, as compared with 5,230 tons valued at $50,296 in 1935. Imports, which are all from the United States, amounted to 1,495 tons valued at $18,070, as compared with 1,708 tons valued at $21,671 in 1935, according to data supplied by the United States Bureau of Mines.

Prices of lime increased slightly during 1936. Prices per ton f.o.b. the principal plants were as follows: hydrated finishing lime, $12.75 to $18.50; masons' and chemical hydrate, $6 to $16; quicklime, $6 to $9.80. The wide range in price is due in large part to differences in the quality of the product and to the geographical location of the plants.

LIMESTONE (GENERAL)

Limestone is marketed in a wide range of forms, 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.

Limestone is produced in all the provinces except Prince Edward Island and Saskatchewan, most of the production being from Ontario and Quebec.

The rock wool industry which was established in Canada in 1934 following the researches and investigations made by the Mines Branch is developing rapidly. In 1936 a new plant was built at Caledonia, Ont., and two others were enlarged. Three plants in Ontario are now making rock wool and one each in Ontario and Quebec makes slag wool. Products include rock wool in bulk, batts, blankets, and granulated form, and also made up into pipe covering, insulating cement, and blocks.

Several new quarries were opened during the year chiefly to supply limestone for chemical use.

New uses are continually being developed for limestone, particularly for ground or pulverized material. Soft, pure limestone ground to a specified degree is being used for cleaning soft-metal moulds by a process similar to sandblasting. Pulverized high-calcium limestone, occasionally with iodine added, is now being widely used as an ingredient of poultry and stock foods. The forcing of a thick slurry made of limestone screenings and water beneath sunken portions of pavement has proved a satisfactory method of raising the pavement to grade. Increasing quantities of ground dolomite are being used in agriculture now that it is realized that magnesia as well as lime is required for the proper growth of many crops.

The 1936 production of limestone for general use, exclusive of that used for building stone, lime, and cement, is estimated at 3,785,000 tons valued at $2,918,000, compared with a production of 3,474,257 tons valued at $2,698,186 in 1935. The largest increases in production were for crushed stone for highway construction and in stone for chemical and metallurgical uses. Exports of limestone are not separately recorded, but comparatively small quantities, chiefly for use in sugar refineries and in agriculture, were exported to the United States. Imports are not separately recorded, but large tonnages for use as blast furnace flux are imported from the United States and Newfoundland, and lesser quantities for use in pulp mills in northern Ontario are imported from the United States. These importations are not because of any lack of suitable limestone in Canada, but because foreign limestone can be obtained more cheaply owing to its more favourable situation with respect to certain centres of consumption. Limestones of great variety of chemical composition and physical characteristics are available in Canada and are being extensively quarried for the numerous uses to which limestone is put. The current production of limestone for all purposes, including the manufacture of cement, constitutes about 95 per cent of the total Canadian stone production.

LIMESTONE (STRUCTURAL)

The principal quarries from which limestone for building purposes is obtained are at St. Marc des Carrières, Quebec (three quarries producing grey limestone); Montreal (two large and several small quarries producing grey limestone); Queenston, Ontario (one quarry producing silver-grey limestone together with small quantities of buff and of variegated grey-and-buff); Longford, Ontario (one quarry producing both buff and silver-grey limestone); Tyndall, Manitoba (three quarries producing mottled grey, mottled buff, and mottled variegated limestone). Other quarries producing small quantities of building stone for local use are worked near Quebec city and at Hull in the province of Quebec; and at Ottawa, Kingston, and Wiarton, in Ontario.

Some of the quarry companies produce 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.

In 1936 Queenston Quarries, Ltd., of Hamilton, Ont., purchased the property of Lake St. John Quarry Company, Ltd., at Longford, Ont., and added new equipment for the production of building stone and marble.

Quarries in Ontario producing limestone for building report a good demand for stone during 1936; but in Quebec and Manitoba production was less than that in 1935.

The total production of limestone for building purposes throughout Canada in 1936 is estimated as being considerably less than the 157,408 tons valued at $555,387 produced in 1935, though only incomplete data are as yet available. Only the value of dimension stone marketed either in mill blocks or in the finished state by the quarry companies is referred to above, the value of the work done on the stone by cut-stone contractors not being included. Exports of limestone for building are very small and are not separately recorded. Imports of all varieties of building stone, excepting marble and granite, during 1936, were valued at $33,124 as compared with imports having a value of $24,549 in 1935.

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 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 8 per cent 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 of 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 work has 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 there has been little further work done.

At Bernic lake, a number of outcrops of lithium minerals were found in 1930 during prospecting operations for tin, and about 100 tons of spodumene and 50 tons of amblygonite were mined and stock-piled; there has been only a small amount of work done since that year and no shipments have been made. 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 the 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 same company has recently acquired control of lithium deposits at Cat lake, north of the Bird river, where important amounts of spodumene occur.

Some interest was shown during the year in deposits of spodumene on the Kobar claims, near Wekusko lake, near Mile 81 on the Hudson's Bay railway, in northern Manitoba, from which a shipment of rock was sent to the Ore Dressing Laboratories of the Bureau of Mines for concentration tests.

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 such, as an ingredient of certain types of glass, particularly those of the heat-resistant (Pyrex) type. 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 salt 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 the chloride. A recent development, also, is the perfection of a process for making lithium fluoride in the form of single crystals having valuable optical properties.

The mineral spodumene, on account of its relatively high alumina content (27 per cent), as compared with feldspar, has lately attracted some attention as a possible silicate mineral for glass-making. Recent work by United States Bureau of Mines on methods of concentrating spodumene ores by decrepitation has given good results, and shows that material of high purity can be obtained from natural quartz-spodumene ores. Spodumene from the Kobar deposits in northern Manitoba has recently been treated by similar means in the Bureau of Mines laboratories at Ottawa with equally good results; the grade was raised from 1·95 per cent Li_2O in the crude material to 6·13 per cent in the screened, heat-treated product.

MAGNESITE

No magnesite, within the strict meaning of the term, is produced in Canada at the present time, but magnesitic dolomite composed of an intimate mixture of magnesite and dolomite, which when properly processed has proved more suitable than magnesite for many uses, is quarried and processed at Kilmar and Harrington East, in Argenteuil county, Quebec. Products marketed include caustic-calcined magnesitic dolomite, dead-burned or grain material, bricks and shapes, finely ground refractory cements; and, in combination with chrome, the dead-burned material is used as an ingredient in certain other types of refractories.

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

Brucite (hydrated magnesium oxide) occurs in limited quantity as an alteration product of serpentine in the asbestos-producing districts of the Eastern Townships of Quebec, and small quantities obtained in connexion with the quarrying of asbestos are exported to the United States.

Continued progress is being made in the development of new refractory products from the magnesitic dolomite deposits of Quebec. One of the newest developments is the production of chemically bonded unburned bricks and shapes, which have proved satisfactory for the lining of cement kilns and metallurgical furnaces. Certain of these materials are particularly adapted for use in the roofs of metallurgical furnaces. New cements and refractory basic plastics have also been developed, and uses have been extended for many of the other products made from magnesitic dolomite.

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

Deposits of earthy hydromagnesite occur in British Columbia near Atlin and Clinton, and large deposits of magnesite containing considerable amounts of silica and alumina occur between Cranbrook and Kimberley. These latter have been acquired by Consolidated Mining and Smelting Company and some development has been done as well as experimental work designed to remove the aluminium silicates, but there has been no commercial production to date.

Certain magnesium products such as magnesium metal and technical carbonate are currently being made in the United States and Europe from materials other than magnesite—metallic magnesium being made from magnesium chloride brine and from dolomite, and technical carbonate from dolomite. In California, sea bittern is used as well as magnesite for the production of magnesia.

Magnesitic-dolomite products having a value of $769,176, were marketed in 1936. This represents an increase of $283,092 over the value of the 1935 production. Exports of magnesitic-dolomite products are recorded as 2,928 tons valued at $71,183, as compared with 1,577 tons valued at $43,338 in the previous year, and imports of magnesite brick, caustic and dead-burned magnesite, crude and ground magnesite had a value of $626,351, as compared with the 1935 valuation of $426,793 on the same products.

Recent trends in the making of magnesia products have been toward the combination of a high degree of refractoriness and slag resistance with ability to resist shock and to carry load at a high temperature, and also toward the further development of chemically bonded unburned brick and shapes for lining cement kilns, lime kilns, and metallurgical furnaces. Caustic-calcined magnesitic-dolomite is used for fettling the bottoms of basic open-hearth furnaces, and for the construction of floors and floor tiles. Increased interest has been manifest in the use of the caustic-calcined products for construction during the past year owing to the greater activity in building.

MAGNESIUM SULPHATE

Natural hydrous magnesium sulphate (Epsom salts) occurs in brine lakes in British Columbia and in association with sodium sulphate in Saskatchewan. 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, said to have a daily capacity of 3·5 tons of refined Epsom salts, was erected at Ashcroft, B.C., to treat the crude salts recovered from lakes at Basque, B.C.

Epsom Refineries, Ltd., the company operating this deposit during 1935, remodelled and enlarged its plant at Ashcroft and is at present in a position to produce from 7 to 10 tons of refined salts per day. Its product is marketed, principally, in the tanning and medicinal industries.

The production in 1936 was 654 tons valued at $13,712, as against 340 tons valued at $7,965 in 1935.

The imports in 1936 were 1,790 tons valued at $37,928, as against 1,842 tons valued at $40,407 in the previous year.

MARBLE

Marble is produced in the form of squared blocks for sawing into slabs and monuments, and in the crude or broken state for making terrazzo, stucco dash, whiting substitute, marble flour, artificial stone, and building rubble. Waste from some quarries producing block marble is sold for chemical and metallurgical uses.

Marble quarries are operated in Quebec, Ontario, Manitoba, and British Columbia.

The largest marble quarry in Canada, at Phillipsburg, Que., is operated by Wallace Sandstone Quarries, Ltd. This quarry yields four varieties of clouded grey marble, some of which are lined and tinted with pale green. Black marble is also produced. The company also operates a large mill for the sawing and polishing of its products. Trenton limestone quarried for building stone at St. Marc des Carrières, Que., takes a good polish and yields a dark brownish grey marble, and some is so used. White dolomitic marble is quarried and crushed by White Grit Company at Portage du Fort, Pontiac county, Que., and by Canada Marble and Lime Company, L'Annonciation, Labelle county, Que., for the making of terrazzo, stucco dash, poultry grit, artificial stone, and other products.

In Ontario, black marble is quarried at St. Albert, near Ottawa, by Silvertone Black Marble Quarries. At Longford, near Orillia, the Lake St. John Quarry Company, Ltd. is producing buff marble and silver-grey marble; this stone is also used for building and has been used with satisfaction for sculpture. At Bancroft, Haliburton county, a number of handsome marbles are available, the most striking of which, known as Bancroft Laurentina, is a clouded-grey breccia in which the bond is of a rich chocolate colour. The Bancroft quarries are at present under lease by Rock Construction Company, Ltd., Toronto. White marble is quarried at Marmora by the Bonter Marble and Calcium Company, Ltd., and at

Haliburton by Bolender Brothers for the making of terrazzo, poultry grit, stucco dash, and artificial stone. Buff, red, white, green, and black marbles are quarried near Eldorado, Hastings county, by Karl Stocklosar of Madoc for use as terrazzo. Deep red limestone for the same purpose is also quarried near Bancroft by Wm. Morrison.

In Manitoba, green serpentine, mottled gold-and-buff, mottled purplish red, and rose marbles are available, but there was no production reported in 1936.

In Alberta small quantities of buff terrazzo chips are obtained from deposits of calcareous tufa near Calgary.

In British Columbia, the Canadian Marble and Granite Works, Ltd., of Edmonton, operates a quarry of bluish grey marble at La Blanche station on the Lardeau branch of the Canadian Pacific railway. The marble blocks are shipped to the company's plant at Edmonton for the making of monuments.

The recent increase in demand for marble, consequent upon increased activity in building, has stimulated interest in a number of undeveloped deposits. Trial shipments of blocks to firms in Toronto have recently been made from a deposit of banded blue marble 12 miles west of Lavant, Lanark county, Ont., and from a deposit of white marble at Kaladar, Lennox and Addington county, Ont. Other deposits of white and of green marble near Perth have been core drilled.

Continued efforts are being made to find new ways of utilizing marble. In the United States thin slabs of semi-translucent, light-coloured marble have been used in place of glass in large windows of buildings such as railway stations to obtain a soft diffused light free from the glare of direct sunlight. The property of marble to diffuse transmitted light is being taken advantage of in new lighting arrangements wherein white and coloured lights are placed behind thin slabs of specially treated marble, giving striking effects in which the veining of the marble is shown to advantage. Artificially coloured black marble is also now being marketed in the United States. White marble dust with white cement is being used for the making of permanent traffic markings on roads and streets.

Many deposits of beautifully coloured marbles in Canada, 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 1936 amounted to 20,492 tons valued at $162,642, compared with the production of 15,975 tons valued at $85,369 in 1935. Exports of marble are recorded with exports of granite and the exports of the two during 1936 amounted to 1,156 tons valued at $8,788, as compared with exports of 1,255 tons valued at $10,301 in 1935. Imports of marble during 1936 had a value of $67,361, against a value of $39,497 in 1935. Current imports of marble are mostly 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. Ordinarily a considerable quantity of block marble is imported, but the comparatively small current import of marble in this form is because large stocks of imported marble blocks are still on hand from 1929-30. 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 the past two years imports of black marble have practically ceased as the Canadian market is now being supplied from domestic quarries, principally from the recently opened black marble quarry at St. Albert, Ontario.

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 instead of slabs or tiles for flooring, 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, and 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.

The production of muscovite, or white mica, in Canada has been negligible. Small amounts have been recovered occasionally from feldspar mining operations, but, in general, the proportion of sound, merchantable sheet mica in Canadian pegmatites has proved too low for profitable mining.

Mica mining in Canada has been at a low ebb for a number of years past, with production 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. Mica demand stiffened somewhat during 1936, and led to an increased interest in mining, but this interest fell short of what might have been anticipated. There was some prospecting and working of both old and new properties, and toward the end of the year two long-idle mines in the Gatineau River district of Quebec were reopened.

In addition, there was a small production of muscovite mica from the old Pied des Monts mine, near Murray Bay, Que., as well as some prospecting of other muscovite occurrences in the Saguenay region.

Mention was made in last year's review of an unusual type of deposit of fine flake muscovite 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. This deposit is controlled by P. M. Ray, 23 Besner Block, Prince Rupert, who reports some development of the deposit during the year, with about 30 tons shipped to Vancouver for grinding. A report on tests made by the Ore Dressing Laboratories of the Bureau upon a shipment of crude mica from this occurrence has been published, (Mines Branch, Department of Mines, Canada, Report No. 748, Invest. No. 606), and copies may be obtained on application to the Director, Bureau of Mines, Ottawa. A small shipment of scrap mica imported from India is reported to have been 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 from the waste dumps of old mines.

The following figures show the production of the five leading mica products in 1935 and 1936:—

	1935		1936	
	Pounds	Value	Pounds	Value
Knife-trimmed..	111,459	$ 52,959	97,344	$ 42,207
Thumb-trimmed..	12,013	3,616	14,753	3,472
Splittings..	32,921	15,506	24,376	9,780
Rough-cobbed..	30,605	2,448	14,775	1,739
Scrap..	1,068,618	7,509	1,252,503	10,092
	1,255,616	$ 82,038	1,403,751	$ 67,290

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 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 operations, 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 where 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. The better grades of Canadian amber mica, however, 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 heater purposes.

The improved market for sheet mica noted in recent years was maintained, and dealers reported an active demand, especially from the British trade, for sizes 1 by 3 inches and up. As for some years past, most of the supply came from mines in Quebec province.

The mica-grinding plant at the Blackburn mine in Templeton township, Que., continued in operation throughout the year: most of the powder produced goes to the roofing and rubber trades.

Price averages improved slightly over 1935; dealers' quotations at the close of the year were as under:—

Knife-trimmed sheet	Per pound	*Splittings*	Per pound
1 by 3 inches..	$ 0·44	1 by 1 inches..	$ 0·45
2 by 3 "	0·70	1 by 2 "	0·50
2 by 4 "	0·95		
3 by 5 "	1·65		
4 by 6 "	2·00		
5 by 8 "	3·00		

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

Exports of mica of all classes in 1936 were valued at $87,300 as compared with $75,950 in 1935. While the trade in trimmed sheet has improved considerably in recent years, there has been a considerable decline in the export of splittings, owing to the causes mentioned above. Imports of splittings in 1936 were valued at $77,822.

Three plants now exist in Canada for the expanding by heat-processing of the variety of mica known as vermiculite. This material expands tremendously when heated, yielding an exceedingly light-weight product which is finding wide application for heat- and sound-insulation purposes. The plants, which are owned by Gypsum, Lime and Alabastine (Canada), Ltd., are situated at Calgary, Alta., Winnipeg, Man., and Paris, Ont.; they draw their supply of crude vermiculite from a deposit at Libby, Montana. No important occurrences of this class of mica are known in Canada, though there have been reports of discoveries in British Columbia.

MOULDING SANDS (NATURAL BONDED)

Every province, with the exception of New Brunswick and Prince Edward Island, is producing some grade of moulding sand; at one time there was a small production at Notre Dame in Kent county and at Irishtown in Westmorland county in New Brunswick; at Charlottetown in Prince Edward Island a local sand at one time found a limited use.

In Nova Scotia deposits are worked in Colchester, Cumberland, Hants, Inverness, Kings, and Pictou counties.

In Quebec deposits are being worked or have been worked in the following counties: Argenteuil, Brome, Joliette, L'Assomption, Missisquoi, Portneuf, and St. Hyacinthe.

Ontario is the leading province in this industry with the greatest development in Welland and Wentworth counties, from Niagara Falls to Hamilton. Deposits are also being worked or have been worked in the following counties: Brant, Bruce, Durham, Essex, Grenville, Haldimand, Kent, Leeds, Lennox and Addington, Middlesex, Norfolk, Peterborough, Prince Edward, Stormont, and Thunder Bay district.

In Manitoba deposits are being worked or have been worked at Brandon, Melbourne, and Mile 80 (Wye) on the Greater Winnipeg Water District railways.

In the following provinces some foundries are using or have used supplies from ore near the places enumerated: Saskatchewan—Humboldt, Moose Jaw, Pilot Butte, Prince Albert, and Saskatoon; Alberta—Calgary, Edmonton, Leduc, Lethbridge, and Medicine Hat; British Columbia—Cranbrook, Holmwood, Metchosin, Nanaimo, New Westminster, Penticton, and Victoria.

A new deposit of moulding sand particularly suitable for the casting of brass and aluminium has been opened up this year at Stead, Manitoba, and a number of cars have been shipped to Winnipeg and Transcona, Manitoba. A considerable quantity of moulding sand, which has been produced for years near Pilot Butte, Saskatchewan, and which formerly had only a limited local market, has been shipped as far as Trail, B.C.

Development is being done on a new deposit of moulding sand in Askin township, Nipissing district, Ontario. Since 1931 a grade of moulding sand not commonly available before in the west, suitable chiefly for medium to heavy weight castings, has been obtained from Edmonton.

A good prospective producing locality for moulding sand suitable for medium to heavy weight castings exists about one mile southeast of Langham, Saskatchewan.

For several years past the Mines Branch[1] has been conducting a general investigation of the natural-bonded moulding sands of Canada, with particular reference to available data concerning all known deposits. A report, No. 767, "Natural Bonded Moulding Sands of Canada" and a French edition No. 768, "Les Sables Naturels de Moulage au Canada" published during the year draws attention to the large number of deposits from which supplies have been used for local foundries, and to the probability of replacing imported material with Canadian sands.

An investigation was started on the possibility of producing artificial or synthetic moulding sands from selected sands and the plastic fireclays and bentonite of Canadian origin.

The Canadian production in 1935 was 13,213 tons. The 1936 figures are not yet available.

Canada imports more natural bonded moulding sand than she produces, mainly from the United States with small quantities from Great Britain and France, and it is estimated that 50 to 60 per cent of our consumption of such sands is imported. Moulding sands as well as other sands and gravels; and sand, silica, for glass and carborundum manufacture, and for use in steel foundries enter Canada duty free.

Small quantities of moulding sands, not tabulated in the official records, are produced in nearly all the provinces by foundrymen for their own use from nearby deposits; or by small 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 order their supplies in the summer and autumn months.

[1] Now Bureau of Mines.

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.

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 the 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 mostly sold to the Electric Reduction Company, at Buckingham, Que., for the production of phosphorus. 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 the Lièvre river, Que., the remainder coming from mica mines in the Templeton-Gatineau district, Que. The grade of mineral averaged around 78 to 80 per cent tricalcic phosphate, worth $9.50 per ton delivered.

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 operations were conducted at two localities in the Crowsnest-Michel area, and several experimental shipments 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 Montana. In 1936, the company reported a production of 40,345 tons of phosphate at its Montana mine. Exports of phosphate to Canada from the Montana-Idaho field in 1935 totalled 27,197 long 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 importations from Morocco in recent years.

The production of phosphate in 1936 was 525 tons valued at $4,927, as against 186 tons valued at $1,103 in 1935.

Imports of phosphate rock into Canada in 1936 totalled 83,474 tons valued at $298,179, as against 63,514 tons valued at $234,580 in 1935; practically the entire amount came from the United States. Canada also imported 96,067 tons of superphosphate valued at $867,666 in 1936.

PYRITES

In 1936 by-product pyrites was produced in the treatment of copper-pyrites ores at the Eustis 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, installed in the mill of the St. Lawrence Paper Mills Company, Ltd., at Three Rivers, Quebec, underwent some further improvements to increase its capacity, and 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, still 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 which may arise in the immediate future. Canada exported a considerable tonnage of pyrites to the United States and Japan; these shipments were made both from Quebec and British Columbia.

Plans are in progress for the resumption of operations on a larger scale at the Aldermac mine in Quebec, and production will be resumed early in the new year.

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.

Import and export statistics are not at present available; probably none was imported, but exports are believed to have increased over the previous year.

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 1936 salt was produced in southern Ontario; at Malagash, Nova Scotia; Neepawa, Manitoba; and from Simpson, Saskatchewan. Ontario salt is obtained from brine wells, as is also the salt produced in Manitoba and Saskatchewan, 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 mines.

There were no new developments in the Ontario field during the year.

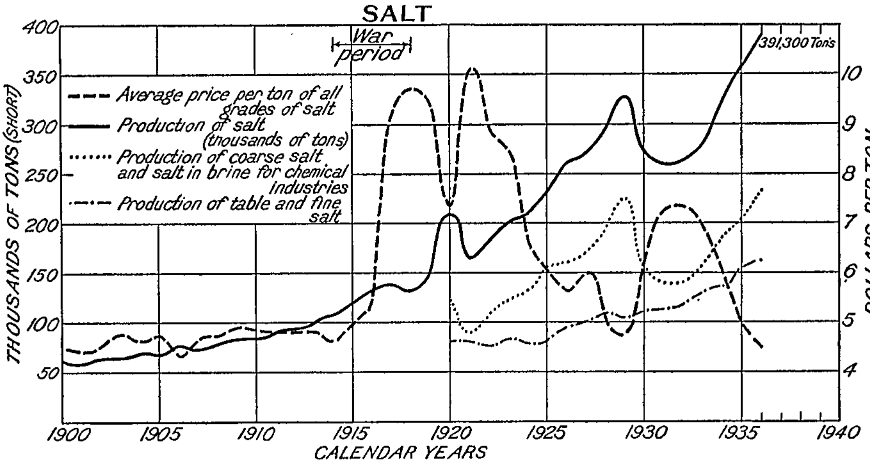
The plant of the Canadian Industries, Limited, at Cornwall, Ont., manufacturing caustic soda, chlorine, and hydrochloric acid, using salt from the company's plant at Sandwich, Ont., operated throughout the year and supplied these products to the markets in eastern Canada.

The Brunner Mond Company at Amherstburg, Ont., recovers calcium chloride from the waste material resulting from the manufacture of soda ash from salt brine and is now in a position to supply this material to the trade.

In Nova Scotia, the Malagash Salt Company showed a substantial increase over 1935. Each year the products from this plant are finding wider markets.

The Neepawa Salt Company, of Neepawa, Manitoba, now part of the Canadian Industries, Limited, maintained steady production throughout the year, numerous alterations being made for better efficiency. Drilling of a second well was completed in order to explore the possibilities of the brine supply and a flow of brine was encountered in this second well similar to that of the first.

At McMurray, Alberta, several drill holes have encountered salt formation and a number of years ago The Alberta Salt Company produced an excellent grade of salt in this district. Endeavours have been made during the year to revive the salt industry in this area, and a company, called Industrial Minerals, Ltd., was formed and a well drilled at Waterways, Alta., adjacent to the terminal of the Alberta and Great Waterways railway. This well encountered a bed of pure salt 199 feet thick at a depth of 694 feet from the surface. A plant with direct-fired pans is now in course of erection and a second well is being drilled from which brine will be obtained to supply this plant which is expected to be in operation by May of 1937.



Salt production and price trends in Canada, calendar years 1900-1936.

In a well drilled for oil a number of years ago near Gautreau, New Brunswick, south of Moncton, extensive beds of rock salt were encountered between depths of 1,300 and 1,800 feet. A second well penetrated 890 feet of salt formation, some of the salt beds being 150 feet thick. So far these salt beds have remained unexploited, but further prospecting may be carried on to determine their extent, and it is probable that this district will become a producer when conditions warrant.

Near Amherst, Cumberland county, Nova Scotia, a well put down by the Imperial Oil Company, 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 1936 was 391,316 tons valued at $1,773,143, as against 360,343 tons valued at $1,880,978 in 1935.

The exports of salt from Canada in 1936 were 5,549 tons valued at $46,601, compared with 9,045 tons valued at $51,239 in 1935. The imports of salt were 108,422 tons valued at $460,998, as against 128,247 tons valued at $526,740 in 1935. The greater part of this salt comes into Canada 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 1936 showed a 7 per cent increase in quantity 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 1936 marks an all-time record appreciably exceeding the former high record in 1929.

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 the west coast of Canada is found and exploited, the Pacific coast fisheries will be dependent, largely, on imported salt.

Experiments have been carried on with encouraging results in Nova Scotia and elsewhere for the past few years to determine the effect of a mixture of salt with clay as a surface veneer and in the foundations of gravel highways, in order to decrease, if not entirely eliminate, the dust nuisance and heavy maintenance cost of such roads, and to form a hard wearing surface. This matter is now being studied seriously not only by the salt producers in Canada, but by several of the provincial departments of highways, and during the past year a number of stretches of road in Ontario were treated in this manner. The stretches of road in Ontario treated by salt stabilization in 1935 have now been under traffic for over a year, including one winter season, and the results have been encouraging enough to warrant further tests. If the producers of salt and others are successful in proving its value for such a purpose, a greatly increased tonnage will result.

Another interesting use is the mixing of salt with the sand piles placed at the side of main highways in Ontario in order to keep the sand free-flowing for distributing on icy roads. This development has proven very satisfactory and the consumption of salt for this purpose has attained an appreciable tonnage during the past year, with a likelihood of a rapid increase.

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, 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 and for use in the steel foundries; silex, the finely pulverized silica used in ceramics and the paint industry.

Quartz and quartzite in sizes from 2 to 6 inches are used in the manufacture of ferrosilicon and 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, while 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 at one plant in the province of Quebec.

Interest in a deposit of silica sand at River Denys, Inverness county, N.S., was revived during the past year and it is possible that it will be reopened in 1937, to supply a high-grade steel foundry sand to the eastern Canada market.

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, Ltd., from its property at Lac Remi, Quebec, is making regular shipments of silica sand to the glass companies and others in the Montreal district.

The National Silicates, Ltd., a subsidiary company of the Philadelphia Quartz Company of Philadelphia, Pennsylvania, in association with G. F. Sterne and Sons of Brantford, Ontario, operated at Toronto, to full capacity, its plant for the manufacture of silicate of soda. The North American Cyanamid Company of Niagara Falls, Ont., operated two furnaces for the manufacture of silicate of soda throughout the year. Although both firms are using imported silica sand, they form a ready market for material from a Canadian deposit when any producer can guarantee continuous supply of a product sufficiently pure to meet the rigid specifications required.

General Refractory Products, Ltd. is developing a deposit of refractory clays 7 miles north of Smoky Falls, Ontario. Associated with these clays are beds of silica sand which the company intends to separate and clean to a purity satisfactory for several of the silica sand markets. Tests made in the laboratories of the Bureau of Mines, Ottawa, on a 4-ton sample gave a product sufficiently low in iron and other impurities for use in the manufacture of the best grades of glass. This company plans to erect a small mill at a later date.

The Chromium Mining and Smelting Company, Ltd. has established a plant at Sault Ste. Marie, Ontario, and is manufacturing ferrosilicon, using silica from several Canadian sources for one of its raw materials.

In the use of silica as 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 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 total tonnage of quartz and silica sand produced in Canada in 1936 was 1,050,625 tons valued at $616,585, as against 233,002 tons valued at $424,882 in 1935. There were 2,393 M silica brick produced in 1936 at a value of $97,285; in the previous year the production was 2,461 M valued at $96,194. No exports of silica or silica products were recorded during the year. The tonnage of the various grades of silica imported during 1936 amounted to 148,900 tons with a value of $378,296, compared with 129,212 tons valued at $382,712 in 1935. The imports of silica brick in 1936 were valued at $261,974, as against $215,500 in 1935.

The price per ton for 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 a small production was made from a lake near Cherry Creek, 13 miles west of Kamloops. Here the crude salts are dissolved by means of steam, and the insoluble impurities allowed to settle out, after which the clarified brine is pumped to a specially prepared reservoir for crystallization. From this reservoir the crystals are harvested and shipped to Vancouver for use in the manufacture of soap. From 10 to 12 carloads are recovered annually in this way. The product shipped contains an appreciable percentage of sodium sulphate.

Production in 1936 was 192 tons valued at $1,677, as against 242 tons valued at $2,430 in 1935.

SODIUM SULPHATE (NATURAL)

(Glauber's Salt and Salt Cake)

The material mined 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 partially 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, Ltd., Dunkirk, Sask.; Horseshoe Lake Mining Company, Ormiston, Sask.; the Sodium Corporation, Alsask, Sask.; the Midwest Chemical Company, Palo, Sask., and the Dominion Sodium Refineries, Ltd., Fusilier, Sask.; with small tonnages from several other properties.

The Natural Sodium Products, Limited, at Dunkirk, Sask., has added a third dryer and now has three rotary steel drum dryers, two of which are in continuous operation, and further construction is under way.

The Horseshoe Lake Mining Company at Ormiston, Sask., was in full operation during the summer months of the year and supplied material for the nitre cake plant at Copper Cliff, Ontario.

The Sodium Corporation at Alsask, Sask., produced a small tonnage during the year as did also the Dominion Sodium Refineries, Ltd., at Fusilier, Sask.

At the central part of Whiteshore lake, the Midwest Chemical Company produced small tonnages from its 50-ton dehydrating plant using direct rotary dryers working on harvested intermittent crystals. 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, Alberta, continued its experimental work on preparing high-grade hydrous Glauber's salt. During the year it erected a small unit dehydrating plant, a modified Oslo Krystallizer, and is turning out a high-grade anhydrous sodium sulphate for the textile trade.

Muskiki Sulphates, Ltd. took up leases on Muskiki lake, 60 miles east of Saskatoon, Sask., and proposes using a modification of the solution and crystallization process. The deposit is one formerly held by Salts and Chemicals, Ltd.

Experimental work carried on during the past year at a number of properties in Saskatchewan by the Sodium Sulphate Company at Ceylon lake, the Canadian Sulphate Company at Berry lake, and others, 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 utilized commercially, but by 1934 the revenue derived by Canadian railways from this industry exceeded $700,000, and will be materially greater for 1936. 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 have made possible the erection of the plant for separating nickel from copper, at Copper Cliff, Ont., by the Orford process.

The production of natural sodium sulphate in 1936 amounted to 75,559 tons valued at $552,086, as against 44,817 tons valued at $343,764 in 1935.

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 1936, including Glauber's salt, salt cake, and the acid sodium sulphate (nitre cake) amounted to 13,598 tons valued at $153,924; in 1935 the imports were 7,229 tons valued at $88,738.

The production of natural sodium sulphate from the deposits of western Canada increased sharply during the year, and a new all-time high for this industry was established. This increase is due to several causes. In 1934 production from the Canadian deposits was greatly in excess of the estimated consumption and at the end of that year many of the pulp companies, as well as the nitre cake plant at Copper Cliff, had large stocks of sulphate on hand. In the United States, competition from domestic sources, both natural and artificial, also further decreased the amount of Canadian product imported. By the end of 1935 the surplus stocks on hand had been mostly absorbed so that during 1936 the demand for fresh supplies was brisk. The demand from both the pulp mills and the metallurgical industry at Copper Cliff has also increased greatly 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 those markets which demand 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 synthetically. With the improved methods of refining, the better quality of the product and reduced costs of production, and with improved facilities for shipment via Churchill, Man., the possibility of the product from these deposits competing in European and other foreign markets looks decidedly promising.

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 by-product sulphur dioxide gas 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 experimental research has also been directed towards the development of processes for the production of elemental sulphur either from the waste gas or from the original sulphide ore, and a number of patents on processes have either been issued or are pending. A plant designed to produce about 60 tons of sulphur per day from waste gases has been erected at Trail, B.C., and is being operated experimentally; two other firms are also engaged in research work on this problem.

The Dominion Bureau of Statistics reports the equivalent amount of sulphur recovered from all sources as 122,132 tons, an increase of about 81 per cent over the previous year; the imports of sulphur in all forms were 168,774 tons valued at $2,802,282 in 1936 as against 136,675 tons valued at $2,297,650 in the previous year.

Canada imports all its requirements of elemental sulphur from the states of Texas and Louisiana. 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 and 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 these gases were wasted. Some years ago plants to absorb a portion of these waste gases were installed at Copper Cliff, Ontario, and at Tadanac, British Columbia. At the first-mentioned plant 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 certain proportion is used for other purposes.

TALC AND SOAPSTONE

Almost the entire production of talc in 1936 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 been in steady operation for a number of years. The talc of the Madoc area is of foliated type, has a good white colour, and occurs as a series of vertical veins or bands in white, crystalline dolomite. Each of the above companies operates 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; a proportion of the output is exported also 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. A few years ago, tests were made in the Ore Dressing Division of the Mines Branch[1] to determine whether the rather considerable proportion of dolomite present in the Madoc talc could be removed satisfactorily, and it was found that flotation methods resulted in lowering the lime content of the crude ore to below 0·5 per cent; however, no process for improving the quality of their products by such means has as yet been adopted by either of the Madoc mills. A report on the above tests has been published (Invest. No. 469, Rept. No. 736), and copies may be obtained by application to the Director, Bureau of Mines, Ottawa. It is of interest to note that a plant for removing magnesite from talc by means of flotation was in process of installation during the year at one of the larger Vermont mills.

In eastern Canada, the only other production of talc (in part soapstone powder) is from a soapstone quarry near Broughton, in the Eastern Townships, Quebec. Crude, lump talc, from a band cutting the soapstone body, and soapstone waste are 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, the company grinds some of its soapstone waste 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 purposes.

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 also fashions 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. During 1934, two other soapstone operators came into production in the same district, in Thetford township; these have installed sawing equipment and shipped small amounts of cut furnace blocks; both were in part-time production during 1936. A recent development which may seriously affect the demand for soapstone for pulp-mill use is the introduction of a new

[1] Now Bureau of Mines.

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.

In British Columbia, there is a small, intermittent production of ground grey talc, 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 is shipped in the crude form to Vancouver for grinding, and that from Sooke is ground in a small plant at the mine. In 1936, only the Sooke mine was in operation.

During the year, a talc deposit in Potton township, Brome county, Que., near Highwater, was prospected by Baker Mining and Milling Company, of Montreal. A number of surface pits were opened, disclosing widths up to 25 feet of fine-textured, foliated, grey talc. Deposits of talc near Sharbot Lake, Frontenac county, and near Coe Hill and McArthur's Mills, in Hastings county, all in Ontario, have recently been prospected, in part by diamond drilling, by the Canada Talc Company, but no development has as yet been attempted.

In consequence of a falling-off in the demand for soapstone blocks, causing competition among the producers, the price of sawn soapstone is stated to have dropped during the year to $2 per cubic foot, only half the figure obtained in the early days of this industry.

The total production of ground talc in 1936 was 22,599 tons valued at $143,929, as compared with 13,803 tons valued at $139,479 in 1935. The 1936 output of cut soapstone was valued at $32,770, as against $32,053 in 1935. Exports of ground talc totalled 10,222 tons valued at $102,071, compared with 8,927 tons valued at $90,823 in 1935. The 1936 imports were 2,936 tons valued at $43,185, compared with 2,694 tons valued at $44,503 in 1935. Prices for ground talc remained unchanged from the 1935 level, quotations for the Madoc product being $17.50 for the best grades, $11.50 for the intermediate, and $9 for the lowest, all f.o.b. mills.

VOLCANIC DUST

Volcanic dusts 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, but none was sold in the past two years. 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. These products to the value of $21,275 were imported in 1936; in 1935 the value of these imports was $30,971.

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. Until 1934, one Canadian company was making whiting substitute from a white dolomite, but at the present time all the whiting substitute produced in this country is made from pure marble or limestone that contains only a small percentage of magnesium carbonate.

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 subangular rather than rounded. Whiting substitute made from a magnesium 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, Ltd., Montreal, and by Gypsum, Lime and Alabastine, Canada, Ltd., 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 1936 much experimental work was done with the object of making whiting substitute from a large deposit of calcite near Robertsville station on the Kingston and Pembroke branch of the Canadian Pacific railway in Frontenac county, Ontario.

A company incorporated under the name of White Valley Mines, Ltd. was formed in 1936 to engage in the production of whiting substitute from a marl deposit in Harvey township, Peterborough county, Ontario, but there has been no production to date. Another company investigated a marl deposit at Drag lake in Hungerford township, Hastings county, 5 miles west of Tweed, with a view to producing whiting substitute.

Closely related in uses to whiting substitute are precipitated chalk and by-product precipitated chalk, the former which is characterized by extreme fineness and freedom from impurities is made by re-carbonating a milk-of-lime made from high-calcium quicklime. It is coming into increasing use as a filler for magazine paper, and preparations are being made for its manufacture in Canada in 1937. By-product precipitated chalk is made from the waste sludge resulting from the manufacture of caustic soda from soda ash and lime. It almost invariably contains a small quantity of free alkali and this restricts its usefulness. 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 1936 amounted to 12,498 tons valued at $121,017, as compared with imports of 12,333 tons valued at $118,451 in 1935.

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.

A study of the possibilities of improvement in the quality of New Brunswick coals and their greater utilization within the province for the manufacture of a special type of coke, was undertaken at the Bureau of Mines Fuel Research Laboratories in co-operation with the Coal Operators Association of New Brunswick.

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.

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 production of coal in Canada in 1936 amounted to 15,214,606 tons valued at $45,752,806 and was the greatest since 1929; this represents an increase of 9 per cent over the output for 1935; Nova Scotia contributed over 43 per cent of the total, Alberta over 37 per cent, British Columbia about 10 per cent, Saskatchewan about 6 per cent, and the rest was derived from New Brunswick, Manitoba, and Yukon. Nova Scotia with 6,648,933 tons showed an increase of 13 per cent over the output of 1935; increases were made in all provinces with the exception of Yukon, which produced only 510 tons.

The imports of coal into Canada during the year totalled about 13,770,623 tons or an increase of about 5·8 per cent over that for 1935.

Anthracite importations consisted of about 3,536,500 tons, 47 per cent of which was from the United States and 37 per cent from Great Britain; the remainder being from Germany, French Indo-China, Belgium, the Netherlands, and China.

Bituminous importations consisted of about 10,202,438 tons, 98 per cent of which was from the United States.

The total amount of coal made available for consumption during the year was approximately 28,546,717 tons.

There was a slight increase in the amount of Canadian coal moved under Federal Government assistance. It is estimated that 2,306,000 tons were moved in this way in 1936, as against 2,125,000 tons in 1935. 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.

The total amount of coal moved under subvention since 1928 when this assistance came into effect is 11,616,000 tons—at a cost to the Government of $11,040,000. 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 Department of Mines and Resources, was continued during the year. Research work on coal preparation, storage properties and general characteristics of coals, 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 which was evidenced during the last two years will be continued in 1937.

COKE

Coke was produced from coal in coke and gas plants, in all provinces except Prince Edward Island and Saskatchewan. Petroleum coke was produced at petroleum refineries in the provinces of Nova Scotia, Quebec, Ontario, Manitoba, Saskatchewan, and Alberta.

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

In Quebec, the Montreal Coke and Manufacturing Company operated its coke ovens, using about one-third Nova Scotia coal, the rest being imported coal.

In Ontario, the coke ovens at Hamilton, including those of the Hamilton By-Product Coke Ovens, Limited and the Steel Company of Canada, and those of the Algoma Corporation at Sault Ste. Marie continued to market increased quantities of coke for use as domestic fuel.

Tests have been conducted at the plant of the Hamilton By-Product Coke Ovens, Ltd. for determining the possibility of the use of Canadian coal in this plant. The object, if economic conditions warrant, is the use of 35 per cent of coal produced in Nova Scotia in a blend with the American coal now being used. The tests, from a technical standpoint, were quite successful.

In Manitoba, the Winnipeg Electric Company, which formerly used United States coal exclusively, is using 100 per cent Canadian coal—(Michel colliery)—in its ovens at Winnipeg.

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.

Experimental work was conducted both at the Bureau of Mines Fuel Research Laboratories and at Coleman, to determine the quality of coke best suited for smelting.

In British Columbia, the coke and gas plant of the British Columbia Electric Power and Gas Company, Ltd., at Vancouver, continued to supply an improved quality of coke for domestic use in Vancouver. A foreign market was also developed to the extent of approximately 2,000 tons, most of which was marketed in Seattle.

The total production of coke from coal in 1936 was reported as 2,412,160 tons. The production in the eastern provinces (Nova Scotia, New Brunswick, and Quebec) in 1936 was 774,026 tons or 32 per cent of the total production; in Ontario, production was 1,452,525 tons or 60 per cent of the total; while in Manitoba, Alberta, and British Columbia, the production was 185,609 tons or 8 per cent of the total. The ratio per area was relatively the same as for 1935. The amount of coal used for making coke approximated 3,360,000 tons, 32 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 (72,191 tons in 1935). About 15 per cent of this petroleum coke is consumed by the refineries themselves.

Canadian exports of coke in 1936 amounted to 18,215 tons. The imports were about 612,858 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

Alberta continues to be the leading producing area in Canada, contributing over 65 per cent of the total Canadian production. The Alberta production comes chiefly from the Turner Valley field, where the wet gas is stripped of its naphtha content and, after scrubbing, is piped into Calgary, Lethbridge, and intermediary points. The Viking field supplies Edmonton and district; the Medicine Hat field, the oldest in the province, supplies the industrial and domestic requirements of Medicine Hat and Redcliff. A small field at Brooks supplies that town with its requirements, and the town of Wainwright is supplied with gas from two wells in the Fabyan field, 7 miles distant.

In Ontario, the chief gas fields are located in Essex, Kent, Norfolk, Haldimand, Lambton, and Welland counties. The Kent or Tilbury field has been the most important and lies mainly in Tilbury East township, but extends into the adjacent townships of Romney and Raleigh.

In New Brunswick, the Stoney Creek field, a small gas field near Moncton, supplies that city with natural gas for domestic and industrial purposes; the gas is also piped into Hillsborough.

In New Brunswick, there were no important developments. The company which controls and is developing the Stoney Creek field carries out systematic explorations and drillings during the non-winter months in order to maintain its supply and continue the life of the field.

Extensive drilling in of new gas supplies has more than overcome the shortage threatened in Ontario in 1933. Geological surveys undertaken in the summer of 1935 and 1936, by the Bureau of Economic Geology, in the natural gas area of southwest Ontario indicate that there is little likelihood of the towns and cities of that area suffering from a shortage for some time to come. During 1936 extensive drilling was done in the new Brownsville field, in Dereham township, Oxford county, and 18 wells were drilled, and of these, 14 were productive, with a total capacity of approximately 16,000M cubic feet per day. Arrangements are being made for utilization of this gas supply, and a purification plant is to be erected at Brownsville to treat the gas, which contains a small amount of sulphur; and the treated product will be turned into the main trunk line at Ingersoll. In Amabel township, Bruce county, several small producing gas wells were brought in during the year and the gas is being piped to the adjacent village of Hepworth. During the year, the city of St. Thomas was supplied with natural gas from the Tilbury field, replacing the artificial gas which had previously been used.

In Manitoba, two wells were being drilled, more for the purpose of testing formations. One test was being drilled in southwestern Manitoba near Manitou, and the other close to the town of Birdtail, in the Riding Mountain area.

In Saskatchewan, the only commercial gas field as yet developed is the Lloydminster field, which straddles the interprovincial boundary between Alberta and Saskatchewan. Another well was being drilled in 1936, just south of Lloydminster, in the hope of further extending the gas area. At North Battleford, a well was being drilled which had small showings of gas. A test well was also being drilled in southern Saskatchewan in the Gem Dome field, near Cummings; and near Reserve Junction, in the Piwei hills and about 100 miles north of Yorkton, two wells were being sunk with the possibilities of oil in view. A second test well in the Simpson area, started in 1934, was deepened in 1936.

In Alberta, the search for oil and gas has been the most extensive for many years past. Practically all the gas from the Turner Valley wells is now passed through the absorption plants, to which a fourth was added in the Turner Valley during the year. A large amount of unused gas is still burned, but a proportion continued to be put into the depleted sands of the Bow Island field. The principal utility company in Alberta, which supplies Calgary, Edmonton, and other parts of the province with their natural gas requirements, continued the large expansion program of recent years, including extensions of its transmission and distribution lines, and geological and exploratory work in various parts of the province, including seismograph surveys. Besides the increased activities in drilling in the south end of Turner Valley, other structures outside Turner Valley which have had test well drilling during 1936 are: High River-Aldersyde, Kootenay Dome, Highwood, Birch Ridge, Moose Mountain, Red Deer, New Valley, and Pekisko in the central area; while in the southern part of the province, test wells were drilling on the following structures: Taber, Watson, Waterton Lakes, Del Bonita, and Twin River.

In British Columbia, the test well in the Sage Creek area, Flathead Valley, in the extreme southeast corner of the province was further extended to a depth of close to 6,000 feet with showings of both oil and gas at depth.

The chief production in Canada, during 1936, came as in former years from Alberta, where the Turner Valley field accounts for the bulk of the production. The production in Canada in 1936 was 27,363,602M cubic feet valued at $10,585,868, as against a production in 1935 of 24,910,786M cubic feet valued at $9,363,141.

A small amount of mixed gas (natural and artificial) is imported each year into Ontario from the United States, and is used at border points for cooking, heating, and illuminating. The 1936 imports amounted to 118,056,000 cubic feet valued at $75,985.

PEAT (AND MOSS)

During 1936, there were five bogs operating in Ontario and one in Quebec for the production of air-dried peat, to be used as fuel in localities close to the bogs. Production is estimated at about 1,641 tons, as compared with some 1,340 tons in 1935. Eleven other deposits were operated for the production of moss litter, and of insulating material, four of them in Quebec, two in Ontario, and one each in New Brunswick, Manitoba, Saskatchewan, Alberta, and British Columbia. In addition, considerable development took place on a peat-shell-marl property in Ontario, the finished material to be used as fertilizer.

PETROLEUM

Alberta is the leading producing province in Canada. The chief product is naphtha which is derived from the wet gas of the Turner Valley field. Light crude oil also is obtained from the Turner Valley and Red Coulee fields, while heavy crude is produced in the Wainwright and Skiff fields. A small intermittent production from a well in the Del Bonita field, which came in at the close of 1935, was obtained during 1936. Ontario's chief oil field is the Petrolia-Oil Springs area, which has been in production since 1861. The Bothwell field is the next largest producer, and the Dawn, Onondaga and Mosa township fields are also important producers. Most of the wells in Ontario have to be pumped to obtain production.

In New Brunswick, the producing area is confined to the Stoney Creek field, about 9 miles southeast of Moncton. The New Brunswick production is relatively small, compared to the Alberta and Ontario figures, but remains fairly constant from year to year. The crude oil is treated in a small topping plant at Weldon, and gasoline and fuel oil are produced.

The two wells in the Norman field, Northwest Territories, which were reopened in 1932, to supply fuel oil and gasoline for mining operations in the Great Bear Lake field, were again operated together with a small topping plant, during the summer season.

In Alberta, one of the most important developments was the bringing in of the Turner Valley Royalties' well, in June, 1936, in the south end of the valley, on the west flank of the 'gas area.' This well came in with a flow of 850 barrels per day of 44° A.P.I. gravity crude and 2,000 M. cubic feet of gas per day and has shown little change to date. Another well, Foundation Petroleums, located about a mile south of Turner Valley Royalties' well, came into production at the close of the year and, after settled production is obtained, it is expected to be an even larger producer. Several other wells are being drilled on the west flank of the south end of the valley. Outside Turner Valley, test wells were in progress on the following structures or fields: in the south central area, New Valley, Highwood, Red Deer, Pekisko, Rickert, Birch Ridge, Moose Mountain, Kootenay Dome, and High River-Aldersyde; in the extreme south, exploratory test wells were being drilled at or near Del Bonita, Twin River, Cardston, Taber, north of Lundbreck, Pincher Creek, Spring Coulee, and Waterton Lakes.

In Saskatchewan, although increased activity has been under way, looking for a commercial supply of gas, no discoveries of commercial oil have as yet been made.

In British Columbia, further drilling was done during 1936 in the Sage Creek section of the Flathead Valley, the well having reached a depth of close to 6,000 feet, with showings of both oil and gas.

During the year, four new small refineries started operations in Saskatchewan, and three in Alberta, while a large refinery in British Columbia with cracking facilities also commenced operations. A refinery was under construction at Montreal East, Quebec, three small refineries were being completed in Manitoba, and two in Saskatchewan. In northern Alberta, two plants were erected for the separation of bitumen from the bituminous sands of the McMurray area, and are expected to be in commercial production in 1937. A total of 46 refineries were in operation in Canada during the year, some of which, however, only operated intermittently.

The total production in 1936 was 1,498,006 barrels valued at $3,616,037, an increase of 3 per cent over that of 1935. The bulk of the production as in previous years came from Alberta.

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

		Quantity	Value
Exports—			
Oil, petroleum crude..	Gal.	216	$ 9
" coal and kerosene, refined..	"	631,681	93,267
" gasoline and naphtha..	"	3,378,983	509,150
" fuel..	"	19,412,825	654,928
" mineral..	"	614,332	181,777
Wax, mineral..	Cwt.	377	1,830
			$ 1,440,961
Imports—			
Petroleum..	Gal.	1,254,188,607	$39,689,138
Kerosene, fuel and illuminating oil..	"	29,291,775	1,167,888
Lubricating oil..	"	14,296,949	2,946,710
Gasoline and other oils..	"	96,594,038	4,781,898
Asphaltum and other petroleum products..		......	1,141,554
			$49,727,188

The marked recovery in trade and industry in Canada that took place during 1936 will probably be reflected in the figures for consumption of petroleum products during 1937. Our refineries depend on imported crude for 97 per cent of their requirements, but the search for new sources of supplies in Canada, particularly in Alberta has been quite active and extensive.

OTTAWA
J. O. PATENAUDE, I.S.O.
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1937