CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

MINES BRANCH

# THE CANADIAN MINERAL INDUSTRY IN 1950

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CONTENTS





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* Geological Survey of Canada.

## PREFACE

This report contains reviews of all the metals and minerals produced in commercial quantities in Canada in 1950. In each case the principal developments are given as are the main uses, and statistics on production, consumption, and trade. Mimeographed separates of the reviews for 1950 were issued during the first half of 1951.

Interest in mineral developments in Canada has been increasing steadily in recent years as a result of the rapid expansion of the mineral industry, and this interest is reflected in a marked increase in the demand for the kind of information contained in the reviews. Quite apart from the distribution made by the Branch through its mailing list and in response to enquiries, this information is widely disseminated through its reproduction in whole or in part in mining and other periodicals in Canada and abroad and in many of the daily newspapers, and through the Canadian Trade Commissioners in various countries.

The Branch is indebted to the officers of the Dominion Bureau of Statistics and to operators of mines and quarries for much of the information appearing in this report. As noted in the table of contents, the reviews on crude petroleum and natural gas were prepared by Dr. J. F. Caley of the Geological Survey of Canada.

John Convey,
Director, Mines Branch.

Ottawa, January, 1952.

## INTRODUCTION

In 1950, the Canadian mineral industry again established a production record, the sixth in succession. For the first time the value of output exceeded a billion dollars, being $1,045,450,073. The increase was general throughout the industry, the principal gains being in the outputs of crude petroleum, asbestos, gold, zinc, copper, and nickel. A record was also established in the physical volume of output, the index in 1950 being 147·6 compared with 133·6 in 1941, the previous peak year. Exports of mine products also reached peak levels, as did the domestic consumption of several of these products.

Metallics accounted for the greater part of the total value, being $617,238,340, a 14·5 per cent increase over that of 1949. Demand for the non-ferrous base metals was exceptionally strong throughout the year. A development of major importance was the disclosure of a large deposit of zinc-silver ore by Barvue Mines Limited in Barraute township, Quebec. Surface drilling on the property indicated 17,000,000 tons of ore averaging over 3 per cent zinc and 1 ounce silver a ton to a depth of 700 feet. Plans were formulated to bring the property into production at the rate of 4,000 tons a day.

Volume output of zinc in 1950 reached a new peak, but that of copper, nickel, and lead was considerably short of the peaks reached during the war, though in each case the value of output was much higher in 1950. Prices of the four metals rose sharply during the year. Nickel, for instance, advanced from 42·5 cents a pound in January to 51·75 cents at the close of the year; copper from 20·35 to 25·95 cents; lead from 13·25 to 17·95 cents; and zinc from 16·50 to 19·30 cents; the prices being in Canadian funds.

The greater part of the lead and zinc exported in 1950 again went to the United States and most of the copper to Great Britain. The United States has been the chief importer of Canadian nickel for a number of years. Exports of the four metals in 1950 reached a value of $285,626,000. Domestic consumption of nickel was still less than 3 per cent of the output, whereas consumption of zinc reached a record of 54,370 tons. Lead consumption at 57,300 tons was well below the peak of 1946, and copper consumption at 106,900 tons was the highest since the war, but was more than 76,000 tons below that of the 1942 peak year.

Although Canadian output of non-ferrous base metals, with the exception of zinc was below peak wartime levels, the industry underwent considerable enlargement through the expansion of productive facilities, the development of new deposits, and the discovery of others. Practically all of the main producers made large expenditures, broadly designed to improve metallurgical practices, to provide greater smelter and refinery capacity, and to handle larger ore tonnages.

Total shipments of iron ore at 3,218,983 long tons was about the same as in 1949 although developments in the industry give promise of a greatly increased output within the next few years. Considerable headway was made in carrying out the expansion program at the Steep Rock deposits in northwestern Ontario which aimed at a production of at least 3,000,000 long tons by 1955 and an eventual annual production of 10,000,000 tons. The Helen mine in the Michipicoten area reached its rated capacity of 1,000,000 tons of sinter a year. Construction was started on the railway from the port of Seven Islands on the Gulf of St. Lawrence to the Quebec-Labrador hematite deposits, and drilling of several magnetite deposits in eastern Ontario was commenced.

An event of significance was the commencement of shipments of titanium ore from the Allard Lake deposits north of Havre St. Pierre in eastern Quebec. A total of 100,000 tons of ore was mined and shipped to the smelter at Sorel, Quebec, where the first of five contemplated furnaces was put into experimental operation to produce iron ingots and titanium dioxide slag.

Much interest was centred in the Beaverlodge area, north of Lake Athabasca, in Saskatchewan, and particularly on the Ace property of Eldorado Mining and Refining (1944) Limited. This property showed promise of becoming a major source of supply of uranium ore and its development toward production was actively under way. The more than 2,300 known occurrences in the area included about 1,100 on claims held by Eldorado. Many of these occurrences seemed to merit further exploratory work.

In the gold industry there was a 318,000-ounce increase in production over 1949, mainly from Quebec, although output from Ontario and Manitoba also increased. Exploratory and development work was less active in 1949 with the exception of a few areas, particularly, the Yellowknife area, Northwest Territories.

Output of the industrial minerals in 1950 reached a record value of $227,000,000, a 27 per cent gain over 1949. Volume records were established in asbestos, cement, sand and gravel, clay products, salt, and gypsum. The output of asbestos for the first time included a substantial quantity of chrysotile fibre from Ontario with the commencement of commercial milling at the Munro mine of Canadian Johns-Manville Company Limited, near Matheson. There was an active search for new deposits and several companies carried out exploratory and development work in Quebec, Ontario, and British Columbia. Exploratory work on an occurrence of chrysotile discovered at McDame Mountain in British Columbia south of the Yukon border proved encouraging, and further examination of the commercial possibilities was planned for 1951.

Capacities were expanded and equipment was improved in several of Canada's gypsum plants. Within the past few years the gypsum industry has shown an increasing interest in the possibilities for beneficiation of the somewhat low-grade ores that constitute the greater part of the raw material available from deposits in central and western Canada. The Department of Mines and Technical Surveys carried out extensive tests on the beneficiation of gypsum from some of these deposits with considerable initial success.

In spite of a record output of cement and capacity operation of the plants it was necessary to import 1,386,200 barrels, 60 per cent of which came from the United Kingdom. Expansion planned by the industry was expected to increase total cement-making capacity to 22,500,000 barrels annually by 1952 compared with a capacity of 17,000,000 barrels at the end of 1950.

Difficulty was experienced by several countries in obtaining adequate supplies of elemental sulphur from the Frasch-mined domes of Texas and Louisiana. Actually, Canadian manufacturers of pulp and paper, heavy chemicals, explosives, and textiles experienced little difficulty obtaining their needs until the third quarter of 1950. By then, however, low producers' stocks and declining reserves threatened to reduce shipments, with the prospect of a continuing shortage for some time. The large reserves of natural gas in the Pincher Creek, Jumping Pound, and Turner Valley fields in Alberta were estimated to contain 8, 4, and 2 per cent, respectively, of hydrogen sulphide gas. In the case of the Pincher Creek field, for instance, it was estimated that 430 tons of elemental sulphur could be recovered from every 100,000,000 cubic feet of natural gas. In the plant it is erecting in the Jumping Pound field, Shell Oil Company of Canada expected to recover 10,000 tons of elemental sulphur a year. Royalite

Oil Company, Limited planned to erect a plant at Turner Valley for the recovery of sulphur from the natural gas of that field. Output from these plants, however, would be sufficient to meet only a part of the Canadian requirements, and, unless the supply situation improves, increased attention will possibly be given to the development of pyrite deposits, some of which in Canada are known to contain large tonnages.

Clay products made from Canadian clays reached a value of $21,790,000 in 1950 and those made from imported clays a value of $15,095,500. Expansion and modernization of plants have been fairly general in recent years and several new plants have been established. The defence program caused a heightened demand for refractories and special electrical porcelains.

Output of fuels was valued at $201,193,957, 9·6 per cent higher than that of 1949. Volume records were established in the production of coal, natural gas, and crude petroleum with output of crude petroleum 36·3 per cent above that for 1949.

Completion of the 1,150-mile pipeline from Edmonton to Superior, Wisconsin, was a notable event of the year. Average daily production for wells in Alberta in 1950 was 75,605 barrels and potential production at the end of the year was 185,000 barrels, or the equivalent of about 45 per cent of present Canadian requirements. Oil companies operating in western Canada made a record expenditure of approximately $150,000,000 on exploration and development in 1950, with the result that new peaks were set in footage drilled, in well completions, and in discoveries made. Total footage drilled for development and exploratory wells in the Prairies reached 4,600,000 feet, compared with 3,273,000 feet in 1949. One hundred and seventeen geophysical parties were in action, of which at least 105 were in Alberta where the greatest exploratory activity was in the central and south-central areas.

The marked increase in productive potential of the Prairie Provinces led to the building of a refinery at Winnipeg at a cost of $10,000,000; construction of a 75-mile, 10-inch connecting pipeline from Gretna, Manitoba, to Winnipeg at a cost of $2,500,000; construction of a 30-mile, 16-inch pipeline from Redwater to Edmonton at a cost of $2,500,000; refinery construction and modernizing at several centres such as Edmonton, Ogden, Lloydminster, Moose Jaw, Regina, and Froomfield near Sarnia, Ontario, at a total cost of approximately $75,000,000; and construction of additional storage capacity at Sarnia.

Natural gas continued to be found in almost every well drilled for oil in Alberta. Throughout most of 1950, markets available to the established gas fields in the plains areas were fully supplied and there was little incentive to prospect for further gas reserves. Despite this, several gas discoveries of commercial importance were made in areas in Alberta stretching from the south-eastern part of the province to the Peace River district. The matter of a policy regarding permission to export natural gas from the province was under review by the Government of Alberta.

Canadian output of coal reached a record of 19,139,100 tons. Output from Alberta was about 500,000 tons lower than in 1949, but that from Nova Scotia, Saskatchewan, and British Columbia was considerably higher.

# 1. METALS

## ALUMINIUM

Production of aluminium in Canada, all of which is from imported ore, amounted to 396,882 tons in 1950, a peacetime record.

Aluminum Company of Canada Limited, the only producer in Canada, operates an alumina preparation plant at Arvida and has reduction plants at Arvida, Ile Maligne, Shawinigan Falls, La Tuque, and Beauharnois in Quebec. These plants have a rated capacity of approximately 550,000 short tons of aluminium annually, which is more than 20 per cent of world production capacity and is exceeded only by that of United States. The plants at Arvida, Ile Maligne, and Shawinigan Falls were in operation during the year and it was reported that the Beauharnois plant would resume production. The company fabricates aluminium and aluminium alloys at plants in Kingston, Etobicoke, and Toronto in Ontario, and at Shawinigan Falls in Quebec. Other companies also operate plants for the manufacture of aluminium products.

Aluminum Company of Canada Limited announced its intention to undertake development of an area in Tweedsmuir Park in northern British Columbia for the erection of a new reduction plant. The first stage in the development is the construction of a 500,000-horsepower Hydro Electric project. The company plans also to erect a hydro-electric plant on the Peribonka River in Quebec to supply electric power for increased ingot-making capacity in the Saguenay district.

Low cost electric power in quantity near desirable locations has been the principal factor in establishing the aluminium industry in Canada. Bauxite from British Guiana, coal and coke from United States, and cryolite from Greenland and United States are the chief raw materials. Fluorspar from Newfoundland is now used for production of synthetic cryolite for the reduction operation.

Although Canada has no bauxite, low-grade potential ores of aluminium, such as clay, shale, nepheline syenite, and anorthosite, containing from 20 to 30 per cent alumina occur in many areas. The utilization of these low-grade raw materials has been the object of much research in various parts of the world, and various processes have been developed. The economic success of any of these processes will depend largely upon local conditions, but it has yet to be proved that any of them can compete on an even basis with the Bayer process, the standard process for producing alumina, and which utilizes bauxite containing from 55 to 60 per cent alumina, and less than 7 per cent silica.

*Production, Trade, and Consumption*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Short tons | $ | Short tons | $ |
| *Production: ingot* | 396,882 | ........... | 369,466 | ........... |
| *Imports: bauxite* | | | | |
| From: British Guiana | 1,679,196 | 7,091,870 | 1,725,104 | 8,961,371 |
| United States | 90,970 | 2,239,082 | 43,378 | 775,567 |
| Gold Coast | 44,976 | 250,959 | ........... | ........... |
| Netherlands Guiana | 27,576 | 227,617 | 24,158 | 326,398 |
| Other countries | 18,909 | 80,597 | ........... | ........... |
| Total | 1,861,627 | 9,890,125 | 1,792,640 | 10,063,336 |

| | 1950 | | 1949 | |
|---|---|---|---|---|
| | Short tons | $ | Short tons | $ |
| *Imports: cryolite* | | | | |
| From: Denmark | 2,646 | 381,184 | 1,378 | 213,563 |
| United States | 1,088 | 217,484 | 150 | 30,353 |
| Total | 3,734 | 598,668 | 1,528 | 243,916 |
| *Imports: aluminium products* | | | | |
| Semi-manufactured | ............ | 1,267,987 | ............ | 2,091,073 |
| Fully manufactured | ............ | 6,879,077 | ............ | 5,753,790 |
| Total | ............ | 8,147,064 | ............ | 7,844,863 |
| *Exports: primary forms* | | | | |
| To: United States | 160,509 | 45,895,471 | 69,690 | 19,023,928 |
| United Kingdom | 138,814 | 39,223,555 | 171,799 | 48,713,854 |
| Brazil | 5,329 | 1,610,190 | 6,863 | 1,978,156 |
| Australia | 5,034 | 1,599,108 | 7,274 | 2,215,700 |
| Netherlands | 4,249 | 1,184,107 | 5,256 | 1,631,619 |
| Italy | 3,509 | 1,093,322 | 3,517 | 985,016 |
| Poland | 2,659 | 748,150 | ............ | ............ |
| Sweden | 2,487 | 856,672 | 9,180 | 3,131,840 |
| Switzerland | 558 | 186,139 | 7,929 | 2,264,604 |
| Other countries | 12,578 | 3,972,831 | 15,398 | 4,828,764 |
| Total | 335,726 | 96,369,545 | 296,906 | 84,773,481 |
| *Exports: semi-fabricated* | | | | |
| To: United States | 3,718 | 1,936,904 | 2,488 | 1,258,058 |
| India | 3,359 | 1,519,898 | 3,227 | 1,551,545 |
| Union of South Africa | 1,109 | 520,133 | 6 | 3,563 |
| Brazil | 199 | 86,235 | 1,164 | 548,028 |
| Other countries | 3,060 | 1,429,583 | 3,691 | 1,793,383 |
| Total | 11,445 | 5,492,753 | 10,576 | 5,154,577 |
| *Exports: manufactured products* | | | | |
| To: Venezuela | ............ | 1,931,014 | ............ | 1,097,047 |
| United States | ............ | 357,055 | ............ | 345,600 |
| Costa Rica | ............ | 177,613 | ............ | 120,941 |
| Cuba | ............ | 176,088 | ............ | 115,432 |
| Colombia | ............ | 156,492 | ............ | 125,878 |
| Other countries | ............ | 863,431 | ............ | 1,160,503 |
| Total | ............ | 3,661,693 | ............ | 2,965,401 |
| *Exports: scrap* | | | | |
| To: United States | 4,642·9 | 1,343,393 | 4,028 | 1,005,291 |
| Other countries | 0·1 | 60 | 356 | 98,814 |
| Total | 4,643·0 | 1,343,453 | 4,384 | 1,104,105 |
| *Domestic consumption: ingot* | 65,000 | ............ | 58,800 | ............ |

## *Uses and Prices*

Aluminium is finding an increasingly wide field of use and markets are continually expanding. It is available in primary forms and semi-fabricated shapes as castings, forgings, sheet, rolled and extruded shapes, tube, rod, wire, foil, powder, and paste. In recent years, transportation, architectural and building uses, household supplies, and the electrical industry have provided the chief market outlets for aluminium.

The domestic base price of aluminium ingot (99·50 per cent minimum) for orders of 30,000 pounds or over f.o.b. Arvida or Shawinigan was $15\frac{1}{2}$ cents a pound until October 1950, when it was increased to 17 cents.

## ANTIMONY

World demand for antimony showed a marked increase in 1950 and this, coupled with the virtual stoppage of supplies of the metal from China, resulted in a gradual tightening of world supply. Major Canadian requirements continued to be met by imported antimony metal and the utilization of domestic antimonial lead scrap largely in the form of old battery plates.

Canada's output of antimony is in the form of antimonial lead, the sole producer being The Consolidated Mining and Smelting Company of Canada Limited. Output in 1950 was 2,932 tons with an antimony content of 322 tons, compared with 1,073 tons of antimonial lead with an antimony content of 79 tons in 1949. Four grades of antimonial lead were produced in 1950 having an antimony content of 2, 5, 7, and 12 per cent, respectively.

*Production and Trade*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Short tons | $ | Short tons | $ |
| *Production* (antimony content of antimonial lead alloy) | 322 | 217,750 | 79 | 61,020 |
| *Imports* (regulus) | | | | |
| From: United States | 911 | 509,511 | 420 | 310,817 |
| Belgium | 553 | 294,426 | 226 | 168,214 |
| United Kingdom | 74 | 36,426 | 67 | 36,416 |
| Yugoslavia | 29 | 13,855 | ........... | ........... |
| China | 28 | 14,617 | 579 | 392,855 |
| Czechoslovakia | 11 | 4,885 | ........... | ........... |
| Total | 1,606 | 873,720 | 1,292 | 908,302 |
| *Exports* (antimony content of antimonial lead) | | | | |
| To: United States | 287 | ........... | 1 | ........... |

The principal producers of antimony are Bolivia, Mexico, South Africa, United States, Czechoslovakia, and Yugoslavia. In 1949, world production of recoverable antimony was estimated to be 34,000 metric tons (United States Bureau of Mines, Minerals Yearbook, 1949).

### *Canadian Occurrences*

Occurrences of antimony are not common in Canada. Deposits are found, largely as the mineral stibnite ($Sb_2S_3$), in Newfoundland, Nova Scotia, New Brunswick, eastern Quebec, British Columbia, and Yukon.

#### *Newfoundland*

A deposit of stibnite on the west shore of Mortons Harbour on New World Island, Notre Dame Bay, was worked intermittently from 1890 until 1916 and a small amount of ore was exported.

The stibnite occurs in a vein along the contact of a 6-foot rhyolite dyke that intrudes chloritized andesitic lavas. The workings, which are in a fair state of preservation, consist of a 230-foot tunnel about 10 feet above tidewater, with a shaft to the surface at the inner end, and a shorter tunnel at 55 feet above sea-level.

Samples taken by the Mines Branch, Ottawa, in 1950, assayed as follows:

| Sample No. | Sb, per cent | As, per cent | Pb, per cent | Au, oz./ton | Ag, oz./ton |
|---|---|---|---|---|---|
| 1........... | 33·0 | 2·14 | 0·40 | 0·02 | 0·39 |
| 2........... | 21·92 | 1·32 | .............. | Trace | .............. |
| 3........... | 38·00 | 1·18 | 0·10 | Trace | 0·24 |

1. 9-inch channel sample of ore from hanging-wall at face in upper drift.
2. 12-inch channel sample of ore and rock from hanging-wall at 4-foot opening over lower drift.
3. 9-inch channel sample of ore from foot-wall over upper drift.

*Nova Scotia*

The West Gore deposit in Hants county, about 25 miles east of Windsor, was first worked in 1884. Mining has been carried on at different periods, the last being between 1910 and 1917, and over 7,700 tons of hand-cobbed ore and concentrates were produced.

The ore occurs as lenses of auriferous stibnite in fissure veins in slate and quartzite. Almost all of the production has come from one vein that has been developed to a depth of 800 feet. Numerous other veins have been reported of which only two have received a limited amount of investigation. Antimony-Gold Mining and Smelting Corporation Limited has owned the property since 1948.

At Lansdowne, Digby county, some surface exploration was carried out during 1949 and 1950.

*New Brunswick*

Stibnite showings in quartz veins at Lake George extend for a length of one mile and a width of half a mile. The deposit was worked intermittently between 1868 and 1931. During several of the active periods smelting furnaces were operated. A number of shafts were sunk at different times, the deepest being 375 feet. Some exploration and drilling was done in 1947 and 1948. Several of the ore dumps sampled at that time assayed 1·77 to 3·10 per cent antimony. The property is now held by Mineral and Oil Exploration Syndicate.

*Quebec*

A deposit of stibnite in South Ham township, Wolfe county, the only known deposit of possible economic interest in the province, was worked around 1874.

*British Columbia*

Limited development has been done on several deposits. The Stuart Lake mine in the Fort St. James area was opened by a shaft in 1940 and shipments of ore were made for test purposes.

There are several occurrences of antimony in the Bridge River area. One of these at the head of Truax Creek has been under development for the past few years, first by Bellore Mines Limited, and later by Gray Rock Mining Company Limited. During 1950, the tunnel was advanced 400 feet.

Consolidated Mining and Smelting Company's Sullivan mine at Kimberley contains small amounts of antimony that is ultimately recovered in the form of an antimonial lead alloy from the residues obtained in the refining of lead at the company's smelter at Trail. Up to 1944 the antimony was recovered as refined metal.

*Yukon*

The principal occurrences are in the Wheaton district. A recent discovery on the east side of Carbon Hill is stated to have a vein exposed for 100 feet with a width of 15 feet, and having an antimony content of about 15 per cent. The claim is within 4 miles of a road.

### *Uses and Consumption*

Antimony is used chiefly as an alloying element with lead, to which it imparts hardness and mechanical strength. Its characteristic of expanding on cooling makes it particularly useful in type-metal alloys. Antimonial lead is used for battery plates, for cable covering, for sheet, pipe, etc., and in the chemical and pulp and paper industries. It is a component of most bearing metals and is alloyed with lead and tin in making solder, foil, collapsible tubes, and type metal.

Sulphides of antimony are used as pigments in paint manufacture and in the rubber industry. The oxides are used in the production of porcelain enamel frits. Antimony is the base in flame-proofing compounds.

Canadian consumption of antimony regulus by specified industries in 1948 and 1949 was:

| | 1949 | 1948 |
|---|---|---|
| | Short tons | Short tons |
| White metal foundries | 683 | 700 |
| Electrical apparatus | 63 | 56 |
| Silverware | 9 | 23 |
| Brass foundries | 11 | 13 |
| Miscellaneous | 18 | 20 |
| Total | 784 | 812 |

### *Prices*

The average Canadian price of antimony in 1950 was 29·958 cents a pound according to the Dominion Bureau of Statistics.

Domestic antimony in United States, according to the Engineering and Mining Journal Metal and Mineral Markets, declined from 35·28 cents to 27·78 cents on March 16. It increased to 31·78 cents early in September, and to 35·28 cents a pound at the end of 1950. The average price for 1950 was 30·90 cents a pound.

## ARSENIC (ARSENIOUS OXIDE)

Although arsenical ores are widely distributed in Canada, the production of arsenic is limited to only a few localities where it is recovered as a by-product in the treatment of gold or silver-cobalt ores. A total of 397 tons of refined white arsenic ($As_2O_3$) valued at $52,029 was produced in 1950, compared with 263 tons valued at $26,332 in 1949.

During 1950 the demand for refined arsenic showed a marked increase over that of the past several years and practically all accumulated stocks were disposed of.

*Production and Trade*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Pounds | $ | Pounds | $ |
| *Production* (refined arsenious oxide) | | | | |
| Ontario | 247,557 | 16,220 | 175,938 | 8,797 |
| Quebec | 546,534 | 35,809 | 350,707 | 17,535 |
| Total | 794,091 | 52,029 | 526,645 | 26,332 |
| *Exports*[1] | 361,400 | 17,382 | 12,400 | 1,030 |
| *Imports*[2] | 12,290 | 3,229 | 256,957 | 18,091 |

[1] Excludes those for which no payment is received.
[2] Arsenious oxide and arsenic sulphide.

World production of arsenic is practically all derived as a by-product from the treatment of gold, silver, cobalt, lead, and other base metal ores. The leading producing countries are Sweden, United States, Mexico, France, Australia, Italy, and Japan.

*Canadian Sources of Supply*

Canada's output of crude white arsenic continued to come from O'Brien Gold Mines, Limited and Consolidated Beattie Mines Limited, in Cadillac and Duparquet townships respectively, in Quebec. Production, which is recovered as a by-product in the roasting of arsenical gold ores, totalled 1,544 tons in 1950.

The output of the O'Brien mine was shipped to Deloro Smelting and Refining Company Limited, Deloro, Ontario, where it was refined to the white arsenic of commerce. Consolidated Beattie Mines Limited shipped 22 tons to Newcor Mining and Refining Limited, Douglas Lake, Saskatchewan, for refining. This company has since been acquired by Asfe Mines Limited.

The gold-arsenic concentrates produced by Bralorne, Kelowna Exploration, Polaris-Taku, and other gold mines in British Columbia were shipped to the smelter at Tacoma, Washington, but as no payment is made for the contained arsenic, this output is not included in the Canadian production figures.

*Uses*

White arsenic is used chiefly in Canada as an oxidizing agent in the manufacture of glass, where it acts as a clearing agent by eliminating the coloration due to traces of iron oxide. It is also used in the form of calcium and lead arsenate for insecticides and weed-killers, but this market is being absorbed to a considerable extent by organic insecticides such as DDT. and 2-4-D.

Other uses are in the manufacture of wood preservatives, pigments for metal finishing, dyestuffs, cattle dip, bearing metals and alloys, and pharmaceuticals. Its use in the medicinal field has declined rapidly with the advent of penicillin.

*Consumers and Consumption*

The more important Canadian consumers are: Niagara Brand Spray Company Limited, Burlington, Ontario; Dominion Glass Company Limited, Consumers Glass Company Limited, Mount Royal Metal Company Limited, Mallinckrodt Chemicals Limited, and Sherwin-Williams Company of Canada Limited, all of Montreal; Canada Metal Company Limited, Toronto; Steel Company of Canada Limited, Hamilton; and International Fibre Board Limited, Gatineau, Quebec.

*Consumption of Arsenious Oxide in Canada*

| — | 1949 | 1948 |
|---|---|---|
| | Pounds | Pounds |
| Glass industry | 392,560 | 432,711 |
| White metal alloys | 34,828 | 30,927 |
| Miscellaneous (including insecticides) | 49,313 | 244,951 |
| Total | 476,701 | 708,589 |

*Prices*

According to Engineering and Mining Journal Metal and Mineral Markets, the price in 1950 of refined arsenious oxide (white arsenic, minimum 99 per cent $As_2O_3$) in barrels, carload lots, delivered, remained at 5½ cents a pound until October 19 when it increased to 6 cents with a further increase on December 7 to 6½ cents a pound.

## BISMUTH

Canada's entire production of metallic bismuth is derived as a by-product from the residues resulting from the electrolytic production of lead bullion by The Consolidated Mining and Smelting Company of Canada Limited at Trail, British Columbia. Output in 1950 was 58 per cent greater than in 1949 due to the marked increase in the output of virgin lead.

Assomoly Registered, a company owned jointly by Molybdenite Corporation of Canada Limited, and Associated Metals and Minerals, New York, produced a small amount of bismuth oxychloride from the operation of its leaching plant at the La Corne mine in Quebec for a short period during 1950.

*Production and Trade*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Pounds | $ | Pounds | $ |
| *Production* | | | | |
| British Columbia (metal) | 162,616 | 365,886 | 102,913 | 210,972 |
| Quebec (in ore) | 29,005 | 65,261 | ........ | ........ |
| Total | 191,621 | 431,147 | 102,913 | 210,972 |
| *Exports* | | | | |
| Metal | 114,000 | ........ | 178,000 | ........ |
| *Imports* | | | | |
| (Bismuth-bearing ore, gross weight) | | | | |
| From: United States | 59 | 206 | 199,397 | 83,382 |
| Australia | ........ | ........ | 1,232 | 721 |
| Bolivia | ........ | ........ | 72,145 | 14,556 |
| Total | 59 | 206 | 272,774 | 98,659 |

World production was estimated at 1,500 metric tons (1,653 short tons) in 1949, the principal producing countries being Peru, Mexico, South Korea, United States, and Canada.

*Canadian Occurrences*

Occurrences of bismuth are rare, the most important being in the lead-zinc-silver ore of the Sullivan mine of Consolidated Mining and Smelting Company at Kimberley, British Columbia, where it occurs in very small amounts.

The mineral tetradynite (a telluride of bismuth) occurs in the Glacier Gulch Group, near Smithers, British Columbia.

Small amounts of bismuth are associated with the silver-cobalt ores of the Cobalt district in northern Ontario.

Bismuth occurs in association with molybdenite in the La Corne mine in Quebec, which produced a small tonnage of bismuth concentrates and metallic bismuth in 1946 and 1947. The mine has been closed since 1947.

A small deposit of bismuth associated with copper and antimony occurs on Pond Island in the Bay of Exploits, Notre Dame Bay, Newfoundland.

*Uses and Consumption*

Owing to its extreme brittleness, bismuth is seldom used alone, but is consumed in the composition of low fusibility, non-ferrous alloys. These low melting point alloys usually contain from 40 to 60 per cent bismuth with varying proportions of other metals, such as tin, cadmium, lead, antimony, indium, and zinc. They are used for sprinkler plugs and other fire protection appliances, electrical fuses, low-melting solders, dental amalgams, and tempering baths for small tools. Bismuth is used in the production of radar equipment and in making optical glass.

Bismuth salts are used extensively in medicinal compounds and pharmaceutical products.

Canada uses less than 50 tons of bismuth metal a year, the principal consumers being: Canada Metal Company Limited, Toronto; Mount Royal Metal Company Limited, Montreal; Mallinckrodt Chemical Works Limited, Ville LaSalle, Quebec; and Merck and Company Limited, Montreal.

*Prices*

The average Canadian price, according to the Dominion Bureau of Statistics, of domestic bismuth for 1950 was $2.078 a pound.

## CADMIUM

Production of cadmium in Canada increased slightly to 848,406 pounds in 1950, compared with 846,541 pounds in 1949, whereas domestic consumption and exports showed respective increases of 4 and 6 per cent. Cadmium advanced in price from $2 to $2.55 a pound during 1950 due largely to expanded production of combat aircraft and other war materials.

Cadmium occurs in close association with zinc and in Canada it is recovered from the high cadmium precipitate obtained in purifying zinc electrolyte at the electrolytic zinc plants of The Consolidated Mining and Smelting Company of

Canada Limited at Trail, British Columbia and of Hudson Bay Mining and Smelting Company Limited at Flin Flon, Manitoba. Consolidated Mining and Smelting Company produced 349 tons at its cadmium refinery at Trail, which has a rated capacity of 700 tons a year, whereas Hudson Bay Mining and Smelting Company, Limited produced 70 tons at its Flin Flon refinery, where the rated capacity is 180 tons. A 99·99 per cent cadmium product can be made at both refineries if required.

*Production, Trade, Consumption*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Pounds | $ | Pounds | $ |
| *Production* | | | | |
| British Columbia and Yukon | 706,950 | 1,640,124 | 665,449 | 1,364,170 |
| Saskatchewan and Manitoba | 141,456 | 328,178 | 181,092 | 371,239 |
| Total | 848,406 | 1,968,302 | 846,541 | 1,735,409 |
| *Exports* | | | | |
| To: United Kingdom | 367,812 | 832,399 | 442,664 | 1,047,509 |
| United States | 231,605 | 500,941 | 64,965 | 126,749 |
| France | 19,800 | 42,099 | 34,749 | 84,980 |
| Sweden | 38,080 | 81,298 | 48,568 | 100,899 |
| Other countries | 18,708 | 41,115 | 42,661 | 94,125 |
| Total | 676,005 | 1,497,852 | 633,607 | 1,454,262 |
| *Consumption* | 231,000 | ........... | 222,000* | ........... |
| Refinery production by principal countries** | | | | |
| United States | 8,982,950 | ........... | 8,023,616 | ........... |
| Canada | 834,218 | ........... | 846,541 | ........... |
| Tasmania (Australia) | 499,747 | ........... | 468,852 | ........... |
| Great Britain | 261,588 | ........... | 221,820 | ........... |

* Revised.
** American Bureau of Metal Statistics.

Most of the output of cadmium at Trail comes from zinc concentrates produced from the lead-zinc ores mined at The Consolidated Mining and Smelting Company's Sullivan mine at Kimberley, British Columbia. The remainder originates in the zinc ores of a number of mines in British Columbia and elsewhere that ship zinc concentrate to the Trail smelter for treatment. The more important of these mines in the order of the cadmium content of their shipments in 1950 are: Canadian Exploration Limited, Britannia Mining and Smelting Company Limited, Reeves MacDonald Mines Limited, Kootenay Belle Gold Mines Limited (Zincton), Silver Standard Mines Limited, Silbak Premier Mines, Limited, all in British Columbia; and United Keno Hill Mines Limited in the Mayo area, Yukon.

Hudson Bay Mining and Smelting Company's cadmium production came largely from its copper-zinc orebody at Flin Flon on the Saskatchewan-Manitoba boundary. The company also treated zinc concentrate containing cadmium from Sherritt Gordon Mines Limited at Sherridon and from Cuprus Mines Limited near Flin Flon, both in Manitoba.

*Uses*

Cadmium is used largely for electroplating iron, steel, and, to a lesser extent, copper alloys. The metal is desirable for this use for the following reasons:

1. A very thin coating provides adequate protection from corrosion.
2. The metal can be plated uniformly on intricately shaped objects at a high rate of deposition.
3. A cadmium-plated article has an attractive and enduring lustre.
4. Cadmium is highly resistant to atmospheric, alkali, and salt water corrosion, although, it has a relatively low resistance to acids.

Cadmium-plated articles include a wide range of items used chiefly in making automobiles, aircraft, and household appliances.

Another important use is in the white metal alloy industry, especially in the manufacture of cadmium base-bearing metals for use in high-speed internal combustion engines.

The addition of 0·7 to 1·0 per cent of cadmium strengthens copper without seriously reducing its electrical conductivity.

Cadmium is used in making low melting point solders and fusible alloys for sprinkler apparatus, fire detector systems, and valve seats for high-pressure gas containers.

New uses are reported to have been found for the metal in atomic energy research.

Cadmium sulphide and cadmium sulphoselenide (red lithopone) are standard agents for producing bright yellow and red colours in paints, ceramic materials, inks, rubber, and leather. Cadmium nitrate is used in white fluorescent lamp coatings; and the oxide, hydrate, and chloride of cadmium are used in electroplating solution. Cadmium bromide, chloride, and iodide are used in the preparation of special photographic film. Cadmium stearate is used in large tonnages as a stabilizer in making vinyl plastics.

*Prices*

The average Canadian price in 1950, estimated by the Dominion Bureau of Statistics, was $2.31 a pound.

The New York price for commercial sticks and bars remained at $2 a pound until June, after which it increased gradually to $2.55 by the end of 1950. Platers' shapes and anodes were 25 cents a pound more.

## CHROMITE

No shipments of chromite were reported in 1950. The Canadian output of chromite declined from a wartime peak of 29,595 tons in 1943 to 361 tons in 1949. The latter consisted mainly of shipments from small stockpiles of ore at the old Montreal pit of Union Carbide Company in the Black Lake area of the Eastern Townships of Quebec.

*Production, Trade, and Consumption*

| Chrome Ore | 1950 | | 1949 | |
|---|---|---|---|---|
| | Short tons | $ | Short tons | $ |
| *Production* (Shipments) | ........... | ........... | 361 | 7,148 |
| *Imports* | | | | |
| From: United States* | 12,055 | 432,730 | 23,386 | 757,195 |
| Union of South Africa | 57,610 | 498,973 | 28,417 | 470,759 |
| Southern Rhodesia | 5,058 | 184,700 | 7,040 | 269,614 |
| Philippines | 10,332 | 147,766 | 6,283 | 132,604 |
| Turkey | 12,317 | 409,964 | 560 | 25,628 |
| Sierra Leone | 10,427 | 276,321 | ........... | ........... |
| Cuba | 6,944 | 108,234 | ........... | ........... |
| Other countries | 4,582 | 133,867 | 560 | 8,282 |
| Total | 119,325 | 2,192,555 | 66,246 | 1,664,082 |
| *Consumption* | 90,798 | ........... | 55,793 | ........... |
| *Consumer's Stocks, Dec. 31,* | 32,842 | ........... | 43,159 | ........... |

* Imported via United States from South Africa, Philippines, Russia, Turkey, Yugoslavia, Sierra Leone, and India.

Most of the chromite deposits from which production was obtained in the past are between Quebec city and Sherbrooke in the Eastern Townships of Quebec, but all mines were inactive during 1950.

The old Montreal pit in the Black Lake district in the Eastern Townships was reopened in 1941 by Union Carbide Company and was operated for the company by Orel Pare until closing in 1947. Small shipments from stock have been made by this company since that time. During World War II production was also obtained from the Sterrett mine in Cleveland township and the Reed-Belanger property in the Black Lake district, both of which ceased to operate in 1944. The Chromeraine mine, also in the Black Lake area, was operated for a short time in 1943 and 1944 by Wartime Metals Corporation.

During the summer of 1942 extensive low-grade chromite deposits were discovered in the Lac du Bonnet district in southeastern Manitoba about 80 miles northeast of Winnipeg. Various zones of disseminated chromite bands have been traced for considerable distances in the Bird River complex of ultrabasic rocks in this district. There is no massive chromite within any of the zones. The average grade of the main chrome band is about 20 per cent $Cr_2O_3$ and is readily beneficiated to a product containing 35 to 40 per cent $Cr_2O_3$ with a chrome-iron ratio of about 1·4 to 1. Test work has been conducted by Hudson Bay Mining and Smelting Company, Limited and by the Mines Branch, Ottawa, in an effort to raise this low chrome-iron ratio to within market requirements.

Although Canada's production of chromite is negligible the availability of abundant electric power, at reasonable rates, has enabled the establishment of extensive ferro-alloy manufacture. Ferrochromium is produced in carbon arc electric furnaces for domestic consumption and export by Electro Metallurgical Company of Canada, Limited in its works at Welland, Ontario. Chromium Mining and Smelting Corporation, Limited at Sault Ste. Marie, Ontario, produces Chrome X and other exothermic chrome addition agents from ores containing about 45 per cent $Cr_2O_3$ with a chrome-iron ratio of from 1·5 to 1 to 1·9 to 1.

This company plans the early erection of a plant at Glendive, Montana, to manufacture chrome addition agents from the low-grade Montana ores. Canadian Refractories Limited in its plant at Kilmar, Quebec, produces a full line of chrome refractories from imported ores for furnace linings.

### *World Production*

World production of chromite, of all grades, varies from 1,100,000 tons to more than 2,000,000 tons annually and comes mainly from Russia, Union of South Africa, the Philippines, Southern Rhodesia, Turkey, and Cuba, with smaller tonnages from New Caledonia, and India.

Southern Rhodesia, Turkey, and Russia are the main sources of metallurgical grade chromite. The Philippines, Cuba, and Southern Rhodesia supply mainly high-grade refractory ores. The Union of South Africa is the chief source of chemical-grade ore.

### *Uses and Specifications*

The uses of chromite are divided into three groups, namely metallurgical (by far the most important), refractory, and chemical.

The chromium content, the ratio of chromium to iron in the ore or concentrate, the amount of non-chromium bearing material in the ore, and the physical character of the ore are the chief factors determining the grade and use of the material.

For standard metallurgical uses, chromite should contain a minimum of 48 per cent chromic oxide ($Cr_2O_3$) with a chromium to iron ratio of 3 to 1 or more, and the material should be in lump form.

For special types of chrome addition agents such as Chrome X, produced by Chromium Mining and Smelting Corporation Limited, Sault Ste. Marie, Ontario, lower grade ores with a ratio of 1·5 to 1 are being used.

Refractory chromite should contain 57 per cent or more of combined $Cr_2O_3$ and alumina ($Al_2O_3$) with approximately 40 per cent $Cr_2O_3$ and should be as low as possible in silica and iron. The ore should be hard and lumpy, not under 10 mesh, and the chromite should be present in an evenly, finely divided state rather than as coarse blobs with silicates.

There are no fixed limits for chemical grade ore except those imposed by price, and the effect of grade on plant capacity. In contrast to metallurgical and refractory ore, concentrates and fines are preferred, and a low chromium to iron ratio is not harmful provided the chromium content is high. The silica content should be low.

Although the grades were named for the major uses, some interchange of grade is possible. Chemical ore has been used for metallurgical purposes, metallurgical concentrates and fines for chemical purposes, and metallurgical lump for refractory purposes.

Chromite finds its largest single use in the steel industry where it is mainly consumed in making ferrochromium for use in the manufacture of stainless and other alloy steels. Some chromite is used directly in the steel bath. Chromium increases hardness and shock resistance and imparts high tensile strength and ductility to steels. Other metallurgical uses include the manufacture of certain cast iron and non-ferrous alloys. The addition of chromium to cast iron reduces the grain size greatly, increases its resistance to wear and corrosion, and reduces oxidation at high temperatures. There is no completely satisfactory substitute for chromium in stainless and other alloy steels but some of the chromium may be replaced by molybdenum or manganese.

Chrome ore (refractory grade) is used in making refractory bricks and cements used largely in basic open hearth furnaces, in arches of furnaces, etc. It is used with magnesia to make chrome-magnesia refractories.

Chemical grade ore is used for the production of chromium chemicals, which in turn are used in tanning leather, pigments, chromium plating, and other applications.

*Prices*

The Engineering and Mining Journal Metal and Mineral Markets Bulletin of December 28, 1950 quoted prices for chromite and allied products, as follows:

(*a*) *Chrome Ore*—per long ton, dry basis f.o.b. cars, New York:

| | |
|---|---|
| (1) Indian and Rhodesian: | |
| 48 per cent $Cr_2O_3$, 3 to 1 ratio, lump | \$36 to \$38 |
| 48 per cent $Cr_2O_3$, 2·8 to 1 ratio | \$34 to \$35 |
| 48 per cent $Cr_2O_3$, no ratio | \$25 |
| (2) South African (Transvaal): | |
| 48 per cent $Cr_2O_3$, no ratio | \$27 |
| 45 per cent $Cr_2O_3$, no ratio | \$20 |
| (3) Turkish: | |
| 48 per cent $Cr_2O_3$, 3 to 1 ratio, lump | \$43 to \$44 |
| (4) Brazilian: | |
| 44 per cent $Cr_2O_3$, 2·5 to 1 ratio, lump | \$31 |

(*b*) *Ferrochromium* per pound of contained chromium containing 65 to 69 per cent chromium and high carbon (4 to 9 per cent C), in lump form in carloads delivered to the eastern zone, 21·75 cents; low carbon 30·5 cents.

(*c*) *Chromium* (chrome metal) per pound on 97 per cent grade \$1.12 for spot transactions and \$1.07 on contract.

## COBALT

Shipments of cobalt of Canadian origin in concentrates exported and in metal alloy, oxide, and salts totalled 292 tons in 1950, compared with 310 tons in 1949. Peak shipments were reported in 1948 when 772 tons of contained cobalt were handled, but this figure included 323 tons of United States stockpiled material accumulated and held in Canada during World War II. (It should be noted that statistics on Canadian "production" of cobalt, by years, do not give a true picture of actual annual production of new cobalt, mined and milled, because of the stockpiling policy of the mine operators, the cobalt refiners, and the purchasers of ores or concentrates. Production of the metal, or its content in compounds, from the Cobalt area does not show up until the finished product has been sold.)

Increasing interest was shown throughout 1950 in the Cobalt-Gowganda area of northern Ontario where production of cobalt and silver increased and exploration and development of properties was extensive. Silver-Miller Mines Limited at Brady Lake, a few miles southeast of Cobalt, operated its mill, which entered production in October 1949, at 75 tons a day. Two additional levels were being developed in the mine following the deepening of the shaft to 575 feet. Developments underground at the property of Cobalt Lode Silver Mines Limited, which adjoins Silver-Miller to the south and east, proved highly satisfactory. In October 1950, milling operations on a 50-ton per day basis were begun in the company's mill, which was acquired during the year from Silanco Mining & Refining Company Limited. This is the second mill to go into operation in the Cobalt area in recent years. Silver-Miller and Cobalt Lode along with other operators in the area, mine rich, narrow, high-grade silver-cobalt veins typical of former operations in the Cobalt and Gowganda areas.

Cobalt occurs in minor amounts in the nickel-copper ores of the Sudbury district of Ontario. The International Nickel Company of Canada, Limited recovers the cobalt in oxide form in its nickel refineries at Port Colborne, Ontario, and Clydach, Wales. The cobalt is contained in the residues of the electrolytic refining of nickel. Falconbridge Nickel Mines Limited, with mines in the Sudbury area, plans to recover cobalt from nickel residues at its nickel refinery in Kristiansand in Norway.

The copper-nickel ores of Sherritt Gordon Mines Limited, at Lynn Lake in Manitoba, contain minor amounts of cobalt, recovery of which is anticipated when production from the deposits begins.

*Production and Trade*

(Cobalt content, short tons)

| — | 1950 | 1949 |
|---|---|---|
| *Shipments (from Canadian ores)*[1] | | |
| In concentrates exported | 12 | 25 |
| In metal, alloy, oxides, and salts produced | 280 | 285 |
| Total | 292 | 310 |
| *Exports* | | |
| *In concentrates* | | |
| To: United States | 8 | 6 |
| Other countries | ........... | 19 |
| *As metal, oxides, and salts*[2] | | |
| To: United Kingdom | 190 | 300 |
| Other countries | 4 | 1 |
| *Imports* | | |
| As metal, oxides, alloys, or concentrate | 180 | 39 |

[1] Not necessarily mined in the years specified.
[2] Includes production from ores, concentrates, alloys, etc., of foreign origin, but does not include the cobalt contained in the nickel bottoms shipped to International Nickel's refinery at Clydach, Wales, where the cobalt is recovered as cobalt oxide.

The following table shows the cobalt contained in ore shipments from the Cobalt-Gowganda area for the years 1949 and 1950 in short tons.

*Cobalt Content (short tons) of Ore Shipments from Cobalt-Gowganda Area*

| Destination | 1950 | 1949 |
|---|---|---|
| Canadian refiners* | 46 | 26 |
| United States | 25 | 6 |
| United Kingdom | ........... | 19 |
| Total | 71 | 51 |

* These shipments not included in shipments from Canadian ores (see previous table) until processed and shipped from refineries as metal, oxides, or salts.

Deloro Smelting and Refining Company Limited, Deloro, Ontario, the Canadian purchaser and processor of cobalt-silver ores and concentrates, recovers cobalt for making "stellite", and produces cobalt metal, oxides, and salts for domestic consumption and export.

*Sudbury Area*

The production of cobalt in cobalt oxide form at the Port Colborne nickel refinery of International Nickel Company was begun in June 1947. It amounted to 193 tons of contained cobalt in 1950 compared with 213 tons in 1949, and is in addition to the recovery of cobalt as cobalt oxide and salts at the company's refinery in Clydach, Wales, from the nickel 'bottoms' it ships from Canada for refining.

Falconbridge Nickel plans to recover annually about 150 tons of cobalt in oxide form at its nickel refinery at Kristiansand in Norway, following alterations to the electrolytic plant. These alterations involve a changeover from sulphate to chloride solutions for the electrolytic refining of nickel. Recovery of the cobalt is expected to be under way by late 1951.

*Cobalt Area*

The area was more active in 1950 than for many years. Four mills were in operation at the end of the year, the main shippers of high-grade silver ores and concentrates containing more than 5 per cent cobalt being Cobalt Lode Silver Mines, Silver-Miller Mines, and Silanco Mining and Refining Company.

Mensilvo Mines Limited operated its mine and mill continuously and shipped high-grade (12 per cent) cobalt concentrates containing some silver. The Agaunico mine of Silanco Mining and Refining Company, formerly a producer of high cobalt-low silver concentrates, was idle.

Shipments of cobalt-silver ore and concentrates were made from the Cross Lake Lease on the O'Brien property near the north end of Cross Lake, from the old workings of the Kerr Lake Lease at the bottom of Kerr Lake, and from the former O'Shaughnessy Lease (now Shag Silver Mines Limited) on the O'Brien and adjoining Reinhardt properties at the southeast end of Cross Lake. Many other properties were examined, drilled, and developed underground with encouraging results.

The smelter of The Cobalt Chemical & Refining Company Limited, about 5 miles south of Cobalt, was destroyed by fire in April and operations were suspended.

The various mining properties of Ausic Mining and Reduction Company Limited, along with the company's fully equipped mill, remained idle. This company formed a subsidiary company, Continental Salts and Metal Limited, to construct and operate a refinery at Cobalt for the treatment of cobalt-silver ores using a new chemical process on a custom basis. However, no progress was made in plant erection.

*Gowganda Area*

Siscoe Metals of Ontario Limited, operating the former Miller Lake-O'Brien mine near Gowganda, about 45 miles north and west of Cobalt, was again a major producer of cobalt and silver, and its 100-ton mill was in continuous operation. Further development work underground proved up faulted extensions of formerly worked veins and disclosed 'new ore' at depth and in the 'old sections' of the mine.

Castle-Trethewey Mines Limited, adjoining the Miller Lake-O'Brien mine on the north and east, met with some success in exploratory work in its recently opened Capitol mine. Narrow, high-grade silver veins containing cobalt, were cut on the lower levels from 1,000 to 1,200 feet. The company plans to resume milling operations in 1951.

New companies were formed on long-dormant properties and exploration and development activities were expected to increase in 1951.

## *World Production*

Belgian Congo, Northern Rhodesia, French Morocco, United States, and Canada (in that order) together contribute about 95 per cent of the world output of cobalt, the Union Minière du Haut Katanga in Belgian Congo being the source of about 65 per cent of the output. In 1949 this company produced 4,350 tons of an estimated world output of 6,000 tons of cobalt.

The United States, by far the largest consumer, used approximately five million pounds of cobalt in 1949.

## *Uses*

At least 75 per cent of the world production of cobalt is used in the metallurgical industry and most of the remainder in the ceramic industry. Its principal metallurgical use is in making permanent magnets and magnet alloy steels, followed by stellite alloys, which contain 40 to 50 per cent cobalt, 30 to 37 per cent chromium, and 12 to 17 per cent tungsten. Stellite alloys are used in high-speed, high-temperature cutting tools, and in die materials.

Many of the high-temperature alloys developed during World War II contain from 13 to 66 per cent cobalt. Capable of maintaining strength at high operating temperatures while resisting wear corrosion, these alloys are being used for various component parts of gas turbines, jet aircraft engines, and turbo-superchargers.

Cobalt is used in carbide-type alloys, welding rods, as a binder for tipping tools, in electroplating, and with other chemicals in nickel-plating solutions as an undercoating for chromium plating.

Cobalt oxide is used chiefly in the ceramic industry because of its fine colouring properties, and it is one of the best known ground-coat frits for porcelain enamels.

There are no satisfactory substitutes for cobalt in its principal uses.

## *Prices and Tariffs*

During most of 1950 the net price of contained cobalt in cobalt ore or concentrate (i.e. above 10 per cent cobalt), f.o.b. Cobalt, Ontario, was 5.5 cents per unit a pound with payment for one-half of the silver at market quotations. Toward the end of the year this price was advanced to 6 cents per unit a pound plus 20 cents, with payment for silver unchanged.

The price of cobalt contained in silver ore or concentrate (i.e. usually 5 to 8 per cent cobalt) f.o.b. Cobalt, Ontario, remained at 5.5 cents per unit a pound with payment for 98 per cent of the silver at market quotations. Smelter and treatment charges were paid by the shipper and penalties were involved for antimony in excess of 0.5 per cent and for moisture above 10 per cent.

The Engineering and Mining Journal Metal and Mineral Markets Bulletin of December 28, 1950, quoted the following prices for cobalt metal and compounds:

*Cobalt metal,* per pound, 97 per cent to 99 per cent cobalt, rondelles or granules, in 500- to 600-pound containers, $2.10 f.o.b. New York or Niagara Falls, freight collect prices effective January 1, 1951.

*Cobalt oxide,* metallurgical grade, 70 per cent to 75 per cent cobalt, 400- to 500-pound containers, f.o.b. New York or Niagara Falls, $2.25 a pound of contained cobalt. Ceramic grade, 70 per cent to 71 per cent cobalt, $1.60 a pound east of the Mississippi, prices effective January 1, 1951.

# COPPER

Canada produced 264,209 short tons of copper in 1950 valued at $123,211,407, which was slightly above that of 1949 in volume and much above it in value. Ontario contributed 44.4 per cent of the output; Quebec 27.6 per cent; Manitoba and Saskatchewan, 18.8 per cent; and British Columbia, 8.0 per cent; the remainder being from Newfoundland. Several new mines were being developed for production.

Output of refined copper in Canada was 238,204 tons compared with 226,083 tons in 1949, whereas consumption of new copper totalled 106,868 tons.

All the copper produced in Canada occurs in association with precious metals or with other base metals, a factor which tends to give stability to the mining operations.

*Production and Trade*

| | 1950 | | 1949 | |
|---|---|---|---|---|
| | Short tons | $ | Short tons | $ |
| *Production, all forms*[1] | | | | |
| Ontario | 117,210 | 54,411,033 | 113,043 | 44,658,786 |
| Quebec | 72,891 | 34,141,997 | 67,822 | 27,092,363 |
| Saskatchewan | 28,982 | 13,575,052 | 34,960 | 13,964,980 |
| British Columbia | 21,088 | 9,823,569 | 27,055 | 10,783,314 |
| Manitoba | 20,817 | 9,750,846 | 16,960 | 6,774,871 |
| Newfoundland | 3,221 | 1,508,910 | 3,617 | 1,444,837 |
| Total | 264,209 | 123,211,407 | 263,457 | 104,719,151 |
| *Production, refined* | 238,204 | ........... | 226,083 | ........... |
| *Exports in ingots, bars, slabs, etc.* | | | | |
| To: United Kingdom | 64,326 | 28,420,435 | 59,491 | 25,814,607 |
| United States | 50,425 | 22,658,320 | 50,211 | 20,364,107 |
| India | 6,683 | 3,102,021 | 5,741 | 2,509,792 |
| France | 5,064 | 2,147,633 | 7,402 | 3,267,767 |
| Netherlands | 1,872 | 706,776 | 706 | 328,778 |
| Switzerland | 1,867 | 806,536 | 1,846 | 705,877 |
| Czechoslovakia | ........... | ........... | 392 | 177,338 |
| Other countries | 4,007 | 1,824,009 | 1,371 | 546,488 |
| Total | 134,244 | 59,665,730 | 127,160 | 53,714,754 |
| *Exports in rods, strips, sheets, tubing* | | | | |
| To: United States | 8,916 | 4,379,982 | 8,841 | 3,988,922 |
| Switzerland | 2,423 | 1,244,548 | 1,455 | 700,349 |
| Netherlands | 1,708 | 841,039 | 4,288 | 1,940,273 |
| United Kingdom | 1,377 | 580,395 | 13,428 | 6,136,449 |
| New Zealand | 474 | 269,398 | 370 | 233,708 |
| Denmark | 280 | 148,427 | 1,119 | 561,886 |
| Other countries | 764 | 566,818 | 2,028 | 1,177,430 |
| Total | 15,942 | 8,030,607 | 31,529 | 14,739,017 |
| *Exports in ore, matte, regulus* | | | | |
| To: United States | 25,494 | 10,197,800 | 29,650 | 11,860,100 |
| Norway | 6,119 | 2,447,420 | 6,496 | 2,598,080 |
| United Kingdom | 686 | 274,460 | 800 | 320,060 |
| Belgium and Luxembourg | ........... | ........... | 112 | 44,900 |
| Total | 32,299 | 12,919,680 | 37,058 | 14,823,140 |

[1] Blister copper made from Canadian ore plus recoverable copper in concentrates, matte, etc., exported.

A large part of the 106,868 tons of ingot copper processed in Canada during 1950 was rolled into wire rods. Part of these was exported, as noted in the table above, and the remainder was re-rolled into a great variety of wire products, much of which was also exported. The rest of the Canadian consumption was used mainly to make brass and bronze.

The American Bureau of Metal Statistics issued the following estimate of copper production in 1950 in most of the countries where copper is produced or refined. Where possible, the copper is credited to the country of origin rather than to the country where it is smelted or refined.

*Copper Output Of Smelters and Refineries in 1950*

(Tons of 2,000 pounds)

| | |
|---|---|
| United States | 1,018,806 |
| Canada | 231,153 |
| Chile | 380,801 |
| Peru | 22,409 |
| Mexico | 61,948 |
| Germany (Bizone) | 211,760 |
| Rhodesia | 314,589 |
| Belgian Congo | 193,917 |
| Union of South Africa | 36,194 |
| Australia | 16,849 |
| Japan | 40,984 |

### *Newfoundland*

*Buchans.* The Buchans mine of American Smelting and Refining Company treated 328,000 tons of ore from which 14,107 tons of copper concentrate containing 3,290 tons of copper was produced. The lead and zinc concentrates also contained appreciable amounts of copper. Orebodies discovered in 1948 at some distance to the north were developed through a new 1,700-foot shaft and production was expected to commence in 1951.

Falconbridge Nickel Mines Limited examined the old copper showings at Gull Lake in the north-central part of the province and at Rambler, 35 miles to the north near Notre-Dame Bay, and is preparing to develop them.

### *Nova Scotia*

*Mindamar.* The old Sterling mine in Cape Breton has been reopened by Mindamar Metals Corporation Limited. Underground examination has outlined 780,000 tons of zinc-lead-copper ore and the company plans to erect a 500-ton mill in 1951.

### *New Brunswick*

*Tetagouche.* The Tetagouche copper-zinc-lead property west of Bathurst has been acquired by Frobisher Limited. The ore is not amenable to selective flotation, and another process is being worked out that is expected to give a good recovery of the three metals.

### *Quebec*

*Noranda.* All the copper concentrate produced from the mines of western Quebec was shipped to the smelter of Noranda Mines Limited, which treated 1,243,700 tons of copper-bearing materials containing 72,687 tons of copper. The anodes are sent to the company's refinery in Montreal East, which is operated by a subsidiary, Canadian Copper Refiners Limited. Output of refined copper totalled 123,200 tons. Additional subsidiaries of Noranda Mines Limited are Canada Wire and Cable Company Limited, with plants at Leaside, near Toronto, and in Montreal; and Noranda Copper and Brass Limited, with a plant at Montreal East.

Noranda's Horne mine produced 1,349,369 tons of ore that yielded 25,731 tons of copper, as well as gold, silver, and pyrite concentrate. The ore reserve at the end of 1950 was 17,547,900 tons. There is also a large tonnage of low-grade ore that contains approximately 50 per cent pyrite.

The Joliet lease, adjoining the Horne mine, was prepared for the production of siliceous fluxing ore.

The Waite Amulet mine and the adjoining Amulet Dufault property, controlled by Noranda, milled 424,365 tons of ore from which 12,936 tons of copper was recovered, as well as zinc, gold, silver, and pyrite concentrate. The ore reserve at the end of 1950 was 1,888,186 tons. The new East Waite orebody is being prepared for production.

At the end of 1950, Gaspe Copper Mines Limited, a subsidiary of Noranda, had a reserve of approximately 57 million tons of copper ore. The company plans to prepare the property for a rated daily production of 5,000 tons.

*Quemont.* Quemont Mining Corporation Limited treated 759,663 tons of ore in 1950, its first full year of production, and recovered 11,634 tons of copper as well as zinc, gold, silver, and pyrite concentrate. The ore reserve is 9,402,000 tons. An orebody was discovered during 1950 in the northern part of the mine.

*Normetal.* Normetal Mining Corporation Limited milled 363,297 tons of ore from which 7,853 tons of copper was recovered, as well as zinc, gold and silver. The reserve is 1,573,100 tons of copper-zinc ore and 437,000 tons of zinc ore. The internal shaft was completed to a depth of 4,211 feet and lower levels to 4,160 feet were partly developed with good results.

*East Sullivan.* East Sullivan Mines Limited during 1950, its second year of operation, treated 869,587 tons of ore in its 2,500-ton mill, from which 16,796 tons of copper as well as zinc, gold, silver, and pyrite concentrate were recovered. The ore reserve is 4,918,000 tons. The mine is partly developed to a depth of 1,050 feet and levels have been established to a depth of 2,000 feet.

East Sullivan has taken over the lead-zinc-copper property of Federal Zinc and Lead Company Limited in the central part of the Gaspe peninsula and is preparing it for development.

*Golden Manitou.* Golden Manitou Mines Limited at Val d'Or produced zinc concentrate only, up to 1950, but during the year a copper-bearing zone of substantial dimensions was found, which the company was preparing for production.

*Ascot Metals.* Ascot Metals Corporation Limited commenced production from the Moulton Hill mine, near Sherbrooke, in its new 400-ton mill in 1950. The copper-lead concentrate is shipped to a smelter in United States. The company's Suffield mine, a few miles west of Sherbrooke, was developed in preparation for production.

The copper-gold deposits at Opemiska and Chibougamau in the northwestern part of the province remained unworked.

*Ontario*

Ontario produced 44 per cent of the Canadian output of copper, production being from the nickel-copper mines of The International Nickel Company of Canada, Limited, and of Falconbridge Mines Limited, in the Sudbury area where the copper is found in the nickel-platinum ores.

*International Nickel.* International Nickel Company has five large mines, one of which, the Creighton, is operated as two separate units. For the past 10 years a large part of the ore has been obtained from an open pit at the Frood mine. As this pit is now near its maximum economical depth, the underground mines, namely, Frood, Garson, Murray, Creighton, and Levack, are being expanded and a new mine and mill are being prepared at Creighton to treat

10,000 tons daily of low-grade ore. With the exception of the new mine at Creighton, all ore is concentrated in a mill at Copper Cliff to give two concentrates, one containing most of the copper and the other high in nickel, which are smelted separately. The blister copper is refined in the company's refinery at Copper Cliff.

The ore mined in 1950 totalled 9,849,024 tons, from which 106,474 tons of copper was recovered. The ore reserve at the end of 1950 was 252,859,725 tons.

The company is erecting a plant to treat its copper concentrate by a new method. It is to be flash-roasted in oxygen to give copper matte and concentrated sulphur dioxide which is to be compressed to liquid form and marketed.

*Falconbridge.* Falconbridge Nickel Mines Limited operates two mines and a smelter in the Sudbury area, and a refinery at Kristiansand in Norway. A third mine, the Hardy, is being developed. The company treated 928,650 tons of ore in 1950, and the matte from the smelter at Falconbridge was shipped to Norway. Surplus matte was sold during 1950 but the expansion facilities under way will increase refinery capacity considerably. The ore reserve is 15,147,500 tons.

### *Manitoba and Saskatchewan*

*Hudson Bay.* Hudson Bay Mining and Smelting Company, Limited operates the Flin Flon copper-zinc mine, the Flin Flon smelter, two small mines in the vicinity, and a power plant on the Churchill River.

As the Flin Flon orebody lies astride the Manitoba-Saskatchewan boundary, part of the output is credited to each province. The plant consists of a concentrator, a cyanide plant to extract copper and precious metals from the tailing, a copper smelter, and an electrolytic zinc refinery. The blister copper is sent to Canadian Copper Refiners at Montreal East for refining. In 1950 the smelter treated concentrate from 1,852,394 tons of Flin Flon ore, as well as concentrate from the Sherritt Gordon and Cuprus mines. The company's own ore yielded 42,632 tons of blister copper. The ore reserve of the Flin Flon mine was 18,800,000 tons.

The Schist Lake mine, 3½ miles southeast of Flin Flon, was being prepared for production. The ore reserve was 655,000 tons.

Cuprus Mines Limited mined 86,202 tons of ore in 1950. The ore reserve is sufficient for 2 years.

*Sherritt Gordon.* The Sherridon mine of Sherritt Gordon Mines Limited produced 7,337 tons of copper as well as zinc, gold, and silver from 375,592 tons of ore. The copper concentrate is smelted at Flin Flon, and the blister copper is refined at Copper Cliff. It is expected that the mine will be worked out during the third quarter of 1951, after which the mine and mill equipment and some of the dwellings will be moved to the company's new mine at Lynn Lake, 120 miles to the north.

The Lynn Lake orebodies had a reserve of 14,055,000 tons at the end of 1950. The company plans to erect a 2,000-ton mill at the mine and a refinery in Alberta in which the company's ammonia leaching process is to be used. Sherritt Gordon is also developing a power site on the Laurie River, near the projected railway line into the Lynn Lake property, from which it is estimated that the annual output will be 4,500 tons copper, 8,500 tons nickel, 150 tons cobalt, and 70,000 tons ammonium sulphate. Metal deliveries are expected to commence in 1954.

### *British Columbia*

*Granby.* The Copper Mountain mine of The Granby Consolidated Mining, Smelting & Power Company, Limited produced less copper than in 1949, as the grade of the ore was lower. The mill at Allenby, 8 miles north of the mine, treated 1,799,852 tons of ore and the payable metal in the concentrate, shipped to the smelter at Tacoma, Washington, was 12,743 tons copper as well as gold and silver.

The ore reserve was 5,530,000 tons at the end of 1950.

*Britannia.* Britannia Mining and Smelting Company Limited operated its mill at 3,000 tons a day, treating 859,698 tons of ore. The 26,500 tons of copper concentrate and 864 tons of copper precipitate, which were obtained from mine waters, were shipped to the smelter at Tacoma, producing approximately 7,950 tons of copper. A substantial production of ore was obtained from the new orebody developed in 1949, which contains more zinc than copper. Continued exploration in the No. 8 mine area gave satisfactory results.

The Big Bull and Tulsequah Chief properties of The Consolidated Mining and Smelting Company of Canada Limited in the Atlin district, not far from the Yukon border, were prepared for mining during 1950. The copper-lead-zinc ore is to be trucked to the concentrator of the Polaris-Taku mine, 5 miles distant, from where the copper concentrate will be shipped to Tacoma, Washington.

### *Uses and Price*

Electrical manufactures such as generators, motors, switchboards, and light bulbs provide the largest single market for copper, followed by copper wire for installation in buildings, railway cars, ships, tramways, and for other similar uses. The automotive industry is an important outlet. A substantial part of the total is used as brass and bronze in many industrial and household forms.

The price of copper in Canada advanced from 20.35 cents a pound at the beginning of 1950 to 25·95 cents at the end of the year.

## GOLD

Canada is the second largest producer of gold, being exceeded only by the Union of South Africa. Production in 1950 totalled 4,441,227 fine ounces, compared with 4,123,518 fine ounces in 1949 and with 5,345,179 fine ounces in 1941, the peak year. Ontario contributed more than half the total in 1950. The increase in output, however, came mainly from Quebec where production was over 130,000 fine ounces greater than in 1949, and 5,300 ounces greater than in the peak year of 1941. Output from Ontario and Manitoba also increased but that from British Columbia continued to decrease. Exploration and development activity also continued to decline.

On September 30, 1950, the Federal Government announced that official fixed rates of exchange were to be abolished and that exchange rates were to be determined by conditions of supply of and demand for foreign currencies in Canada.

On October 24, 1950, the Minister of Mines and Technical Surveys announced the Government's decision to recommend to Parliament the continuation of "cost-aid" payments on a modified basis in respect of gold produced and sold in the calendar year 1951. Legislation to be introduced during the next session of Parliament would also provide for additional assistance payments in respect of gold produced and sold during the last quarter of 1950.

### *British Columbia*

Despite an increase in output from base metal operations, production of gold decreased 13,817 fine ounces to 290,490 fine ounces due mainly to a decline in output from the lode mines.

*Canadian Gold Production*

(Fine ounces)

| Provinces | 1950 | 1949 | 1941* |
|---|---|---|---|
| *Ontario* | | | |
| Auriferous quartz mines: | | | |
| Porcupine | 1,100,122 | 1,047,949 | 1,440,590 |
| Kirkland Lake | 448,391 | 475,819 | 743,032 |
| Larder Lake | 341,081 | 314,434 | 205,766 |
| Matachewan | 50,048 | 49,526 | 69,870 |
| Sudbury | 36,930 | 32,725 | 12,197 |
| Algoma | ........ | ........ | 11,560 |
| Thunder Bay | 131,413 | 117,863 | 242,478 |
| Patricia | 336,854 | 280,348 | 390,750 |
| | 2,444,839 | 2,318,664 | 3,116,243 |
| *Base metal mines* | 36,271 | 35,845 | 78,065 |
| Total | 2,481,110 | 2,354,509 | 3,194,308 |
| *Quebec* | | | |
| Auriferous quartz mines | 743,241 | 703,677 | 812,704 |
| Base metal mines | 351,404 | 260,507 | 276,635 |
| Total | 1,094,645 | 964,184 | 1,089,339 |
| *British Columbia* | | | |
| Auriferous quartz mines | 238,949 | 260,088 | 510,161 |
| Placer operations | 14,632 | 14,497 | 35,020 |
| Base metal mines | 36,909 | 29,722 | 63,022 |
| Total | 290,490 | 304,307 | 608,203 |
| *Northwest Territories* | | | |
| Auriferous quartz mines | 200,663 | 177,493 | 74,417 |
| *Manitoba* | | | |
| Auriferous quartz mines | 137,020 | 106,755 | 80,330 |
| Base metal mines | 54,705 | 30,644 | 70,223 |
| Total | 191,725 | 137,399 | 150,553 |
| *Saskatchewan* | | | |
| Placer operations | ........ | 14 | 57 |
| Base metal mines | 79,784 | 94,194 | 137,958 |
| Total | 79,784 | 94,208 | 138,015 |
| *Yukon* | | | |
| Placer operations | 93,339 | 81,970 | 70,959 |
| *Newfoundland* | | | |
| Base metal mines | 9,254 | 9,269 | ........ |
| *Alberta* | | | |
| Placer operations | 152 | 115 | 215 |
| *Nova Scotia* | | | |
| Auriferous quartz mines | 65 | 64 | 19,170 |
| Total ounces | 4,441,227 | 4,123,518 | 5,345,179 |
| Total value $ | 168,988,687 | 148,446,648 | 205,789,392 |

*Peak year of Canadian gold output.

Lode gold production came mainly from Bralorne Mines Limited in the Bridge River area, Kelowna Exploration Company Limited in the Osoyoos area, and Polaris-Taku Mining Company Limited in the Atlin area, and the remainder from the Pioneer mine in the Bridge River area, Cariboo Gold Quartz and Island Mountain mines in the Cariboo area, and Sheep Creek and Kenville mines in the Nelson area. Most of the gold production from base metal mines came from Britannia Mining and Smelting Company Limited at Britannia Beach, and The Granby Consolidated Mining, Smelting & Power Company, Limited, at Copper Mountain.

Among the placer operations, Noland Mines Limited at Atlin came into production during 1950 and produced over 9,000 ounces of gold. Trebor Placer Exploration Limited produced gold in the Quesnel-Wells area, and Cariboo Metals, Limited produced 2,300 ounces in the Likely area.

*Saskatchewan*

Output came from the Saskatchewan part of the copper-zinc deposits of Hudson Bay Mining and Smelting Company, Limited, at Flin Flon, Manitoba.

*Manitoba*

The Nor-Acme mine, a subsidiary of Howe Sound Exploration Company, Limited, in the Snow Lake area, the San Antonio mine and its subsidiary, the Jeep, in the Rice Lake Area; and the Ogama-Rockland mine produced gold in 1950, the output from Acme alone being 75,000 ounces.

The Jeep mine discontinued the shipment of gold ore to the San Antonio mill during 1950 and suspended production.

The gold output from base metal mining came from the Flin Flon mine of Hudson Bay Mining and Smelting Company, Limited, and from the Sherridon mine of Sherritt Gordon Mines Limited.

*Ontario*

The gold mines of the Porcupine, Kirkland Lake, Larder Lake, and Patricia areas supplied most of the output, other important contributors being those of the Thunder Bay, Matchewan, and Sudbury areas, and the nickel-copper mines of the Sudbury area. The largest increase in production came from the Patricia area.

In the Porcupine area, the producers in order of output were: Hollinger, McIntyre, Dome, Aunor, Pamour, Preston, East Dome, Hallnor, Porcupine Reef, Delnite, Paymaster, Coniaurum, Buffalo Ankerite, Ross, Broulan, Bonetal, and Hugh-Pam.

In the Kirkland Lake-Larder Lake area, the producers in order of output were: Kerr-Addison, Lake Shore, Wright-Hargreaves, Sylvanite, Macassa, Teck-Hughes, Kirkland Lake Gold, Upper Canada, Chesterville, and Toburn.

In the Patricia area, the main producers in order of output were: Madsen Red Lake, Campbell Red Lake, Pickle Crow, Cochenour Willans, Starratt Olsen, McKenzie Red Lake, Central Patricia, New Dickenson, Hasaga, New Jason, and Theresa.

In the Thunder Bay area, the chief producers were: MacLeod-Cockshutt, Little Long Lac, Leitch, Hard Rock, and Magnet.

Production came also from the Young-Davidson and Matachewan Consolidated mines in the Matachewan area, and from the Renabie mine in the Missinaibi area.

Output from the nickel-copper mines of the Sudbury area totalled 36,271 ounces.

*Quebec*

Quebec accounted for approximately one-quarter of the Canadian production of gold. The output comes from the Rouyn-Harricanaw belt of northwestern Quebec, the producing gold mines in 1950 in the order of output being Lamaque, Malartic Gold Fields, Sigma, East Malartic, Consolidated Beattie, Sullivan, Canadian Malartic, Belleterre, O'Brien, Barnat, Senator-Rouyn, Elder, Powell Rouyn, Donalda, Perron, Bevcourt, Anglo-Rouyn, Quesabe, and Consolidated Duquesne.

Output from base metal operations came from Noranda, Quemont, East Sullivan, Golden Manitou, Waite Amulet, Normetal, New Calumet, Anacon, and Ascot Metals.

*Nova Scotia*

Production in 1949 and 1950 was the lowest in the history of the province.

*Newfoundland*

The output of 9,254 fine ounces was a by-product from the copper-lead-zinc mines of Buchans Mining Company Limited.

*Northwest Territories*

Production came from the Giant Yellowknife, Con, Negus, Discovery Yellowknife, and Rycon mines.

*Yukon*

Production, all from placer operations, came from the Dawson, Mayo, and Whitehorse areas.

The Yukon Consolidated Gold Corporation Limited, the largest producer, continued to operate its dredges in the Dawson area.

Yukon Gold Placers, Limited, operated a dredge on Thistle and Henderson Creeks. Other operations were carried out in the Dawson area by Clear Creek Placers Limited, and Yukon Explorations, Limited.

Various individuals carried out smaller operations on Last Chance, Hunker, Goldbottom, Quartz, and Bonanza Creeks, and on Homestake Gulch.

## IRON ORE

Canada's production (shipments) of 3,218,983 long tons of iron ore in 1950 was about the same as that of 1949 but developments in the industry gave promise of a greatly increased output within the next few years.

Considerable headway was made in carrying out the expansion program under way at the Steep Rock deposits in northwestern Ontario, which is aimed at a production of at least 3 million tons by 1955 and an eventual annual production of 10 million tons. The Helen mine reached close to its rated capacity of a million tons of sinter a year. Construction was started on the railway from the Gulf of St. Lawrence to the Labrador-Quebec hematite regions. Drilling of several magnetite deposits in eastern Ontario was commenced. The output of by-product iron from the base metal mines at Noranda, Quebec, and at Kimberley, British Columbia, was brought a step nearer. By-product iron was produced from the first unit of the Sorel plant of Quebec Iron and Titanium Corporation.

### *Developments at Properties*

*Newfoundland*

*Wabana.* Shipments from the Wabana hematite mines of Dominion Steel and Coal Corporation Limited to the company's furnaces at Sydney, Nova Scotia, showed an increase of 12 per cent over shipments in 1949, but due to a shortage of foreign exchange, overseas shipments, particularly to the United Kingdom, were much lower. Small shipments were made to Germany and United States. Total shipments in 1950 were 1,044,237 long tons, compared with 1,480,256 tons in 1949. Contracts made at the end of 1950 ensure increased shipments to the United Kingdom in 1951.

The beds of hematite, in which the Wabana mines are developed, outcrop on Bell Island and dip gently under the sea. All production is from submarine workings. The three beds now being worked vary in thickness from 5 to 30 feet and are suited to highly mechanized mining. The ore is transferred across the island, a distance of from 1½ to 2 miles, to bins from which vessels are loaded by gravity. At the end of 1950 the company replaced the tramways, formerly used for transfer purposes, with 20-ton trucks.

The extent of the beds out under the sea is not known, but the present workings indicate that several hundred million tons of ore are available. The comparatively high content of phosphorus and silica, however, restricts its more general use on this continent.

*Labrador-Quebec*

Exploration during 1950 was conducted by a newly incorporated company, Hollinger-Hanna Limited, on behalf of Iron Ore Company of Canada. Several new hematite deposits were discovered and drilling increased the tonnage in some already known, the total proven ore at the end of 1950 being 417 million tons in about forty deposits. Of this, approximately two-thirds is in Quebec, and the remainder in Labrador. A breakdown of the ore estimate at the end of 1950 shows 57 per cent of it as top-grade Bessemer ore (under 0·045 per cent phosphorus) running about 60 per cent iron; 31 per cent, non-Bessemer, containing 57 to 58 per cent iron; and 12 per cent manganiferous ore (containing 7·55 to 7·98 per cent manganese) averaging 50 per cent iron.

Following the letting of a contract for the construction of the 360-mile railway from the port of Seven Islands on the Gulf of St. Lawrence to the main ore zone at Knob Lake, supplies were distributed along the first 100 miles of right of way from Seven Islands, and construction was commenced at a number of points. The location is served by a winter road and construction of two airstrips was also started along the right of way to give ready access during the summer of 1951. Temporary docks were built at the port of Seven Islands and supplies were delivered for the commencement of construction of permanent docks in 1951.

It is intended that the first shipments of ore will take place in 1954 and that the initial objective of 10 million tons a year will be reached shortly thereafter. The five steel companies that have joined with Hollinger and Hanna to finance the project have arranged to buy most of the output, but an ample amount has been reserved for possible customers in Canada and Great Britain.

*Quebec*

*Quebec Iron and Titanium Corporation.* The Sorel plant of Quebec Iron and Titanium Corporation commenced the production of iron as a by-product from the smelting of ilmenite. The full capacity of the plant as designed, is 500 tons of iron a day.

*Noranda Mines Limited.* Progress was made by Noranda Mines Limited in its process for treatment of pyrite to give elemental sulphur and iron oxide sinter. By the Noranda process about one-third of the sulphur will be recovered as elemental sulphur, and the remainder as sulphuric acid. The residue of iron oxide can be sintered.

*Ontario*

*Algoma Ore Properties Limited.* Algoma Ore Properties Limited drew its entire output of siderite in 1950 from the new underground mine at its Helen property in the Michipicoten district. The block-caving system of mining has proven successful and the conveyer belt method of taking the ore to surface has fulfilled economic expectations. The two levels beneath the Helen open pit comprise a block of ore 1,200 feet long with an average width of 200 feet and a depth of 600 feet. This ore does not require treatment by sink-float and is expected to feed the sinter plant for 10 years or more. Alongside it to the east and beneath the Victoria open pit is a block of ore of similar size that is to be developed in due course. A part of this ore like that of the Victoria open pit may require treatment in the sink-float plant.

The ore reserve of the Helen mine is estimated to be 100 million long tons.

The sinter plant produced 958,113 long tons of sinter during 1950. It has been found more economical to ship the winter production of sinter after the close of navigation to Algoma Steel Corporation in Sault Ste. Marie by rail rather than to stockpile it until navigation opens. About one-third of the total sinter is used by Algoma Steel and the remainder is sold on the open market, principally in United States where it is much in demand due to its comparatively high (3 per cent) content of manganese and to its self-fluxing quality.

Several other deposits of siderite in the Michipicoten district are available for exploitation. At Siderite Hill, 3 miles northeast of the Helen mine, 100 million tons of ore of a grade slightly better than the Helen ore has been outlined by drilling. About 10 million tons can be mined conveniently by open pit.

Six miles northeast of the Helen are the Lucy and Ruth deposits where 40 million tons have been indicated by drilling. The property is held by Jalore Mining Company Limited, Canadian subsidiary of Jones & Laughlin Steel Corporation, under lease from Sherritt Gordon Mines Limited.

The Britannia (formerly Bartlett) deposit of Algoma Ore Properties, 10 miles northeast of the Helen mine, is smaller than either the Helen or Siderite Hill deposits and is not suited to open-pit mining. However, the ore is of somewhat better grade, and deep drill-holes indicate that it widens with depth.

*Steep Rock Iron Mines Limited.* Steep Rock Iron Mines Limited shipped 1,216,613 long tons of hematite in 1950 from its Errington open pit, mainly to United States. This ore was obtained from the southeastern part of the open pit or "B" pit extension that was stripped for production during the winter of 1949-50. Stripping of the northern part of the Errington pit has been under way for some months to prepare it for an anticipated production of 1,200,000 tons in 1951.

Development of an underground mine that will have a maximum annual capacity of 1·5 million tons has been commenced at the Errington deposit. A shaft is being sunk in the hanging-wall from which two production levels will be developed at depths of 200 and 400 feet below the open pit. A third level at

600 feet will be used initially for draining the porous ore to that level and eventually will be used for production when deeper levels are opened. Present plans provide for mining to a depth of 2,000 feet below the open pit or 2,500 feet below the collar of the shaft, and indications are that the central part of the Errington orebody will support an annual yield of a million tons or better for at least 50 years. A caving method is to be used and ore will be brought to surface on belt conveyers. It is anticipated that the first ore will come from underground in 1953 and that the underground mine will furnish ore at the rate of a million tons a year or better by the end of 1955. There is evidence that the ore continues downwards well below 2,500 feet.

Development of the Hogarth mine on "A" orebody is under way. A large suction dredge is removing about 1·5 million cubic yards a month of silt out of an estimated total of 45 million cubic yards. Production will be commenced with the exposure of the upper part of the orebody and full production at the rate of 2 million tons a year or better is anticipated in 1955.

Continued drilling in the mile of geologically favourable ground between the Errington and Hogarth orebodies has given further indications of commercial deposits.

Intensive drilling on "C" deposit in Falls Bay, under lease to Inland Steel Company, is yielding favourable results.

Examination of the 2-mile stretch between "B" and "C" deposits was commenced. A limited amount of drilling indicated the presence of an orebody on "D" zone about 3 miles southeast of "C".

Plans were made to drill along the west arm of the lake through which the Seine River now flows and where geological conditions are considered favourable.

## *Other Developments*

### *Grenville Area of Ontario and Quebec*

Detailed examination was commenced of magnetite deposits in the Grenville-type rocks of eastern Ontario and the adjacent part of Quebec.

At Marmora, a deposit of magnetite was found beneath 100 feet of Ordovician limestone following the publication of maps containing data obtained during an airborne magnetometer survey of the area in 1949. Drilling is being carried out by Bethlehem Steel Corporation.

Several other deposits are being examined by diamond drilling.

### *British Columbia*

The magnetite deposits on Vancouver and Texada Islands remained idle in 1950. In December, The Consolidated Mining and Smelting Company of Canada Limited announced plans for a phosphate fertilizer plant at Kimberley adjoining its Sullivan mine, which produces a large daily tonnage of pyrrhotite mill tailing. Part of this pyrrhotite is to be burned to give sulphuric acid for the fertilizer plant, making available as an ore of iron the residue of iron oxide, the initial output of which is expected to be about 200 tons a day.

*Production and Trade*

Shipments of Canadian iron ores by properties are shown in thousands of long tons in the following table:

| — | Steep Rock hematite | Wabana hematite | Helen sinter | Campbell River B.C. magnetite | Total |
|---|---|---|---|---|---|
| 1949 | 1,134 | 1,480 | 662 | 5 | 3,281 |
| 1950 | 1,217 | 1,044 | 958 | ..... | 3,219 |

A large part of the ore from mines in Ontario is exported to United States where it is much in demand because of its high grade and its good furnace qualities. Most of the ore used in the blast furnaces of Ontario is imported from United States. The furnaces at Sydney, Nova Scotia, use Wabana ore almost exclusively.

*Canadian Production, Trade, and Consumption of Iron Ore*

(Thousands of long tons)

| — | 1950 | 1949 |
|---|---|---|
| *Production* (shipments) | 3,219* | 3,281* |
| *Imports* | | |
| From: United States | 2,657 | 2,099 |
| Other countries | 85 | 111 |
| Total | 2,742 | 2,210 |
| *Exports* | | |
| To: United States | 1,814 | 1,612 |
| United Kingdom | 127 | 720 |
| Germany | 48 | ..... |
| Total exports | 1,989 | 2,332 |
| Indicated consumption in Canada | 3,972 | 3,159 |
| Imported ore as per cent of consumption | 69% | 70% |

* Includes Newfoundland production.

Ore imported from overseas is used at Sydney, Nova Scotia, mainly as open-hearth lump ore.

*Canadian Imports of Iron Ore from Overseas*

(Long tons)

| — | Sweden | Brazil | United Kingdom | Total |
|---|---|---|---|---|
| 1949 | 15,216 | 96,204 | 10 | 111,430 |
| 1950 | 9,146 | 75,574 | 10 | 84,730 |

The first four companies listed below account for almost all of the Canadian consumption of iron ore.

*Blast Furnaces, Open-hearth Furnaces, and Electric Furnaces operated by Primary Steel Producers in Canada*

| — | Blast furnaces | | Open-hearth | | Electric[1] | |
|---|---|---|---|---|---|---|
| | Number | Annual capacity | Number | Annual capacity | Number | Annual capacity |
| | | (net tons) | | (net tons) | | (net tons) |
| Dominion Steel & Coal Corporation, Sydney, Nova Scotia | 4 | 730,000 | 15 | 761,500 | 1 | 28,000 |
| Algoma Steel Corporation, Limited, Sault Ste. Marie, Ontario | 5 | 1,035,000 | 12 | 1,000,000 | ........ | ........ |
| Canadian Furnace Limited, Port Colborne, Ontario | 2 | 223,000 | ........ | ........ | ........ | ........ |
| The Steel Company of Canada Limited, Hamilton, Ontario | 3 | 757,000 | 13 | 1,020,000 | 1 | 85,500 |
| Dominion Foundries & Steel Company Limited, Hamilton, Ontario | ........ | ........ | 4 | 202,900 | 5 | 145,400 |
| Total | 14 | 2,745,000 | 44 | 2,984,400 | 7 | 258,900 |

[1] Eight other companies operate electric furnaces having a combined capacity of approximately 460,000 net tons.

Dominion Foundries and Steel has a 600-ton blast furnace under construction at Hamilton, which is expected to be blown-in during 1951. Steel Company of Canada has announced construction of a 1,000-ton blast furnace and four 250-ton open hearths to be completed in 1952.

Several other steel companies that make steel from scrap in small open-hearth furnaces and electric furnaces require a small tonnage of lump ore.

## LEAD

Canada produced 165,697 tons of lead valued at $47,886,452 in 1950 compared with 159,775 tons valued at $50,488,879 in 1949. About 90 per cent of the production was refined lead produced at the smelter and refinery of The Consolidated Mining and Smelting Company of Canada Limited at Trail, British Columbia. Exports of both refined lead and concentrate were approximately the same as in 1949 but there was a slight increase in the domestic consumption of lead. The price of lead fluctuated widely during 1950, the average Canadian price being 14.365 cents a pound compared with an all-time peak of 20.75 cents a pound at the end of 1948.

*Production, Trade, and Consumption*

| | 1950 | | 1949 | |
|---|---|---|---|---|
| | Short tons | $ | Short tons | $ |
| *Production, all forms* | | | | |
| Newfoundland | 17,918 | 5,178,320 | 18,608 | 5,880,191 |
| Quebec | 7,676 | 2,218,475 | 5,799 | 1,832,510 |
| British Columbia | 133,660 | 38,627,700 | 132,689 | 41,929,866 |
| Yukon | 6,443 | 1,861,957 | 2,679 | 846,312 |
| Total | 165,697 | 47,886,452 | 159,775 | 50,488,879 |
| *Production, refined* (includes lead from imported ores) | 170,023 | ..... | 146,149 | ..... |
| *Exports in ore* | | | | |
| To: Belgium | 13,564 | 4,103,418 | 13,340 | 3,209,967 |
| Germany | 1,689 | 556,297 | ..... | ..... |
| United States | 4,023 | 900,795 | 6,551 | 1,531,404 |
| Total | 19,276 | 5,560,510 | 19,891 | 4,741,371 |
| *Exports, refined lead including scrap* | | | | |
| To: United States | 106,382 | 29,795,474 | 61,869 | 19,441,226 |
| United Kingdom | 8,276 | 2,157,474 | 44,595 | 14,458,125 |
| Brazil | 932 | 239,092 | 1,344 | 499,949 |
| Venezuela | 590 | 193,164 | 19 | 8,938 |
| France | ..... | ..... | 1,104 | 464,666 |
| Netherlands | 38 | 12,513 | 3,654 | 1,116,834 |
| Other countries | 745 | 146,713 | 2,855 | 1,154,793 |
| Total | 116,963 | 32,544,430 | 115,440 | 37,144,531 |
| *Exports, lead manufactures* | | | | |
| To: Venezuela | ..... | 43,274 | ..... | 24,729 |
| Cuba | ..... | 23,950 | ..... | 18,372 |
| India | ..... | 15,704 | ..... | 1,233 |
| Iran | ..... | 29 | ..... | 164,501 |
| Colombia | ..... | ..... | ..... | 29,547 |
| United States | ..... | 3,436 | ..... | 1,860 |
| Other countries | ..... | 7,600 | ..... | 60,892 |
| Total | ..... | 93,993 | ..... | 301,134 |
| *Imports of tetraethyl lead compounds* | | | | |
| From: United States | 11,604 | 8,817,224 | 8,586 | 6,356,843 |
| *Domestic consumption of refined lead* | | | | |
| Solders and alloys *(a)* | 10,480 | ..... | 12,135 | ..... |
| Wire coating and cable covering | 12,758 | ..... | 12,622 | ..... |
| Paints and pigments | 6,183 | ..... | 5,026 | ..... |
| Storage batteries *(b)* | 21,832 | ..... | 18,095 | ..... |
| Hot dipping and annealling | 1,531 | ..... | 1,511 | ..... |
| Foil and collapsible tubes | 43 | ..... | 196 | ..... |
| Ammunition | 564 | ..... | 675 | ..... |
| Miscellaneous | 3,923 | ..... | 2,736 | ..... |
| Total | 57,314 | ..... | 52,996 | ..... |

*(a)* Excluding lead in antimonial lead for storage batteries.
*(b)* Includes new lead and lead content of antimonial lead.

*World Production of Refined Lead*[1]

| — | 1950 | 1949 |
|---|---|---|
| United States[2] | 531,767 | 500,689 |
| Canada | 170,364 | 146,149 |
| Mexico | 243,445 | 252,739 |
| Argentina | 25,400 | 19,882 |
| Peru | 34,483 | 39,668 |
| Belgium | 68,446 | 87,417 |
| France | 68,779 | 59,103 |
| Germany[3] | 171,330 | 133,837 |
| Italy | 42,780 | 30,112 |
| Spain | 38,443 | 29,910 |
| Sweden | 18,387 | 11,857 |
| Yugoslavia | ............ | 62,600 |
| Japan | 17,599 | 13,841 |
| Rhodesia | 15,355 | 15,619 |
| Tunisia | 25,945 | 21,581 |
| Australia | 223,468 | 207,273 |
| Russia | 123,000 | 99,200 |
| Other countries | ............ | 16,174 |

[1] From American Bureau of Metal Statistics.
[2] Includes production from secondary material.
[3] Federal Republic.

Lead consumption in United States was estimated at 1,212,000 tons compared with 868,000 tons in 1949. About 32 per cent of the consumption went into storage batteries, the other principal outlets being for cable covering and the manufacture of tetraethyl products. There was a marked increase in consumption in all principal uses except cable covering.

The United Kingdom, the second largest consumer of lead, used 328,500 tons, of which cable covering, the principal outlet, accounted for 26 per cent.

## *Production and Developments*

### *British Columbia*

Consolidated Mining and Smelting Company's Sullivan mine at Kimberley is Canada's principal source of lead and zinc and in 1950 was the source of about 90 per cent of the province's lead output. The ore is milled near the mine to produce lead and zinc concentrates, which are then shipped to the company's smelter and refineries at Trail, the output of lead in 1950 being: 170,364 tons compared with 146,176 tons in 1949. Due to the installation in 1949 of a sink-float plant to eliminate coarse waste rock before milling, the company was able to mine a lower grade of ore without reducing overall recovery. It mined 2,680,962 tons of ore, compared with 2,297,672 tons in 1949. At the Sullivan mine plans were completed for open-cut mining of a section of the orebody close to surface and the removal of overburden for this purpose was commenced.

Considerable progress was made in the modernization of the lead smelter and plans were completed to expand the output of the electrolytic zinc plant. There was an increase in the receipt of custom ores and concentrates, particularly of lead concentrates, for treatment at the Trail smelter. About half of the lead recovered from the custom ores came from foreign sources, chiefly from South America.

A large number of other silver-lead-zinc mines produced ores or concentrates during the year, the more important lead producers being Canadian Exploration Limited and Reeves MacDonald Mines Limited, both near Salmo; Base Metals

Mining Corporation Limited, at Field; Violamac Mines (B.C.) Limited and Ainsmore Consolidated Mines Limited, in the Ainsmore-Slocan district; Silver Standard Mines Limited, near Hazelton; and Silbak Premier Mines Limited, near Stewart.

Sheep Creek Gold Mines Limited, which commenced production of lead and zinc concentrates at its Paradise mine near Invermere, resumed milling in its 50-ton concentrator in April 1950 after being shut down during the winter.

Giant Mascot Mines Limited partly completed the construction of a 150-ton mill at its property near Spillamacheen.

Yale Lead and Zinc Mines Limited at Ainsworth started construction of a 300-ton sink-float plant and a 180-ton concentrator.

Base Metals Mining Corporation Limited commenced construction of a 100-ton mill at its Cork Province mine near Kaslo.

Kootenay Belle Gold Mines Limited prepared to instal a second sink-float plant to increase the treatment of old dump material in the Slocan district at its 300-ton mill at Retallack.

The Consolidated Mining and Smelting Company did preproduction development at the Bluebell mine, Kootenay Lake, where construction of a 500-ton concentrator was started; at the Big Bull and Tulsequah Chief properties on the Taku River, the ore from which will be treated in 1951 at the Polaris Taku mill; and at the H. B. property near Salmo where trial shipments of lead-zinc oxide ore were made to the Trail smelter.

*Ontario*

McWilliams-Beardmore Mines Limited, which had worked the Silver Mountain zinc-lead mine near Fort William on a small scale for several years, discontinued operations in December.

Matarrow Lead Mines Limited commenced underground development at its property near Matachewan.

Consolidated Rochette Mines Limited, which had reopened an old lead-zinc mine near Kingston, was inactive most of the year.

*Quebec*

Lead concentrate was produced by New Calumet Mines Limited, Pontiac county; Anacon Lead Mines Limited, Portneuf county; Golden Manitou Mines Limited, Abitibi county; and by Ascot Metals Corporation Limited, near Sherbrooke. The concentrate produced by New Calumet Mines and Anacon Lead Mines was shipped to Trail, British Columbia, for smelting and refining, whereas that produced by Golden Manitou Mines and Ascot Metals Corporation was exported to lead smelters in United States.

New Calumet milled an average of 700 tons a day to produce about 8,400 tons of lead concentrate containing 50 per cent lead. Important new ore zones were discovered by drilling from the lower mine workings.

Golden Manitou Mines milled 333,180 tons of ore in its 1,000-ton a day concentrator to produce lead and zinc concentrates containing 1,200 tons of lead and 10,100 tons of zinc.

Anacon Lead Mines milled 199,191 tons and produced lead concentrate containing 2,187 tons of lead. The mill capacity was increased from 475 to 700 tons a day. A new shaft 2,300 feet north of the main shaft was sunk 750 feet to open up a new zinc-lead orebody discovered by exploratory drilling.

Ascot Metals Corporation Limited commenced production of zinc concentrate and a bulk copper-lead concentrate at its Moulton Hill mine in August. The mill has a rated capacity of 400 tons but this is to be increased to 650 tons in 1951. The deepening of the shaft to open up three new levels was commenced.

At the company's Suffield mine about 8 miles south of the Moulton Hill mine several ore zones containing copper, zinc, and lead were outlined by drilling. A shaft to develop this ore was started late in 1950.

Consolidated Candego Mines Limited in North Gaspe county did development work for most of the year. It rebuilt the power house that was destroyed by fire in 1949 and prepared to resume production of concentrates early in 1951.

*New Brunswick*

New Calumet Mines Limited acquired the Tetagouche lead-zinc-copper property near Bathurst and did research work to find a suitable process to treat the ore.

*Newfoundland*

The Buchans copper-lead-zinc mine in the central part of the Island is the only producing base metal mine. It is operated by Buchans Mining Company Limited, a subsidiary of American Smelting and Refining Company. Production from 328,000 tons of ore milled in the company's 1,300-ton concentrator included 30,902 tons of lead concentrate containing 17,776 tons of lead. Most of this concentrate was exported to Europe. A shaft to develop important new orebodies discovered by drilling to the northwest of the older workings was sunk to a depth of 1,796 feet and lateral development was commenced.

*Yukon*

United Keno Hill Mines Limited produced ore and concentrates containing 6,958 tons of lead from its silver-lead-zinc deposits in the Mayo district. A road constructed from Mayo to Whitehorse provides for the shipment of concentrates by truck instead of by river barge to the smelter at Trail, British Columbia.

*Northwest Territories*

Consolidated Mining and Smelting Company continued exploratory drilling of the 500-square-mile concession it holds jointly with Ventures Limited and Northern Lead-Zinc Limited at Pine Point, Great Slave Lake. The work indicated that commercial deposits of lead-zinc ore extend over a wide area. Further drilling will be undertaken to outline orebodies in detail.

## *Uses*

Lead has a wide variety of industrial uses and is an essential component of a number of important chemical compounds and products. The principal uses vary in different countries, but the overall peacetime uses in order of importance are: for storage battery manufacture, cable covering, tetraethyl lead compound, bearing metal and solders, red lead and litharge, and white lead. Other uses include sheeting, ammunition, plumbing, caulking, foil for packaging, type metal, and chemical products.

The large quantities of lead recovered as secondary metal from battery plates, cable sheathing, plumbing, and caulking lead, etc., are of increasing importance.

## *Prices*

The Canadian price of lead at the beginning of 1950 was 13·250 cents a pound. It decreased to 11·5 cents on March 16 and subsequently increased to 17·950 cents at the end of the year.

## MAGNESIUM

Ingot magnesium was produced in Canada by Dominion Magnesium Limited at Haley, Ontario in 1950 for the first time since 1945. The electrolytic magnesium plant of Aluminum Company of Canada Limited at Arvida, Quebec, was not in operation.

Dominion Magnesium Limited also installed a 2,400-ton extrusion press at its Haley plant and is now making available to industry a variety of alloy shapes from Canadian metal.

Advances in magnesium technology continued to be made particularly in alloying fabrication, and protection against corrosion. Certain of the newer alloys possess improved mechanical properties.

Several foundries are now engaged in the production of magnesium castings of various types. Those in operation in 1950 were: Robert Mitchell Company, Limited, Montreal; Aluminum Company of Canada, Limited at Etobicoke, Canadian Magnesium Products, Limited at Preston, Grenville Castings, Limited at Merrickville, Barber Die Castings at Hamilton, and Light Alloys, Limited, subsidiary of Dominion Magnesium, Limited at Renfrew, all in Ontaro; and Western Magnesium Limited at Vancouver, British Columbia.

### *Canadian Sources of Supply*

Canada has several potential sources of magnesium metal including the minerals magnesite, dolomite, serpentine, brucite, and sea water, but brucite and dolomite form the two sources of raw material for Canadian production.

Dolomite, which is widely distributed in several provinces, is used in the thermal ferrosilicon process of Dominion Magnesium, Limited at Haley. Brucite, a magnesium hydroxide mineral, disseminated throughout certain deposits of crystalline limestone in Quebec, Ontario, and British Columbia and recovered at Wakefield, Quebec, is used by Aluminum Company of Canada at its Arvida, Quebec, plant.

### *Production, Trade, Uses, and Prices*

Information on production, exports, and imports is not available for publication.

Since World War II, the field of usefulness for magnesium has expanded steadily, but the metal remains of prime importance to aircraft construction and defence needs account for large quantities.

The physical properties of the metal are such that alloys are easily formed into useful articles by casting, forging, extrusion, and sheet working. Many of the uses have evolved from its light weight and the high strength to weight ratio of many of its alloys.

The price of magnesium in United States f.o.b. producers' plant in ingot form and in carload lots increased from 20½ cents a pound at the beginning of 1950 to 24½ cents by October 5, 1950. Less than carload lots were quoted at a premium of 2 cents a pound above the carload figure.

## MANGANESE

Canada imports all its requirements of manganese as none of its known deposits is of commercial grade. These imports are obtained from the producing countries direct or via United States, and in 1950 amounted to 135,698 short tons, compared with 137,854 tons in 1949.

From time to time efforts have been made to utilize the bog manganese ores of New Brunswick, but no continuing production has resulted.

Although Canada produces no manganese ore its production of manganese addition agents has averaged about 80,000 tons a year over the past few years, a development resulting from the availability of abundant electric power at reasonable rates. Over 85 per cent of the output has been in the form of ferromanganese, mainly high carbon, and most of the remainder as silicomanganese.

Canada's imports of manganese ore and its exports of ferromanganese and spiegeleisen are shown, respectively, in the two tables that follow.

*Canadian Imports of Manganese Ore*

| Country from which shipped | 1950 | 1949 |
|---|---|---|
| | Short tons | Short tons |
| United States* | 21,718 | 93,570 |
| Gold Coast | 87,328 | 27,904 |
| United Kingdom | 72 | 33 |
| India | 25,879 | 15,456 |
| Others | 701 | 891 |
| Total | 135,698 | 137,854 |

* This ore entered Canada via United States, which was not the source country.

*Canadian Exports of Ferromanganese and Spiegeleisen*

| Country of destination | 1950 | 1949 |
|---|---|---|
| | Short tons | Short tons |
| United States | 24,085 | 33,175 |
| Mexico | 2,123 | 1,301 |
| United Kingdom | 470 | 894 |
| Others | 247 | 478 |
| Total | 26,925 | 35,848 |

*World Sources*

It is estimated that Russia accounts for close to half of the world estimated annual production of 4,000,000 tons. The other major sources of world supply in recent years have been the Gold Coast, Union of South Africa, India, and Brazil. The manganese deposits of Nsuta, Gold Coast, are the largest single source of manganese in the world. Shipping bottlenecks by rail from the mines to the coast have hampered production from the Gold Coast, Union of South Africa, and Brazil, but increased shipments are expected in the near future. Two large potential deposits of high-grade manganese ore in Brazil, both of which are considerable distances from the coast, were being investigated.

*Uses*

About 95 per cent of the manganese consumed is used in the steel industry, and the remainder in making dry cell batteries and chemicals. There are no satisfactory substitutes for manganese in its major uses. The manufacture of one short ton of steel requires about 13 pounds of manganese, of which about 11·7 pounds is in the form of ferromanganese, 1 pound as silicomanganese, and the remainder as spiegeleisen and ore.

Specifications for metallurgical grade of manganese call for a minimum of 48 per cent manganese and maxima of 7·0 per cent iron, 8·0 per cent silica, 0·15 per cent phosphorus, 6·0 per cent alumina, and 1·0 per cent zinc. The ore should be in hard lumps less than 4 inches, and not more than 12 per cent should pass a 20-mesh screen.

Manganese ore for battery use must be a manganese dioxide (pyrolusite) ore of not less than 75 per cent $MnO_2$ and not more than 1·5 per cent iron and should be very low in such metals as arsenic, copper, zinc, nickel, and cobalt. Canada consumes about 4,000 tons of this type of ore annually which is imported mainly from the Gold Coast.

Manganese ore for chemical use contains 35 per cent or more manganese and is used to make manganese sulphate (fertilizers) and other salts which in turn are used in the glass, enamel, paint, pigment, rubber, and pharmaceutical industries.

### *Prices and Tariffs*

The following information on the purchase of manganese ores appeared in the December 28, 1950 issue of the Engineering and Mining Journal Metal and Mineral Markets:

(1) On long-term contracts involving large tonnages, prices were wholly nominal and a matter of negotiation.

(2) On current business on the basis of 46 to 48 per cent manganese, 92 to 96 cents per long ton unit (22·4 pounds), c.i.f. United States ports, duty for account of the buyer being ½ cent per pound of contained Mn.

(3) Chemical grades, per ton coarse or fine with a minimum of 80 per cent $MnO_2$, Brazilian or Cuban, carloads in barrels, $60 and $65; Javan or Caucasian, 85 per cent minimum, $70 and $75; domestic, 70 to 72 per cent, $45 and $50 f.o.b. mines.

## MERCURY

No mercury has been produced in Canada since September, 1944, and all shipments since then have been from producers' stocks. Nearly all the production came from the Pinchi mine of The Consolidated Mining and Smelting Company of Canada Limited, and most of the remainder from the Takla mine of Bralorne Mines Limited. If necessary, these mines, both of which are in the Omineca mining division of British Columbia, could supply Canadian requirements of mercury for many years.

All known Canadian deposits of cinnabar (HgS), the principal ore of mercury, are in British Columbia and many showings have been prospected in the belt of favourable rocks between the Pinchi mine and the Takla property. The ore occurs as discontinuous stringers, small grains, or scattered blobs, often in veins or stringers of dolomite or calcite.

*Imports and Consumption*

| — | 1950 | 1949 |
|---|---|---|
| *Imports* | *Pounds* | *Pounds* |
| From: United States[1] | 372,706 | 186,740 |
| Italy | 233,220 | ........... |
| Mexico | 3,660 | 71,700 |
| Spain | 3,800 | 19,560 |
| United Kingdom | 619 | 69 |
| Total | 614,005 | 278,069 |
| *Consumption*[2] | | |
| Heavy chemicals and electrolytic cells | ........... | 332,652 |
| Pharmaceuticals and fine chemicals | ........... | 62,320 |
| Gold mining | ........... | 6,004 |
| Electrical apparatus | ........... | 9,120 |
| Total | ........... | 410,096 |

[1] Country of origin not necessarily the United States.
[2] Figures for 1950 not available.

In recent years most of the mercury imported has been used in the initial installation of mercury cells for the electrolytic production of caustic soda and chlorine in plants at Beauharnois in Quebec and at Sarnia in Ontario. Once the cells have been put into service only minor amounts of mercury are used.

*Production of Mercury by Principal Countries*

(Flasks of 76 pounds)

| Country | 1950 | 1949 |
|---|---|---|
| Italy | 43,300 | 43,000 |
| Mexico | * | 5,250 |
| Spain | 50,025 | 32,289 |
| United States | 4,440 | 9,930 |

*Not available.

All but a small part of the production in United States comes from California, the next two States in order being Nevada and Oregon.

*Uses*

Large quantities of mercury have been used in recent years in the initial installations of mercury cells for the electrolytic production of caustic soda and chlorine. Such cells were developed in Germany and were introduced to America after World War II.

Large quantities of mercury are used in the preparation of pharmaceuticals and in electrical and industrial control instruments and meters. Large amounts are used in making agricultural disinfectants, fungicides, and in anti-fouling compounds and as oxides for use in the coating of ships' hulls. Mercury is used as a catalyst; in dental preparations; and as the fulminate in making munitions and blasting caps.

*Prices*

The Engineering and Mining Journal Metal and Mineral Markets of December 28, 1950, quoted $138 and $141 per flask, New York basis. These prices include a $19 per flask United States import duty for foreign-produced mercury.

## MOLYBDENUM

There has been no mine production of molybdenite ($MoS_2$) in Canada since the closing of the La Corne mine of Molybdenite Corporation of Canada Limited, La Corne township, Quebec, in December 1947. The mine was developed to 550 feet, with four levels, during World War II by Wartime Metals Corporation. Ore reserves at the time of closing were estimated by company engineers at about 130,000 tons averaging about 0·5 per cent $MoS_2$. The ore contains some bismuth as bismuth sulphide ($Bi_2S_3$). During 1949 Assomoly Registered, a company formed jointly by Molybdenite Corporation and Associated Metals and Minerals of New York, treated the 265 tons of 'rejected' concentrates from former production. This recovery operation resulted in the shipment in January 1950, of 110 tons of molybdenite-bismuth concentrate to Europe.

Practically all of the more than 400 known molybdenite occurrences in Canada consist of 'splashes' of high-grade molybdenite, but tonnages and continuity are lacking. The Indian Molybdenum Limited mine in Preissac township, Quebec, and the Moss mine of Quyon Molybdenite Company Limited near Quyon, Quebec, were closed in 1944.

*Canadian Imports and Consumption*

Canadian requirements of molybdenum are imported from United States through Climax Molybdenum Company for which Railway Power and Engineering Corporation is the Canadian agent, and through Molybdenum Corporation of America, New York.

*Imports of Molybdenum Addition Agents*

(Tons of contained molybdenum)

| — | 1950 | 1949 |
|---|---|---|
| Molybdic oxide (55·5 per cent Mo) | 153 | 117 |
| Ferromolybdenum (61·8 per cent Mo) | 64 | 54 |
| Calcium and sodium molybdate | 56 | 5 |
| Total | 273 | 176 |

*World Production*

About 90 per cent of the world production of molybdenum comes from the United States, the other chief sources being Chile and Mexico.

For many years Climax Molybdenum Company was the top producer in the United States from ores mined at its Climax, Colorado, property. However, in recent years, Kennecott Copper Corporation has produced slightly more than Climax from its recovery of molybdenite in copper concentrates. Other large producers of copper in United States, Chile, and Mexico recover molybdenite from their bulk copper flotation concentrates.

## *Uses and Specifications*

About 70 per cent of the consumption of molybdenum is as an alloying element in the manufacture of steels, to which it is added as molybdic oxide, calcium molybdate, or ferromolybdenum and about 20 per cent is used in grey iron and malleable castings. In general, when an entire open-hearth heat is to be alloyed to not over 0·8 per cent molybdenum the addition is in the form of molybdic oxide or calcium molybdate, whereas ferromolybdenum is used when higher percentages of molybdenum are desired.

Molybdenum and tungsten can be substituted for each other to impart strength and hardness to steel. Molybdenum intensifies the effect of other alloying metals in steel, such as nickel, chromium, and vanadium.

Most molybdenum alloy steels contain from 0·15 to 0·5 per cent molybdenum but in some instances this is considerably higher. High speed tool steels contain up to 9 per cent molybdenum.

Increasing amounts of molybdenum ranging up to 25 per cent in content are being used in alloys in jet propulsion engines, turbo superchargers, and gas turbines. For these uses it has been described as the best additive for high-temperature strength. It also increases the resistance of stainless steels to chemical action.

The use of molybdenum in various forms in the chemical, electrical, and ceramic industries amounts to about 10 per cent of the total consumption. Molybdenum wire and sheet are used in the incandescent lamp and radio industries, and new alloys suitable for heating elements, electrical resistance, and contact points contain molybdenum. The salts of molybdenum are used in pigments, in vitreous enamels for coating steels and sheet iron, in welding rod coatings, in lithographing, and printing inks, and in many other applications.

A marketable molybdenum concentrate must contain not less than 85 per cent molybdenum sulphide ($MoS_2$) and must be within very low limits in copper, arsenic, and bismuth. In deposits containing large, pure flakes of molybdenite a marketable grade can be obtained by hand-picking, but the amount would be small. Most molybdenite mineralization responds well to flotation treatment, and marketable grades can be produced.

## *Prices and Tariffs*

Climax Molybdenum Company announced the following prices to be in effect for its products on December 1, 1950. Corresponding prices in 1949 are shown in brackets.

Per pound of contained molybdenum in:

| | | |
|---|---|---|
| Molybdenite concentrate | $1.00 | ( .90) |
| Ferromolybdenum | $1.32 | (1.10) |
| Molybdic oxide briquettes | $1.14 | ( .95) |
| Calcium molybdate | $1.15 | ( .96) |

All prices are f.o.b. Langeloth, Pa., except for the concentrate, which is quoted f.o.b. Climax, Colorado.

The import duty into United States was increased on January 1, 1951, from 17½ cents to 35 cents a pound of contained molybdenum in concentrates. The present duty, therefore, on a short ton of 90 per cent $MoS_2$ concentrate (1,080 pounds of Mo) was $378 in United States funds.

# NICKEL

Canada produces over 80 per cent of the world supply of nickel. Output, which comes from the nickel-copper mines of the International Nickel Company of Canada, Limited, and Falconbridge Nickel Mines Limited in the Sudbury area, Ontario, totalled approximately 124,000 short tons in 1950.

Demand increased suddenly with the outbreak of hostilities in Korea and, before the end of 1950, a voluntary rationing system was put into effect when it became apparent that demand for nickel would exceed the available supply. To meet the increased demand International Nickel Company supplemented the extensive development and expansion program it has had under way for some time by installing emergency facilities to increase temporarily mine, mill, and smelter capacities.

In spite of an active search no new deposits of nickel were found, but the Lynn Lake deposits of Sherritt Gordon Mines in Manitoba were brought closer to production.

The Petsamo mine near Murmansk in Russia is still possibly the principal single source of nickel outside Canada. Production from silicate ores in New Caledonia has been hampered by local difficulties. Towards the end of 1950 steps were taken to reopen the Nicaro plant in Cuba, which has a capacity of 16,000 tons of nickel a year. There is a steady, small output of nickel in connection with the production of platinum at Rustenberg, South Africa. Exploitation of the silicate ore of Celebes awaits a suitable metallurgical process. The high-grade sulphide ore of Goias, Brazil, remains beyond reach of transportation. Deposits at Mount Ayliff in East Griqualand, South Africa, are being examined in detail.

*Production and Trade*

About 97 per cent of the Canadian production of nickel is exported, 65 per cent to the United States, 20 per cent to Great Britain, and the remainder to many other countries. The amount recorded as exported to Norway is for refining and re-export, and not for industrial use in that country.

| Year | Production | | Exports | |
|---|---|---|---|---|
| | Short tons | $ | Short tons | $ |
| 1948 | 131,740 | 86,904,235 | 131,840 | 73,801,871 |
| 1949 | 128,690 | 99,173,289 | 127,141 | 92,323,686 |
| 1950 | 123,659 | 112,104,685 | 121,651 | 105,299,743 |

*Exports of Nickel in Various Forms*

| Year | In Matte or Speiss | | In Oxide | | Refined Nickel | |
|---|---|---|---|---|---|---|
| | Short tons | $ | Short tons | $ | Short tons | $ |
| 1948 | 50,801 | 24,320,922 | 9,792 | 5,020,167 | 71,247 | 44,460,782 |
| 1949 | 56,902 | 41,760,237 | 1,151 | 689,148 | 69,088 | 49,874,301 |
| 1950 | 53,090 | 46,423,080 | 1,667 | 1,308,141 | 66,894 | 57,568,522 |

*Nickel Exports by Country of Destination*

| Destination | 1950 | | 1949 | |
|---|---|---|---|---|
| | Short tons | $ | Short tons | $ |
| United States | 88,543 | 76,184,024 | 86,525 | 62,693,150 |
| United Kingdom | 21,645 | 18,997,379 | 28,265 | 20,545,673 |
| Norway | 10,888 | 9,574,232 | 11,848 | 8,673,249 |
| Belgium | 235 | 213,013 | 54 | 44,100 |
| Italy | 143 | 147,663 | 22 | 19,084 |
| Brazil | 57 | 50,627 | 104 | 81,510 |
| Mexico | 38 | 34,069 | 1 | 760 |
| Malta | 28 | 23,841 | ........ | ........ |
| France | 14 | 15,733 | 3 | 3,400 |
| Australia | 13 | 12,669 | 25 | 18,611 |
| Chile | 7 | 6,688 | 18 | 13,857 |
| Japan | 4 | 4,760 | 234 | 195,229 |
| Other countries | 36 | 35,045 | 42 | 35,063 |
| Total | 121,651 | 105,299,743 | 127,141 | 92,323,686 |

*Canadian Nickel-Producing Mines*

The mines of the Sudbury area are still the only source of nickel, with the exception of a very small amount recovered from the treatment of cobalt-silver ore. By-products from the nickel smelters are copper, platinum metals, gold and silver, and minor quantities of cobalt, selenium, and tellurium. Sulphur may soon be an important by-product, and researches are under way to recover iron.

*The International Nickel Company of Canada, Limited.* The company has five large underground mines in production and a sixth at the point of production. In addition there is the Frood-Stobie open pit from which a large part of the increased wartime supply of ore was obtained and which is now near its maximum economic depth.

The anticipated completion in 1953 of the extensive development and expansion program, which will mean full conversion to underground operations, will permit the mining of 13 million tons of ore annually, compared with 9·8 million tons in 1950.

New shafts have been sunk at the Frood-Stobie, Creighton, and Levack mines, and the main shafts of the Garson, Murray, and Levack mines have been extended. During 1950 the Murray mine reached its rated daily capacity of 4,500 tons. Plans for the new low-grade mine at Creighton were altered to allow for a greater capacity and the output is expected to reach 10,000 tons a day by the end of 1951.

Ore mined during 1950 was 9,849,024 tons or an average of 27,000 tons a day. Reserves of ore at the end of 1950 were 252,859,725 tons containing 7,669,219 tons of copper-nickel, an average of 3·03 per cent of the combined metals, which are present in about equal proportions.

The ore from the new mine at Creighton is to be concentrated at a mill on the site, and the bulk concentrate will be pumped through a 7½-mile pipeline to the Copper Cliff reduction plant. The ore from the other five mines is treated by flotation in the large concentrator at Copper Cliff, with the exception of a comparatively small tonnage of lump ore that is smelted to matte in blast furnaces at Coniston, largely for the production of Monel metal. The concentrator makes two products, a copper concentrate and a nickel-rich concentrate. The copper concentrate is treated in roasters, reverberatory furnaces, and converters to make blister copper which is refined in the adjoining copper refinery. The nickel-rich concentrate is roasted, then treated in reverberatory furnaces to give matte that is cooled under controlled conditions so that particles of nickel and copper compounds crystallize separately. The matte is ground and the two are separated by flotation. The nickel concentrate is treated to give nickel oxide sinter, which can be substituted economically for electrolytic nickel for many uses. A part of the sinter is converted to refined nickel in the refinery at Port Colborne, Ontario. The copper concentrate joins the main copper circuit. Refinery sludges from the copper and nickel refineries are shipped to Great Britain for extraction of the precious metals.

Progress was made in the new plant at Copper Cliff for conservation of sulphur. The copper concentrate is to be flash-roasted in oxygen to give a high-grade matte, and concentrated sulphur dioxide that can be compressed to liquid and marketed. Research is under way on a method of recovering iron from a pyrrhotite-nickel concentrate.

*Falconbridge Nickel Mines Limited.* The company's mine at Falconbridge produced 881,838 tons of ore in 1950. It is partly developed to a depth of 4,025 feet, but production has come from above the 2,800-foot level except for ore from development. The new McKim mine, which is partly developed to a depth of 1,350 feet, produced 46,997 tons of ore from the first four levels. By the end of 1950 it had reached its rated capacity of 500 tons a day. Preparations were made to begin a new mine in Levack township, which is to be called the Hardy mine. The ore reserve at the end of 1950 was as follows: developed ore, Falconbridge and McKim mines, 9,396,000 tons; indicated ore, Sudbury area properties, 5,778,500 tons.

At the smelter 574,073 tons of ore was concentrated by flotation and the concentrate was sintered. This sinter and 354,577 tons of raw ore were smelted in the blast furnaces to give a copper-nickel matte. The matte is blown in a converter to raise the grade, and the converter matte is shipped to the company's electrolytic refinery at Kristiansand in Norway for production of the metals. Progress was made at the refinery in changing over to the chloride electrolyte and in expanding the capacity, which work is expected to be completed in 1951. The products are electrolytic nickel and copper, gold, and silver, the platinum metals, and cobalt.

### *Prospective Producers and Prospects*

The Lynn Lake mine of Sherritt Gordon Mines Limited in northern Manitoba was developed further toward production. Development ore was concentrated in the pilot mill at the mine and the concentrate was treated in the pilot plant in Ottawa by the company's ammonia leaching process for the extraction of nickel and copper. The reserve of ore at the end of 1950 was 14,055,000 tons.

The mine and mill equipment of the Sherritt Gordon mine at Sherridon, Manitoba, will be available before the end of 1951, when the ore will be exhausted. This equipment will be brought to Lynn Lake, where it will be re-erected. The richer ore of the new mine will be prepared for production at the rate of 2,000 tons a day. Concentrate will be shipped to a treatment plant in Alberta, where an annual output of 8,500 tons of nickel, 4,500 tons of copper, 150 tons of cobalt, and 70,000 tons of ammonium sulphate is contemplated, commencing in 1954. An extension of the railway to Lynn Lake is proposed.

Two companies, Nickel Offsets Limited, and East Rim Nickel Limited, are developing nickel-copper prospects on the north and east sides, respectively, of the Sudbury nickel area.

International Nickel Company, through its subsidiary, Canadian Nickel Company Limited, acquired by tender a concession of 500 square miles at Ferguson Lake, 150 miles west of the comparatively small nickel deposit at

Rankin Inlet on Hudson Bay, which was drilled over 20 years ago. Indications of nickel have been found in the concession area, but little is known as yet of their nature.

The nickel-bearing deposits at Shebandowan, 75 miles west of Port Arthur, Ontario, at Rankin Inlet on the west coast of Hudson Bay, and near Hope, British Columbia, remained inactive during 1950.

### *Uses*

Most of Canada's output of nickel is used in United States, chiefly in the manufacture of stainless and other steels, and in electroplating.

### *Prices*

In Canada, the price of nickel increased from 42·5 cents a pound at the beginning of 1950 to 51·75 cents a pound at the end of the year.

According to Engineering and Mining Journal Metal and Mineral Markets, nickel was 40 cents a pound in United States from January to June, 1950, when it increased to 48 cents, with a further increase in December to 50·5 cents a pound. These prices are f.o.b. refinery, Port Colborne, Ontario.

## PLATINUM METALS

Canada furnishes about one-half of the annual world supply of platinum metals, the Canadian output being a by-product from the nickel-copper ores of the Sudbury district, Ontario. The other half comes from Russia, Transvaal, Colombia, and more recently, East Griqualand, where deposits of the Sudbury type are being developed. The output from Rustenburg, Transvaal, was increased considerably during 1950. Osmiridium is obtained mainly as a by-product of gold mining in the Transvaal.

Demand for platinum metals increased rapidly during the second half of 1950 and prices rose in proportion. Though Canadian production in 1950 was less than in 1949, accumulated concentrates were drawn upon to meet this increased demand.

*Production and Trade*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Fine ounces | $ | Fine ounces | $ |
| *Production* | | | | |
| Platinum | 124,571 | 10,255,929 | 153,784 | 11,603,002 |
| Palladium, rhodium, ruthenium, iridium, and osmium | 148,741 | 7,578,144 | 182,233 | 8,289,915 |
| Total | 273,312 | 17,834,073 | 336,017 | 19,892,917 |
| *Exports* of platinum metals in concentrates, and other forms except scrap: | | | | |
| To: United Kingdom | ........... | 11,549,685 | ........... | 11,964,741 |
| United States | ........... | 9,650,977 | ........... | 6,020,638 |
| Other countries | ........... | 126 | ........... | 30,644 |
| Total | ........... | 21,200,788 | ........... | 18,016,023 |
| *Imports* of platinum metals, all forms: | | | | |
| From: United Kingdom | ........... | 21,260,917 | ........... | 10,618,744 |
| United States | ........... | 573,751 | ........... | 504,428 |
| Other countries | ........... | 386 | ........... | 1,068 |
| Total | ........... | 21,835,054 | ........... | 11,124,240 |

The annual Canadian output of platinum metals, as recorded by the Dominion Bureau of Statistics, does not correspond with the annual amount recovered from ore treated. The reason is that the anode residues containing these metals are gathered at irregular intervals and the accumulations of these residues at the refineries are shipped to the precious metals refinery in Acton near London, England, at similarly irregular intervals. The only practicable way to record the output is to estimate the precious metals content of the shipments to Acton.

Five of the nickel-copper mines from which Canada's platinum metals are obtained belong to International Nickel Company of Canada, Limited, which has smelters at Copper Cliff and Coniston in the Sudbury area, a copper refinery at Copper Cliff, and nickel refineries at Port Colborne, Ontario, and at Clydach in Wales. The platinum metals, along with gold and silver, are collected in the refinery residues that are shipped to the company's precious metals refinery at Acton, England, for treatment. The refined platinum metals from Acton are sold in world markets, but are mainly sent back to this Continent for use in the United States. A large part of these shipments to United States are via Canada, which accounts for the substantial Canadian imports of the metals.

The two mines of Falconbridge Nickel Mines Limited supply a smelter at Falconbridge in the Sudbury area, Ontario, from which matte is shipped to the company's refinery at Kristiansand, Norway, where the platinum metals are recovered as anode residues.

From the records of ore smelted and of platinum metals produced for several years past, it can be deduced that the average recovery from a ton of ore is 0·033 ounce, an amount that can be extracted profitably only because it is concentrated automatically and without extra cost in the refinery residues.

The nickel-copper deposits at Lynn Lake in northern Manitoba that are being prepared for production by Sherritt Gordon Mines Limited contain small amounts of the platinum metals.

### *Consumption*

As United States is the principal consumer of platinum metals, an idea of the relative amounts used annually can be gained from statistics published by the United States Bureau of Mines.

*Platinum Metals Used in United States in 1950*

| — | Platinum | Palladium | Others | Total | Per cent of total |
|---|---|---|---|---|---|
| Chemical | 114,430 | 16,673 | 13,875 | 144,978 | 29·2 |
| Electrical | 45,229 | 80,024 | 3,316 | 128,569 | 25·9 |
| Dental and medical | 18,182 | 18,359 | 371 | 36,912 | 7·4 |
| Jewellery and decorative | 127,374 | 35,293 | 12,810 | 175,477 | 35·4 |
| Miscellaneous | 3,783 | 107 | 6,119 | 10,009 | 2·1 |
| Total | 308,998 | 150,456 | 36,491 | 495,945 | 100·0 |

### *Uses*

The six platinum metals fall naturally into two categories. Platinum, osmium, and iridium have atomic weights around 190, and specific gravities of 21 to 22. Palladium, rhodium, and ruthenium have atomic weights of about 100, and specific gravities of 11 to 12. The particular qualities that make them useful are as follows:

*High Melting Point.* This ranges from 1554° C. for palladium to 2700° C. for osmium.

*Corrosion Resistance.* The resistance of platinum to common reagents except chlorine is well known. The metals and their alloys are mostly resistant to tarnishing. Silver is electroplated with an extremely thin coating of rhodium to make it non-tarnishing. A reflector of rhodium in optical instruments can be used at high temperatures.

*Ductility.* The metals are used mainly in wrought forms. Platinum and palladium are extremely ductile. Rhodium and iridium are worked with difficulty, ruthenium with still more difficulty, and osmium is almost completely non-ductile.

*Alloys.* The metals are used mainly as alloys. Rhodium, iridium, ruthenium, palladium, copper, gold, and nickel are the elements most commonly added to platinum, seldom over 25 per cent and often 10 per cent or less. Iridium and ruthenium increase the strength and hardness of platinum at room temperatures. Rhodium produces alloys resistant to oxidation at high temperatures.

*Catalysts.* Platinum in particular is a useful catalyst. Eighty-mesh gauze of 10 per cent platinum-rhodium alloy is used commonly for nitrogen fixation. A unit containing 90 troy ounces of gauze, operating at about 1000°C., can give 40 tons of nitric acid in 24 hours with a conversion efficiency of 96 per cent. Production of high octane gasoline is aided by a platinum catalyst.

### *Prices*

Prices of the platinum metals fluctuated greatly during 1950:

*Platinum* in January was $69 an ounce in New York, dropped to $66 in February, increased to $74 in July, $100 in September, and dropped to $90 in October where it remained for the rest of 1950.

*Ruthenium* in January was $69-$72 an ounce, decreased to $66-$69 in June, rose to $74-$77 in July, and to $100-$103 in September, and dropped to $90-$93 in November where it remained.

*Iridium* in January was $100-$105, increased to $160 in July, $220 in September and dropped to $200 in October where it remained.

*Palladium* was constant at $24 an ounce as was *Rhodium* at $125 an ounce.

*Osmium* in January was $100, increasing to $150 in July, and to $200 in September where it remained.

## SELENIUM AND TELLURIUM

Selenium and tellurium are closely associated in their natural occurrence and are produced in Canada as by-products from the electrolytic refining of copper. Selenium is of much greater economic and industrial importance than is tellurium. Ordinarily, relatively small amounts of the metals or their compounds are required by industry but demand for selinium for defence and hydro-electric purposes has increased considerably.

The metals are recovered from the residues (tank slimes) which result from the electrolytic refining of copper, the two Canadian producers being the International Nickel Company of Canada, Limited, at Copper Cliff, Ontario, and Canadian Copper Refiners Limited (subsidiary of Noranda Mines Limited) at Montreal East, Quebec. At Copper Cliff, the metals produced originate in International Nickel Company's extensive copper-nickel deposits near Sudbury. The Copper Cliff refinery has a demonstrated capacity production of 270,000 pounds of selenium a year. At Montreal East, selenium and tellurium are recovered from the refining of copper anodes made at Noranda, Quebec, from copper ores of that area, and from blister copper produced by Hudson Bay Mining and Smelting Company Limited from its deposits at Flin Flon, Manitoba, which straddle the Manitoba-Saskatchewan boundary. The Montreal East refinery has a rated capacity of 450,000 pounds of selenium and 50,000 pounds of tellurium a year and is the largest selenium and tellurium plant in the world.

*Production and Trade*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Pounds | $ | Pounds | $ |
| *Selenium Production* | | | | |
| Quebec | 46,245 | 111,913 | 99,709 | 204,403 |
| Manitoba and Saskatchewan | 152,019 | 367,886 | 131,674 | 269,932 |
| Ontario | 63,709 | 154,176 | 86,842 | 178,026 |
| Total | 261,973 | 633,975 | 318,225 | 652,361 |
| *Exports, selenium and salts* | | | | |
| To: United States | 343,787 | 744,574 | 170,780 | 314,579 |
| United Kingdom | 187,659 | 421,886 | 137,328 | 230,158 |
| Italy | 3,587 | 10,528 | 690 | 1,460 |
| France | 198 | 589 | 29,066 | 70,401 |
| Other countries | 7,170 | 17,566 | 5,920 | 10,960 |
| Total | 542,401 | 1,195,143 | 343,784 | 627,558 |
| *Tellurium Production* | | | | |
| Quebec | ..... | ..... | ..... | ..... |
| Manitoba and Saskatchewan | 4,065 | 7,724 | 2,966 | 5,339 |
| Ontario | 6,010 | 11,419 | 8,726 | 15,707 |
| Total | 10,075 | 19,143 | 11,692 | 21,046 |

The exports of tellurium are not reported separately, but most of Canada's production is exported.

United States is the principal producer of both metals. They are also produced in the United Kingdom, Australia, Sweden, Belgium, and Russia.

*Uses*

Selenium is used chiefly in the electronics, glass, and rubber industries. Increasing amounts are being used to make electrical dry plate rectifiers, particularly miniature types suitable for radio and television circuits. In glass manufacture, selenium is used as a decolorizer, and, if added in slightly greater amounts, to impart a red or ruby colour to the glass. Small additions of selenium to rubber promote resistance to heat, and to oxidation and abrasion.

A unique characteristic of selenium is that its conductivity increases on exposure to light. This property is used to make photo-electric or light-sensitive cells for automatically operating alarms, swinging doors, lamps, etc., and in television and sound film.

Selenium is used also as an antioxidant in lubricating oil; for fat hardening; as a catalyst in the petroleum industry; in the hydrogenation of coal; for treating skin diseases, and for making certain inks and insecticides.

Selenium dioxide is used to make a number of selenium compounds, particularly accelerators for vulcanizing rubber. Ferroselenium (about 50 per cent selenium) is used as a master alloy for addition to steels to improve machineability. Selenium oxychloride is used as a solvent; sodium selenite in the preparation of an insecticide; sodium selenate in the manufacture of glass; and sodium sulpho-selenite to produce brown tones in photographic toning baths. Cadmium sulpho-selenite pigments are used to prepare a durable outdoor paint with colours ranging from orange to maroon.

Tellurium is used fairly extensively as a chill inducer to prevent shrinkage in iron castings. It is used to improve the durability of rubber; in zinc refining; in the ceramic and glass industries, where it imparts bluish or brownish tints; in toning silver tints; and when added to copper it improves the machineability of the metal without reducing the electrical conductivity.

### *Prices*

In New York black powdered selenium, 99·5 per cent pure, was $2 a pound from January 1 to June 8; $2.25 a pound from June 8 to October 19; and $3.50 a pound for the rest of the year. The price of tellurium remained at $1.75 a pound throughout 1950.

## SILVER

Canada's production of 23,221,431 ounces of silver in 1950 was about 32 per cent greater than in 1949 and was the largest output since 1940. The value ($18,767,561) of the production was higher than for any year since 1918. Most of the output is a by-product from the treatment of base metal ores, but the revival of several mines, the chief value of whose production is silver, accounted for much of the increase. Exports of silver were greater but domestic consumption was less than in 1949 due mainly to reduced requirements for coinage and war service medals. The average price of the metal was 80·98 cents an ounce compared with 74·32 cents in 1949.

*Production, Trade, Consumption*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Fine ounces | $ | Fine ounces | $ |
| *Production, by provinces* | | | | |
| British Columbia | 8,528,107 | 6,892,416 | 7,573,506 | 5,623,328 |
| Quebec | 4,343,379 | 3,510,319 | 3,250,578 | 2,413,554 |
| Ontario | 4,408,620 | 3,563,047 | 2,562,859 | 1,902,923 |
| Yukon | 3,202,779 | 2,588,486 | 1,562,730 | 1,160,327 |
| Saskatchewan | 1,207,796 | 976,141 | 1,482,009 | 1,100,392 |
| Manitoba | 893,099 | 721,803 | 554,266 | 411,542 |
| Newfoundland | 575,524 | 465,138 | 585,026 | 434,382 |
| Other provinces | 62,127 | 50,211 | 70,519 | 52,360 |
| Total | 23,221,431 | 18,767,561 | 17,641 493 | 13,098,808 |
| *Production, by sources* | | | | |
| Base metal ores | 19,543,479 | ........... | 15,980,762 | ........... |
| Gold ores | 709,980 | ........... | 680,401 | ........... |
| Silver-cobalt and silver ores | 2,945,256 | ........... | 960,527 | ........... |
| Placer gold operations | 22,716 | ........... | 19,803 | ........... |
| Total | 23,221,431 | ........... | 17,641,493 | ........... |
| *Imports of unmanufactured silver* | | | | |
| From: Mexico | 329,090 | 263,272 | 401,819 | 288,886 |
| United States | 10,158 | 8,006 | 927,803 | 681,716 |
| Nicaragua | 2,167 | 2,157 | ........... | ........... |
| United Kingdom | 190 | 241 | 3,091 | 2,212 |
| Total | 341,605 | 273,676 | 1,332,713 | 972,814 |

*Production, Trade, Consumption*—(cont'd)

| — | 1950 Fine ounces | 1950 $ | 1949 Fine ounces | 1949 $ |
|---|---|---|---|---|
| *Imports of Silver Manufactures* | | | | |
| From: United Kingdom | ........... | 574,727 | ........... | 467,994 |
| United States | ........... | 121,006 | ........... | 66,172 |
| Denmark | ........... | 36,083 | ........... | ........... |
| Japan | ........... | 14,057 | ........... | 16,235 |
| Other countries | ........... | 28,420 | ........... | 59,481 |
| Total | ........... | 774,293 | ........... | 609,882 |
| *Exports of Silver in Ore and Concentrate* | | | | |
| To: Belgium | 204,524 | 154,340 | 339,827 | 232,486 |
| Germany | 29,369 | 23,436 | ........... | ........... |
| United States | 3,260,214 | 2,564,823 | 3,714,787 | 2,772,698 |
| Total | 3,494,107 | 2,742,599 | 4,054,614 | 3,005,184 |
| *Exports of Silver Bullion* | | | | |
| To: United States | 8,353,183 | 6,676,807 | 6,207,090 | 4,564,237 |
| Cuba | 2,000 | 1,700 | ........... | ........... |
| Brazil | ........... | ........... | 4,822 | 4,050 |
| Total | 8,355,183 | 6,678,507 | 6,211,912 | 4,568,287 |
| *Exports of Silver Manufactures* | | | | |
| To: United States | ........... | 252,853 | ........... | 259,886 |
| Other countries | ........... | 14,720 | ........... | 17,922 |
| Total | ........... | 267,573 | ........... | 277,808 |
| *Consumption by Uses* | | | | |
| Coins | 3,459,938 | ........... | 5,200,000 | ........... |
| Sterling | 2,404,746 | ........... | 2,857,245 | ........... |
| Anodes | 1,166,289 | ........... | 2,463,095 | ........... |
| Silver nitrate | 1,025,161 | ........... | 968,841 | ........... |
| Brazing alloys | 303,104 | ........... | 46,034 | ........... |
| Wire and Sheet | 305 | ........... | ........... | ........... |
| Lead-silver alloys | 5,146 | ........... | 2,393 | ........... |
| Miscellaneous | 304,177 | ........... | 195,832 | ........... |
| Total | 8,668,866 | ........... | 11,733,440 | ........... |

## *World Production of Silver (Principal producing countries)*

(From American Bureau of Metal Statistics)

| — | 1950 (fine oz.) | 1949 (fine oz.) |
|---|---|---|
| Canada | 22,416,150 | 17,641,493 |
| United States | 42,068,000 | 34,559,000 |
| Mexico | 49,140,311 | 49,453,741 |
| Bolivia | 6,566,766 | 6,623,052 |
| Peru | 13,469,886 | 10,609,404 |
| Australia | 10,455,000 | 9,849,213 |
| Belgian Congo | 4,468,953 | 4,549,225 |

## *Production and Development*

### *British Columbia*

The Sullivan mine at Kimberley, owned and operated by The Consolidated Mining and Smelting Company of Canada, Limited, is Canada's chief source of silver. The ore is concentrated near the mine and the lead and zinc concentrates are shipped to the company's smelter at Trail where the contained metals are recovered.

Output of refined silver at Trail reached a record of 12,120,568 ounces, compared with 8,325,300 ounces in 1949. Most of it came from the treatment of custom ores and concentrates which are shipped to Trail by a large number of mines in Canada and other countries. The volume of this custom business has grown appreciably in recent years.

Torbit Silver Mines Limited, the second largest producer of silver in the province, shipped 1,943,000 ounces contained in concentrate, and recovered 350,000 ounces in bullion, from its mine near Alice Arm.

Highland-Bell Limited at Beaverdell, which previously shipped silver-lead ore to Trail, constructed a 50-ton mill at its property and commenced shipping concentrate in October. Total shipments contained about 700,000 ounces of silver.

Silver Standard Mines Limited, near Hazelton, produced concentrates containing about 890,000 ounces of silver.

Violamac Mines Limited and Western Exploration Company Limited were the principal producers of silver in the Slocan district.

The Granby Consolidated Mining, Smelting & Power Company, Limited, near Princeton, produced 173,424 ounces of silver, and Britannia Mining and Smelting Company Limited, at Howe Sound, 85,000 ounces. Both companies export copper concentrate containing precious metals to the Tacoma smelter in United States.

### *Manitoba and Saskatchewan*

Hudson Bay Mining and Smelting Company, Limited shipped blister copper containing 1,965,328 ounces of silver produced from its copper-zinc deposit at Flin Flon on the Manitoba-Saskatchewan boundary. Sherritt Gordon Mines Limited at Sherridon, Cuprus Mines Limited near Flin Flon, and the Snow Lake and San Antonio gold mines, all in Manitoba, also contributed to the silver output.

### *Ontario*

The International Nickel Company of Canada, Limited sold approximately 957,000 ounces of silver in 1950. The company recovers the metal as a by-product from the treatment of its copper-nickel ores in the Sudbury area.

The marked revival of production in the Cobalt and Gowganda districts, which commenced in 1949, continued and the output in 1950 amounted to almost 3,000,000 ounces. Most of the production was shipped in the form of concentrates either to Noranda Mines Limited, Noranda, Quebec, or to Deloro Smelting and Refining Company Limited, Deloro, Ontario. Shipments were also made to refineries in United States.

Silver Miller Mines Limited at Brady Lake, 3 miles southeast of Cobalt, shipped silver concentrates and sorted high-grade ore containing about 1,800,000 ounces of silver.

Cobalt Lode Silver Mines Limited developed several silver veins at its property, formerly the Adanac mine, south of the Silver Miller. It purchased the former O'Brien mill near Cobalt, and commenced milling at a rate of about 75 tons a day in November, prior to which it made substantial shipments of high-grade ore.

Silanco Mining & Refining Company Limited milled ore from the Beaver-Temiskaming section of its properties and shipped concentrates containing about 180,000 ounces of silver.

In the Gowganda area, Siscoe Metals of Ontario, Limited built a new flotation mill in which it commenced treating 500 tons of accumulated mill tailings daily. A total of 848,398 ounces of silver was recovered from concentrates shipped.

Castle-Trethewey Mines Limited, adjoining Siscoe Metals on the north, carried out underground exploration and development and rehabilitated its mill. Production was resumed in May 1951.

Ontario's forty-five gold mines in operation in 1950 produced 421,127 ounces of silver as a by-product, Hollinger Consolidated Gold Mines Limited being the chief producer, with a silver output of 95,533 ounces from its Hollinger and Ross mines.

*Quebec*

Noranda Mines Limited produced copper anodes containing 2,356,105 ounces of silver at its smelter at Noranda. Of this, 572,080 ounces came from its Horne mine and the remainder mostly from copper concentrates produced by Waite Amulet Mines, Limited, Quemont Mining Corporation, Limited, East Sullivan Mines Limited, and Normetal Mining Corporation Limited, all copper-zinc mines in western Quebec that shipped copper concentrates containing gold and silver to the Noranda smelter.

Golden Manitou Mines Limited, near Val d'Or, shipped lead concentrate and gold precipitates containing 1,140,637 ounces of silver. Important new ore deposits were partly developed on the property. The company acquired a controlling interest in Barvue Mines Limited, whose property lies near the Canadian National railway between Amos and Senneterre. About 17,000,000 tons of zinc-silver ore was indicated by drilling at the Barvue mine.

New Calumet Mines Limited on Calumet Island, Ottawa River, produced lead concentrate containing 750,439 ounces of silver. Important new ore was discovered.

Anacon Lead Mines Limited, Portneuf county, produced concentrates from which 268,150 ounces of silver was recovered. Several new ore deposits containing appreciable amounts of silver were outlined at this property.

Ascot Metals Corporation Limited commenced production at its Moulton Hill copper-lead-zinc mine, near Sherbrooke, in August. The ore contains important amounts of gold and silver.

Dome Exploration (Canada) Limited completed its present program of exploratory drilling on its zinc-lead-silver deposit at Bachelor Lake, about 160 air miles northeast of Noranda.

*Newfoundland*

Buchans Mining Company Limited, a subsidiary of American Smelting and Refining Company, shipped copper, lead, and zinc concentrates that contained about 794,000 ounces of silver. Located near the centre of the Island, Buchans is the only producing base metal mine in the province.

*Yukon*

United Keno Hill Mines Limited, at Mayo, milled an average of 212 tons of silver-lead-zinc ore a day in 1950. It produced 9,458 tons of lead concentrate, 5,043 tons of zinc concentrate, and 205 tons of crude ore that contained 3,349,800 ounces of silver. Most of the ore came from the Hector mine but considerable development was done on other mines. Completion of the road between Mayo and Whitehorse during 1950 permits concentrates to be handled by truck instead of by river navigation.

### *Uses*

A large amount of the world silver output is minted into coins. Ornaments, jewellery and sterling ware are other long-established outlets. Much silver is used in the electroplating industry.

Silver is used either pure or in alloyed form in the electrical field, especially where a very low resistance conductor is required. Various silver alloys are used in certain types of bearings, brazing, solders, and in dentistry.

A new outlet for silver has been developed in its use to replace part of the tin normally used in solders. Proportionately less silver is required than the tin replaced.

Silver nitrate is used chiefly in the preparation of light sensitive emulsions for use on photographic film.

### *Prices*

Canadian prices, although based on New York quotations, were higher due to the exchange rate between Canadian and United States currencies. The average Canadian price in 1950, as estimated by the Dominion Bureau of Statistics, was 80·98 cents an ounce compared with 74·32 cents in 1949. Early in January 1951, the price of silver in New York increased by 10 cents to 90·16 cents an ounce or the equivalent of about 95 cents an ounce in Canadian funds. Silver produced within United States continued to be purchased by the United States treasury for 90·5 cents an ounce.

## TIN

Marked changes occurred in the world tin position in 1950, the most significant being the re-establishment of free tin markets; the removal of governmental controls; a steady increase in production; expansion of the tin plate industry; and a sharp rise in prices. World production of metallic tin for 1950 was 172,100 long tons, an increase of 3,300 long tons over 1949.

Canadian production was 356 long tons valued at $828,259, compared with 276 long tons valued at $633,047 in 1949; this was only about 8 per cent of domestic requirements. Output comes from the small cassiterite ($SnO_2$) content of the lead-zinc-silver ore of the Sullivan mine of The Consolidated Mining and Smelting Company of Canada Limited, Kimberley, British Columbia. Some of this tin content is recovered as a by-product by concentration of the tailings from the lead and zinc flotation units. The cassiterite concentrate obtained is ultimately smelted and refined by electric smelting. By the end of 1950, a total of 3,160 long tons had been produced from this source.

Over 80 per cent of the world production of tin comes from British Malaya, Indonesia, Bolivia, Belgian Congo, and Nigeria.

*Production and Trade*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Long tons | $ | Long tons | $ |
| Production | 356 | 828,259 | 276 | 633,047 |
| *Imports of tin and allied products; blocks, pigs, bars.* | | | | |
| From: British Malaya | 2,312 | 5,048,945 | 2,096 | 4,833,743 |
| Belgium | 1,028 | 2,276,695 | 805 | 1,466,404 |
| United Kingdom | 947 | 1,915,493 | 71 | 158,024 |
| United States | 501 | 1,038,173 | 247 | 521,197 |
| Netherlands | 29 | 58,024 | ........ | ........ |
| Hong Kong | ........ | ........ | 423 | 809,905 |
| Bolivia | ........ | ........ | 34 | 72,436 |
| Total | 4,817 | 10,337,330 | 3,676 | 7,861,709 |
| *Tin plate* | | | | |
| From: United Kingdom | 397 | 95,223 | 199 | 67,935 |
| United States | 1,090 | 194,287 | 2,828 | 3,745,344 |
| Total | 1,487 | 289,510 | 3,027 | 3,813,279 |
| | Pounds | $ | Pounds | $ |
| *Tin foil* | | | | |
| From: United Kingdom | 25,478 | 5,742 | 92 | 58 |
| United States | 9,065 | 11,130 | 5,696 | 5,492 |
| Total | 34,543 | 16,872 | 5,788 | 5,550 |
| *Babbitt metal* | | | | |
| From: United Kingdom | 12,900 | 9,180 | 64,700 | 17,812 |
| United States | 32,400 | 6,343 | 23,700 | 11,884 |
| Germany | 56,000 | 5,674 | ........ | ........ |
| Netherlands | 32,000 | 18,461 | ........ | ........ |
| Total | 133,300 | 39,658 | 88,400 | 29,696 |

*Occurrences*

No deposits of cassiterite of economic grade have been found in Canada. The mineral occurs in the New Ross area, Lunenburg county, Nova Scotia; in the Sudbury and Thunder Bay districts of Ontario; in the Lac du Bonnet district, southeastern Manitoba; in southern British Columbia; in the Mayo area, Yukon; and in the Yellowknife area, Northwest Territories. Most of the occurrences are in pegmatite dykes. Stream tin occurs in placer gravels on numerous creeks in Yukon, and small associations of cassiterite and stannite ($Cu_2S$. FeS. $SnS_2$) are found in association with certain base metal ores in southern British Columbia.

*Uses and Consumption*

Tin is used in Canada mainly in making tinplate and solder, the former accounting for over 50 per cent of the tin used in 1950. Tin is used also to make babbitt metal, bronze, and type metal; in tinning, as foil and collapsible tubes; and in chemicals.

The demand for electrolytic tin plate was much greater than in 1949. About 40 per cent of the production of tin plate was electrolytic compared with about 25 per cent in 1949. The 0·25 pound per base box grade accounts for well over 50 per cent of this type of tin plate. In the manufacture of food cans, there is an increasing use of the 0·50 pound per base box plate due to this grade replacing 1·25-pound hot-dipped plate.

The use of tin for tin foil and collapsible tubes has been replaced to a large extent by aluminium.

*Consumption of Tin in Canada*

| — | Long tons 1950 | Long tons 1949 |
|---|---|---|
| Tin plate and tinning | 2,440 | 2,823 |
| Solder | 1,427 | 966 |
| Babbitt metal | 317 | 247 |
| Brass and bronze | 159 | 195 |
| Tin foil and collapsible tubes | 41 | 31 |
| Miscellaneous | 142 | 56 |
| Total | 4,526 | 4,318 |

### *Prices*

The Canadian price of tin f.o.b. Montreal or Toronto increased from 87 cents a pound at the beginning of 1950 to $1.59 at the end of the year. Straits tin in New York increased from 77·5 cents a pound to $1.50 in the same period.

## TITANIUM

The deposits of ilmenite at Allard Lake in Quebec were brought into production in 1950 and 100,717 tons of ore was mined and shipped to the smelter at Sorel before the close of the shipping season. At Sorel the first of five contemplated furnaces was completed and put into experimental operation to produce iron ingots and titanium dioxide concentrate. There was also a small production of ilmenite from the St. Urbain deposits in Quebec. Dominion Magnesium Limited continued its experimental work on the production of titanium metal at its plant in Haley, Ontario. All other titanium products used in Canada were imported.

### *Production*

Quebec Iron and Titanium Corporation formed jointly by Kennecott Copper Corporation and the New Jersey Zinc Company operated its reduction plant at Sorel on a test basis. Each furnace is rated at 18,000 kilowatts and the contract with Shawinigan Water and Power Company calls for a total of 160,000 horsepower. The products are low-carbon iron and a titanium concentrate containing about 70 per cent titanium dioxide. The rated capacity of the plant when completed is 500 tons of iron and 700 tons of titanium dioxide concentrate daily, to be obtained from 1,500 tons of ore. The concentrate will be used to produce refined titanium dioxide for pigments and other purposes.

Mining operations at Allard Lake are being carried out by open-cut methods by a subsidiary, Allard Lake (Quebec) Mines Limited. The ore is shipped 27 miles by rail to Havre St. Pierre and then by boat to Sorel.

In 1950, United States produced approximately 100 tons of titanium metal from titanium tetrachloride, which is derived from refined titanium dioxide. In Canada the metal is made direct from refined titanium dioxide by Dominion Magnesium Limited at Haley, Ontario, the output in the latter months of 1950 being at the rate of a ton a month. The Canadian metal is used for making alloys as the grade is not yet sufficiently consistent to be suitable for forging and rolling.

*Imports*

With the exception of the titanium metal made by Dominion Magnesium, all titanium products used in Canada are imported, mainly from United States.

*Production, Trade, Consumption*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Short tons | $ | Short tons | $ |
| *Production:* ilmenite exported | 1,253 | 7,706 | 540 | 2,892 |
| Iron ingots from ilmenite | 1,697 | 138,284 | ........ | ........ |
| Titanium dioxide concentrate | 1,596 | 149,565 | ........ | ........ |
| *Imports:* titanium dioxide and of pigments containing not less than 14 per cent titanium* | | | | |
| From: United States | 23,987 | 6,117,925 | 20,075 | 4,902,730 |
| United Kingdom | 3,138 | 935,706 | 718 | 254,809 |
| Total | 27,125 | 7,053,631 | 20,793 | 5,157,539 |

* Includes a comparatively small amount of antimony pigments.

*Titanium White Used in Canadian Paint Industry*

| | Short tons |
|---|---|
| 1939 | 928 |
| 1947 | 4,117 |
| 1948 | 5,766 |
| 1949 | 5,894 |
| 1950 | 7,900* |

*Preliminary

*Ferrotitanium Used in Canadian Steel Industry*

| | Short tons |
|---|---|
| 1939 | 132 |
| 1947 | 500 |
| 1948 | 442 |
| 1949 | 142 |
| 1950 | 143 |

*Uses*

Titanium is used mainly as titanium dioxide (titanium white) in pigments. A smaller amount is used in the iron and steel industry as ferrotitanium and ferrocarbontitanium to purify and strengthen the metal. A rapidly increasing amount of titanium dioxide is being used to produce titanium metal.

Titanium white is used mainly in the paint industry where it is usually mixed with other pigments. It has many other uses, such as: to make paper opaque; to make rubber white; in ceramic glazes; for printing inks; in linoleum; in cosmetics; and to de-lustre artificial silks. Thus, the annual tonnage of titanium white imported into Canada is much larger than that noted for the paint industry in the table above.

Titanium-bearing steel is used commonly as a base for white glazes. Titanium carbide is the hard ingredient of the "carbide" high-speed cutting steels, usually mixed with tungsten carbide. Titanium dioxide, made artificially or in the natural form of rutile, is used commonly as a coating for welding rods. Titanium tetrachloride has been used extensively in time of war for smoke screens. A small amount is used for purifying alloys of aluminium. Crystals of titanium dioxide, made artificially, have a very high index of refraction and are being used in place of diamonds.

Titanium metal melts at about 1800° Centigrade, can be rolled, drawn and forged, and has a specific gravity of 4·5 (iron is 7·8). It has excellent corrosion resistance, except for certain acids, and shows no tarnish after 30 days' exposure to salt spray. The tensile strength of the annealed metal is 82,000 pounds per square inch. Cold-worked to 50 per cent reduction, the tensile strength is 126,000 pounds per square inch. These properties suggest important uses for the metal when the cost has been reduced sufficiently.

### *Prices*

Prices in United States at the end of 1950 were as follows:

*Ilmenite*: per gross ton, 56 to 59 per cent $TiO_2$, f.o.b. Atlantic seaboard, $14 to $16 according to grade and impurities.

*Rutile*: 94 per cent $TiO_2$ minimum, 3½ to 4½ cents a pound, nominal.

*Titanium metal*: 96 to 98 per cent, $5 a pound.

## TUNGSTEN

No scheelite ore or concentrates have been produced in Canada since the close of operations late in 1948 at the Emerald mine of Canadian Exploration Limited, a wholly owned subsidiary of Placer Development Limited, near Salmo, in southern British Columbia. However, following negotiations with the company late in 1950, the Federal Government announced early in 1951 that it had purchased the remaining tungsten ore reserves at the Emerald property and that the mine would be reopened to produce much-needed tungsten concentrates. Under the agreement, the company is to rehabilitate the mine and erect a mill on a cost-plus basis and then operate the project at Government expense. The main deposit in the Emerald mine at the time of closing was estimated to contain about 200,000 tons of 1·0 per cent $WO_3$ ore. Only the tungsten section of the property is involved in the agreement, Canadian Exploration retaining the right to treat in the new mill any tungsten ore that it may develop in other sections of the property.

Wolframite, $(FeMn)WO_4$, the principal ore of tungsten, is a dark brown to black, heavy mineral containing 76·4 per cent $WO_3$ (tungstic oxide) when pure. The most extensive deposits are in the Nanling belt in Krangsei, Kwangtung, and Hunan provinces in China, formerly the source of over 30 per cent of the annual world output. Large deposits of wolframite also occur in Korea and Burma. In Canada tungsten occurs mainly as scheelite $(CaWO_4)$, a heavy, fairly soft, usually buff sometimes white mineral with a dull lustre, containing 80·6 per cent $WO_3$ when pure. Most of the numerous Canadian occurrences are small. The mineral is commonly associated with quartz and frequently occurs in patches in gold-bearing quartz veins in Canadian mines. It can be readily detected in the dark by its brilliant, pale bluish white fluorescence under ultra violet light and purple filter. In 1950, Clarence M. Sands of Atlin,, B.C. is reported to have shipped about 4·5 tons of wolframite containing about 45 per cent $WO_3$ from gold placer operations near Atlin.

The Emerald mine was Canada's chief source of high-grade scheelite concentrates during World War II. Discovered in 1942, the property was operated by Wartime Metals Corporation until late in 1943. Canadian Exploration acquired it in 1947 from Wartime Metals Corporation and produced high-grade scheelite concentrates until the end of 1948, when it decided to mine a lead-zinc deposit on the same property and to change the mill flow sheet to make lead and zinc concentrates.

There are no plants in Canada for the conversion of wolframite to ferrotungsten but high-grade scheelite concentrates may be added directly to the steel bath because of the comparative ease with which calcium enters the slag. The major consumer in Canada of ferrotungsten and scheelite, used in the manufacture of alloy steels, is Atlas Steels Limited of Welland, Ontario.

*Shipments, Trade, and Consumption*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Short tons | $ | Short tons | $ |
| *Shipments*[1]—Scheelite | 943 | ........... | 167 | ........... |
| $WO_3$ content | 142 | 160,343 | 126 | 252,380 |
| *Imports*—Scheelite[2] | | | | |
| From: Brazil | 28 | 49,942 | ........... | ........... |
| Spain | ........... | ........... | 28 | 34,613 |
| Total | 28 | 49,942 | 28 | 34,613 |
| *Imports*—Ferrotungsten[3] | | | | |
| From: United Kingdom | 11 | 20,545 | 11 | 32,060 |
| Japan | 50 | 111,847 | ........... | ........... |
| United States | 46 | 150,574 | 140 | 257,673 |
| Total | 107 | 282,966 | 151 | 289,733 |
| *Consumption* in the primary iron and Steel Industry | | | | |
| Ferrotungsten[3] | 117 | 302,872 | 190 | 428,535 |
| Scheelite[2] | 84 | 116,411 | 135 | 206,027 |

[1] From Emerald Mine stocks.
[2] Approximately 60 to 65 per cent $WO_3$.
[3] Approximately 70 per cent tungsten.

During World War II Bralorne Mines Limited obtained a high-grade scheelite concentrate from the Red Rose mine south of Hazelton, in northern British Columbia. Production also came from Hollinger Consolidated Gold Mines Limited, Timmins, Ontario, where a scheelite recovery plant was operated, and from several other gold mines where scheelite patches are associated with gold quartz veins.

World production of tungsten has declined from a wartime peak of approximately 61,000 tons of concentrate containing 60 per cent $WO_3$ to between 25,000 and 35,000 tons annually.

The loss of Chinese and Korean production as a result of the war in Korea has brought rapid increases in the price of tungsten and this has stimulated the production of tungsten minerals from other countries. Brazil and Bolivia have increased their output of ores. Other major producers include Portugal, Spain, Australia, and United States.

### *Uses*

Tungsten is used mainly in the production of tool and die steels to impart hardness and toughness, which properties the steels retain even at high temperatures. It is the hardest metal used by industry and its ability to retain this hardness even at high temperatures makes it invaluable. Tungsten steel tools maintain a sharp cutting edge at working temperatures far above those that would ruin carbon steel tools. Tungsten has no satisfactory substitutes for its main uses and it is absolutely essential in military applications.

High-speed cutting tools contain 12 to 20 per cent tungsten, and steels for hot working dies, chisels, and punches contain from 1·5 to 2·5 per cent tungsten. Most of these tungsten alloy steels also contain varying amounts of chromium, vanadium, and carbon. Other tungsten alloy steels are used in valve seats for internal combustion engines, in steels for gun riflings, and linings, and in making permanent magnets. In the last use, however, tungsten is being replaced by cheaper chromium steels of the more expensive but magnetically stronger cobalt alloys.

Tungsten alloys are used in gas turbine and jet propulsion engines because of their ability to give increased strength at high operating temperatures as well as increased resistance to corrosion. Tungsten carbide cores are used in making armour-piercing shells, particularly anti-tank projectiles, as tungsten maintains its hardness even at a bright-red heat that is far above the softening temperature of high-speed steel.

The pure metal is used in contact points for electrical circuits in many devices such as airplane magnetos, telephones, temperature control thermostats, and many others. It is used in the manufacture of armour plate, propeller blades, and armour for submarine cables; and its compounds are used to flameproof and waterproof materials. Tungstic acid is one of the ingredients used in processing toluol to TNT.

Stellite, a non-ferrous alloy, contains 10 to 15 per cent tungsten, with higher percentages of chromium and cobalt.

### *Prices*

The Engineering and Mining Journal Metal and Mineral Markets of December 28, 1950, gave the following quotations on tungsten ore, per short ton unit of $WO_3$, for ore of known good analysis: foreign ore, $47 and $48 in bond, equivalent to $55 and $56 at prevailing (50 cents a pound of tungsten) duty. Domestic high-grade scheelite (Western), $47 f.o.b. mine.

North Carolina high-grade ore sold at $56.50, f.o.b. Henderson.

Canadian prices, plus exchange, for high-grade scheelite are comparable to those in United States, Atlas Steels of Welland, Ontario, being the only Canadian purchaser. There is no market for wolframite in Canada.

## ZINC

Production of refined zinc in Canada in 1950 was slightly less than in 1949, but there was a substantial increase in the output of zinc concentrates for export. A record output value of $98,040,145 was reached for the fourth successive year. Approximately 63 per cent of the tonnage output was comprised of electrolytically refined zinc made by The Consolidated Mining and Smelting Company of Canada Limited at Trail, British Columbia, and by Hudson Bay Mining and Smelting Company, Limited at Flin Flon, Manitoba. The remainder, which was exported to United States, United Kingdom, and several European countries, was contained in concentrates produced in Quebec and Newfoundland. The price of ordinary electrolytic zinc in Canada increased from 11·75 cents a pound to 19·3 cents a pound.

*Production, Trade, and Consumption*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Short tons | $ | Short tons | $ |
| *Production, all forms (a)* | | | | |
| British Columbia (inc. Yukon) | 147,926 | 46,300,744 | 144,518 | 38,288,581 |
| Manitoba and Saskatchewan | 48,943 | 15,319,357 | 49,174 | 13,028,163 |
| Quebec | 85,819 | 26,861,397 | 62,661 | 16,601,312 |
| Newfoundland | 30,539 | 9,558,647 | 31,909 | 8,454,091 |
| Total | 313,227 | 98,040,145 | 288,262 | 76,372,147 |
| *Production, refined metal (b)* | 204,367 | ........... | 206,045 | ........... |
| *Exports of refined metal* | | | | |
| To: United States | 108,117 | 29,767,815 | 108,068 | 26,227,108 |
| United Kingdom | 35,823 | 9,901,647 | 52,692 | 13,994,579 |
| France | ........... | ........... | 3,417 | 1,164,780 |
| India | 1,853 | 648,006 | 1,934 | 512,220 |
| Sweden | 593 | 132,759 | ........... | ........... |
| Other countries | 494 | 143,442 | 2,196 | 584,295 |
| Total | 146,880 | 40,593,669 | 168,307 | 42,482,982 |
| *Exports in ore* | | | | |
| To: United States | 76,484 | 8,838,982 | 59,298 | 8,562,595 |
| Belgium | 24,216 | 3,652,837 | 23,069 | 1,912,484 |
| United Kingdom | 16,421 | 2,627,436 | 15,445 | 1,409,055 |
| France | 7,025 | 1,347,726 | 4,288 | 369,532 |
| Other countries | 5,415 | 932,697 | 4,584 | 309,265 |
| Total | 129,561 | 17,399,678 | 106,684 | 12,562,931 |
| *Exports of scrap, dross and ashes* | | | | |
| To: Belgium | 3,204 | 313,287 | 2,695 | 388,979 |
| United States | 1,455 | 310,955 | 3,032 | 205,555 |
| Other countries | 426 | 92,368 | 297 | 59,222 |
| Total | 5,085 | 716,610 | 6,024 | 653,756 |
| *Exports of zinc manufactures* | ........... | 183,160 | ........... | 162,203 |
| *Imports of zinc and zinc products* | | | | |
| From: United States | ........... | 5,679,342 | ........... | 4,055,837 |
| United Kingdom | ........... | 619,426 | ........... | 441,236 |
| Other countries | ........... | 109,356 | ........... | 43,657 |
| Total | ........... | 6,408,124 | ........... | 4,540,730 |
| *Consumption* | | | | |
| Galvanizing | 23,711 | ........... | 25,789 | ........... |
| Zinc oxides and dust | 9,692 | ........... | 5,856 | ........... |
| Brass and copper products | 6,523 | ........... | 4,196 | ........... |
| Diecasting alloys | 4,025 | ........... | 3,176 | ........... |
| Dry batteries | 2,315 | ........... | 1,323 | ........... |
| Secondary smelters (c) | 7,660 | ........... | 4,794 | ........... |
| Miscellaneous | 444 | ........... | 535 | ........... |
| Total | 54,370 | ........... | 45,669 | ........... |

(a) Includes zinc estimated recoverable from concentrate exported.
(b) Includes zinc recovered from imported concentrates.
(c) Most of the virgin zinc consumed in secondary smelting plants goes into alloys that are subsequently diecast, and into brass. They are not included in brass, and diecasting alloys above, the amounts not being available separately.

*World Production of Slab Zinc for Specified Countries*

(From American Bureau of Metal Statistics)

| — | 1950 | 1949 |
|---|---|---|
| United States[1] | 910,354 | 869,823 |
| Canada | 204,448 | 206,045 |
| Mexico | 54,089 | 58,162 |
| Belgium | 195,466 | 194,631 |
| France | 78,849 | 67,148 |
| Germany[2] | 135,355 | 95,812 |
| United Kingdom | 78,725 | 71,798 |
| Italy | 41,929 | 29,384 |
| Netherlands | 21,342 | 17,212 |
| Norway | 47,505 | 45,294 |
| Spain | 23,406 | 21,530 |
| Japan | 54,021 | 35,622 |
| Rhodesia | 25,442 | 25,592 |
| Australia | 94,596 | 90,536 |
| Russia | 141,900 | 121,300 |
| Other countries | ............ | 108,159 |

[1] Includes production from secondary material.
[2] Federal Republic.

*British Columbia*

Canada's principal source of zinc is the Sullivan mine at Kimberley operated by The Consolidated Mining and Smelting Company. The ore is milled near the mine to produce lead and zinc concentrates which are shipped to the company's smelter and zinc plant at Trail. A total of 2,680,962 tons was mined, compared with 2,297,672 tons in 1949. A sink-float plant installed in 1949 to eliminate a large part of the coarse waste rock before milling, made possible the mining of lower grade ore without reducing overall recovery. The removal of overburden was commenced in preparation for open-cut mining of a section of the Sullivan orebody.

A total of 156,021 tons of slab zinc was produced at Trail, compared with 157,204 tons in 1949. The main zinc leaching plant was enlarged in 1949 and 1950, and an increase of about 70 tons a day in the zinc output capacity will result from the installation of additional cells in the zinc electrolytic refinery.

In addition to concentrates from the Sullivan mine, substantial amounts of zinc concentrates from other mines were treated at Trail on a custom basis. The more important shippers were Britannia Mining and Smelting Company Limited, Canadian Exploration Limited, Reeves MacDonald Mines Limited, Sheep Creek Gold Mines Limited from its Zincton and Paradise mines, and Base Metals Mining Corporation Limited from its Monarch and Kicking Horse mines at Field and its Cork Province mine near Kaslo.

At Britannia on Howe Sound concentrates containing 11,000 tons of zinc were produced largely from a new zinc orebody developed in the upper section of the mine.

Canadian Exploration near Salmo increased the capacity of its concentrator from 300 to 550 tons a day, and Reeves MacDonald about 12 miles south of Salmo increased its capacity from 500 to 1,200 tons a day. Zinc concentrate produced at these properties contained 8,183 tons of zinc and 8,651 tons of zinc respectively.

Sheep Creek resumed production of zinc and lead concentrates at its Paradise mine near Invermere in April 1950 after a shut-down during the winter. It took over the operation and control of its former subsidiary, Zincton Mines Limited at Zincton.

Yale Lead and Zinc Mines Limited at Ainsworth commenced construction of a 300-ton a day sink-float plant and a 180-ton concentrator.
Kootenay Belle Gold Mines Limited prepared to install a second sink-float plant to increase output of concentrates at its 300-ton mill at Retallack.

At the Mastodon mine, controlled by Golden Manitou Mines Limited, large deposits of zinc ore were developed and plans were made to bring the property into production. The mine is 17 miles north of Revelstoke.

Estella Mines Limited reopened its property 16 miles east of Wasa and developed about 100,000 tons of good grade zinc-lead ore. It made plans to commence production of concentrates in 1951 in a 200-ton mill to be erected at Wasa.

The Consolidated Mining and Smelting Company carried out pre-production development at its Bluebell lead-zinc mine on Kootenay Lake, where construction of a 500-ton concentrator was commenced, and at its copper-lead-zinc deposits at the Tulsequah Chief and Big Bull properties in the Taku River area. The company planned to bring these three properties into production in 1951. It also did development work at its H. B. property near Salmo and made trial shipments of lead-zinc oxide ore to the Trail smelter.

*Manitoba and Saskatchewan*

Hudson Bay Mining and Smelting Company, Limited at Flin Flon on the Saskatchewan-Manitoba boundary mined 1,854,755 tons of ore compared with 1,885,107 tons in 1949. In addition to 138,736 tons of zinc concentrate produced at Flin Flon the company purchased and treated about 16,400 tons of zinc concentrate produced by Sherritt Gordon Mines Limited and Cuprus Mines Limited. A total of 48,943 tons of slab zinc was produced at the electrolytic zinc plant, most of this being four-nines-plus grade. The construction of a slag fuming plant, an addition to the zinc plant, and associated projects designed to recover zinc from the company's large stockpile of zinc plant residues were nearing completion.

At Hudson Bay Mining and Smelting Company's Schist Lake mine, 3½ miles southeast of Flin Flon, development of the copper-zinc orebody was commenced on four levels and preparations were made for stoping.

Production at Sherritt Gordon Mines Limited, 40 miles northeast of Flin Flon, decreased due to the near exhaustion of the orebody, which is expected to be worked out in 1951. Production from 375,592 tons of ore milled in 1950 included 8,344 tons of zinc concentrate averaging 50 per cent zinc.

Cuprus Mines Limited, a subsidiary of Hudson Bay Mining and Smelting Company, 13 miles southeast of Flin Flon, produced 9,522 tons of zinc concentrates containing 45 per cent zinc.

*Ontario*

McWilliams-Beardmore Mines Limited, which worked the Silver Mountain zinc-lead mine near Fort William for several years, discontinued operations in December 1950.

Consolidated Rochette Mines Limited was inactive most of 1950 at its lead-zinc property at Long Lake in Frontenac county.

*Quebec*

Zinc concentrates were produced by Waite Amulet Mines Limited; Normetal Mining Corporation Limited; Quemont Mining Corporation, Limited; East Sullivan Mines Limited; Golden Manitou Mines Limited; New Calumet Mines Limited; Anacon Lead Mines Limited; and by Ascot Metals Corporation Limited. Most of the cencentrate output was exported to zinc plants in United States, but shipments were also made to the United Kingdom and several European countries.

Waite Amulet, near Noranda, milled 424,365 tons of ore and shipped concentrates containing 22,688 tons of zinc. A shaft was sunk 1,600 feet on the new East Waite orebody and a level was established at 1,554 feet from which 700,000 tons of ore was outlined by drilling. Additional ore was also found in several other orebodies on the company's property.

At Normetal, in Desmeloizes township, about 54 miles northwest of Noranda, 363,297 tons were milled compared with 292,235 tons in 1949. A total of 46,603 tons of zinc concentrates containing 24,027 tons of zinc was produced. The No. 4 internal shaft was completed to a depth of 4,200 feet and considerable development was carried out on three new levels, the deepest being at the 4,160-foot horizon.

Quemont, adjoining Noranda Mines on the east, milled 759,663 tons of ore, an average of 2,080 tons a day. A total of 16,951 tons of zinc concentrate was produced. Shipments, including some material stocked in 1949, contained 9,210 tons of zinc.

East Sullivan Mines, near Val d'Or, operated its concentrator at close to its rated capacity of 2,500 tons a day to treat 869,587 tons of ore. A total of 26,000 tons of zinc concentrate was produced containing 13,442 tons of zinc.

Golden Manitou, 9 miles east of Val d'Or, milled 331,180 tons of ore. Production included 17,027 tons of zinc concentrate containing 10,100 tons of zinc. Lead concentrate and silver-gold precipitate were also produced and exported.

New Calumet, on the Ottawa River, near Campbell's Bay, Pontiac county, milled 256,000 tons and produced 26,080 tons of zinc concentrate containing 52 per cent zinc. New ore was discovered by drilling in the lower mine workings during 1950.

Anacon Lead Mines, at Montauban les Mines, Portneuf county, produced zinc concentrate containing 6,987 tons of zinc from about 200,000 tons of ore milled. Three new orebodies were outlined by surface drilling and a shaft was sunk over 700 feet to develop the largest of these.

Ascot Metals Corporation commenced production of zinc concentrate and copper-lead concentrate at its Moulton Hill mine in August 1950. The mill has a rated capacity of 400 tons a day but this is to be increased to 650 tons in 1951. The deepening of the shaft to establish three new levels was commenced. Exploration of several ore bodies containing copper, lead, and zinc was commenced at the company's Suffield mine, 8 miles south of the Moulton Hill mine.

At Barvue Mines Limited, a subsidiary of Golden Manitou Mines Limited, 30 miles north of Val d'Or, a large deposit of zinc-silver ore was outlined. Surface drilling is reported to have indicated 17,000,000 tons of ore averaging over 3 per cent zinc and 1 ounce of silver per ton to a depth of 700 feet. Plans were formulated to bring this property into production at a rate of 4,000 tons a day.

Eldona Gold Mines Limited leased a part of its property near Noranda containing a zinc-gold orebody to Harrison Drilling and Exploration Company Limited. This company will mill the ore in the former McWatters mill which it purchased and re-equipped to treat 200 tons a day and to produce zinc concentrate.

Dome Exploration (Canada) Limited completed the drilling exploration program of its zinc-lead-silver deposit at Bachelor Lake, 160 miles northeast of Noranda. About 240,000 tons of ore averaging 14 per cent zinc, 0·7 per cent lead, and 6 ounces per ton of silver were indicated.

*New Brunswick*

New Calumet Mines Limited acquired the Tetagouche lead-zinc-copper property near Bathurst. Research was carried out to attempt to find a suitable method to treat the complex ore in this deposit.

*Nova Scotia*

Mindamar Metals Corporation Limited, a subsidiary of Dome Mines Limited, reopened the Sterling zinc-lead-copper property on Cape Breton Island. Plans were made to bring the mine into production in 1951 at a milling rate of 500 tons a day.

*Newfoundland*

The Buchans zinc-lead-copper mine in the central part of the Island, operated by Buchans Mining Company Limited, is the only producing base metal mine. Production from 328,000 tons of ore milled included 64,609 tons of zinc concentrate containing 35,708 tons of zinc. A shaft to develop orebodies discovered by drilling in recent years to the northwest of the older mine workings was sunk to a depth of 1,796 feet. Lateral development of the ore was commenced.

*Yukon*

United Keno Hill Mines Limited produced concentrates containing 3,520 tons of zinc from its rich silver-lead-zinc deposits at Mayo.

*Northwest Territories*

The Consolidated Mining and Smelting Company continued exploratory drilling on the 500-square-mile concession it holds jointly with Ventures Limited and Northern Lead Zinc Limited near Pine Point, Great Slave Lake. Results indicated that commercial deposits of lead and zinc occur over a wide area. Further drilling will be done to outline the orebodies in detail.

## *Uses*

Zinc has a wide range of industrial uses. United States, the greatest consumer, used 947,400 tons of new zinc in 1950 or 33 per cent more than that used in 1949. Approximately 46 per cent was used in galvanizing; 30 per cent in diecasting and zinc base alloys; 14 per cent for brass products; and 7 per cent in rolled zinc fabrications. The United Kingdom, the second largest consumer of zinc, used 265,300 tons with galvanizing and brass products each accounting for about 30 per cent of the consumption.

The metal is marketed to industry in grades, varying according to their respective contents of lead, iron, cadmium and other impurities. In North America, the principal grades produced are "Special High Grade" used chiefly for diecasting; "Regular High Grade" used for brass manufacture, and rolled zinc fabrications; and "Prime Western" used for galvanizing. In Canada zinc is refined only by the electrolytic process, by which most "Special", and "Regular High Grade" zinc is produced. To fill orders for "Prime Western", Canadian producers debase their product to meet specifications.

In galvanizing, zinc is applied to iron or steel as a thin coating to prevent rusting. It has an affinity for iron, and the coating is usually applied by hot dipping. However, for some purposes such as wire screening, the coating is applied by electroplating.

Zinc base alloys prepared from high-grade electrolytic zinc to which is added 3 to 4 per cent aluminium, up to 3·5 per cent copper, and 0·02 to 0·1 per cent magnesium, are used extensively for diecasting complex shapes, especially for automobile parts.

Brass, a copper-zinc alloy containing up to 50 per cent zinc, has many diversified uses in industry and the arts. Rolled zinc is used for fabrications exposed to corrosion such as weather stripping, fruit jar sealer rings, battery cups, boiler and hull plates, and brake linings. Zinc dust is used to make zinc salts and compounds; for purifying fats; manufacture of dyes; and to precipitate gold and silver from cyanide solution. Zinc oxide is used in compounding rubber, and in making paint, ceramic materials, inks, matches, and many other commodities. Among the more important of the zinc compounds and products are lithopone, zinc carbonate, zinc chloride, zinc stearate, zinc sulphate, and zinc sulphide.

### *Prices*

Ordinary electrolytic zinc increased in price in Canada from 11·75 cents a pound in January to 19·3 cents a pound in December 1950. The average price in 1950 according to the Dominion Bureau of Statistics was 18·89 cents a pound for ordinary electrolytic zinc and 6·7 cents a pound for zinc contained in concentrates exported.

# II. INDUSTRIAL MINERALS

## ABRASIVES (NATURAL)

Brief reviews only are given below of corundum, emery, garnet, grindstones, oilstones, and pulpstones, volcanic dust (pumicite), and grinding pebbles.

### CORUNDUM ($Al_2O_3$)

Canada has produced no corundum since completion of the treatment of the old tailings at the disposal dump on the Craigmont property, Renfrew county, Ontario, in October 1946. From 1944 to the close of this recovery operation, approximately 2,600 tons of concentrate containing 1,726 tons of fine corundum, was shipped to American Abrasive Company at Westfield, Massachusetts, the only dealer in corundum on the continent, for use in polishing precision lenses for optical instruments.

Several small and scattered deposits of corundum occur in the nepheline syenite belt, which is about 100 miles long and 6 miles wide and crosses Haliburton, Hastings, and Renfrew counties in eastern Ontario, but the corundum content rarely reaches 5 per cent.

#### *Production and Trade*

Canada imported 103 tons of corundum ranging from fine to coarse grain in 1950 compared with 126 tons in 1949. Most of the imports are used in making grinding wheels and the remainder for precision lens grinding. Imports enter Canada via United States from the Transvaal, Union of South Africa, the chief producer for the past 30 years.

#### *Uses and Prices*

Grain corundum is used in making grinding wheels and very coarse grain in 'snagging' wheels. Both types of wheels are used in the metal trades, where the hardness of corundum, coupled with its ability of leaving sharp cutting edges on fracturing, makes it an ideal cutting tool. The finest corundum (flour grades) are used for polishing high-precision lenses.

Quotations on crude corundum imported into United States are estimated to have varied from \$90 to \$110 a ton, according to grade. Prices of prepared grain vary considerably according to mesh size and at the end of 1950, prices quoted by the Engineering and Mining Journal Metal and Mineral Markets were: natural, a pound, size 8 to 60 inclusive, 8½ cents; 70 to 275, 9½ cents; 500, 28 cents; 850 to 1,000, 45 cents; 1,200 to 1,600, 65 cents; and 2,600, 70 cents.

### EMERY

True emery is an intimate mixture of corundum and magnetite, with or without hematite, and varies in hardness and toughness according to the amount of iron oxides present. Emery is massive, nearly opaque, and dark grey to blue-black with a reddish tint depending upon the amount of hematite present.

Commercial emery has not been found in Canada although some deposits of corundum east of the Madawaska River in Ontario are so intimately mixed with magnetite that they are practically a coarsely crystalline emery.

Greece, Turkey, and United States are the three main emery producing countries. Grecian (or Naxos) emery contains approximately 65 per cent corundum and about 25 per cent of the remainder is magnetite. American emery, most of which comes from New York state, and Virginia, and which is the softest of the three, contains about 45 per cent iron oxide. Turkish emery approaches that produced in Greece in corundum content and quality.

Canadian consumption of emery in abrasive papers amounted to 113 tons in 1949 (1950 figures not available) compared with 87 tons in 1948. A large part of American emery, about 5,000 tons a year, is consumed as the 'nonskid' agent in concrete and asphalt floors of industrial concerns because of its marked resistance to wear and its non-skid nature. The balance of the output, together with imports from Greece and Turkey, is used for abrasive purposes, as in making grinding wheels, abrasive sticks, coated papers, and similar products.

The Engineering and Mining Journal Metal and Mineral Markets quoted American first-grade emery ore at the end of 1950, f.o.b. New York, at $12 a ton and grain emery, f.o.b. Pennsylvania, at 10 cents a pound for Turkish and Naxos grain, and 6½ cents a pound for American grain.

## Garnet

There was no mine output of garnet in Canada in 1950 but Niagara Garnet Company Limited, Sturgeon Falls, Ontario, treated a few tons of garnet concentrate in its mill at Sturgeon Falls and shipped small quantities of graded grain. This company operates a garnet deposit intermittently near River Valley in Dana township and in past years shipped minor amounts of flour grades to United States' consumers. The garnet is of good grade and occurs in crystals ranging from the size of marbles up to crystals 4 inches in diameter. The garnets, which occur in a band of mica schist, are roughly concentrated by crushing and trommel screen sizing at the pit site and are then trucked the 40 miles to the mill at Sturgeon Falls, where they are further crushed and concentrated to about 95 per cent garnet grain, and prepared for market either as garnet grain or as flour grades of garnet.

Canada Garnet Limited, with property near Labelle, Quebec, had no production in 1950. The garnet occurs as small, shattered garnets in gneiss and there exists the difficult concentration problem of providing marketable garnet grain. Originally the company operated a deposit of good, massive garnet in pyrrhotite that cut through the gneiss. However, all of this type of garnet has been mined.

Over 85 per cent of the world output of garnet comes from deposits near North Creek, New York, which are owned and operated by Barton Mines Corporation. The product from these deposits is regarded as world standard garnet. Production in United States has averaged about 8,000 tons of all grades during the past few years.

### *Consumption and Uses*

Canadian consumption of garnet grain for making sandpapers amounts to approximately 350 tons a year, the two Canadian consumers being Canadian Durex Abrasives Limited, Brantford, and Canada Sandpapers Limited, Preston, both in Ontario. Both these companies import graded grain for their needs.

Consumers in United States over the past several years have used from 6,000 to 8,000 tons annually of all types. Most of the garnet is used for making coated abrasive papers but it is also used in sandblasting, whereas flour grades (under 350-mesh) are used in the polishing of precision lenses.

### *Prices*

The cost of ungraded garnet concentrates suitable for sandpapers, according to the Engineering and Mining Journal Metal and Mineral Markets, was $93 a ton f.o.b New York, at the end of 1950. Prices of other garnet products ranged up to $160 a ton, with the superfine powders in 5 to 10 micron size used for lens polishing selling for approximately $200 a ton.

## Grindstones, Oilstones, Pulpstones, Etc.

Material suitable for these stones occurs in certain sandstone beds in Nova Scotia, New Brunswick, and on the coast of British Columbia. Many years ago the output was considerable but demand is now almost negligible due mainly to competition from artificial abrasives, and output is small.

Read Stone Company Limited of Sackville, and Bay of Chaleur Grindstone Company of Clifton, both in New Brunswick, the only Canadian producers of grindstones, shipped approximately 100 tons of grindstones valued at $10,000 in 1950, compared with 184 tons valued at $13,700 in 1949. Read Stone Company, by far the larger operator, ships its material from quarries near Stonehaven. Bay of Chaleur Company obtains its material from along the Bay of Chaleur at low tide near Grand Anse.

Pulpstones of natural sandstone for use in magazine grinders of pulp mills have been largely replaced on this continent by segmental pulpstones built of bonded silicon carbide grit by makers of artificial abrasives. Most of these are supplied by Norton Company of Canada Limited at its plant in Hamilton, Ontario. Pulpstones supplied by Canadian Carborundum Company Limited to Canadian firms are made in its United States plant and imported into Canada. About 900 artificial pulpstones are in use in Canadian pulp and paper mills and about 300 are in stock at the various mills. Some segmental pulpstones of artificial abrasive material are made in Canada for export.

## Volcanic Dust (Pumicite)

Volcanic dust or pumicite is a natural glass or silicate, atomized by volcanic explosions and thrown into the air in great clouds that ultimately settle into beds varying from a few inches to many feet in thickness. The dust occurs as finely divided powder of a white to grey or yellowish colour and is composed of small, sharp angular fragments of highly siliceous volcanic glass.

Pumice is a highly cellular, glassy volcanic rock or lava that is formed in the vicinity of volcanoes as porous blocks of a white or light grey colour. It has the same composition as normal rhyolites, and ground pumice has the same appearance and character as pumicite.

Widespread deposits of volcanic dust occur in Saskatchewan, Alberta, and British Columbia, but because of thinness of beds or remoteness from markets there has been no production for many years.

Volcanic dust is used in Canada mainly for making scouring and cleansing aids. Light-weight building blocks composed of pumice aggregrate and cement mixture are made at several block plants in British Columbia. The pumice aggregate is imported from nearby Oregon and Washington states at prices ranging from $6 to $9 a short ton, f.o.b. Vancouver plants.

Imports are grouped with a number of similar products (pumice, pumicite, volcanic dust, lava, and calcareous tufa) and in 1950 were valued at $127,885, compared with $105,977 in 1949 and $108,684 in 1948. Most of these imports came from United States and the remainder from Italy.

At the close of 1950, according to Engineering and Mining Journal Metal and Mineral Markets, the price of pumice stone a pound, f.o.b. New York, or Chicago, packed in barrels, was 3 to 5 cents for powdered and 6 to 8 cents for lump. These prices varied widely and were dependent upon availability of supply, the use to which it was put, and the quantities required.

In United States increasing amounts of pumicite and pumice are being used as concrete admixture and concrete aggregate. Pumicite is also consumed as a carrier or filler as well as a cleaning and scouring agent in soaps and powders.

### Grinding Pebbles

Extremely hard and tough, rounded pebbles usually of flint, are used in cylindrical or conical mills for grinding ores and minerals mainly of a non-metallic nature where iron would prove detrimental due to the use of the usual steel balls.

Grinding pebbles were produced in the past in several Canadian localities. Production in recent years, however, has been confined to Alberta, where W. May produces pebbles from deposits at Elkwater and ships them to several Canadian mining and milling companies.

## ASBESTOS

Canada in 1950 accounted for approximately 65 per cent of the world output of asbestos. Production in 1950 reached a peak of 875,344 tons of fibre of all grades valued at $65,854,568, an increase of 22 per cent in volume and 56 per cent in value over that of 1948, the previous record year. Most of Canada's output is exported to United States, the principal consumer.

Several significant developments took place within the industry in 1950, the most important being the production for the first time of a substantial quantity of chrysotile fibre in a province outside Quebec. Commercial milling of fibre began at the Munro mine of Canadian Johns-Manville Company Limited, near Matheson, in northern Ontario in the early summer.

The year also marked a period of active search and prospecting for new deposits of the mineral, with several companies carrying out exploratory and development work in Ontario, Quebec, and British Columbia. Demand for fibre of all grades continued at an unprecedented level, as existing consuming industries expanded their facilities and new uses appeared. In Quebec, progress continued in the changeover from open pit to underground operations.

*Production and Trade*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Short tons | $ | Short tons | $ |
| *Production* (Shipments) | | | | |
| Crude | 904 | 587,569 | 652 | 420,188 |
| Milled fibres | 305,194 | 41,002,785 | 194,583 | 24,463,703 |
| Shorts and refuse | 569,246 | 24,264,214 | 379,671 | 14,862,181 |
| Total | 875,344 | 65,854,568 | 574,906 | 39,746,072 |

*Production and Trade*—Continued

| — | 1950 Short tons | 1950 $ | 1949 Short tons | 1949 $ |
|---|---|---|---|---|
| *Exports of Crude* | | | | |
| To: United States | 555 | 330,568 | 459 | 277,584 |
| Other countries | 290 | 213,077 | 172 | 138,661 |
| Total | 845 | 543,645 | 631 | 416,245 |
| *Exports of Milled Fibres* | | | | |
| To: United States | 180,854 | 23,502,603 | 126,338 | 14,939,832 |
| United Kingdom | 29,887 | 3,856,543 | 18,957 | 2,282,956 |
| France | 14,128 | 2,204,787 | 8,505 | 1,427,182 |
| Belgium | 9,444 | 1,403,885 | 5,625 | 827,274 |
| Australia | 9,346 | 1,246,156 | 5,513 | 696,558 |
| Brazil | 5,319 | 768,979 | 1,970 | 317,469 |
| Mexico | 4,881 | 693,225 | 2,826 | 400,076 |
| Other countries | 35,939 | 5,437,473 | 11,907 | 1,877,489 |
| Total | 289,798 | 39,113,651 | 181,641 | 22,768,836 |
| *Exports of Shorts and Refuse* | | | | |
| To: United States | 485,597 | 20,351,920 | 334,656 | 12,936,464 |
| United Kingdom | 22,483 | 876,075 | 9,790 | 395,854 |
| Belgium | 7,818 | 473,161 | 2,315 | 113,130 |
| France | 6,765 | 384,927 | 4,439 | 231,443 |
| Germany | 5,227 | 280,306 | 200 | 6,095 |
| Other countries | 11,446 | 727,819 | 1,318 | 65,675 |
| Total | 539,336 | 23,094,208 | 352,718 | 13,748,661 |
| *Exports of Manufactures* (Brake linings, clutch facings, roofing, packing, etc.) | | | | |
| To: United States | ........... | 386,820 | ........... | 66,321 |
| Mexico | ........... | 85,673 | ........... | 4,455 |
| Hong Kong | ........... | 48,324 | ........... | 40,231 |
| Venezuela | ........... | 43,238 | ........... | 25,303 |
| Cuba | ........... | 32,040 | ........... | 9,296 |
| Colombia | ........... | 23,543 | ........... | 9,748 |
| Other countries | ........... | 103,755 | ........... | 209,253 |
| Total | ........... | 723,393 | ........... | 364,607 |
| *Imports* | | | | |
| Packing | ........... | 179,000 | ........... | 145,695 |
| Brake linings for motor vehicles | ........... | 461,938 | ........... | 439,616 |
| Clutch facings for motor vehicles | ........... | 285,222 | ........... | 221,208 |
| Brake linings and clutch facings | ........... | 53,304 | ........... | 60,641 |
| Miscellaneous manufactures | ........... | 1,651,888 | ........... | 1,729,200 |
| Total | ........... | 2,631,352* | ........... | 2,596,360 |

* 85 per cent of which comes from United States.

No amosite or crocidolite has been found in Canada, but there are numerous deposits of fibrous tremolite, actinolite, and anthophyllite. These varieties are commercially termed amphibole asbestos. The fibres are harsher, longer, and weaker than those of chrysotile and cannot be spun, but they have a higher resistance to acids, and are usually preferred to chrysotile fibre for the filtering of acid solutions. Fibre from certain of the tremolite deposits in Ontario and Quebec has proved suitable for this use and small-scale development work is proceeding on a deposit of fibrous tremolite near Calabogie, Ontario, and near St. Luc de Matane, Quebec.

*Quebec*

Production came from seven companies. Asbestos Corporation Limited worked two properties at Thetford Mines, and one each at Black Lake and Vimy Ridge; Johnson's Company Limited operated at Thetford Mines and at Black Lake; Bell Asbestos Mines Limited, at Thetford Mines; Quebec Asbestos Corporation, at East Broughton; Canadian Johns-Manville Company Limited, at Asbestos; Nicolet Asbestos Mines Limited at St. Rémi de Tingwick; and Flintkote Mines Limited, 2½ miles east of Thetford Mines. A small production of crude asbestos was reported by St. Laurent Asbestos Company from St. Odilon.

Canadian Johns-Manville Company is the main producer and its Jeffrey mine is the largest single producer in the world.

Asbestos rock in mined by both open cut and underground methods. Block caving is coming into general use at many operations and within a few years all production from the older properties will be by this method. At its Jeffrey mine, Canadian Johns-Manville began regular production of asbestos rock from underground development in February 1950, and by the end of the year more than half the mine production originated from underground.

Asbestos Corporation announced its decision to develop the new orebody at its Vimy property as an underground operation. The changeover to the new mill at the British Canadian property at Black Lake was completed.

United Asbestos Corporation Limited continued exploration and development of its property underlying Black Lake. Surface rights were acquired and a shaft sunk to permit underground development.

Production in the Thetford area has been continuous since 1878 and reserves of asbestos-bearing rock are huge. Core drilling to depths of from 1,200 to 1,700 feet has revealed the presence of fibre comparable in quantity and quality with that in the present workings. Most of the output consists of vein fibre obtained from veins less than ½ inch in width, though in rare instances veins exceeding 5 inches in width are found. The fibres run crosswise of the vein and thus the width of the vein determines the length of the fibre. Slip fibre, occurring in fault veins, is obtained largely in the East Broughton area.

*Ontario*

Output of a substantial tonnage of fibre was reported in 1950 from the Canadian Johns-Manville Munro mine, near Matheson, following the construction of the mill which was completed in the record time of 190 days.

Exploratory and development work was done on groups of claims in the Matheson and South Porcupine areas of Cochrane district, and in Timiskaming and Thunder Bay districts. Several claims were staked west of Port Arthur in the latter district.

*British Columbia*

A promising occurrence of chrysotile was discovered in the northern part of the province at McDame Mountain south of the Yukon border. Access to the property is by 100 miles of road and trail from the Alaska Highway. Exploratory work proved encouraging. Further examination of the commercial possibilities of the area is planned for 1951.

## *World Production*

Other major sources of world output include Southern Rhodesia, which has made a substantial increase in the quantity of fibre produced during the past few years, Union of South Africa, United States, Russia, Swaziland, and Cyprus.

### *Uses and Prices*

Asbestos has a great variety of uses, the principal being in the manufacture of cloth, brake linings, clutch facings, packings, insulation, mill board, siding, shingles, roofing, tile, pipe, and paper.

Short fibre is being used in protective coatings, in plastics, in lubricating greases, and several other applications.

According to Engineering and Mining Journal Metal and Mineral Markets, Canadian asbestos f.o.b. mines, remained at the following quotations:

| | |
|---|---|
| No. 1 Canadian | $960 - $1,050 |
| No. 2 Canadian | 492 - 550 |
| Spinning fibre | 232 - 475 |
| Single stock | 95.50 - 141 |
| Paper stock | 78.50 - 88 |
| Waste | 58 |
| Shorts | 27 - 52 |

## BARITE

Canada is a leading producer of barite. Output of the mineral in both crude and ground form in Canada in 1950 increased nearly 64 per cent over 1949 to 77,177 short tons, of which crude shipments accounted for over 62 per cent. Canadian Industrial Minerals Limited, with mine and mill at Walton, Hants county, Nova Scotia, again accounted for most of the output, the remainder being supplied by Mountain Minerals Limited, Lethbridge, Alberta, from a deposit at Parson, British Columbia.

### *Production, Trade, and Consumption*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Short tons | $ | Short tons | $ |
| *Production* (mine shipments) | | | | |
| Crude | 48,280 | 366,256 | 10,238 | 74,366 |
| Ground | 28,897 | 384,122 | 36,900 | 483,296 |
| Total | 77,177 | 750,378 | 47,138 | 557,662 |
| *Imports* (ground) | | | | |
| From: United States | 1,593 | 55,946 | 939 | 32,269 |
| Germany | 436 | 10,842 | ... | ... |
| United Kingdom | 49 | 3,077 | ... | ... |
| Italy | 11 | 230 | ... | ... |
| Total | 2,089 | 70,095 | 939 | 32,269 |
| *Exports* | | | | |
| Crude | 33,451 | ... | 39,726 | ... |
| Ground | 37,090 | ... | 9,730 | ... |
| Total | 70,541 | ... | 49,456 | ... |
| *Consumption* | | | | |
| Paints | ... | ... | 1,202 | ... |
| Rubber goods | ... | ... | 559 | ... |
| Glass | ... | ... | 184 | ... |
| Miscellaneous | ... | ... | 1,200 | ... |
| Total | ... | ... | 3,145 | ... |

*Nova Scotia*

Canadian Industrial Minerals Limited continued to produce crude barytes for the chemical trade and ground barytes for use as industrial filler and drilling mud.

Maritime Barytes Limited, with two properties near Brookfield, Hants county, began construction of a mill to produce various grades of barite products from barite-siderite ore.

*British Columbia*

Mountain Minerals Limited, with property at Parson, continued to produce white barytes for grinding in Eastern plants.

*World Sources*

United States is by far the largest producer of barytes and contributes over half the total output. Other producers besides Canada include the United Kingdom, Italy, India, Greece, Brazil, Argentina, and Spain.

## *Uses and Specifications*

Ground barite is used principally as a pigment and filler in paints; as a filler in rubber goods; in moulded flint glass; in chemicals; and in drilling mud.

For drilling mud, barite is combined with bentonite and other materials to form a heavy suspension used in drilling oil and gas wells to overcome gas pressures and to remove cuttings from the drilling face. For these purposes barite with a minimum barium sulphate ($BaSO_4$) content of 95 per cent, minimum specific gravity of 4·2, and an absence of soluble salts, is required. Size required is about 98 per cent minus 325 mesh.

As a filler for the rubber and paint trades, barite should contain not less than 95 per cent $BaSO_4$, grind to a pure white colour, and be free from carbonaceous impurities.

For the chemical trade, barite should have a minimum of 95 per cent $BaSO_4$, maximum of about 3 per cent silica, and 1 per cent $Fe_2O_3$. Colour is not important.

For the glass trade, barite should be relatively pure, particularly as regards $Fe_2O_3$, which should not exceed 0·04 per cent.

Barite is used as a filler in a number of commodities including paper, linoleum, textiles, asbestos products, and artificial ivory. It is used also in materials to provide protection against X-rays; in glass to improve brilliancy and cutting properties; and as a heavy medium in sink and float processes, particularly in coal washing.

Barium chemicals are used widely in industry. Barium carbonate is used to reduce "dry house" scum on bricks; in pharmaceuticals; as a flux in the enamelling and ceramic trades, and in heat treatment compounds. The chloride is used as a pigment in lithographic inks; for the purification of salt brine and water treatment; as a mordant in dyeing textiles, and in many other applications. Other compounds include the hydrate, phosphate, oxide, sulphide, stearate, and chlorate.

## *Prices and Tariffs*

Final 1950 quotations on barite as published in Engineering and Mining Journal Metal and Mineral Markets were as follows: Georgia, crude, $13 to $13.50 per long ton; Missouri, crude ore, minimum 94 per cent $BaSO_4$ less than 1 per cent iron, $9.50; and 93 per cent $BaSO_4$, $9.25 per cent ton f.o.b. mines. The value of crude white barytes in Canada was about $12 per ton f.o.b. rail and that of off-colour material about $7.50.

The Canadian tariff on barite in 1950 was as follows:

| | |
|---|---|
| British preferential | Free. |
| Most Favoured nations | 25 per cent ad valorem. |
| General | 25 per cent ad valorem. |

The United States tariff was as follows:

| | |
|---|---|
| Crude and unmanufactured | $3.50 a ton. |
| Ground or otherwise manufactured | 7.50 a ton. |

## BENTONITE

Canada's output of bentonite comes from Manitoba and Alberta. Output of processed domestic bentonite in Manitoba increased 48 per cent over 1949, but it decreased 80 per cent in Alberta due largely to the increased use of imported bentonite from Wyoming.

*Production and Imports*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Short tons | Value $ | Short tons | Value $ |
| *Crude Bentonite mined* | | | | |
| Manitoba | 11,965 | ........... | 15,000 | ........... |
| Alberta | 272 | ........... | 2,021 | ........... |
| Total | 12,237 | ........... | 17,021 | ........... |
| *Shipments of Processed Bentonite*[1] | 9,613 | 546,410 | 8,271 | 430,735 |
| *Imports of Activated Clay*[2] | | | | |
| From: United States | ........... | 334,444 | ........... | 265,793 |
| Germany | ........... | 1,527 | ........... | ........... |
| Total imports | ........... | 335,971 | ........... | 265,793 |

[1] Includes ground natural bentonite and activated material.
[2] Considerable unrecorded amounts of bentonite are imported from United States for foundry use and for use in oil well drilling.

All of the output of activated clay in Canada is produced by Pembina Mountain Clays, Limited, 915 Paris Building, Winnipeg, Manitoba. The clay is mined, coarse ground, and dried at Morden and shipped to Winnipeg for activation. Output of crude bentonite to the end of 1950 was estimated at over 65,000 tons.

Alberta's production has all been of the colloidal, swelling variety for use in oil well drilling and comes from the Red Deer Valley at Drumheller. Gordon L. Kidd and Aetna Coal Company, Drumheller, reported shipments in 1950.

*Occurrences*

The main occurrences of bentonite in Canada are in the Prairie Provinces and British Columbia.

*British Columbia*

Large deposits of non-swelling bentonite of high purity occur in gently dipping Tertiary sediments at Princeton and Quilchena, where the beds are up to 15 feet thick. Huge tonnages of bentonite are easily available in these deposits but no important market has been found as yet. The main occurrences are as follows:

1. Quilchena Creek, approximately 2 miles south of Quilchena Post Office. The mineral rights are held by Guichon Cattle Company Limited at Quilchena.

2. Outskirts of Princeton on Copper Mountain railway. The mineral rights are held by Princeton Properties Limited represented by Francis Glover, 1029 Marine Building, Vancouver.

3. Five miles south of Princeton on Copper Mountain railway. The mineral rights are held by H. Knighton, Princeton.

*Alberta*

Many swelling and non-swelling bentonite deposits occur in the southern half of the province. All of the main known deposits occur in sedimentary rocks of Upper Cretaceous age.

The main bentonite deposits are in the Red Deer Valley in the vicinity of Drumheller. An 8-inch bed of good quality swelling bentonite occurs in the No. 1 coal seam being mined in the various district mines. In the past, three of these mines shipped bentonite to Calgary for processing for use in oil well drilling. A bed of swelling bentonite averaging about 4 feet thick occurs just north of Drumheller. This deposit is strip-mined by Gordon Kidd, Drumheller, and is sent to Calgary for processing.

Large deposits of non-swelling bentonite of high purity are present on the McLeod River, southwest of Edson. In the past, one of these locations was opened by underground mining and two carloads of the bentonite are reported to have been shipped for use in the preparation of cosmetics.

Bentonite occurs in small amounts associated with the coal being mined in the Edmonton district. Beds of bentonite up to 1½ feet thick occur south of Camrose, and to 2 feet thick in the Belly River formation, southwest of Milk River and on the north side of the Milk River Ridge. There are numerous beds from a few inches up to 1½ feet thick in the Bearpaw formation on the St. Mary River south of Lethbridge. South of Medicine Hat, the Bearpaw formation flanking the Cypress Hills contains numerous beds of bentonite, some of which are up to 4 feet in width. Most are thin but have remarkable lateral persistence. No information is available as to the quality of these various deposits.

*Saskatchewan*

There has been no production in Saskatchewan other than a few trial shipments.

Both swelling and non-swelling bentonite are widely distributed in the Upper Cretaceous and Tertiary sediments in southern Saskatchewan, especially in the Cypress Hills and Wood Mountain areas. Bentonite occurs at Pelly where the beds are comparable to those being mined at the same stratigraphic horizon in southern Manitoba.

Laboratory work on the swelling bentonites of Saskatchewan has shown that they have sufficient swelling ability to make them suitable for use in oil well drilling. Some of the non-swelling bentonites have shown a high efficiency when activated for decolorizing oils. The deposits range in thickness from a few inches up to 11 feet.

*Manitoba*

Bentonite occurs near the base of the Pembina member of the Vermilion River formation, which is of Upper Cretaceous age. This bentonite horizon is very pronounced from the United States border northwestward to Miami, a distance of approximately 35 miles. Beyond this, sporadic occurrences have been reported in the Vermilion River formation all along its trend to the northwest across Manitoba, a distance of approximately 250 miles.

## *Uses*

Bentonite is used chiefly in refining mineral and vegetable oils; as a bonding ingredient in foundry sands; and to control the viscosity of oil-well drilling muds. To a minor extent it is used as a filler in paper, rubber, and other products; as a detergent in soaps and cleaners; as a coagulant for clarifying wines, honey, and turbid waters; as a stabilizer in various hydraulic cements and emulsions; as a carrier for insecticides, fungicides, and herbicides; and in toiletries, and medicinal preparations. It is used for grouting dams and irrigation ditches and to prevent seepage around foundations of buildings. Bentonite is used also in bonding and plasticizing ceramic bodies and ore briquettes for smelting. Treated bentonite is used as a dessicant to prevent atmospheric moisture from entering packaged goods and for coating small seeds to increase their bulk and facilitate sowing.

Most of the output in Manitoba undergoes activation and is used in bleaching and refining petroleum products. Alberta bentonite is used mainly as a drilling mud in oil-well drilling in the province. Smaller amounts from Alberta have been used by the gold and coal mining industries in exploratory drilling; in foundry work; and for grouting and lining the dams and irrigation canals on the prairies. The Alberta bentonite is shipped to Alberta Mud Company Limited, 609 Herald Building, and to Western Industries Limited, 200 Lancaster Building, both in Calgary, for drying and grinding.

Consumption figures for 1950 are not available. According to the Dominion Bureau of Statistics, the steel furnaces used 3,092 tons in 1949; iron foundries, 1,800 tons (partly estimated); petroleum refining, 8,421 tons; oil-well drilling, 15,000 tons; soaps, 871 tons; pulp and paper, 182 tons; miscellaneous, 200 tons.

## *Prices and Tariffs*

Activated bentonite for bleaching and refining oils sold for $80 a ton, and unactivated for $40 a ton, f.o.b. plant for less than carload lots. Alberta crude bentonite in 1950 sold for $5.50 a short ton at the mine, while the processed bentonite for oil-well drilling was unchanged at $35 a ton f.o.b. plant. Imported Wyoming bentonite for oil-well drilling sold for approximately $50 a ton f.o.b. Calgary.

Wyoming, South Dakota, and Mississippi bentonite increased slightly in price during the latter part of 1950. Wyoming and South Dakota standard 200-mesh bentonite sold for $12.50 a ton, f.o.b. plant, bagged, in carload lots. Oil-well grade bentonite sold for $14 a ton, f.o.b. plant, for carload lots. Special grades in dust form were quoted as high as $90 a ton. Ground Mississippi bentonite was quoted at $14 a ton, bagged, in carload lots, f.o.b. plant.

Bentonite not further manufactured than ground enters Canada duty free. Activated bentonite imported into Canada pays 10 per cent ad valorem. The duty on manufactured bentonite entering the United States is 75 cents a ton, and on manufactured, $1.62½ a ton. Artificially activated bentonite entering United States pays ¼ cent a pound and 30 per cent ad valorem.

## CEMENT

Production of Portland cement in Canada reached a peak of 16,741,826 barrels valued at $35,894,124 in 1950, an increase of 825,000 barrels over that of 1949, the previous peak year. In spite of a record output, plants working to capacity were unable to satisfy the continued high demand. To meet the deficiency, 1,386,219 barrels were imported, 60 per cent of which came from the United Kingdom. Although new construction contracts exceeded those of previous years, apparent consumption of Portland cement in Canada showed a slight decrease below that in 1949. The expansion planned by the industry was expected to increase total cement-making capacity to over 19,000,000 barrels annually within the next 2 years.

Satisfactory raw materials for making cement are distributed fairly widely across Canada and it has thus been possible to establish production facilities near the important marketing areas. Mills are operated in five of the ten provinces, namely: Quebec, Ontario, Manitoba, Alberta, and British Columbia.

Three companies are engaged in processing Portland cement directly from raw materials, and a fourth imports and grinds clinker for production of white cement. Aggregate daily capacity is approximately 47,000 barrels, with nineteen kilns in operation.

*Production and Trade*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Barrels 350 pounds | $ | Barrels 350 pounds | $ |
| *Production* | 16,741,826 | 35,894,124 | 15,916,564 | 32,901,936 |
| *Exports* | | | | |
| United States | 23,897 | 111,234 | 1,069 | 3,848 |
| Dominican Republic | 12 | 117 | ... | ... |
| Venezuela | ... | ... | 15,634 | 41,056 |
| Other countries | ... | ... | 2,509 | 6,829 |
| Total | 23,909 | 111,351 | 9,212 | 51,733 |
| *Imports* | | | | |
| United Kingdom | 834,805 | 1,874,161 | 450,779 | 1,098,001 |
| United States | 453,951 | 1,640,991 | 1,649,266 | 5,278,986 |
| Belgium | 68,784 | 167,989 | 167,275 | 433,102 |
| Colombia | 13,429 | 55,125 | ... | ... |
| Germany | 12,319 | 35,238 | 14,483 | 56,804 |
| Other countries | 2,931 | 15,477 | 2,198 | 11,046 |
| Total | 1,386,219 | 3,788,981 | 2,284,001 | 6,877,939 |

In addition to the above imports of finished cement, 44,745 barrels of clinker valued at $154,174 were imported for further processing in Canada.

Canada Cement Company Limited, the largest producer, operates manufacturing plants at Exshaw, Alberta; Fort Whyte, Manitoba; Port Colborne and Belleville, Ontario; and Hull, and Montreal East, Quebec. The company also ships bulk cement to distribution plants at Halifax, Nova Scotia; Chatham, New Brunswick; Quebec City in Quebec; and at Toronto and Windsor in Ontario.

During 1950, Canada Cement Company announced that a subsidiary, Maritime Cement Company Limited, had commenced construction of a new 1-kiln, dry process plant at Havelock, New Brunswick, with production scheduled for the autumn of 1951. Local limestone, shale, and gypsum will be used. The parent company is also expanding its Exshaw and Brockville plants through the addition of new kilns.

British Columbia Cement Company Limited manufactures cement at Bamberton, Vancouver Island, with quarries at Bamberton, and Blubber Bay, Texada Island.

The St. Mary's Cement Company Limited operates a plant at St. Mary's, Ontario. The construction of a new kiln, scheduled for production in 1952, and the addition of other equipment will increase the capacity of the plant appreciably.

Medusa Products Company of Canada Limited grinds imported clinker for the production of white cement at Paris, Ontario.

The Government of Newfoundland announced the erection of a new cement plant near Corner Brook, Newfoundland. Production is planned for 1951.

### *Uses and Prices*

The amount of Portland cement used in the cement products industry has increased substantially in recent years. Ready-mix concrete, concrete pipe, hollow building block, concrete brick, burial vaults, laundry tubs, artificial stone were processed in 423 plants in 1949 with an output of $32,693,645, compared with $3,716,692 in 1939.

Average prices of Portland cement in 1950 (1949 in brackets) f.o.b. cars at the following cities per barrel of 350 pounds were: Montreal, $2.29 ($2.19); Toronto, $2.82 ($2.68); Winnipeg, $2.56 ($2.48); Regina, $3.75 ($3.54); Vancouver, $3.18 ($3.15); Calgary, $2.64; and Halifax, $3.20.

## CLAYS AND CLAY PRODUCTS

Sales of all types of clay products in 1950 showed an increase over 1949. This trend has been, in general, upwards since the end of World War II. Although the art pottery industry still faced serious foreign competition, the demand for Canadian-made pottery improved somewhat in 1950. In step with increasing demands for clay products, expansion and modernization of plants have been fairly general, and new plants have been established. The defence program has caused a heightened demand for such products as refractories, so important in the metallurgical industry, and special electrical porcelains, and production of these lines of clay products is likely to increase.

Proven advantages of nepheline syenite as a flux in ceramic bodies has given added incentive to the establishment of vitreous tableware plants in Canada since it makes possible the production of this ware at lower temperatures, which is conducive to the use of electricity as the source of heat. Development programs have been carried forward to improve the quality of refractories made in Canada, and efforts are being made, particularly in the western provinces, to find new or better sources of various kinds of clay.

*Production and Trade*

| — | 1950 | 1949 |
|---|---|---|
| | $ | $ |
| *Production* | | |
| From: Canadian clays[1] | 21,790,888 | 17,981,709 |
| Imported clays[2] | 15,095,524 | 14,457,000 |
| *Imports* | | |
| *Clays* | | |
| From: United States | 2,003,714 | 1,730,126 |
| United Kingdom | 605,732 | 494,037 |
| Total | 2,609,446 | 2,224,163 |
| *Clay Products* | | |
| From: United States | 17,108,786 | 16,608,513 |
| United Kingdom | 12,972,660 | 13,076,975 |
| Other countries | 1,230,064 | 923,047 |
| Total | 31,311,510 | 30,608,535 |
| *Exports* | | |
| *Clays* | | |
| To: United States | 14,906 | 16,726 |
| Other countries | ............. | 783 |
| Total | 14,906 | 17,509 |
| *Clay Products* | | |
| To: United States | 511,944 | 363,955 |
| Brazil | 408,025 | 134,733 |
| New Zealand | 220,354 | 191,562 |
| India | 169,659 | 106,886 |
| Sweden | 135,905 | 275,934 |
| Australia | 136,744 | 9,747 |
| Other countries | 603,735 | 628,946 |
| Total | 2,186,366 | 1,711,763 |

[1] Products comprise building brick, structural tile, drain tile, roofing tile, sewer pipe, stoneware, pottery and refractories.
[2] Products comprise electrical porcelain, sanitary ware, sewer pipe, tableware, pottery, ceramic floor and wall tile thermal insulating materials, and various kinds of refractories.

## Common Clays

Common clays or shales suitable for the production of building brick and tile occur in all provinces of Canada, but materials suitable for making high quality brick and other clay products are not plentiful. This has presented difficulties in attempts to establish new plants in various parts of the country. However, good brick clays or shales occur near Toronto, Hamilton, Montreal, and in the eastern and western coastal areas, and in these localities production of good quality brick and structural tile is on a large scale. Good quality structural clay products are also produced in certain areas of the Prairie Provinces. The value of building brick, structural tile, drain tile, etc. produced in Canada in 1950 from domestic clays was $17,080,672, compared with $14,379,869 in 1949.

There has been a great demand for light-weight concrete aggregate. "Haydite" (shale bloated by heat treatment) is produced regularly in a large plant near Toronto, but the demand exceeds the amount of available material suitable for making lightweight structural units.

## Stoneware Clays

The largest production in Canada of stoneware clays is in southern Saskatchewan, particularly in the vicinity of Eastend. The clay is selectively mined and is shipped to Medicine Hat, Alberta, where, owing to the availability of cheap natural gas, it is used extensively to make a wide variety of stoneware articles, sewer pipe, pottery, etc.

The stoneware clays or semi-fireclays that occur associated with the fireclays in the Sumas Mountain, south of Vancouver, are utilized on a rather large scale for making sewer pipe, flue liners, and other stoneware products.

Stoneware clays and moderately refractory fireclays that occur near Shubenacadie and Musquodoboit, Nova Scotia, have been used for the production of pottery, certain stoneware products, and low-grade refractories, but have not been developed extensively for ceramic use. Stoneware clays or semi-fireclays occur also near Williams Lake and Chimney Creek Bridge in British Columbia, and near Swan River, Manitoba, but they are difficult of access and have not been exploited extensively.

In Ontario and Quebec, stoneware clays where needed must be imported.

The value of stoneware articles (sewer pipe, artware, etc.) produced in Canada from domestic clays was approximately $2,826,952 in 1950, compared with $2,121,201 in 1949. The value of such products made from imported clays in 1950 was $862,730 and in 1949, $976,586.

## Fireclays

Two large plants and a few small plants make fireclay refractories from domestic clay. Firebrick and other refractory materials are made on a large scale at a plant about 50 miles south of Vancouver, from the high-grade, moderately plastic fireclay that is extracted by undeground mining from the clay beds in the Sumas Mountain. Other smaller enterprises have been established in this area in recent years for the manufacture of refractories or allied products from material obtained from the Sumas Mountain deposits. Some of this material is exported to northwestern United States for use in making refractories. A plant at Claybank, Saskatchewan, utilizes the highly plastic refractory clays obtained by selective mining of the "Whitemud" beds in the southern part of the province. Small amounts of the most refractory clays in the deposits near Shubenacadie, Nova Scotia, have been used for refractory purposes by the steel plant at Sydney, and some of the Musquodoboit clay has been used for the production of stove linings.

Other production of fireclay refractories (firebrick, high-temperature cements, plastic refractories, etc.) in Canada, particularly in eastern Canada, is from imported clays.

The rather extensive deposits of plastic fireclays that occur in the Mattagami, Missinaibi, and Abitibi Rivers in northern Ontario have received little active development attention owing to their remoteness and to certain difficulties attending efforts to extract uniform high-quality material.

Suitable deposits of such alumina or alumina-silica minerals as bauxite, sillimanite, kyanite, and andalusite, valuable raw materials for the production of super-duty refractories, have not been found in commercial quantities in Canada.

Fireclays imported by rail or water transportation from United States enter Canada duty free if not further processed than ground.

The value of refractories produced in Canada from domestic clays in 1950 was approximately $527,638, compared with $444,667 in 1949. The value of refractories made from imported clays in 1950 was $1,803,920. In 1949 it was $1,510,734.

## China Clay and Ball Clay

China clay (kaolin) has been produced commercially in Canada only in the vicinity of St. Remi d'Amherst, Papineau county, Quebec, where a large plant was established some years ago to refine the kaolinized material found there into high-grade china clay, and to recover washed silica sand as a by-product. However, this project was abandoned in 1948 because of mining and operational difficulties.

None of the several other smaller deposits of kaolin in Quebec has been developed. One of these is near Point Comfort, Thirty-one Mile Lake, Hull county, the others being near Brebeuf, Lake Labelle, and Chateau Richer.

The clay deposits in northern Ontario (see "Fireclays" above) contain material that may be classified as crude china clay, and in British Columbia, parts of the extensive clay deposits that occur along the Fraser River, about 25 miles above Prince George, yield high-grade kaolin. However, their distance from industrial centres has prevented their development.

The Saskatchewan Government has undertaken an extensive program of exploration and development of the ball clay resources of the southern part of the province largely with the hope that markets for western ball clays may be expanded in eastern Canada and United States.

China clay imported from England or United States is used to make electrical and other porcelains, sanitary ware, tableware, ceramic floor, and wall tile, etc. The value of such clay products made in Canada in 1950 was $12,428,874. In 1949 it was $11,950,187. Large quantities of china clay are also imported for use in the paper and rubber industries. Imports of china clay in 1950 were valued at $1,494,349, of which imports valued at $908,663 came from United States, and at $585,686 from the United Kingdom.

## DIATOMITE

Production of diatomite in Canada is small, domestic requirements being met by imports, all from United States. Output, which comes from Nova Scotia and British Columbia, totalled 49 short tons in 1950, compared with 60 tons in 1949.

The more than 400 known occurrences of diatomite in Canada are mainly of the bog type and the calcined diatomite product from the processing of the material is not suitable for the major uses. The remainder of the occurrences consist of material of Tertiary age. The largest known of these in Canada is in the Cariboo area of British Columbia, where transportation difficulties have hindered their development.

*Production, Trade, and Consumption*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Short tons | $ | Short tons | $ |
| *Production* (Sales) | 49 | 1,665 | 60 | 1,703 |
| *Imports* | | | | |
| From: United States | 18,246 | 599,127 | 16,913 | 551,825 |
| *Consumption** | | | | |
| Fertilizer dusting | 7,873 | ........... | 6,944 | ........... |
| Filtration | 7,539 | ........... | 6,722 | ........... |
| Fillers | 2,227 | ........... | 2,292 | ........... |
| Insulation | 305 | ........... | 189 | ........... |
| Concrete admixture | 60 | ........... | 80 | ........... |
| Chemicals and miscellaneous | 7 | ........... | 10 | ........... |
| Total | 18,011 | ........... | 16,237 | ........... |

*Based on information supplied to the Mines Branch.

### *Canadian Deposits*

Diatomite consists of microscopically small, siliceous, skeleton remains of diatoms, a form of algae, that at one time lived in water.

The bog type material is of Recent (geologically) freshwater origin and occurs as a grey to brown to black mud, or ooze, in the swamps and lake bottoms of northern Nova Scotia, in southern New Brunswick, in the Muskoka area of Ontario, and in the bogs of northwestern Quebec. The largest known freshwater (swamp) deposit in Canada occurs at Digby Neck, Nova Scotia, from which some calcined diatomite is shipped each year to a Toronto firm that manufactures a lime diatomite brick for insulation purposes.

The material of Tertiary age occurs in dry, compact beds and is very light in weight with relatively low moisture content. It is from white to cream in colour. The Tertiary freshwater deposits near Quesnel in the Cariboo area of British Columbia extend for many miles along the Fraser River, are compact, and in places are up to 40 feet thick. Small amounts of this diatomite have been marketed for insulation purposes, and tests have shown that the material is suitable for nitraprill coating if the moisture content is brought under 5 per cent.

### *World Production*

United States is by far the largest producer and consumer of diatomite, the average annual production for the 3-year period 1945-47 being over 200,000 short tons. Production comes from four states, California, Oregon, Nevada, and Washington, California being the leading producer. Most of the output comes from two companies, Johns-Manville Corporation (Celite products) from deposits at Lompoc, California, and Great Lakes Carbon Corporation, Dicalite Division, (Dicalite products) from deposits near Bradley in California, Terrebonne in Oregon, and Basalt in Nevada. The Quincy Corporation operates deposits at Quincy, Washington.

Other producing countries include Denmark (Moler), Germany (kieselguhr), Algeria, Japan, France, and Union of South Africa.

### *Uses*

Diatomite is used as a fertilizer dusting agent in coating ammonium nitrate prills (nitraprills) by The Consolidated Mining and Smelting Company of Canada Limited in its plants at Warfield, British Columbia, and at Calgary, Alberta; and by North American Cyanamid Limited in its plant at Welland, Ontario. Diatomite is highly porous, and on coating the nitraprills it absorbs any moisture, thus preventing them from caking and sticking together, or from packing when the bags of fertilizer are stacked. Specifications for this use call for uncalcined diatomite of 95 per cent minus 325 mesh with less than 5 per cent moisture content.

Diatomite is used to aid in speeding up the rate of filtration and to clarify solutions in many industries across Canada. These include sugar refining, liquor distilling, dry cleaning, syrup making, in water filtration and purification, and in the mining industry in filter presses. Most of the remainder is used as fillers in the paint, paper, rubber, soap, textile, and chemical industries.

Some Canadian diatomite is used in making lime-diatomite insulation bricks by a Toronto firm that uses Nova Scotia calcined diatomite. Minor amounts are consumed in concrete admixtures, insecticide carriers, insulation materials, metal polishes etc.

The United States Bureau of Mines Minerals Yearbook (1949) reports that in that country filtration accounted for about three-fifths of the total consumption; fillers for about one-quarter; insulation, about one-tenth; and other uses, including abrasives, the remainder.

### *Prices*

Diatomite varies widely in price depending upon the use to which it is put and the quantity purchased. Prices in 1950 did not change materially from those in effect during 1949. Filtration grades, f.o.b. Toronto or Montreal, varied from $100 to $160 a ton in ton lots with filler grades somewhat lower at $75 to $110 a ton. Diatomite for other purposes varied from $30 to $60 a ton f.o.b. consuming plants. Diatomite purchased in small lots for insecticide carriers, metal polishes, etc., ranged in price up to $200 a ton. Imported diatomite insulation bricks varied from $50 to $250 a thousand according to grade, source, and insulating properties.

## FELDSPAR

Feldspar production in Canada in 1950 declined 1,400 tons below the 1949 output to 35,548 short tons. Approximately 84 per cent of the output came from Quebec and the remainder from Ontario.

Exports, mostly to United States, declined 12 per cent to 15,465 short tons.

*Production and Trade*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Short tons | $ | Short tons | $ |
| *Production* | | | | |
| Quebec | 29,788 | 378,782 | 31,848 | 384,892 |
| Ontario | 5,760 | 49,619 | 5,100 | 43,610 |
| Total | 35,548 | 428,401 | 36,948 | 428,502 |
| *Imports* | | | | |
| All from United States | 144 | 3,702 | 228 | 4,555 |
| *Exports* | | | | |
| To: United States | 14,956 | 97,616 | 17,527 | 108,323 |
| Other countries | 509 | 15,141 | 43 | 3,592 |
| Total | 15,465 | 112,757 | 17,570 | 111,915 |

### *Quebec*

Canadian Flint and Spar Company Limited, Ottawa, Ontario, with mines in Derry, West Portland, Buckingham, and Templeton townships in Papineau County, was the principal producer. The company's grinding mill at Buckingham continued production of ground feldspar for the domestic trade. Bon Ami Limited, Montreal, continued to grind feldspar for its own use. The remainder of the production came from a number of mines in the Buckingham district.

### *Ontario*

Canadian Flint and Spar Company Limited operating in the Verona and Perth areas, and Bathurst Feldspar Mines Limited operating in Bathurst township were the principal producers. Bowser Bros., and Messrs. W. Cameron and L. Aleck, operating in Murchison township in Renfrew county and Wesley Jessop operating in Monteagle township, contributed to the output.

*Consumption and Uses*

Consumption of feldspar in Canada in 1949 (1950 figures not available) declined 10 per cent below 1948 to 15,158 tons. Use distribution is shown in the following table.

| — | 1949 Short tons |
|---|---|
| Clay products | 7,111 |
| Cleansers | 3,164 |
| Glass | 2,902 |
| Enamelling | 1,966 |
| Abrasives | 15 |
| Total | 15,158 |

For its main uses feldspar must be low in iron and in other colouring oxides. For whiteware, porcelain, glass, etc., the iron ($Fe_2O_3$) content should not exceed 0·06 per cent. Users of dental spar may tolerate up to 0·10 per cent.

The highest quality of feldspar is potash microcline of high purity. Feldspar comprising mixtures of potash and soda spar (albite) are subject to lower grading. For ceramic use, colour is not important. For cleansers, however, for which both potash and soda spar are accepted, the material should be of good white colour.

*Markets, Prices, Tariff*

Canadian Flint and Spar Company Limited is the principal purchaser of crude feldspar of all grades in Canada. Bon Ami Limited purchases white spar for cleanser use. Buyers of Canadian ceramic grade spar in United States include Consolidated Feldspar Corporation, Rochester, New York; Genesee Feldspar Company Incorporated, Rochester, New York; and Shenango Pottery Company, New Castle, Pennsylvania. Buyers of dental grade spar include Myerson Tooth Corporation, Cambridge, Massachusetts; Dentists' Supply Company, 220 W. 42nd St., New York City; and Universal Dental Company, Brown at 48th St., Philadelphia, Pennsylvania.

Prices for No. 1 crude feldspar in 1950 ranged up to $8.50 a short ton f.o.b., rail, and for special high quality ceramic crude up to $13. The average declared unit value of crude shipped to United States was $7.27 a short ton compared with $6.37 in 1949. Final 1950 quotations for ground pottery grade, in bags for car lots were $22, and less than car lots, $24 a short ton, f.o.b. Toronto or Montreal.

The duty on crude feldspar entering United States was 25 cents a long ton and on ground feldspar 15 per cent ad valorem.

## FLUORSPAR

Production of fluorspar in Canada in 1950 amounted to 64,213 tons valued at $1,553,004 compared with the record of 64,477 tons valued at $1,592,908 in 1949. Approximately 90 per cent of the output came from Newfoundland and the remainder from Ontario. Exports were 7 per cent and imports 37 per cent lower than in 1949.

Prior to the entry of Newfoundland into Confederation, Canada depended chiefly upon imports to meet its requirements, as is shown by the fact that 82 per cent of the average consumption of 21,800 tons during the 30-year period ended 1948 was imported.

Over 500,000 tons of fluorspar having a value of nearly $10,000,000 has been shipped from the St. Lawrence area of Newfoundland since operations began in 1932. However, the fluorspar reserves of the area remain virtually untapped, and Newfoundland is capable of considerably increasing its annual production of all grades of the mineral should the need arise.

*Production, Trade, and Consumption*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Short tons | $ | Short tons | $ |
| *Production* (shipments) | | | | |
| Newfoundland | 55,595 | 1,290,361 | 58,077 | 1,405,033 |
| Ontario | 8,618 | 262,643 | 6,400 | 187,875 |
| Total | 64,213 | 1,553,004 | 64,477 | 1,592,908 |
| *Imports* | | | | |
| From: United States | 844 | 38,609 | 1,522 | 59,146 |
| Mexico | 579 | 10,528 | 988 | 22,504 |
| Other countries | 149 | 17,686 | ........... | ........... |
| Total | 1,572 | 66,823 | 2,510 | 81,650 |
| *Exports* | | | | |
| To: United States | 14,238 | ........... | 15,344 | ........... |
| Total | 14,238 | ........... | 15,344 | ......... |
| *Consumption* | | | | |
| Non-ferrous smelters | ........... | ........... | 30,335 | ........... |
| Steel furnaces | ........... | ........... | 21,136 | ........... |
| Heavy chemicals | ........... | ........... | 2,612 | ........... |
| Glass | ........... | ........... | 432 | ........... |
| Enamelling and glazing | ........... | ........... | 297 | ........... |
| Miscellaneous | ........... | ........... | 14 | ........... |
| Total | ........... | ........... | 54,826 | |

*Ontario*

The output in 1950 came from the Madoc area in Hastings county, which supplied about 66 per cent of the Canadian fluorspar production from 1905 to the end of 1948. Production in 1950 came from the Rogers mine operated by Reliance Fluorspar Mining Syndicate Limited, and the Bailey mine operated by Millwood Fluorspar Mines Limited.

During 1950 Cardiff Fluorite Mines Limited completed the sinking of a 315-foot incline shaft on its property about 3 miles from Wilberforce, Haliburton county. In addition, the shaft was connected with the existing valley floor adit and over 350 feet of lateral work was done on the first level, 125 feet below the adit level. Development work has shown the orebodies to contain uraninite, a crystal variety of pitchblende, in addition to the purple calcium fluoride.

*Newfoundland*

All the commercial fluorspar veins occur in the vicinity of St. Lawrence, a town on the southeast coast of Newfoundland, most of the veins being within 6 miles of St. Lawrence Harbour. St. Lawrence Corporation Limited and Newfoundland Fluorspar Limited are the two producers.

Production of St. Lawrence Corporation came from its Iron Springs mine, one of the 'higher grade' veins located 2½ miles southwest of St. Lawrence. By means of a combination gravity and flotation mill the company turns out one of the highest grade concentrates in the world. The flotation concentrates average over 98 per cent calcium fluoride ($CaF_2$) with less than 1 per cent silica and less than 0·01 per cent sulphur. Production in 1950 totalled 19,956 tons of concentrates, consisting of 4,600 tons metallurgical grade; 946 tons assaying 94 per cent or better; and 14,410 tons of acid grade; compared with 21,375 tons in 1949, consisting of 7,125 tons metallurgical, and 14,250 tons acid. Shipments amounted to 17,780 tons compared with 24,304 tons in 1949, and consisted of 4,260 tons metallurgical to Canadian steel plants; 1,420 tons assaying 94 per cent or better to the mainland; and 12,100 tons acid grade to United States. The acid grade flotation concentrates were shipped to a subsidiary, St. Lawrence Fluorspar, Inc., at Wilmington, Delaware, where they were dried before reshipping to the chemical and ceramic industries.

Production of Newfoundland Fluorspar Limited, a subsidiary of Aluminum Company of Canada Limited, is derived from the Director mine, 1½ miles west of St. Lawrence. The vein averages 15 to 25 feet in width and has an average calcium fluoride content of 75 per cent. Production in 1950 amounted to 36,032 tons of hand-picked, crushed ore, having an average calcium fluoride content of 75 per cent. Shipments totalled 37,815 tons: of which 29,808 tons went to Arvida, Quebec; 7,193 tons of metallurgical grade to other parts of Canada; and 814 tons of metallurgical grade to United States. At Arvida the ore is improved by flotation, and with the exception of a few shipments to other consumers, is used in the manufacture of aluminium by the electrolytic process. During the latter part of 1950 the company erected a heavy-media separation plant at the Director mine. This plant, which has a capacity of 30 tons per hour and employs ferrosilicon as a medium, commenced operations in January 1951. The feed to the mill will be the regular run of mine grade, and the product will average 80 to 85 per cent $CaF_2$.

No serious estimate of Newfoundland's ore reserves can be made, but they are probably in excess of 20,000,000 tons. Over 24 veins have been located to date, none of which has been completely traced longitudinally or vertically. However, fluorite mineralization is known to extend for as much as 3 miles longitudinally, and at depths of over 500 feet no significant changes are noted in grade and width.

The fluorspar veins in Newfoundland are steeply dipping, ranging from vertical to 65° with a few minor exceptions, and vary in width from a few inches to more than 50 feet. The 'higher grade' veins average between 4 and 5 feet in width, have a $CaF_2$ content of at least 95 per cent, and silica content of 1 to 4 per cent, whereas the 'lower grade' veins average between 15 and 20 feet in width, have a $CaF_2$ content of about 75 per cent, and a silica content of 10 to 15 per cent.

### *Other Canadian Occurrences*

Fluorspar deposits occur also in Ross township, Renfrew country, Ontario; in Huddersfield township, Pontiac country, Quebec; in the Lake Ainslie district, Cape Breton Island, Nova Scotia; and at the Rock Candy mine of The Consolidated Mining and Smelting Company of Canada Limited, near Grand Forks, British Columbia.

### *Uses and Specifications*

Fluorspar is used chiefly in Canada in making aluminium fluoride for use in the aluminium industry. The aluminium fluoride is added directly to the pots as a make-up to the electrolyte. The other uses of fluorspar in order of importance are: as a powerful fluxing agent in the steel industry, where about 6 pounds of spar is required per ton of steel made in the open-hearth, and 20 pounds per ton for that made in the electric furnace; in the manufacture of heavy chemicals; and in the ceramic industry as a fluxing and opacifying ingredient in glass and enamels. Fluorspar is used in small amounts in numerous other metallurgical industries, including foundries and various metal-refining operations.

In the United States the steel industry is the largest consumer of fluorspar. The next largest use is in the manufacture of hydrofluoric acid. The anhydrous acid is used mainly in the production of the organic 'Freons' used as refrigerants and as propellants for aerosol fumigators, and in the production of 100-octane gasoline. Small amounts are used to prepare elemental fluorine, and numerous fluorine compounds.

The synthetic organic chemical industry in particular, with its diversity of compounds and extensive applications, offers unlimited opportunities for the development of organic fluorine compounds. A thermally stable fluorine compound, uranium hexafluoride, requiring elemental fluorine in its synthesis, is used for the gaseous diffusion separation of uranium isotopes $U_{235}$ and $U_{238}$.

Standard fluxing gravel or lump grade for metallurgical use is usually sold on a specification of a minimum of 85 per cent $CaF_2$, and not over 5 per cent silica or 0·3 per cent sulphur. Fines should not exceed 15 per cent.

Glass and enamel grades call for not less than 95 per cent $CaF_2$, with a maximum of $2\frac{1}{2}$ to 3 per cent $SiO_2$ and 0·12 per cent $Fe_2O_3$. The material must be in mesh sizes ranging from coarse to extra fine.

Acid-grade spar has the most rigid specifications, namely a minimum of 98 per cent $CaF_2$ and not over 1 per cent silica. Like the ceramic grade, it is used mainly in powder form.

### *Prices*

Prices received for fluorspar vary widely, and the following quotations can serve only as a general guide to prices obtained by producers and dealers in Canada for their own product. The value of the various grades of fluorspar can be ascertained only by direct negotiations between buyers and sellers.

Canadian Chemistry and Process Industries quotations for metallurgical gravel, 85 per cent grade fluorspar, in 1950 opened at $40 a ton, carlots, f.o.b. Toronto, then increased to $60 in May, where it remained for the rest of the year. Quotations on ceramic ground, 95 per cent grade, in bags, increased from $4.05 to $4.20 per 100 pounds to $4.10 to $4.25 by the end of the year.

In United States, Engineering and Mining Journal quotations indicate that prices for metallurgical grade increased by about $4 a ton during 1950. Based on effective units of $CaF_2$, and f.o.b. Kentucky-Illinois mines, prices at the end of 1950 were as follows: 70 per cent and over, $41 a ton; under 60 per cent, $38; and pellets under 60 per cent, $34. "Effective units" are computed as the actual $CaF_2$ content less $2\frac{1}{2}$ times the percentage of contained silica. Acid grade fluorspar, 97 per cent $CaF_2$, bulk, increased from $43.50 to $46.50 in the latter part of the year. Foreign fluorspar, metallurgical grade, duty paid, was quoted at $38 to $40 a net ton, Atlantic seaboard.

### *Tariffs*

The duty on fluorspar entering United States in 1950 was $3.75 a short ton if it contained more than 97 per cent $CaF_2$, and $5·625 a short ton if it contained 97 per cent or less. Fluorspar enters Canada duty free.

## GRANITE

Production of granite in 1950 continued near the record level of 1949. The value of granite lies in its use as polished building stone and monumental stone. The granite used as concrete aggregate, road metal, roofing granules, breakwater, etc., accounts for over 98 per cent of the tonnage but little more than 55 per cent of the value of the stone.

The term 'granite' as applied to commercial stone includes practically all igneous rocks as well as metamorphic rocks of igneous origin, that may be quarried for use as building, monumental, or crushed stone. A large part of Canada is underlain by such rocks, but to be economically productive, granite must have certain qualities such as strength, uniformity, colour, etc., and the deposits must be near transportation facilities and markets.

Quebec is the granite province of Canada because of the proximity of the granite areas to population centres and transportation facilities. Small quantities of granite are produced in all provinces with the exception of Alberta and Saskatchewan. Ontario also produces a considerable tonnage of crushed granite.

*Production and Trade*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Short tons | $ | Short tons | $ |
| *Production* of monumental and building granite | | | | |
| Dressed | 18,823 | 1,906,608 | 21,801 | 1,764,721 |
| Rough | 18,447 | 281,804 | 20,388 | 326,231 |
| Total | 37,270 | 2,188,412 | 42,189 | 2,090,952 |
| *Production* of rubble and riprap, roofing granules, concrete aggregate, road metal, etc. | 2,033,782 | 2,782,732 | 2,280,028 | 3,063,786 |
| Total | 2,071,052 | 4,971,144 | 2,322,217 | 5,154,738 |
| *Exports* of granite and marble (unwrought): | | | | |
| To: United States | 5,579 | 76,184 | 5,123 | 99,242 |
| Jamaica | ........... | ........... | 1 | 192 |
| Total | 5,579 | 76,184 | 5,124 | 99,434 |
| *Imports* of granite: | | | | |
| *Rough* | | | | |
| From: United States | ........... | 73,915 | ........... | 53,325 |
| Sweden | ........... | 53,718 | ........... | 70,785 |
| Finland | ........... | 18,456 | ........... | 32,783 |
| Total | ........... | 146,089 | ........... | 156,893 |
| *Sawn* | | | | |
| From: United States | ........... | 29,263 | ........... | 41,136 |
| Sweden | ........... | 5,150 | ........... | 2,968 |
| Finland | ........... | 5,051 | ........... | ........... |
| Total | ........... | 39,464 | ........... | 44,104 |
| *Granite manufactures* | | | | |
| From: Sweden | ........... | 94,772 | ........... | 13,354 |
| Finland | ........... | 14,108 | ........... | ........... |
| United States | ........... | 12,705 | ........... | 15,680 |
| Other countries | ........... | 1,534 | ........... | 1,649 |
| Total | ........... | 123,119 | ........... | 30,683 |

In Quebec, grey granite is the principal rock quarried and comes from many districts, including Riviere-á-Pierre, St. Samuel, St. Sébastien, Stanhope, Scotstown, and Stanstead. Black granite is produced at St. Joseph d'Alma in the Lake St. John district and in the Noranda area; dark bluish grey granite in the Mount Johnson area about 40 miles east of Montreal; and red granites in the Grenville, Guenette, and Lake St. John districts.

In Nova Scotia, grey granite is produced in the Nictaux and Shelburne areas, and black granite in the Shelburne area.

New Brunswick has deposits of red, black, and grey granite of good quality. Red granite is produced in the St. George and Bathurst districts; black granite in the Bocabec district; and grey and bluish grey granite in the Hampstead area.

In Ontario, some development work has been done on the black granite at River Valley and there are occurrences of black and red granite in northwestern Ontario.

Manitoba produces small amounts of red, grey, and black granite from quarries near the Manitoba-Ontario boundary for the Winnipeg market.

British Columbia has widespread occurrences of granite in varied colour, one of the best known building stones being the andesite from Haddington Island. The grey granite from Nelson Island is also used extensively in building.

### *Uses*

Granite is usually quarried in Canada for use as building or monumental stone and in both cases there is a large amount of waste in the quarries. Some of the large irregular blocks are used as riprap to strengthen breakwaters and causeways against heavy washes or currents, whereas some of the smaller pieces are crushed for concrete aggregrate or are used as poultry grit, paving blocks, or curbstones. However, these uses for granite waste are extremely limited compared with the amount of granite produced. Granite as a building stone is used chiefly for ornamental purposes forming the outside facing of the lower part of many buildings.

Some of the granite produced in Canada has good export possibilities, especially the red and black varieties that are much in demand as a monumental stone in United States.

## GRAPHITE

Production of natural graphite in Canada was again confined to the Black Donald mine near Calabogie, Ontario, operated by Black Donald Graphite Company, Limited, subsidiary of Frobisher Limited. Shipments of finished products in 1950 (1949 figures in brackets), of which 87 per cent was exported to United States, consisted of 2,893 (1,623) short tons of amorphous foundry grades; 389 (188 short tons of dust, and 304 (336) short tons of high-grade lubrication and pencil flake.

Total unmanufactured imports, of which 50 per cent by value consisted of amorphous graphite from Mexico, and 36 per cent of miscellaneous grades from United States, amounted to $71,440, a decrease of 14 per cent below 1949. Ground and manufactured imports increased 13 per cent in value and crucible imports, all from United Kingdom and United States, increased 27 per cent.

Canadian production of natural graphite virtually ceased in November when Black Donald mine was unexpectedly flooded by the entry of lake water. The plant continued to operate, however, on supplies from other local sources. Artificial graphite is produced by Electro-Metallurgical Company of Canada Limited, Welland, Ontario.

Production in Canada, mostly of small flake and amorphous, has come in the past from widely scattered deposits in the crystalline limestones and gneisses of the general Ottawa region in adjacent sections of eastern Ontario and western Quebec. Other deposits are known to occur in New Brunswick, British Columbia, Manitoba, Labrador, and the Northwest Territories.

*Production and Trade*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Short tons | $ | Short tons | $ |
| *Shipments by types* | | | | |
| Amorphous foundry grades | 2,893 | 280,734 | 1,623 | 130,913 |
| Dust grades | 389 | 53,959 | 188 | 23,186 |
| High-grade lubricating and pencil flake | 304 | 56,122 | 336 | 58,397 |
| Total | 3,586 | 390,815 | 2,147 | 212,496 |
| | Per cent | | Per cent | |
| *Shipments by destination* | | | | |
| United States | 86·8 | ........... | 82·3 | ........... |
| Europe | ........... | ........... | 1·1 | ........... |
| Domestic market | 13·2 | ........... | 16·6 | ........... |
| | Short tons | $ | Short tons | $ |
| *Exports, crude and refined* | | | | |
| To: United States | 3,032 | 311,508 | 1,630 | 162,655 |
| Other countries | 12 | 1,949 | 21 | 3,569 |
| Total | 3,044 | 313,457 | 1,651 | 166,224 |
| *Imports, unmanufactured* | | | | |
| From: Mexico | ........... | 35,502 | ........... | 55,099 |
| United States[1] | ........... | 26,053 | ........... | 19,931 |
| Ceylon | ........... | 9,885 | ........... | 8,271 |
| Total | ........... | 71,440 | ........... | 83,301 |
| *Imports, ground and manufactured*[2] | | | | |
| From: United States | ........... | 319,157 | ........... | 286,536 |
| Mexico | ........... | 6,868 | ........... | 5,906 |
| United Kingdom | ........... | 4,417 | ........... | 825 |
| Total | ........... | 330,442 | ........... | 293,267 |
| *Imports of crucibles* | | | | |
| From: United Kingdom | ........... | 86,488 | ........... | 67,859 |
| United States | ........... | 77,654 | ........... | 60,200 |
| France | ........... | ........... | ........... | 637 |
| Total | ........... | 164,142 | ........... | 128,696 |

[1] Mainly re-exported graphite.
[2] Excluding crucibles.

Principal world sources are Madagascar (large flake), Ceylon (plumbago), and Mexico (amorphous).

*Uses*

The iron and steel industry accounts for a high percentage of the consumption of graphite in the form of crucibles, foundry facings, and other refractories. Other consumers include manufacturers of heavy chemicals, electrical apparatus, paints, polishes, lubricants, lead pencils, and various compounds used as cement, and protective coating. Colloidal graphite is used for the impregnation of wearing metal surfaces to reduce friction.

Carbon-graphite is used as a structural material for bearings and related parts particularly in equipment liable to exposure to a wide temperature range.

Carbon content and type (flake, crystalline, or amorphous) are the principal factors governing application but standards vary according to consumers' preferences. No universal code of specifications is available.

Artificial graphite is employed as an alternative to natural amorphous in many applications. Its principal uses are for the manufacture of heavy electrodes, dry batteries, lubricants, commutator brushes, and colloidal graphite.

Canadian consumption of graphite by industries in 1949 (1950 not available) was:

| | *Short tons* |
|---|---|
| Iron and steel | 1,332 |
| Paints | 72 |
| Electric apparatus | 125 |
| Heavy chemicals | 186 |
| Foundry facings | 222 |
| Polishes | 27 |
| Brass and bronze | 32 |
| Total | 1,996 |

### *Prices and Tariffs*

Final 1950 Canadian quotations published in Canadian Chemistry and Process Industries were: graphite, various grades, 6 to 60 cents a pound; plumbago (s.t. extra), 5½ to 10½ cents a pound.

The average declared unit value of Canadian exports of natural graphite in 1950 was 5·1 cents a pound.

Final United States quotations as published in the Engineering and Mining Journal Metal and Mineral Markets were: Madagascar, c.i.f. New York, "Standard grades 85 to 87 per cent C", $215 a ton; special mesh, $270-$300; special grades, 99 per cent C, $700. Sales on the better grades of graphite are usually made against the exacting requirements of consumers; published quotations are largely nominal. Amorphous graphite, Mexican, f.o.b. point of shipment, per metric ton, $9 to $16, depending upon grade.

The Canadian tariff is as follows:

| — | British | Intermediate | General |
|---|---|---|---|
| | Per cent | Per cent | Per cent |
| Crucibles | Free | 15 | 15 |
| Graphite, not ground or otherwise manufactured | Free | 7½ | 10 |
| Graphite, ground and manufactures of, n.o.p.,* and foundry facings of all kinds | 15 | 22½ | 25 |

* Not otherwise provided for.

## GYPSUM AND ANHYDRITE

Gypsum production in Canada reached a peak in 1950 of 3,666,336 short tons, an increase of 14 per cent over the previous peak of 3,216,809 short tons in 1948 and of 22 per cent over production in 1949. Approximately 87 per cent of the output of crude gypsum came from Nova Scotia and the remainder from Ontario, Manitoba, New Brunswick, and British Columbia.

Plant capacities were expanded and equipment improved in several Canadian plants. The Government of Newfoundland announced that it was building two new gypsum plants at Humbermouth in that province, which would utilize gypsum from local deposits.

Over 80 per cent of the output of crude gypsum continued to be exported mainly to United States. In Canada there was a noted increase in the demand for gypsum by the Portland cement industry, which has expanded steadily in the past few years.

Canada has good gypsum deposits in all provinces except Saskatchewan and Prince Edward Island but the Alberta and Quebec deposits are difficult of access and have not been developed.

Within the past few years the gypsum industry has shown a definite and growing interest in the possibilities for beneficiation of the somewhat low-grade ores that constitute the greater part of the raw material available from economically workable deposits in central and western Canada. The Mines Branch has carried out extensive tests on the beneficiation of gypsum with considerable success.

*Production and Trade*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Short tons | $ | Short tons | $ |
| *Production* | | | | |
| Nova Scotia | 3,185,199 | 3,802,786 | 2,555,795 | 2,766,005 |
| New Brunswick | 82,641 | 371,885 | 80,436 | 371,529 |
| Ontario | 199,314 | 875,217 | 203,187 | 871,467 |
| Manitoba | 114,555 | 1,037,510 | 94,918 | 797,723 |
| British Columbia | 84,627 | 620,108 | 79,913 | 616,966 |
| Total | 3,666,336 | 6,707,506 | 3,014,249 | 5,423 690 |
| *Exports* of crude and ground gypsum, plaster of Paris, and wall plaster (practically all crude). | | | | |
| To: United States | 2,963,793 | 3,053,239 | 2,544,708 | 2,640,071 |
| Puerto Rico | 6,260 | 11,261 | ........... | ........... |
| Other countries | 23 | 128 | 47 | 1,104 |
| Total | 2,970,076 | 3,064,628 | 2,544,755 | 2,641,175 |
| *Imports* of gypsum, plaster of Paris and wall plaster. | | | | |
| From: United States | 23,120 | 433,710 | 9,143 | 201,500 |
| United Kingdom | 167 | 4,872 | 154 | 5,119 |
| Total | 23,287 | 438,582 | 9,297 | 206,619 |

*Newfoundland*

The known deposits are limited to a small area along the west coast of the island. These have not been explored but surface samples indicate the presence of high quality gypsum comparable to the best found in Nova Scotia. Of the two plants that the Provincial Government is considering building at Humbermouth, one with a planned capacity of 200 tons daily will produce gypsum plaster, and the other is to produce gypsum wallboard and lath, and will have a daily capacity of 250,000 square feet. When the plants are built and equipped, the Government plans to either lease or sell them if possible.

*Nova Scotia*

Exploration was carried out on many of the deposits in various parts of the province during 1950 but production was limited to deposits in Victoria county in Cape Breton Island and in Hants county on the mainland. Most of the production is exported to United States but small quantities are processed in Nova Scotia and Quebec.

Canadian Gypsum Company, Limited, a subsidiary of United States Gypsum Company, and the largest Canadian producer of gypsum, operates large quarries at Wentworth near Windsor in Hants county. The gypsum is shipped 15 miles by rail to a storage and shipping pier at Hantsport from where it is taken by company boats to United States Gypsum Company plants at various points on the eastern seaboard of United States.

National Gypsum Company (Canada), Limited operates a quarry for export purposes in Hants county at Walton, and Windsor Plaster Company, Limited produces raw gypsum from a small quarry near Brooklyn for its plaster mill in Windsor.

In Victoria county, National Gypsum Company (Canada), Limited and Victora Gypsum Company, Limited operate quarries at Dingwall and Little Narrows respectively. From Dingwall the gypsum is shipped principally to company-owned plants in United States, but some is sold to gypsum plants in Quebec and to cement plants in eastern Canada. From Little Narrows the gypsum is exported to United States and the West Indies.

*New Brunswick*

Canadian Gypsum Company, Limited produces all grades of plaster and wallboard, including high quality plasters for specialized uses at its Hillsborough plant from local deposits of gypsum.

*Quebec*

Gypsum Lime and Alabastine, Canada, Limited produces plasters and wallboard at its Montreal East plant, from rock obtained from Dingwall, Nova Scotia.

*Ontario*

Gypsum Lime and Alabastine, Canada, Limited at Caledonia, and Canadian Gypsum Company, Limited at Hagersville, manufacture a wide variety of gypsum plasters and wallboards from gypsum rock obtained by mining methods from gypsum beds underlying the respective plants.

*Manitoba*

Gypsum Lime and Alabastine, Canada, Limited and Western Gypsum Products, Limited produce gypsum plasters and wallboards at Winnipeg. The former company obtains gypsum rock from its own quarry at Gypsumville and the latter from a mine at Amaranth, both in Manitoba.

*Alberta*

Gypsum Lime and Alabastine, Canada, Limited produces gypsum plasters at its plant in Calgary from raw gypsum obtained from the company's quarry at Falkland, British Columbia.

Western Gypsum Products, Limited, which also has a plant in Calgary, produces plasters and wallboards from raw gypsum obtained from the company's mine at Amaranth, Manitoba, and from the new gypsum deposits at Windermere, British Columbia.

*British Columbia.*

Gypsum Lime and Alabastine, Canada, Limited produces gypsum plasters and wallboards at its New Westminster plant from gypsum rock obtained from the company quarry at Falkland.

Columbia Gypsum Products, Incorporated continued development of the gypsum deposits at Windermere. The company exported some gypsum to the company plant at Spokane, Washington, and sold to buyers in Alberta.

### *Uses*

Gypsum is the principal component of plasters and wallboards. When heated at a low temperature, gypsum gives off three-quarters of its water of crystallization. The resultant product, known as plaster of Paris, sets quickly to a hard porous mass when water is added. Plaster of Paris, as such, has only limited uses, as in moulding work where quick setting is required, or in ceramic work where its porous properties are essential. To make plasters and wallboards certain materials are added to the plaster of Paris as retarders and fillers. This gives the final products a longer period of set and greater strength than the original plaster of Paris. Special products are made also from calcined gypsum, such as acoustic boards, partition tile, fire resisting walls, insulating tile, etc. Gypsum is added in small quantities to Portland cement where it acts as a retarder in the time of set of the cement.

Gypsum in the ground form was formerly used in large quantities as a fertilizer on many types of soil. This use, however, now appears to be limited mainly to black alkali soils.

### ANHYDRITE

Compared with gypsum, anhydrite has few uses. Production is usually limited to quarries where the removal of anhydrite beds is essential to the continued production of gypsum. The material is used as a soil conditioner on peanut crops in United States.

### *Prices*

The nominal price of crude gypsum in 1950 as quoted by Canadian Chemical and Process Industries was $3 to $3,50 a ton f.o.b. quarry or mine. However, large contracts with seaboard quarries were at prices much below these figures.

## IRON OXIDES (OCHRES)

The iron oxide industry in Canada is relatively small. Production of natural iron oxides and ochres has been confined for many years to the province of Quebec and has come chiefly from the Trois Rivières area. The term 'ochre' is commonly used to designate those forms of iron hydroxide that are used in making pigments and polishing rouge, for colouring oilcloth and linoleum, and for purification of coal gas. Extensive deposits of such material, some of which have been in continuous production since 1886, occur in St. Maurice and Champlain counties, Quebec.

Sherwin Williams Company of Canada Limited, the only Canadian producer of calcined iron oxides, worked its two deposits at Red Mill and Champlain, and its calcining and grinding mill at Red Mill in Quebec.

*Production and Trade*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Short tons | $ | Short tons | $ |
| *Production* (sales) | | | | |
| Quebec | 13,696 | 262,632 | 10,873 | 184,586 |
| British Columbia | ........... | ........... | 2,752 | 23,301 |
| Total | 13,696 | 262,632 | 13,625 | 207,887 |
| *Imports* (ochres, siennas, umbers) | | | | |
| From: United States | 1,398 | 79,967 | 1,505 | 79,000 |
| United Kingdom | 146 | 9,076 | 75 | 6,171 |
| Total | 1,544 | 89,043 | 1,580 | 85,171 |
| *Exports* | | | | |
| To: United States | 3,500 | 341,980 | 2,559 | 185,289 |
| Italy | 103 | 15,919 | 237 | 39,629 |
| Mexico | 100 | 16,803 | 90 | 13,657 |
| Belgium | 65 | 9,411 | 98 | 15,058 |
| Netherlands | ........... | ........... | 179 | 27,769 |
| Brazil | ........... | ........... | 103 | 21,750 |
| Other countries | 166 | 27,782 | 122 | 21,050 |
| Total | 3,934 | 411,895 | 3,388 | 324,202 |

*Quebec*

Output included both crude ochre and calcined oxide, about 80 per cent of it in the form of crude, uncalcined ochre.

Four producers shipped crude, air-dried ochre from eight deposits in Champlain and St. Maurice counties, within 20 miles of Trois Rivières, and from a deposit at St. Raymond, Portneuf county. The output was marketed in Quebec, Ontario, Nova Scotia, British Columbia, and eastern United States.

The average price of crude ochre, f.o.b. mine in Quebec, was $4.53 a ton against $4.39 in 1949.

Sherwin Williams Company of Canada Limited produced calcined, milled and air-floated products, in its mill at Red Mill, Champlain county, the quantity of calcined oxides produced being 28 per cent higher than in 1949. Output is used principally in mineral pigments and polishing rouge.

*Manitoba*

The large deposits near Grand Rapids and Cedar Lake remained undeveloped owing to lack of markets.

*Saskatchewan*

The principal deposit of possible economic interest is at Loon Lake, 32 miles from St. Walburg on the Canadian National railway.

*British Columbia*

No production was recorded in 1950 from the deposit at Alta Lake, New Westminster area, where output has been small and intermittent. Bog iron ore suitable for treatment of illuminating gas occurs in the Peace River district.

*Uses*

Canadian consumption of iron oxide by the illuminating gas industry in 1950 was 11,624 tons valued at $114,138. The paint industry consumed 2,453 tons of calcined iron oxide valued at $378,423 and 268 tons of ochres, siennas, and umbers valued at $51,514.

Iron oxide pigments are used as colouring agents and fillers in making imitation leather, shade cloth, shingle stain, paper and cardboard. Siennas and umbers are used in wood stains and wood fillers. The natural ochre is used as a pigment for linoleum and oilcloth; in wood stains and wood fillers; and in coloring cement, stuccos, and mortar.

*Prices*

The Canadian price of red iron oxide, f.o.b. Toronto or Montreal, as given by Canadian Chemistry and Process Industries, varied from 6 to 10¾ cents a pound in 1950, whereas yellow, brown, and black iron oxides varied between 5 and 12 cents. Siennas sold at $8.75 to $12 a pound, and umbers at 7¼ to 10¼ cents a pound.

## LIME

Production of lime in Canada during 1950 reached a record of 1,124,188 tons valued at $12,281,084. The high demand reflected the continued high level of industrial activity. Approximately 80 per cent of Canadian lime production is used by industry in general, and the remainder by the building trades, in agriculture, and for miscellaneous uses.

Although lime is burned in all provinces except Saskatchewan and Prince Edward Island, over 85 per cent of the production in 1950 was from Ontario, and Quebec. Across Canada there are approximately 45 lime plants operating about 150 kilns ranging in size from small pot to large rotary types. Several plants produce lime for their own requirements.

Due to widespread distribution of limestone and lime plants, lime is not commonly an article of international trade. Some trade is carried on, however, across the International Boundary in local areas where economic factors favour export or import of relatively small quantities.

With the exception of Prince Edward Island, deposits of limestone suitable for the production of lime occur in all provinces. However, much of the lime industry is concentrated near the main consuming areas in the industrial sections of Ontario and Quebec. The large demand in these areas has favoured the development of larger kilns and more efficient production techniques.

High-calcium lime is produced in British Columbia, Alberta, Quebec, and Newfoundland, and both dolomitic and calcium limes are available in Ontario, Manitoba, and New Brunswick.

In spite of the abundant distribution of limestone in this country, readily accessible, high-calcium deposits of purity that will yield white chemical lime are becoming scarce.

Lime is marketed both as quicklime and as the hydrate. The former accounts for about 78 per cent of total sales and is marketed as lump or pebble either in bulk or containers, and as crushed and pulverized lime, in which case it is bagged. Hydrate of lime is sold in containers, usually multiwall paper bags. It is a dry, slaked lime with a fineness of 95 per cent or more through minus 325 mesh.

*Production, Trade, and Consumption*

| | 1950 | | 1949 | |
|---|---|---|---|---|
| | Short tons | $ | Short tons | $ |
| *Production* | | | | |
| Quicklime | 885,219 | 9,748,936 | 798,187 | 8,971,040 |
| Hydrated lime | 238,969 | 2,532,148 | 220,636 | 2,338,780 |
| Total | 1,124,188 | 12,281,084 | 1,018,823 | 11,309,820 |
| *Imports* (quicklime) | | | | |
| From: United States | 13,921 | 155,424 | 16,408 | 173,350 |
| United Kingdom | 150 | 4,536 | 91 | 3,094 |
| Total | 14,071 | 159,960 | 16,499 | 176,444 |
| *Exports* | | | | |
| To: United States | 33,033 | 508,283 | 30,132 | 497,308 |
| Other countries | 40 | 1,170 | 56 | 1,349 |
| Total | 33,073 | 509,453 | 30,188 | 498,657 |
| *Production, showing purpose for which used or sold* | | | | |
| Pulp and paper mills | 210,290 | 2,397,303 | 202,614 | 2,439,950 |
| Metallurgical | 158,204 | 1,162,442 | 139,234 | 1,068,074 |
| Building trades | 182,558 | 2,738,830 | 174,075 | 2,630,405 |
| Sugar refineries | 23,883 | 321,599 | 16,847 | 155,371 |
| Glass works | 13,633 | 159,892 | 13,940 | 141,449 |
| Agriculture | 14,088 | 187,863 | 15,274 | 202,053 |
| Sand-lime brick | 12,813 | 132,190 | 10,269 | 102,514 |
| Other industrial uses | 489,086 | 5,030,217 | 439,919 | 4,530,743 |
| Various non-industrial uses | 19,633 | 150,748 | 6,651 | 39,261 |
| Total | 1,124,188 | 12,281,084 | 1,018,823 | 11,309,820 |
| *Production by provinces* | Short tons | Per cent | Short tons | Per cent |
| Newfoundland | 396 | 0·1 | 466 | 0·1 |
| New Brunswick | 23,694 | 2·1 | 23,082 | 2·3 |
| Quebec | 393,905 | 35·0 | 329,973 | 32·4 |
| Ontario | 571,490 | 50·8 | 529,986 | 52·0 |
| Manitoba | 49,218 | 4·4 | 51,019 | 5·0 |
| Alberta | 33,564 | 3·0 | 27,071 | 2·6 |
| British Columbia | 51,858 | 4·6 | 57,226 | 5·6 |
| Total | 1,124,188 | 100·0 | 1,018,823 | 100·0 |

*Uses and Prices*

Lime is an essential raw material in many industrial and chemical processes. As a chemical it is the lowest cost alkali available for use in acidity control. It is also essential in the production of calcium cyanamide, calcium carbide, of soda ash and caustic soda, and other chemical processes. Large quantities are used in the pulp and paper mills, in metallurgical plants, and in making glass and sugar.

The building trades use approximately 17 per cent of the Canadian output.

It is used in agriculture as a soil sweetener, and as an ingredient in spray mixtures, and in dusting compounds.

Prices of lime products vary widely and are dependent on the geographical location of the plants, and variations in the quality of lime. According to Canadian Chemistry and Process Industries, the price of lump quicklime f.o.b. plants, carload lots, in December 1950, was $9.75 to $10 a ton.

## LIMESTONE (GENERAL)

Canadian production of limestone in 1950, excluding stone quarried for cement and lime making, was 12,267,432 tons valued at $15,964,617, compared with 10,951,312 tons valued at $13,876,845 in 1949.

Because of its distribution and variety of use, limestone is quarried more widely than any other rock. In 1950 it supplied 68 per cent of all the stone marketed in Canada. Ontario and Quebec together quarry almost 88 per cent of the limestone sold in Canada for uses other than the manufacture of cement and lime. The remainder is quarried in Newfoundland, Nova Scotia, Manitoba, Alberta, and British Columbia.

Composition of Canadian limestone ranges from high-calcium through magnesian to dolomite and includes both argillaceous and siliceous varieties. There are large deposits of brucitic limestone and dolomitic magnesite, some of which are being worked. Although deposits of limestone are widespread, there is a scarcity of high-calcium stone that meets exacting modern chemical and metallurgical specifications and that are economically accessible. If future industrial requirements are to be met, consideration will have to be given to underground mining or to beneficiation of impure deposits.

As limestone is widely distributed and is usually marketed at a low price per ton, there is little trade in it between Canada and other countries. However, in certain areas where Canadian supplies are not available, stone is imported from United States for the sugar refining, metallurgical, and wood pulp industries. In other areas Canadian stone is exported for similar uses. Trade in limestone is not recorded separately.

### *Uses*

To supply the many uses, limestone is marketed in a variety of forms ranging from dimensional blocks used in building construction to pulverized material used as an industrial filler. Approximately 79 per cent of Canadian production, or 9,733,778 tons in 1950, is sold as crushed stone for concrete aggregate, road metal, and railroad ballast.

Limestone is an important raw material for the chemical and metallurgical industries. It is used as a flux in smelting operations, as an ingredient in the manufacture of glass, and in processing beet sugar. Both dolomite and calcium limestone in lump form are used by the pulp and paper industry to prepare pulp-cooking liquors. The chemical and metallurgical industries in 1950 used 1,369,906 tons of stone.

Screenings from the preparation of crushed stone at several quarries are now pulverized and marketed as asphalt filler, agricultural limestone, and for several other uses. High quality white limestone is ground as whiting substitute. In Canada increasing amounts are used as lining materials to correct acidity conditions in soil and to remedy calcium and magnesium deficiency. At present the chief market is in the province of Quebec and smaller quantities are sold in Ontario, Manitoba, Nova Scotia, New Brunswick, British Columbia, and Newfoundland. Sales of agricultural limestone and marl in 1950 amounted to $1,256,094.

Argillaceous dolomite is used in making rock wool.

Dolomite is used in Canada for the production of magnesium metal by the thermal ferrosilicon process. Dead burned dolomite, prepared in a plant at Dundas, Ontario, is used as a refractory in basic open hearth steel furnaces. Canada's requirements for basic refractories are met largely from dolomitic magnesite at Kilmar, Quebec, and from magnesia recovered from brucitic limestone at Wakefield, Quebec. At the latter plant, fertilizer grade magnesia and hydrated lime are also produced.

### *Prices*

Prices of limestone vary greatly with its different uses. As a prepared concrete aggregate or road metal, it is often sold at from $1 to $1.50 a ton, f.o.b. quarry.

## LIMESTONE (STRUCTURAL)

Production of dimensional limestone in Canada in 1950 came from Ontario, Quebec, Manitoba, and New Brunswick and amounted to 72,263 tons valued at $1,803,061 compared with 56,871 tons valued at $1,412,851 in 1949. A marked increase was noted in the volume of output from Ontario.

Modern construction techniques require most stone to be sawn to accurate dimensions for use in the larger types of buildings. Quarry output is, therefore, directed chiefly towards sawn slabs, or mill blocks, for shipment to stone dressing plants. Stone of this type must be heavily bedded, free from cracks and other defects, and must be easily worked. Since occurrences of this type are not plentiful in Canada, much of Canada's requirements are supplied by imports from United States. A small number of mill blocks of Portland Stone were imported from the United Kingdom in 1950.

There are, as well, several small quarries, mainly in Quebec, marketing hand-trimmed stone as sills, lintels, and for use as facing in residential and small building construction.

### *Production and Trade*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Short tons | $ | Short tons | $ |
| *Production of limestone for building purposes** | | | | |
| New Brunswick | 200 | 300 | ........... | ........... |
| Quebec | 26,337 | 1,136,449 | 24,645 | 971,451 |
| Ontario | 40,745 | 455,002 | 22,861 | 281,580 |
| Manitoba | 4,981 | 211,310 | 9,365 | 159,820 |
| Total | 72,263 | 1,803,061 | 56,871 | 1,412,851 |
| *Imports of building stone (except marble and granite)* | | | | |
| From: United States | 9,308 | 135,252 | 15,085 | 213,475 |
| United Kingdom | 310 | 11,370 | 1,739 | 30,209 |
| Elsewhere | ........... | ........... | 37 | 1,283 |
| Total | 9,618 | 146,622 | 16,861 | 244,967 |
| *Exports of building stone unwrought (except marble and granite)* | | | | |
| All to United States | 128 | 2,951 | 130 | 3,713 |

* Value of production refers to stone marketed as mill blocks or in finished condition by the quarry and does not include the value of work done on the stone by cut stone contractors.

In Quebec, limestone is quarried as a building stone, principally at St. Marc des Carrieres, Portneuf county, and in the vicinity of Montreal. Both supply a grey stone.

Heavily bedded deposits of silver-grey stone of the Lockport formation are quarried near Queenston and Thorold in the Niagara district. The former also yields variegated buff and grey stone. Inactive quarries at Longford Mills, Rama township, near Orillia, formerly yielded buff, silver, grey, and brown stone.

A characteristic mottled limestone in buff and grey is quarried near Tyndall, Manitoba. The stone is used for both exterior and interior work. For the latter, it is usually polished.

### *Prices*

The price of mill blocks depends upon quarry location, size of blocks, grade of stone, and ease of quarrying. Prices in 1950 ranged upwards from approximately $1.25 per cubic foot at quarry.

## MAGNESITE AND BRUCITE

Refractory and other magnesia products valued at $1,717,879 were made in Canada from dolomitic magnesite and brucitic limestone during 1950 compared with $1,536,200 in 1949.

Dolomitic magnesite is an intimate mixture of dolomite and magnesite and occurs in Argenteuil county, Quebec. It is mined by underground methods at Kilmar, by Canadian Refractories Limited, as a raw material for its basic refractories plant. Control of impurity content is maintained by treating the mined rock in a heavy media separation plant. The product is ground, dead-burned in a rotary kiln, and made into a variety of refractory products.

Brucitic limestone occurs along the Ottawa River in Ontario and Quebec. It is quarried near Wakefield, Quebec, by Aluminum Company of Canada Limited. The brucite (magnesium hydroxide) is thickly distributed as granules through a matrix of calcite and the rock is processed for the recovery of magnesia and lime. The magnesia is used in the production of basic refractories, as a source of metallic magnesium, as a general chemical, and as a fertilizer.

Hydrated lime produced during the process of recovering the magnesium is used by the building trades, metallurgical, pulp and paper industries, and in agriculture.

Other deposits of brucitic limestone are known to occur near Rutherglen, in Ontario, near Wakefield and Bryson in Quebec, and on West Redonda Island in British Columbia.

Although there are several occurrences of both hydromagnesite and magnesite in western Canada, principally in British Columbia and Yukon, there is no production. Most of these are either limited in extent or far from transportation. The most important deposits of magnesite are those owned by the Consolidated Mining and Smelting Company of Canada Limited at Marysville near Cranbrook, British Columbia. Impurities of silica and alumina can be removed by a flotation process devised by the company.

The deposits of earthy hydromagnesite found near Atlin and Clinton, in British Columbia, have been worked intermittently.

### *Uses*

The entire production of dolomitic magnesite is used in making basic refractories. A variety of bricks and shapes, refractory cements, and dead-burned grain are marketed.

*Production and Trade*

| — | 1950 Short tons | 1950 $ | 1949 Short tons | 1949 $ |
|---|---|---|---|---|
| *Production*—Dolomitic magnesite brucite | ........... | 1,717,879 | ........... | 1,536,200 |
| *Imports* | | | | |
| Dead-burned and caustic calcined magnesite | | | | |
| From: United States | 5,259 | 494,895 | 3,603 | 250,272 |
| United Kingdom | 693 | 68,269 | 1,038 | 127,025 |
| Other countries | 35 | 4,732 | 42 | 5,262 |
| Total | 5,987 | 567,896 | 4,683 | 382,559 |
| Magnesite fire brick | | | | |
| From: United States | ........... | 414,335 | ........... | 486,671 |
| Magnesia alba and levis | | | | |
| From: United States | 550 | 126,852 | 365 | 78,927 |
| United Kingdom | 65 | 24,449 | 64 | 21,204 |
| Total | 615 | 151,301 | 429 | 100,131 |
| Magnesia pipe covering | | | | |
| From: United States | ........... | 14,046 | ........... | 76,505 |
| United Kingdom | ........... | 10,670 | ........... | 88,247 |
| Total | ........... | 24,716 | ........... | 164,752 |
| Magnesium carbonate | | | | |
| From: United States | 238 | 30,685 | 113 | 13,471 |
| United Kingdom | 1,439 | 157,966 | 874 | 112,935 |
| France | ........... | ........... | 1 | 802 |
| Total | 1,677 | 188,651 | 988 | 127,208 |
| Magnesium sulphate | | | | |
| From: United States | 1,084 | 52,044 | 2,196 | 99,649 |
| Germany | 1,036 | 22,505 | 427 | 11,232 |
| United Kingdom | 413 | 19,017 | 160 | 10,000 |
| Netherlands | 260 | 7,078 | ........... | ........... |
| Total | 2,793 | 100,644 | 2,783 | 120,881 |
| *Exports* | | | | |
| Basic refractories, dead-burned | | | | |
| To: United States | 2,132 | 90,357 | 1,618 | 63,701 |
| Brazil | 450 | 31,055 | 401 | 21,775 |
| New Zealand | 20 | 1,020 | ........... | ........... |
| Other countries | ........... | ........... | 18 | 2,383 |
| Total | 2,602 | 122,432 | 2,037 | 87,859 |

Magnesia from brucite is used by the refractory industry in making both burned and chemically bonded bricks, and shapes, and for the production of magnesium metal by the electrolytic process. Ground magnesia has been used in the preparation of magnesium bisulphite liquor. It has also been demonstrated experimentally that it is possible to use it in magnesium oxychloride and oxysulphate cements, and in the production of magnesia insulation.

## MARBLE

Production of marble in Canada in 1950 was 55,179 tons valued at $436,502 compared with 52,152 tons valued at $446,905 in 1949.

Most marble is quarried in Canada for crushing or grinding and is marketed as terrazzo chips, poultry grit, stucco dash, whiting substitute, and marble flour and as an aggregate in making artificial stone. Close to two-thirds of the quarry production is from Ontario, the remainder being from Quebec and British Columbia.

Imports are usually in the form of rough blocks or sawn slabs that are processed to finished marble to customers' specifications by dressing establishments. Imports increased appreciably in 1950 mainly because of increased shipments of Italian rough and sawn types. No marble was exported.

*Production and Trade*

| Province | 1950 | | 1949 | |
|---|---|---|---|---|
| | Tons | $ | Tons | $ |
| Quebec | 20,602 | 250,114 | 18,721 | 267,272 |
| Ontario | 34,227 | 174,738 | 33,131 | 174,083 |
| British Columbia | 350 | 11,650 | 300 | 5,550 |
| Total | 55,179 | 436,502 | 52,152 | 446,905 |

*Imports in 1950*

(By countries of origin)

| Type of marble | United States | Belgium | Italy | France | Other Countries | Total |
|---|---|---|---|---|---|---|
| | $ | $ | $ | $ | $ | $ |
| Rough | 16,752 | 2,482 | 96,737 | 2,850 | 5,366 | 124,187 |
| Sawn | 44,250 | 7,189 | 74,281 | ......... | ......... | 125,720 |
| Tombstones | 55,405 | ......... | 7,748 | ......... | ......... | 63,153 |
| Manufactured | 23,904 | 2,826 | 65,707 | ......... | 6,092 | 98,529 |
| Ornamental for churches | 53 | ......... | 49,362 | 6,543 | ......... | 55,958 |
| Total | 140,364 | 12,497 | 293,835 | 9,393 | 11,458 | 467,547 |

In addition to the above, mosaic flooring materials, part of which are marble, were imported to the value of $297,859, compared with $271,363 in 1949.

*Quebec*

Missisquoi Stone and Marble Company Limited operates the largest marble quarry in Canada at Phillipsburg, near the foot of Lake Champlain, and produces a clouded grey marble.

Orford Marble Company Limited produces terrazzo chips from quarries near North Stukely, in Shefford county. A few mill blocks were shipped to dressing plants in 1950. The deposit is of the serpentine variety in red, green, and grey.

Canadian Dolomite Company Limited at Portage du Fort, Pontiac county, quarries a white dolomite that is crushed for terrazzo chips, stucco dash, aggregate in artificial stone, and various other products.

South Stukely Marble and Terrazzo Company in Shefford county commenced production from white marble of terrazzo chips and marble dust for use as agricultural limestone.

From the building stone quarries at St. Marc des Carrieres, Portneuf county, a brown marble from the Trenton limestone is produced to supply an intermittent demand. The marble is dressed for store counters, and wainscotting.

*Ontario*

Silvertone Black Marble Quarries Limited quarries black marble at St. Albert Station, 30 miles southeast of Ottawa, for terrazzo chips, and as mill blocks.

Stocklosar Marble Quarries produces red, pink, buff, green, black and white terrazzo chips from deposits near Madoc.

Verona Rock Products Limited, Verona, about 20 miles northwest of Kingston, produces poultry grit and stucco dash from white limestone.

Bolenders Limited produces poultry grit, stucco dash, and plaster aggregate from a deposit of crystalline limestone 8 miles north of Haliburton at Eagle Lake.

Pulverized Marble Products Limited shipped a small quantity of plaster aggregate in 1950 from a deposit of crystalline dolomite at Kaladar.

*Manitoba*

There are a number of undeveloped occurrences of highly coloured marbles along the Hudson Bay and the Flin Flon branches of the Canadian National railway, and at Fisher Branch, 100 miles north of Winnipeg.

*British Columbia*

A small tonnage of white marble is quarried by Marble and Associated Products, from a quarry near Victoria, for use mainly as stucco dash and as whiting substitute in the manufacture of putty.

There are several undeveloped occurrences in the province.

## MICA

Primary production (sales) of mica of all classes in Canada in 1950 increased 133 per cent in value and 11 per cent in volume over 1949. Phlogopite and biotite accounted for 83 per cent of the volume and 47 per cent of the value, the remainder being muscovite. Production came from Quebec, Ontario, and British Columbia.

Exports of all classes, all to United States, increased 15 per cent in volume and 175 per cent in value.

*Quebec*

Quebec produced all the splittings, mine run, and material sold for mechanical splitting, 90 per cent of the ground, 11 per cent of the scrap, and 6 per cent of the trimmed sheet. Quebec contributed 58 per cent of the total volume. Blackburn Bros. with mine at Cantley, and E. Wallingford, at Perkins, were again the principal producers. Other production came from a number of producers mostly in the Gatineau-Lievre River area.

The grinding plant of Blackburn Bros., Cantley, continued in operation.

*Ontario*

Ontario produced 72 per cent of the scrap and 94 per cent of the trimmed mica which together amounted to 30 per cent of the total volume.

Principal producers included: North Bay Mica Company Limited, which produces muscovite from the Purdy Mine near Mattawa; Ontario Mica Mines

*Production and Trade*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Pounds | $ | Pounds | $ |
| *Production* (primary sales) | | | | |
| Trimmed | 180,730 | 153,856 | 47,882 | 31,731 |
| Splittings | 2,100 | 1,785 | 8,550 | 7,470 |
| Sold for mechanical splitting | 104,400 | 17,062 | 8,019 | 1,762 |
| Rough, mine-run or rifted | 20 | 4 | 10,091 | 1,214 |
| Unclassified | ........... | ........... | 43,069 | 3,172 |
| Ground or powdered | 2,215,919 | 68,253 | 1,854,844 | 49,907 |
| Scrap | 1,376,040 | 11,651 | 1,518,101 | 13,202 |
| Total | 3,879,209 | 252,611 | 3,490,556 | 108,458 |
| *Imports* (including manufactures) | | | | |
| From: United States | ........... | 474,724 | ........... | 351,872 |
| India | ........... | 237,647 | ........... | 182,830 |
| Other countries | ........... | 45,454 | ........... | 32,767 |
| Total | ........... | 757,825 | ........... | 567,469 |
| *Exports* (all to United States) | | | | |
| Trimmed | 67,300 | 96,481 | 97,900 | 26,571 |
| Rough | 164,800 | 27,983 | 78,000 | 12,983 |
| Ground | 560,000 | 28,117 | 460,000 | 17,086 |
| Scrap | 1,183,000 | 12,585 | 678,300 | 3,526 |
| Total | 1,975,100 | 165,166 | 1,314,200 | 60,166 |
| *Mica manufactures* | | | | |
| Brazil | ........... | 1,000 | ........... | 1,271 |
| United States | ........... | 426 | ........... | 1,747 |
| Other countries | ........... | 49 | ........... | 408 |
| Total | ........... | 1,475 | ........... | 3,426 |

Limited, which produces phlogophite from the old Orser mine near Godfrey in Frontenac county; Bancroft Mica and Stone Products Mining Syndicate Limited, which produces trimmed sheet and scrap biotite from a deposit near Bancroft; and C. C. Orser, who produces muscovite from a deposit near Mazinaw Lake. Messrs. F. J. Powers and J. C. Donnelly, both of Stanleyville, and others contributed to the output.

Suzorite Company Limited, with grinding plant at Cornwall, continued to produce ground mica for the roofing and filler trades from suzorite rock previously mined from a large deposit in Suzor township, Quebec.

*British Columbia*

British Columbia produced 10 per cent of the ground mica and 25 per cent of the grinding scrap in the form of fine flake recovered in the Albreda district from schist rock.

Ground mica, chiefly for the local roofing trade, is produced in Vancouver by George W. Richmond and by Fairey and Company.

*Uses*

Mica is used in three principal forms, namely: natural sheet, used mainly for electrical insulation; splittings, used in making built-up sheet; and ground mica, used mainly in the roofing, paint, and rubber trades.

The quality of sheet mica depends upon its colour, splitting qualities and freedom from cracks, blow holes, gas inclusions, ripples, rulings, mineral inclusions, hardness, and other physical characteristics. In general the lighter coloured phlogopite and clear muscovite have the highest electrical qualities and therefore bring the highest prices.

Splittings, comprising films as thin as one-thousandth of an inch or less, are used in various pressed and moulded forms, including sheet, cloth (mica with cloth backing), paper, tape for binding insulation, tubes, washers, and many other shapes. They are manufactured from both muscovite and phlogopite according to use. Micanite is the general term used for all bonded mica sheet.

Ground mica of all classes is used extensively as an extender and pigment in paint; as a filler and dusting agent in roofing materials; and in rubber. It is also used in mould washes for foundry work, lubricants, wallpaper, pipe enamel, annealing, tinsel powder, and in high frequency insulators.

### *Canadian Buyers*

Mica buyers in Canada include: Blackburn Brothers, Blackburn Building, Ottawa; Walter C. Cross, 209 Bridge Street, Hull, Quebec; and Mica Company of Canada, 2 Lois Street, Hull, Quebec.

### *Prices*

Prices offered for trimmed sheet mica by Ottawa region dealers at the close of 1950 were approximately as follows:

| | Per pound |
|---|---|
| 1 x 1 and 1 x 2 | $0.30 |
| 1 x 3 | 0.70 |
| 2 x 3 | 1.10 |
| 2 x 4 | 1.50 |
| 3 x 5 | 2.00 |
| 4 x 6 | 2.50 |
| 5 x 8 | 3.00—$3.60 |

Grinding scrap sold from about $14 to $22 a short ton, according to quality.

### *Tariffs*

The following tariffs were in force at the end of 1950.

*Canadian*

Mica, phlogopipe and muscovite, unmanufactured, in blocks, sheets, splittings, films, waste and scrap.

British preferential ............ 12½ per cent
Most favoured ................. 12½ per cent
General ....................... 25 per cent

*United States*

Mica, unmanufactured,

valued at not above 15 cents a pound, 4 cents a pound;
valued at above 15 cents a pound, 2 cents a pound and 15 per cent ad valorem.
Cut or stamped to dimensions, shape or form, 40 per cent ad valorem.
Films and splittings, not cut or stamped to dimensions—
not over 0.0012 inch thick, 12½ per cent ad valorem;
over 0.0012 inch thick, 20 per cent ad valorem.
Films and splittings, cut or stamped to dimensions, 45 per cent ad valorem.
Plates and built-up mica, and all manufactures of mica, or of which mica is the component material and chief value, 40 per cent ad valorem.
Untrimmed phlogopite from which no rectangular piece exceeding 2 inches in length or 1 inch in width may be cut, 15 per cent ad valorem.
Waste and scrap, not more than 5 cents a pound, 25 per cent ad valorem.
more than 5 cents a pound but not above 15 cents a pound, 4 cents a pound
valued at above 15 cents a pound, 4 cents a lb. and 25 per cent ad valorem.
Ground or pulverized, 20 per cent ad valorem.

## NEPHELINE SYENITE

Shipments of nephline syenite in Canada in 1950 declined almost 17 per cent below 1949 to 65,638 short tons, almost all of which was ground glass and pottery grades. Production continued to be confined to American Nepheline Limited, sole producer in the Western Hemisphere, and came from extensive deposits on Blue Mountain, Peterborough county, Ontario.

During 1950 the company completed the removal of its fine grinding plant from Rochester, New York, to Lakefield in Peterborough county, and in subsequent expansion more than doubled the plant's grinding capacity.

*Production and Trade*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Short tons | $ | Short tons | $ |
| *Production*—crude (ore transported to storage) | 100,251 | ........... | 89,731 | ........... |
| *Shipments* | | | | |
| Ground, | | | | |
| " glass grade | 45,497 | 550,587 | 26,931 | 341,128 |
| " pottery grade | 16,387 | 260,320 | 6,413 | 106,422 |
| " miscellaneous | 3,390 | 29,976 | 2,705 | 4,396 |
| Total ground | 65,274 | 840,883 | 36,049 | 451,946 |
| Crude | 364 | 2,003 | 42,734 | 171,056 |
| Total shipments | 65,638 | 842,886 | 78,783 | 623,002 |
| *Exports* of crude and processed materials | | | | |
| To: United States | 50,982 | 558,762 | 55,217 | 344,927 |
| Porto Rico | 1,184 | 20,128 | 200 | 3,400 |
| Netherlands | 1,133 | 20,398 | 1,271 | 26,671 |
| United Kingdom | 313 | 5,595 | 444 | 9,550 |
| Other countries | 739 | 14,319 | 159 | 2,406 |
| Total | 54,351 | 619,202 | 57,291 | 386,954 |

Deposits of nepheline syenite occurs elsewhere in Ontario near Bancroft, Hastings county; Gooderham, Haliburton county; in the French River area, Georgian Bay district; and at Port Coldwell, Thunder Bay district. In Quebec, nepheline syenite occurs in the Labelle-Annonciation and other areas, and in British Columbia, in the Ice River district near Field.

Canada and Russia are the only important producers of nepheline syenite, Canada being the sole source of high-grade ceramic material.

*Uses*

Nepheline syenite is used almost exclusively for ceramic purposes, for which it is favoured principally because it effects a material lowering of firing temperatures. It is valued in the glass batch because of its high alumina content (23 per cent in Lakefield nepheline syenite) to which a lowering of annealing temperature, reduced coefficient of expansion, increased tensile strength, hardness, and brilliancy are attributed.

Nepheline syenite is used in all types of pottery, enamels, floor and wall tile, as a bond in refractory cements, porcelain balls, and liners, and in other ceramic products. About two-thirds of the annual Canadian production is consumed by the glass industry.

B-grade dust, a by-product, finds a limited market for use in cleansers, enamels, and certain clay products.

*Prices and Tariffs*

Prices of processed nepheline syenite, which remained unchanged during 1950 were as follows: f.o.b. Lakefield, Ontario, glass grade, 28 mesh, bulk carload lots, $14 a ton; pottery grade, 200-mesh, bulk carload lots, $18 a ton; grade B, 150-mesh, bagged, carload lots, $10 a ton.

Nepheline syenite, all classes, entered United States free of duty.

## PHOSPHATE

Production of crude phosphate in Canada in 1950 amounted to 129 short tons of which 106 tons came from Ontario and the remainder from Quebec. Phosphate mining in Canada virtually ceased 50 years ago with the development of extensive sedimentary deposits in United States that have since been a low-cost source of supply. Imports of phosphate rock, mainly from United States, declined 21 per cent below 1929 levels to 491,026 short tons. Imports of superphosphate fertilizer increased 9 per cent to 182,822 short tons in the same period.

*Trade and Consumption*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Short tons | $ | Short tons | $ |
| *Imports, phosphate rock* | | | | |
| From: United States | 481,566 | 3,154,910 | 610,112 | 3,738,472 |
| Netherlands Antilles | 8,960 | 128,181 | 10,696 | 141,051 |
| French Africa | 500 | 13,250 | ..... | ..... |
| Total | 491,026 | 3,296,341 | 620,808 | 3,879,523 |
| *Imports, superphosphate* | | | | |
| From: United States | 165,038 | 2,711,778 | 154,736 | 2,511,016 |
| Netherlands Antilles | 17,684 | 423,528 | 12,836 | 182,351 |
| French Africa | 100 | 2,650 | ..... | ..... |
| Total | 182,822 | 3,137,956 | 167,572 | 2,693,367 |
| *Imports, phosphoric acid* All from United States | 300 | 35,175 | 246 | 26,312 |
| *Consumption* | | | | |
| Fertilizers | ..... | ..... | 390,370 | ..... |
| Chemicals | ..... | ..... | 28,949 | ..... |
| Miscellaneous | ..... | ..... | 10,209 | ..... |
| Total | ..... | ..... | 429,528 | ..... |

Output in Ontario came from Canadian Phosphate Industries Limited, who shipped 106 tons from the McLaren mine, Bedford township, Ontario.

Quebec Smelting & Refining Limited, Montreal, continued development work on the High Rock mine, Notre Dame de La Salette, and shipped 23 tons.

Canadian reserves of apatite, of which no estimate is available, occur in numerous scattered deposits in the general Ottawa region of Ontario and Quebec. Production in the past reached a maximum of about 30,000 tons a year, almost 90 per cent of which came from Quebec.

### *Uses*

Phosphate rock is used chiefly in the manufacture of commercial fertilizers, mostly in the form of superphosphate made by treating the raw material with sulphuric acid. In United States, furnacing processes developed in recent years (mostly by T.V.A.) have given rise to the production of phosphatic fertilizers of the slag type. Finely ground phosphate rock, untreated, is also applied directly to the soil on a minor scale.

Phosphorus and many phosphorus compounds enter into the manufacture of a large variety of products including detergents, flame retardents, water softeners, pigments, opacifiers, food preservatives, pharmaceutical preparations, livestock feed supplements, flotation reagents, glass, rodent poisons, pyrotechnics, non-ferrous alloys as a hardening agent, and many others. Ferro-phosphorus is used in iron and steel castings to increase fluidity, and in rolled sheet to prevent sticking.

### *Specifications*

To be acceptable for acid treatment phosphate ore or concentrates should be virtually free from common impurities such as iron oxides, calcite, and ferro-magnesian minerals. The grade should approach 80 per cent tricalcium phosphate.

For furnace treatment common impurities are tolerated within reasonable limits but purchasers prefer rock containing a minimum of 70 per cent tricalcium phosphate. Size specifications call for a minimum of 80 per cent plus 10-mesh.

### *Prices and Tariff*

Closing 1950 quotations for Florida pebble phosphate f.o.b. mines were as follows: 76-77 per cent B.P.L. (bone phosphate of lime) $6.90; 66-68 per cent B.P.L. $3.75.

The price offered by eastern consumers for domestic phosphate was $15 a short ton for 80 per cent B.P.L. f.o.b. works with a penalty or bonus of 19 cents per unit below or above that figure.

Phosphate rock is not dutiable under the Canadian tariff.

## ROOFING GRANULES

Production of roofing granules in Canada accounts for less than one-third of domestic consumption so that output is heavily supplemented by imports, all of which come from United States. In 1950 these increased to 122,766 short tons and accounted for 71 per cent of the consumption, compared with 115,992 short tons or 68 per cent of the consumption in 1949.

Most of the roofing granule production in Canada comes from deposits in eastern Ontario, the remainder being from British Columbia. Building products Limited, with quarries near Madoc and Havelock in eastern Ontario, is the chief producer.

Canadian manufacturers of roofings and sidings showed increasing preference for artificially coloured granules over the natural material.

*Consumption and Trade*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Short tons | $ | Short tons | $ |
| *Consumption* | | | | |
| Natural | 38,532 | 719,287 | 38,486 | 722,216 |
| Artificially coloured | 84,234 | 2,256,281 | 77,506 | 2,029,470 |
| Total | 122,766 | 2,975,568 | 115,992 | 2,751,686 |
| *Consumption by colours* | | | | |
| Grey and black | 34,710 | 651,579 | 34,549 | 647,328 |
| Red | 27,138 | 638,620 | 25,080 | 582,415 |
| Green | 38,086 | 951,327 | 35,862 | 862,473 |
| Blue | 11,152 | 383,604 | 9,724 | 335,815 |
| Buff and browns | 5,010 | 134,895 | 5,863 | 160,900 |
| White and grey-white | 6,670 | 215,534 | 4,914 | 162,755 |
| Total | 122,766 | 2,975,559 | 115,992 | 2,751,686 |
| *Imports* | | | | |
| From: United States | 86,977 | 2,145,517 | 78,749 | 1,898,889 |
| United Kingdom | ........... | ........... | ........... | ........... |
| Total | 86,977 | 2,145,517 | 78,749 | 1,898,889 |

Almost two-thirds of the consumption consisted of granules made from rocks of igneous origins, crushed to size, and artificially coloured. Roofing manufacturers of "double-coated" shingles use natural black and grey, and off-colour granules for the undercoating, which does not show on the finished shingle. The price of these undercoat granules is considerably less than that of the topcoat granules. The remainder of the consumption, with the exception of porcelain and clay origin granules, which comprised about 2 per cent, consisted of granules made from slate, of which 16·9 per cent was natural and 14·7 per cent was artificially coloured.

*Quebec*

Wendell Mineral Products Limited, Montreal, had nearly completed its plant at Landrienne, east of Amos, where a grey rhyolite material from the company's large deposit, a short distance north of its plant, is to be crushed to size and artificially coloured. Production is expected early in 1951.

Suzorite Company Limited did not operate its quarry near McCarthy, in Suzor township, about 160 miles east of Senneterre. The rock formerly quarried consisted of mica (50 per cent), and feldspar, apatite, and pyroxene. After removing the mica, the remainder was crushed and screened to granule size for use as undercoat granules at the company's plant in Cornwall, Ontario.

*Ontario*

Building Products Limited quarries a black amphibole rhyolite deposit 4 miles northeast of Madoc, and a syenite deposit, about 2 miles north of its crushing plant at Madoc, where the rock from both quarries is crushed and screened to size. It discontinued the quarrying of a pink rhyolite deposit east of Madoc near Moira Lake. During 1950 the company took over the green-grey basalt quarry, near Havelock, formerly owned by Ontario Rock Products Limited, from which it has continued to supply road metal for road surfacing and, from the undersize of which, it produces granules in its plant near the quarry. The granules made at Madoc, and at Havelock, are artificially coloured at the Havelock plant, the only colouring plant for roofing granules in Canada.

*British Columbia*

Geo. W. Richmond and Company quarries a dark grey slate at McNab Creek, Howe Sound, and a green siliceous rock at Bridal Falls near Chilliwack. This company produces natural granules in its Vancouver plant for shipment to local roofing manufacturers, mainly for undercoat granules.

## *Roofing Plants*

Granule-coated roofings and sidings are manufactured by ten companies at a total of fourteen plants across Canada at Asbestos, Montreal, and Lennoxville, in Quebec; Toronto, Hamilton, Brantford, and London, in Ontario; Winnipeg, in Manitoba; and Vancouver, and Victoria in British Columbia.

Sidney Roofing and Paper Company Limited, with plant in Vancouver, let a contract for construction of a new asphalt roofing materials plant that is scheduled for completion early in 1951.

Building Products Limited with asphalt roofing plants in Montreal, Hamilton, and Winnipeg, announced the completion of plans for the establishment of a new roofing plant at Edmonton, Alberta.

## *Specifications and Colouring*

Specifications for rock types suitable for making roofing granules are very rigid and few types are able to meet all specifications. Rocks suitable for granules should be fairly hard and tough enough to withstand breakage and dusting through handling with mechanical equipment. They should be fine-grained, with low porosity to withstand weathering effects from freezing and thawing; and should contain no "foreign materials" such as carbonates, feldspars, mica, sulphides, fibrous minerals etc., that would deteriorate through natural weathering agencies or through poor adhesion to the asphalt. They should be opaque to the transmission of the actinic rays of the sun and should not allow the passage of ultra-violet, or infra-red rays, to the underlying asphalt; should "break well"; and should be uniformly textured to take "artificial colouring" well so that no blotchy effect is apparent in the shingles on a roof, light coloured rock being preferable to dark coloured.

Specifications of granules used for under coats are almost as rigid as those for the top coat granules. However, most of these are dark rocks and are not artificially coloured. They are generally much cheaper than the artificially coloured top coat granules.

The deposits of rock must contain sufficient tonnage of uniform characteristics within economical haulage distance of the colouring plant to support many years of production. The plant site should be close to rail haulage facilities and not too distant from the roofing manufacturing plants.

Two mesh grades of granules are used by manufacturers of roofings and sidings, most of the granules being "medium coarse" (between −10 +35 mesh) and the remainder, "fines" (−28 +60 mesh).

Processes for colouring granules are covered by many patents, the two most widely used being the sodium silicate process in which the granules are thoroughly coated with sodium silicate, clay, the required pigment, and a little titanium oxide, and heated to the required temperature in a rotary kiln; and the phosphoric acid process in which the granules are mixed thoroughly with zinc oxide, clay, liquid phosphoric acid, the required pigment, and then heated.

Slates on heating will, on occasion, take on a deeper, darker colour and become harder. Sometimes oxides of iron and chromium are mixed thoroughly with the granules, which are then "burned" to produce satisfactory shades of reds and greens. The methods and mixes employed by any manufacturer of artificially coloured granules are closely held secrets.

### *Prices*

Prices depend upon the type of granule and upon whether the colour is natural or artificial. Imported natural granules in 1950 averaged $18.67 a short ton, delivered to eastern Canadian plants, compared with $18.75 a short ton in 1949. The average price of artificially coloured granules a short ton in 1950, with comparative 1949 figures in brackets were reds $23.53 ($23.21); greens $24.98 ($24.72); blues $34.40 ($34.53); buff or brown $26.97 ($27.45); and white or white-grey $32.31 ($33.33). The average value of all types a short ton was $24.24 in 1950 compared with $23.72 in 1949.

## SALT (SODIUM CHLORIDE)

Canadian salt plants operated at higher capacities in 1950 and production increased from 749,015 short tons in 1949 to 858,896 short tons despite the cessation of operations at a plant in Alberta. Over 90 per cent of the output is obtained from brine, the only salt mine in Canada being operated at Malagash in Nova Scotia. Salt beds or brines occur in all provinces but production is limited to Ontario, Nova Scotia, and the Prairie Provinces.

Dominion Salt Company Limited took over the plants of Standard Chemicals Limited at Goderich in Ontario, and Amherst in Nova Scotia in 1950, bringing to a total of five the number of plants controlled by Dominion Tar and Chemical Company Limited. In addition to the two above named plants, the company also controls those at Sarnia in Ontario, Unity in Saskatchewan, and Waterways in Alberta. Operations at the Waterways plant were suspended during 1950.

Imports consisting chiefly of grain sizes and of purities not obtainable in Canada, continued at a high level and totalled 238,239 short tons.

Much additional information on the extent and location of the huge reserves of rock salt underlying the Prairie Provinces was obtained from oil drilling operations. These reserves have assumed much significance with the development of the oil industry and associated chemical industries which will serve to create markets for the chemicals produced from rock salt.

The salt obtained in Canada from vacuum pan evaporation is of high purity but only fine grain sizes are produced. That obtained from direct mining of rock salt beds, as at Malagash, Nova Scotia, usually contains many of the impurities of the original beds and, although all grain sizes required can be obtained by this method, the purity may not be sufficiently high to satisfy all uses.

### *Nova Scotia*

The only salt mine in Canada is operated at Malagash, Cumberland county, by Malagash Salt Company, Limited. The mined rock salt is crushed, screened, and sold chiefly as a de-icing salt for roads and railways. It is also used as fishery, refrigerator, hay, and dairy salts; as stock licks; and for dust laying.

Fine salt from vacuum pan evaporators is produced near Amherst by Dominion Salt Company Limited from a brine obtained from massive salt beds that come within 860 feet of the surface at this point.

*Ontario*

Most of the large output of salt is used to supply the province's expanding chemical industries. The salt is obtained from wells drilled 800 to 1,500 feet below the surface at Goderich, Sarnia, Warwick, and Sandwich in southwestern Ontario.

*Production and Trade*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Short tons | $ | Short tons | $ |
| *Production by types* | | | | |
| Fine vacuum salt | 290,538 | 4,816,077 | 265,959 | 4,149,240 |
| Coarse grainer salt | 9,869 | 273,919 | 11,437 | 264,035 |
| Mined rock salt | 57,068 | 438,155 | 43,303 | 380,695 |
| Salt produced for chemical purposes* | 501,421, | 1,483,155 | 428,316 | 772,755 |
| Total | 858,896 | 7,011,306 | 749,015 | 5,566,725 |
| *Production by provinces* | | | | |
| Ontario | 696,582 | 4,639,867 | 607,206 | 3,477,583 |
| Nova Scotia | 101,930 | 1,080,154 | 86,612 | 1,030,126 |
| Alberta | 25,606 | 539,287 | 28,359 | 547,304 |
| Manitoba | 16,592 | 378,297 | 18,734 | 367,186 |
| Saskatchewan | 18,186 | 373,701 | 8,104 | 144,526 |
| Total | 858,896 | 7,011,306 | 749,015 | 5,566,725 |
| *Imports* | | | | |
| From: United States | 170,991 | 1,158,715 | 153,151 | 951,558 |
| Bahamas | 33,853 | 220,685 | 41,955 | 331,463 |
| Portugal | 13,200 | 122,615 | 11,166 | 56,796 |
| United Kingdom | 10,268 | 180,142 | 6,156 | 101,925 |
| Jamaica | 182 | 910 | 18,220 | 85,468 |
| Other countries | 9,745 | 51,296 | 6,039 | 40,662 |
| Total | 238,239 | 1,734,363 | 236,687 | 1,567,872 |
| *Exports* | | | | |
| To: United States | 3,776 | 42,514 | 2,600 | 32,462 |
| Greenland | 165 | 3,135 | ........... | ........... |
| Bermuda | 138 | 6,347 | 132 | 6,162 |
| New Zealand | ........... | ........... | 182 | 6,951 |
| Hawaii | ........... | ........... | 220 | 5,595 |
| Other countries | 21 | 978 | 340 | 11,845 |
| Total | 4,100 | 52,974 | 3,474 | 63,015 |
| Apparent Consumption | 1,093,035 | 8,692,695 | 982,228 | 7,071,582 |

* Mainlyi n brine, and used by the producers in the manufacture of chemicals.

Dominion Salt Company Limited operates plants at Sarnia and Goderich, the main production being fine salt from vacuum pan evaporators. Some of this fine salt is shipped to the Beauharnois plant of Dominion Alkali and Chemical Company Limited. Dominion Salt Company also produces coarse salt from grainers.

At Sandwich, Canadian Industries Limited produces both fine and coarse salt from vacuum evaporators and from open type grainers. The brine from these salt wells is also used in the company's caustic soda and chlorine plant at Sandwich and fine salt was shipped to company alkali plants at Cornwall, Ontario, and Shawinigan Falls, Quebec.

Purity Flour Mills produces fine and coarse salt at its plant in Goderich and Warwick Pure Salt Company Limited produces coarse salt only from open pan evaporation of brine obtained from wells on its property near the village of Warwick.

Brunner-Mond Canada Limited operates a large soda ash plant at Amherstburg. The brine for this plant is obtained from wells several miles to the north.

Dow Chemical of Canada Limited produces caustic soda and chlorine at its plant in Sarnia from nearby company brine wells.

*Manitoba*

Canadian Industries Limited at Neepawa, the only producer of salt in the province, produces fine salt by vacuum evaporators from a nearly saturated brine that is obtained by pumping salt beds lying over 1,000 feet below the surface. Magnesium and calcium chloride salts are also obtained by evaporation of this brine.

*Saskatchewan*

Dominion Tar and Chemical Company Limited, through its subsidiary Prairie Salt Company Limited, operates a vacuum pan plant for the production of fine salt at Unity. The brine is obtained from salt beds about 3,500 feet below the surface.

*Alberta*

The plant of Alberta Salt Company Limited at Lindbergh obtains brine from salt beds lying over 2,800 feet below the surface. Natural gas is obtained from strata above the salt beds and is used as fuel for the production of fine salt from vacuum pan evaporators.

### *Areas of Potential Production*

*Newfoundland*

Salt springs occur at several places in the carboniferous area in western Newfoundland. It is possible that salt beds may be found in this area.

*Nova Scotia*

Massive salt beds have been discovered on the west coast of Cape Breton Island and there is evidence of other salt beds from brine springs in Antigonish, Pictou, and Cumberland counties on the mainland.

*Prince Edward Island*

Salt beds were discovered in Hillsborough Bay at a vertical depth of over 2 miles.

*New Brunswick*

Large domes of salt at shallow depths have been explored at Weldon and Dorchester in the southeastern part of the province.

*Quebec*

There is an outcrop area of carboniferous sediment on the Magdalen Islands in the Gulf of St. Lawrence and it is probable that salt beds could be found in this area.

*Ontario*

The drilling for gas and oil has continued to outline the vast area in the southwestern part of the province that is underlain by salt beds.

*Prairie Provinces*

Salt beds underlie these provinces in the shape of a huge crescent extending from the extreme northern part of Alberta to the central part of Saskatchewan and the boundary of Manitoba. The beds vary in thickness from a few feet to a total of many hundreds of feet in one section. The reserves of salt in this area are practically incalculable and may be of great importance for their content of potassium salts.

*British Columbia*

Deposits of salt have been indicated by salt springs at various points in the province, but the best indication is at Kwinitsa, 45 miles east of Prince Rupert on the Canadian National railway.

*Uses*

Fine grades of salt are used chiefly in the chemical industries, and extensively for household and food purposes, whereas the coarse grades are used in the curing of fish and hides, for ice and dust control on highways, for dairy uses, and in refrigeration.

The fine grades of salt are made in vacuum pan evaporators, usually double or triple effect, from saturated brines that are obtained by circulating fresh water through salt beds.

Coarse salt is obtained in Canada by open type evaporators and by mining, crushing and screening rock salt. Although coarse salt produced from open type evaporators is pure, it is extremely expensive, and is thus used only where purity is essential such as in making dairy products. The mined salt is impure and can be used only for such purposes as de-icing and dust control of highways.

Cheap coarse salt of fair purity is required for such uses as the curing of fish. This salt is obtained principally by solar evaporation of sea water in tropical or semi-tropical countries, and this accounts chiefly for Canada's relatively large imports of salt from the West Indies for the fishing industry on both the east and west coasts.

*Prices**

| — | December 1950 | December 1949 |
|---|---|---|
| Fine industrial salt, per ton, bulk, carlots, f.o.b. plant......... | $ 8.00 | $ 7.00— 8.80 |
| Coarse industrial salt, per ton, bulk, carlots, f.o.b. plant....... | $17.00 | $15.40—17.20 |

* Quotations are from Canadian Chemistry and Process Industries.

## SAND AND GRAVEL

Production of sand and gravel in Canada in 1950 totalled 73,095,163 tons valued at $36,434,759 compared with 63,356,308 tons valued at $31,181,541 in 1949.

The demand remained strong and in the more densely populated areas experiments were undertaken to produce a good grade of sand by crushing local limestone or gravel. Supplies of sand are being depleted in these areas and costs are such that the possible use of artificially made sand is becoming economically feasible.

Beneficiation of low-grade gravels is coming into practice. From past and present investigations it is evident that some gravels contain certain minerals that are harmful to asphalt or concrete pavement. Removal of these minerals results in the production of a first rate gravel, especially since the method entails a wet process that produces a washed end product.

*Production*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Quantity tons | Value $ | Quantity tons | Value $ |
| Newfoundland | 1,619,389 | 780,315 | 1,416,202 | 999,598 |
| Nova Scotia | 1,600,932 | 1,488,593 | 1,933,652 | 1,738,114 |
| New Brunswick | 4,789,585 | 2,997,779 | 3,142,633 | 1,106,479 |
| Quebec | 20,313,415 | 7,172,632 | 19,179,692 | 7,326,456 |
| Ontario | 30,271,214 | 15,551,406 | 22,320,753 | 11,214,136 |
| Manitoba | 2,720,951 | 721,494 | 2,260,196 | 696,783 |
| Saskatchewan | 2,104,797 | 1,439,870 | 1,930,959 | 1,795,766 |
| Alberta | 3,866,662 | 2,572,795 | 2,448,814 | 1,553,589 |
| British Columbia | 5,808,218 | 3,709,875 | 8,723,407 | 4,750,620 |
| Canada | 73,095,163 | 36,434,759 | 63,356,308 | 31,181,541 |

*Uses*

Most of the output of gravel and sand is used in road building and concrete construction. Gravel has proved a good material for low-cost, all-weather road surfaces. The development of improved methods of processing the material and of compacting the understructure of the pavements has led to its extensive use for wearing and base courses on paved rural roads.

Most of the gravel used for road work comes from pits worked exclusively for that purpose. They are operated to supply the immediate need and to build up a reserve of processed gravel, in the form of stockpiles, large enough for 1 or 2 years' requirements, after which the processing equipment is moved elsewhere. The road pits may remain idle for 2 or more years.

The use of crushed, screened, and washed gravel is increasing steadily. Most provinces use crushed instead of pit-run gravel for surfacing their main highways because the angular aggregate produced by crushing can be more densely compacted and imparts greater stability to the road surface under traffic.

Pit-run gravel is being replaced gradually by processed gravel or crushed stone as ballast on main railway lines. The crushed gravel or stone is bought from commercial plants or processed by contract in pits or quarries owned by the railway companies. In the latter case the pits or quarries are operated not only for the immediate need, but to build stockpiles for several years' requirements, after which the quarries or pits remain idle for a year or more.

Large tonnages of sand and gravel are used for refilling the worked out parts of mines.

Large commercial plants are equipped for producing crushed, screened, and washed gravel, a product that can compete with most types of crushed stone.

Most of the sand excavated is used in the building industry such as in concrete work, cement and lime mortar, and wall plaster. For these purposes the sand must be free from dust, loam, organic matter, or clay. When demand is high a large part of these materials is obtained from rivers or lakes either with dredging boats or portable dredging equipment installed at the shore.

Other important uses of sand are for moulding in foundries, filtering of water supplies, and glass making, all of which require special grades of sand. Some large foundries buy ordinary sand and process and blend it to the required grade.

*Prices*

Prices for carlots, f.o.b., cars, at end of 1950, as reported by "Engineering and Contract Record", were as follows:

(Dollars per short ton)

| —— | Montreal | Toronto | Winnipeg | Vancouver[1] |
|---|---|---|---|---|
| Sand | 2·00 | 3·45 | 3·60[2] | 2·15 |
| Gravel, ¾ inch | 2·50 | 4·00 | 3·75[2] | 2·15 |
| Crushed stone, ¾ inch | 1·50 | 4·00 | 4·36[2] | 2·33 |

[1] Prices subject to 3 per cent Provincial Government tax.
[2] Per cubic yard.

## SILICA MINERALS

Canadian production of silica minerals consists of quartz, quartzite, and low-grade silica sand. The 1950 output totalled 1,730,695 short tons compared with 1,722,476 short tons in 1949.

There is little production of high-grade silica sand in Canada at present, domestic requirements for such industries as glass, silicon carbide, and sodium silicate being imported in large quantities mainly from United States. The expansion under way in these industries and the resultant heavy demand for such sands led to an increase in the volume imported in 1950 to 573,362 short tons compared with 511,116 short tons in 1949.

The growing demand for high quality silica sand has centred interest on the possibility of utilizing Canadian deposits of quartzite and sandstone as sources for these sands. Extensive investigations were carried out of several deposits particularly in Quebec and Ontario. Considerable success was achieved in the development of methods of beneficiation to meet the specifications of industry, mainly the glass and ceramic industries, and by the end of 1950 there was promise of the development of several new industries that will use silica sand in these provinces within a year or two.

Two new plants for the production of silicon carbide were opened at Cap de la Madeleine in Quebec, and the construction of a new sheet glass plant in Toronto was nearing completion.

Most of the Canadian output of quartz, quartzite, and low-grade silica sand is used as a flux in base metal smelters, followed by the production of lump silica for making silicon and ferrosilicon alloys. The remainder of the output is quartzite for silica brick, and silica sand for use in artificial abrasives and in the steel industry.

*Nova Scotia*

Dominion Steel and Coal Corporation, Limited is the chief user of silica and obtains quartzite from Chegoggin Point, Yarmouth county, for use in its silica brick plant at Sydney.

Further investigations were made in 1950 of the beach sands, sandstones, and quartzites of the province as probable sources for high quality silica sands, and in some cases promising results were obtained.

*Quebec*

Canadian Carborundum Company, Limited produces silica sand at St. Canut in Two Mountains county for use in its abrasive plant at Shawanigan Falls.

*Production and Trade*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Short tons | $ | Short tons | $ |
| *Production* of quartz and silica sand... | 1,730,695 | 1,740,268 | 1,722,476 | 1,588,531 |
| *Production* of silica brick (thousands of bricks)........................ | 3,126 | 408,813 | 3,663 | 453,797 |
| *Imports* of silica sand | | | | |
| From: United States.............. | 569,724 | 1,555,937 | 505,723 | 1,354,514 |
| Belgium.................... | 3,515 | 5,699 | 5,219 | 7,086 |
| United Kingdom............ | 123 | 3,312 | 174 | 839 |
| Total................. | 573,362 | 1,564,948 | 511,116 | 1,362,439 |
| *Exports*—Quartzite | | | | |
| All to the United States........... | 195,430 | 540,940 | 144,302 | 326,091 |

Various grades of silica are produced by St. Lawrence Alloys and Metals, Limited at its crushing and screening plant in Melocheville from a quarry in Potsdam sandstone. Most of the products are used in the company's ferrosilicon plant at Beauharnois.

Several companies did development work on quartzite and sandstone properties in various parts of the province.

*Ontario*

Kingston Silica Mines, Limited produces silica sands from an outcrop of Potsdam sandstone near Joyceville, 11 miles north of Kingston. The sand is used in making artificial abrasives, and as steel foundry sand.

Dominion Mines and Quarries, Limited, Killarney, on the north shore of Georgian Bay, and Canadian Silica Corporation, Limited, Sheguindah, Manitoulin Island, produce quartzite from large outcrops of Lorrain quartzite. This quartzite is used in Canada and the United States as a raw material to make silicon and ferrosilicon alloys.

Algoma Steel Corporation, Limited, Sault Ste. Marie, obtains quartzite from Bellevue, 20 miles to the north, for use in its silica brick plant.

Prospecting and development work was carried out on several sandstone properties in eastern Ontario during 1950.

*Other Centres of Production*

Silica for use as a flux in base metal smelters is produced near Noranda, Quebec; Sudbury, Ontario; Flin Flon, Manitoba; and Trail, British Columbia.

## *Uses*

*Quartz* and quartzite are used mainly in lump form as sources of silica for smelting operations, or for the production of silicon and ferrosilicon. If the quartz is exceedingly pure it may be ground down into very fine powder and sold as silica flour for various uses, mainly in the ceramics industry. Quartzite when crushed into sands is used as a source of silica for silica brick, or for sandblast sand, and, infrequently, as silica sand for glassmaking, etc.

*Sandstone* is broken down and cleaned to produce silica sand for use in glassmaking, steel foundry casting, sodium silicate, and the manufacture of artificial abrasives. The coarser grades are used for sand blasting and the fines are used as fillers for asbestos shingles, asbestos cements, paints, and soaps. In value of products this is the most important silica raw material.

*Quartz crystals.* Clear crystals of quartz without flaws and possessing the necessary piezo-electric properties are valuable in radio frequency control apparatus. Very few suitable crystals have been found in Canada, and Canadian requirements are obtained from Brazil.

### *Specifications*

Some typical specifications for the more important uses for silica are given below.

I. *Silica Sands*

*Glassmaking.* Grains should vary in size from 28 mesh to 150 mesh. For container-glass the $Fe_2O_3$ content should be under 0·04 per cent. For optical glass the iron oxide content should be as low as 0·015 per cent. Other impurities such as alumina, lime, magnesia, titanium oxide, and alkalis should be closely controlled. Shape of grain is of little importance.

*Foundry Sands.* Silica content must be over 95 per cent and grain size and shape are of great importance. Size varies from 20 mesh down to 200 mesh depending upon the type of casting, foundry practice, etc., and the grain is usually rounded in shape.

*Artificial Abrasives.* Grain size is usually coarser than glass sands. The chief impurity to be eliminated is alumina. Silica content must be well over 99 per cent, and iron content usually under 0·10 per cent iron oxide.

*Sodium Silicate.* The specifications are similar to those for glass sand as far as impurities are concerned but grain sizes are slightly coarser.

*Sand Blast.* This requires a very tough clean grain of between 8 and 48 mesh in size.

II. *Lump Silica*

*Ferrosilicon.* Lumps should contain over 98·5 per cent silica and under 1·0 per cent alumina, with size varying from over 1 inch to a maximum of from 3½ to 4 inches.

*Fluxes.* These are dependent upon the type of smelter. Initial cost must be low.

*Silica Brick.* Lump is crushed to about 8-mesh maximum size. Silica content should be above 98 per cent; alumina and iron oxide content, low; and alkali content, very low.

III. *Silica Flour*

*Ceramics.* Silica content should be over 99 per cent and iron oxide, under 0·10 per cent. Size is generally all minus 325 mesh.

*Fillers.* A white colour is usually very important, and size of material is generally all minus 150 mesh. Silica content should be 90 per cent and over, dependent upon the industry.

### *Prices*

The price per ton of the several grades of silica varies greatly, depending upon its purity and the purpose for which it is to be used. Silica generally is a low-priced commodity, and, therefore, the location of a deposit with respect to markets is of great importance. The largest markets for silica are in Quebec and Ontario and new deposits, to be of interest to these markets, should be within economic reach of the southwestern Ontario, Toronto, or Montreal areas. In western Canada the main markets are in Alberta and Manitoba. West of Winnipeg the silica needs are almost entirely imported.

Prices, according to Canadian Chemistry and Process Industries, increased slightly during 1950, chiefly in the coarser grades.

*Silica Sand*

| — | Various grades | | Silica, quartz, 99 per cent silica soft | |
|---|---|---|---|---|
| | Toronto carload lots | Toronto L.C.L. | 110–220 grade | Decomposed 325 mesh |
| | Per ton | Per ton | Carlots, per ton | Carlots, per ton |
| December, 1949 | $11.-12. | $16.-17. | $21.-33. | $30.-35. |
| December, 1950 | $12.-13. | $17.-18. | $21.-33. | $30.-35. |

## SODIUM SULPHATE (NATURAL)

Industrial demand for natural sodium sulphate, particularly by the pulp and paper industry, strengthened perceptibly in 1950. Production, which comes entirely from Saskatchewan, totalled 130,730 short tons, an increase of 9 per cent over the 1949 output, whereas exports increased 35 per cent to 28,375 short tons. Demand, however, outstripped supply and imports rose to 17,961 short tons to meet industrial needs in eastern and western coastal areas of Canada, compared with 6,289 short tons in 1949. Despite increased demand, the price of natural sodium sulphate remained steady during 1950.

Large reserves of sodium sulphate occur in Saskatchewan, mainly, and in Alberta, in beds and in highly concentrated brines in alkali lakes.

*Production and Trade*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Short tons | $ | Short tons | $ |
| *Production* (shipments) | 130,730 | 1,615,867 | 120,259 | 1,614,731 |
| *Imports* | | | | |
| From: United States | 12,826 | 184,650 | 5,584 | 110,094 |
| United Kingdom | 4,307 | 63,029 | ........... | ........... |
| Germany | 828 | 16,577 | 705 | 15,587 |
| Total | 17,961 | 264,256 | 6,289 | 125,681 |
| **Exports* to the United States | 28,375 | 302,329 | 21,090 | 294,367 |

* From United States Import Statistics.

The producers of natural sodium sulphate in 1950 were: Natural Sodium Products, Limited, which operated its plant at Bishopric but not at Alsask in 1950; Ormiston Mining & Smelting Company Limited, which took over the operation formerly conducted by Horseshoe Lake Mining Company Limited at Ormiston; Midwest Chemicals, Limited at Palo; Sybouts Sulphate Company at Gladmar; and Saskatchewan Minerals, Sodium Sulphate Division, which announced plans for expanding its plant at Chaplin Lake.

Although production methods vary considerably, the general trend is towards the production of a higher grade product by means of the crystallizing pond.

In some lakes the sodium sulphate occurs as an actual bed in a dried-up lake or under a saturated brine; in others, as a brine with little or no actual crystal beds. In the late summer months the brine in all lakes is usually almost saturated and at this time the brine is pumped from the lake into an enclosed pond. After being subjected to more evaporation and the effects of cooler weather, the sodium sulphate crystallizes out and the excess brine is returned to the main lake. The crystal or Glauber's salt is collected and stockpiled. The salt is then fed to a dehydrating plant to remove the water of crystallization, which amounts to over 50 per cent of the weight of the crystal. The dehydrating plants usually consist of a simple rotary kiln and a crushing and screening plant. The finished salt commonly known as 'salt cake' is shipped in bulk. The product from this crystallizing pond method is usually purer than that produced from the mining of the salt beds with all their included silt and other salts.

### *Uses and Prices*

Sodium sulphate is used chiefly in the sulphate process in making kraft pulp. It is used in the glass, dye, chemical, and textile industries, and to a lesser extent, for medicinal purposes, and for tanning.

The price of natural sodium sulphate (salt cake) continued at the same price of from $13 to $13.50 a ton f.o.b plant throughout 1950. The price for salt cake varies considerably depending upon the size and period of time covered by contract, and on the purity of the salt cake supplied.

## SULPHUR AND PYRITES

The uncertainty of obtaining adequate supplies of elemental sulphur from the Frasch-mined domes of Texas and Louisiana in the United States led all countries in 1950 to seek alternative sources of supply of this necessary element.

Canadian industry has been supplied, for many years, with most of its sulphur requirements by United States Frasch-mined sulphur. World demand for this sulphur has necessitated the imposition of controls on its distribution as production has not kept pace with demand. Until the third quarter of 1950, Canadian manufacturers of pulp and paper, heavy chemicals, explosives, and textiles experienced little difficulty in obtaining their needs of elemental sulphur from United States. However, at that time, low producers' stocks and declining reserves threatened to reduce shipments from producers with the prospect of a continuing shortage for some time. These conditions, together with higher prices, stimulated the search for alternative sources of supply in Canada.

Canada has no known deposits of elemental sulphur. From 1935 to 1943 sulphur was produced from smelter gases by The Consolidated Mining and Smelting Company of Canada Limited, at Trail, British Columbia, using a coke reduction process. Since 1943 the sulphur dioxide ($SO_2$) in stack gases has been used by the company to make sulphuric acid, which in turn is used to make fertilizers in its plant at Trail. There has been no further production of elemental sulphur.

Noranda Mines Limited has experimented on a laboratory scale, and more recently by pilot-plant operation, on the production of elemental sulphur, sulphur dioxide, and an iron oxide sinter from the estimated 100,000,000 tons of pyrite reserves in its mine at Noranda, Quebec. The company has also leased the pyrite reserves blocked out in the MacDonald mine, about 4 miles north of Noranda.

With the introduction of the new flash-roasting process for smelting the copper concentrates at the Copper Cliff smelter of The International Nickel Company of Canada, Limited, in the spring of 1951, greatly increased recovery of the sulphur dioxide in stack gases will be obtained. At present only a small part of the $SO_2$ in the fumes is recovered as sulphuric acid in the adjacent plant of Canadian Industries Limited. The first flash-roasting unit is expected to be in operation in the early summer of 1951 and this unit will be utilized to increase the output of sulphuric acid. With the installation of additional units, the manufacture of liquid sulphur dioxide is planned. In its report on "The Removal of Sulphur Gases from Smelter Fumes (1949)" the Ontario Research Foundation estimated that about 1,250,000 tons of sulphur are lost each year in stack gases as $SO_2$ from the three smelters in the Sudbury area.

The recovery of sulphur in elemental form from 'sour' natural gases containing hydrogen sulphide ($H_2S$) is a development of recent years. The amount of $H_2S$ in natural gases varies with the fields but large volumes of proven reserves have been established in the Pincher Creek, Jumping Pound, and Turner Valley fields of Alberta and are estimated to contain 8, 4 and 2 per cent hydrogen sulphide gas, respectively. One million cubic feet of $H_2S$ gas contains approximately 44·6 tons of elemental sulphur and, with a recovery of 80 to 90 per cent of the sulphur contained in the natural gas, one million cubic feet of hydrogen sulphide in the gas would yield from 35·7 to 40·1 tons of elemental sulphur.

Shell Oil Company of Canada expects to clean about 25,000,000 cubic feet of gas from the Jumping Pound field daily in its proposed sulphur recovery plant. This would result in the recovery of about 10,000 tons of elemental sulphur each year. Other natural gas distribution companies also plan to recover elemental sulphur.

Naturally, the amount of elemental sulphur to be recovered from sour natural gases depends upon the volume of gas being consumed and its $H_2S$ content. Within the next few years it is possible that some 50,000 tons might be recovered annually, but in the immediate future even this figure must be scaled downwards. The cost of recovery of sulphur from natural gases is estimated to vary from $2 to $6 a ton, excluding capital costs.

Fortune Oils Limited in 1950, while drilling for oil 100 miles north of Edmonton, reported the discovery of elemental sulphur in the cuttings from two holes. Core drilling is to be undertaken to verify the presence of sulphur which is said to occur at about the 3,000-foot horizon. To date, no Frasch-mined sulphur from Texas and Louisiana has come from depths greater than 2,000 feet.

Recovery of elemental sulphur from coke-oven, oil refinery, and other industrial gases does not appear to be practicable in Canada at present. Several processes are used in plants in United States for such recovery but overall annual recovery amounts only to about 50,000 long tons.

The extensive deposits of anhydrite and gypsum in Canada, particularly in New Brunswick and Nova Scotia, constitute a huge potential source of sulphur and its compounds. Plants for the recovery of sulphur as sulphuric acid, and production of Portland cement from anhydrite, are in operation in England, Germany, and France.

*Pyrite in Canada*

Canada's production of pyrite in recent years has been obtained as a by-product from the treatment of base metal ores and has been considered as a small profit operation, bringing from $2 to $2.50 a long ton f.o.b. the mine to the producers. Production in 1950 came from the Noranda, Waite Amulet, Quemont, and East Sullivan mines in western Quebec, and from the Britannia mine in British Columbia. Most of the output of pyrite from these mines has been contracted for to the end of 1953. It is sold for making sulphuric acid at the plants of the Nichols Chemical Company Limited at Valleyfield in Quebec, Sulphide in Ontario, and Barnet in British Columbia, and to St. Lawrence Paper Mills Limited at Three Rivers, Quebec, the only Canadian paper company presently burning pyrite as a source of sulphur. All other pulp and paper companies burn imported elemental sulphur as a source of sulphur for their sulphite plants. Consolidated Mining and Smelting Company used some pyrrhotite tailings in 1950 to increase its output of suphuric acid for use in making fertilizers.

Large deposits of pyrite are known to occur in several localities in Canada. Near the turn of the century, before the Frasch-mined domes of Texas and Louisiana were in operation, large shipments of high-grade pyrite were made from mines in Newfoundland and in the Eastern Townships of Quebec. Several of these long idle properties are resuming operations. Nearly massive pyrite bodies were mined, in conjunction with chalcopyrite, at Pilley's Island in Newfoundland and at the Eustis mine (now Albert Metals Corporation) in the Eastern Townships, near Sherbrooke. Ascot Metals Corporation Limited and Suffield Metals Corporation Limited, with properties near Sherbrooke, are

*Canadian Production, Consumption, and Trade*

(Tons of 2,000 pounds)

| — | 1950 | 1949 |
|---|---|---|
| *Production* | | |
| Sulphur equivalent in pyrites shipped | 150,487 | 117,581 |
| Sulphur equivalent recovered from smelter gases | 150,685 | 144,290 |
| Total | 301,172 | 261,871 |
| *Imports* | | |
| Crude, roll, and flour sulphur, all from United States | 390,333 | 280,557 |
| *Exports*, in pyrites (sulphur equivalent) | | |
| To: United States | 110,368 | 60,291 |
| Mexico | 1,284 | 1,902 |
| Japan | ........... | 28,360 |
| Total | 111,652 | 90,553 |
| *Consumption* | | |
| Pulp and paper | 282,608 | 252,502 |
| Heavy chemicals | 230,693* | 212,798* |
| Rubber goods | 2,524 | 2,001 |
| Insecticides | 4,114 | 2,333 |
| Explosives | 1,900 | 1,712 |
| Miscellaneous | 1,193 | 1,246 |
| Total | 523,032 | 472,592 |

* Includes sulphur equivalent from smelter gases.

developing copper-lead-zinc orebodies with pyrite as a likely by-product. In western Canada, Noranda Mines Limited has blocked out about 100,000,000 tons of good grade pyrite low in copper, and has leased part of the property of MacDonald Mines Limited, in Dufresnoy township, where substantial reserves of pyrite have been blocked out.

Several mines in Ontario that produced pyrite for acid manufacture before the advent of Frasch-mined sulphur might bear re-examination. Shipments of pyrite grading above 40 per cent sulphur were made from several properties in eastern Ontario and from the Northland Pyrites mine about 12 miles north of Timagami. The Goudreau Lake deposits, about 18 miles southwest of Missanabie, consist of large pyrite lenses of good grade material on which relatively little exploratory work has been done. The Vermilion Pyrites mine, about 7 miles west of Sioux Lookout, was developed to a depth of 260 feet and appears to be one of the larger known Canadian deposits of good grade pyrite. There are many other known occurrences of pyrites in Ontario.

In British Columbia large tonnages of pyrite associated with copper and zinc sulphides have been indicated by drilling in the Ecstall River deposits near its junction with the Skeena River about 35 miles above Port Essington.

### *World Production*

World reserves of pyrite are widely distributed and deposits are operated in at least thirty countries. The largest known reserve, located in the southern part of Spain and in Portugal, is estimated to contain 200 million tons of recoverable sulphur in 500 million tons of ore.

Approximately 5,200,000 long tons of elemental sulphur were produced from the seven salt dome sulphur deposits mined in United States by the Frasch process in 1950. Six of these domes are in Texas and one in Louisiana. They are the only deposits from which sulphur has been produced by the Frasch method.

### *Uses*

Sulphur in the elemental form is used in making a long list of commodities, including rubber and insecticides, and large tonnages are used in the manufacture of paper. Most of the sulphur from all sources, however, is converted into sulphuric acid, which is used chiefly in the manufacture of fertilizer, steel, and explosives, and in the petroleum refining, the textile, chemical, and metallurgical industries.

### *Prices*

In the latter half of 1950 the price of elemental sulphur, per long ton, f.o.b. Texas mines, was advanced to $22 from $18. With freight charges added, elemental sulphur can be laid down at about $30 a long ton at Canadian consumers' plants.

The price of Spanish pyrites at United States east coast ports remained at 14 to 16 cents a long ton unit (22·4 pounds) of contained sulphur, c.i.f., guaranteed 48 per cent sulphur. Thus, a 50 per cent sulphur content pyrite would cost 50 x 16=$8 a long ton c.i.f. New York.

Prices paid for by-product pyrite from Canadian mines were a matter of negotiation and varied from $2 to $2.50 a short ton, f.o.b. mine, for total output over a period of years.

# TALC AND SOAPSTONE

Sales of talc and soapstone in Canada in 1950 totalled 32,604 short tons, an increase of 21 per cent over that of 1949. Production came from the Eastern Townships of Quebec, and from the Madoc area in Ontario.

Approximately 14 per cent of the output was exported, mostly to United States.

Imports consisted mainly of special grades for the ceramic, paint, and cosmetic trades from United States and, on a smaller scale, from Italy. Canadian requirements of sawn dimension soapstone blocks and crayons are met by domestic producers. Imports increased to 8,974 short tons, compared with 7,269 short tons in 1949.

*Production, Trade, and Consumption*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | Short tons | $ | Short tons | $ |
| *Production* (sales) | | | | |
| Ground | 32,163 | 340,953 | 26,563 | 301,655 |
| Sawn soapstone blocks and talc crayons | 441 | 24,042 | 359 | 19,138 |
| Total | 32,604 | 364,995 | 26,922 | 320,793 |
| *Imports* | | | | |
| From: United States | 8,081 | 248,087 | 6,633 | 200,046 |
| Italy | 853 | 38,497 | 599 | 26,768 |
| Other countries | 40 | 1,436 | 37 | 1,594 |
| Total | 8,974 | 288,020 | 7,269 | 228,408 |
| *Exports* | | | | |
| To: United States | 4,306 | 55,401 | 4,144 | 52,153 |
| Ecuador | 105 | 1,351 | ........ | ........ |
| Australia | ........ | ........ | 29 | 1,485 |
| Other countries | 56 | 869 | 49 | 877 |
| Total | 4,467 | 57,621 | 4,222 | 54,515 |
| *Consumption* | | | | |
| Roofing | 8,595 | ........ | 7,696 | ........ |
| Paints | 5,378 | ........ | 6,041 | ........ |
| Rubber | 3,002 | ........ | 3,125 | ........ |
| Insecticides* | ........ | ........ | 2,461 | ........ |
| Pulp and paper | 3,827 | ........ | 3,722 | ........ |
| Toilet preparations | 864 | ........ | 1,242 | ........ |
| Clay products | 882 | ........ | 1,127 | ........ |
| Other uses | 7,199 | ........ | 1,368 | ........ |
| Total | 29,747 | ........ | 26,782 | ........ |

* 1949 consumption included under other uses.

## *Quebec*

Broughton Soapstone and Quarry Company, Limited, Broughton Station, continued to produce ground talc, sawn soapstone blocks, bricks, and crayons. Baker Mining and Milling Company, Limited, with mine and mill near High-water, continued production of ground talc. Eastern Townships talc is adapted for use as filler material where colour is of secondary importance.

*Ontario*

Canada Talc Limited, Madoc, the only other producer, continued production of prime white talc for ceramic, cosmetic, and filler trades.

*British Columbia*

Ground talc is produced from imported materials by Geo. W. Richmond and Company for the local roofing trade.

## *Uses and Specifications*

The roofing, rubber, and paint industries account for the bulk of Canadian consumption. Lower grade talc is used as a surfacing material and dusting agent in asphalt paper roofing, as a filler and dusting agent in rubber products, and as a polishing agent for wire nails, rice, peanuts, and other commodities. For paint use, colour, particle shape, packing index, and oil absorption are the principal factors. The ceramic trade demands prime white colour and the paper industry, talc of high brightness, high retention, low abrasiveness, and freedom from chemically active substances. For lubricants, talc must be soft, free from grit, and have high slip. Talc of high purity is demanded for the cosmetic and pharmaceutical trades.

Other uses include cleansers, plaster, polishes, plastics, foundry facings, linoleum, and oilcloth, oil absorbent preparations, and filler for textiles, pipeline enamel, and other products.

Steatite, the massive, compact form of talc, is used in making ceramic insulators.

Purchasers of crude talc for grinding purposes include Industrial Fillers, Limited, Montreal, Quebec, and Geo. W. Richmond and Company, Vancouver, British Columbia.

## *Prices and Tariffs*

Final 1950 quotations as published in Canadian Chemistry and Process Industries were unchanged from 1949 as follows: $9.50 to $44 a short ton according to size and quality f.o.b. Madoc, Ontario; imported Italian, in bags, f.o.b. Toronto or Montreal, 4 to 5 cents a pound.

The Canadian tariff was as follows:

| — | British | Most favoured nation | General |
|---|---|---|---|
| | Per cent | Per cent | Per cent |
| Up to May 30, 1950 | 15 | 20 | 25 |
| After May 30, 1950 | 10 | 15 | 25 |

The United States tariff in 1950 was as follows:

| | |
|---|---|
| Crude and unground | ⅛c a pound. |
| Washed and powdered: | |
| not more than $14 a ton | 10 per cent ad valorem; |
| more than $14 a ton | 14½ per cent ad valorem. |
| Cut, sawn blocks, crayons, disks, or other forms | ½c a pound. |

## Pyrophyllite

Pyrophyllite, a mineral similar to talc, but with alumina substituted for magnesia, is adaptable generally to the same uses as talc. Pyrophyllite has been produced intermittently in Newfoundland from a large deposit near Manuels, Conception Bay. There was no production in 1950.

## VERMICULITE

There has been no production of vermiculite in Canada up to the present. Imports, all of which have been obtained from United States and South Africa were valued at $262,559 in 1950, an increase of 33 per cent over that of 1949.

Siscoe Vermiculite Mines, Limited, subsidiary of Siscoe Gold Mines, Limited, in 1950 undertook the development of a deposit discovered during the year near Stanleyville, about 8 miles southwest of Perth, Ontario. A deposit of vermiculite was reported also from Blue River, Kamloops mining division, British Columbia.

*Trade and Consumption*

| — | 1950 | 1949 |
|---|---|---|
| | $ | $ |
| *Imports*—crude, cleaned and screened | | |
| From: United States | 201,278 | 153,958 |
| Union of South Africa | 61,281 | 43,097 |
| Total | 262,559 | 197,055 |
| | 1949 | — |
| | Short tons | $ |
| *Ore used* | 14,835 | 378,913 |
| *Products produced:* | | |
| Insulation products | ............ | 677,010 |
| Other products | ............ | 90,178 |

*World Sources*

United States and South Africa are the principal suppliers of crude vermiculite. In United States the deposit at Libby, Montana, is outstanding. Other deposits occur in North and South Carolina, Wyoming, Texas, Colorado, Georgia, and other states. In South Africa the principal deposits occur at Palabora, East Transvaal, with others in Tanganyika, Kenya, Uganda, and other areas. Russia is known to be a producer, and occurrences have been reported in India, Australia, and Japan.

*Description and Uses*

Vermiculite, a hydrated magnesian aluminium silicate, resembles mica closely but is softer and inelastic. Colours range from black through brown and dark green to almost colourless. Its principal characteristic is its ability to expand many times on heating. In its expanded form it possesses low bulk density, low thermal conductivity, high heat resistance, chemical inertness, and acoustic properties. Vermiculite is generally regarded as a product of alteration and is usually associated with metamorphosed ultra-basic rocks.

Vermiculite is used principally as loose insulation in buildings; as concrete and plaster aggregate; in the manufacture of lightweight fire-resistant and acoustic tile and wallboard; and as a rooting medium and soil amendment. It is also used in lubricants, dry chemicals (as a diluent), combination refractory and insulating brick, as a pigment and extender in paint, and as decorative filler in wallpaper. Vermiculite has been used as fireproof deck covering and partitions on ships, as loose insulation in fire and sound-proof partitions in vehicles and aircraft, as filler for life jackets, and, in finely powdered form, for oil-less bearings.

### *Markets and Specifications*

Purchasers of imported raw vermiculite include F. Hyde and Company, Limited, 5350 Connaught Ave., Montreal; Insulation Industries (Man.) Limited, 760 Wall St., Winnipeg; Vermiculite Insulating Limited, 5095 City Hall, Montreal; and Suzorite Company of Ontario Limited, Cornwall, Ontario.

Raw vermiculite is usually sold as concentrate screened to commercial sizes. Specifications vary according to the requirements of individual purchasers but, in general, foreign impurities should not exceed 5 per cent and total unexpandable material, 10 per cent.

Size classifications are approximately as follows:

Acoustic tile, $-\frac{1}{2}$ inch + 3 mesh.
Loose insulation, $-3 + 14$ mesh.
Concrete and plaster aggregate, soil amendment, etc. $-6$ or $-8 + 65$ mesh.

Bulk densities of expanded vermiculite sold in Canada range from under 5 pounds a cubic foot for loose insulation to about 7 pounds for concrete and plaster aggregate.

### *Prices and Tariffs*

According to Engineering and Mining Journal Metal and Mineral Markets vermiculite quotations remained unchanged throughout 1950 as follows: crude, cleaned and screened f.o.b. Montana mines, $12 a short ton; South African, f.o.b. Atlantic ports, $30.

Crude vermiculite enters both Canada and United States free of duty.

## WHITING SUBSTITUTE

Whiting substitute is usually termed domestic whiting or marble flour in Canada. Whereas true whiting is prepared from chalk, whiting substitute is a pulverized form of white limestone, marble, calcite, or marl. It may also be prepared from calcium carbonate which has been precipitated in chemical processes. Although marl had been the source of much of the whiting substitute produced in Ontario for several years, Canadian production in 1950 was obtained entirely from marble and limestone.

In processing whiting substitute, the limestone and marble are pulverized to a fineness of 200 to 400 mesh. Precipitated calcium carbonate is recovered from residues in the manufacture of caustic soda by the lime soda process. This material has a restricted use owing to the presence of free alkali. It is not recovered in Canada.

*Production and Trade*

Production statistics for 1950 and 1949 are shown in the following table:

| Stone Processed into Whiting | 1950 | | 1949 | |
|---|---|---|---|---|
| | Short tons | $ | Short tons | $ |
| Marble | 10,587 | 128,248 | 8,130 | 97,560 |
| Limestone | 7,016 | 44,212 | 7,527 | 38,603 |
| Total | 17,603 | 172,460 | 15,657 | 136,163 |

Canadian producers of whiting comprise Industrial Fillers Limited, Montreal, which operates a quarry at St. Armand, Bedford county, Quebec; Marlhill Mines Limited, Thorold, Ontario; Gypsum Lime and Alabastine (Canada) Limited, Winnipeg, Manitoba; and Beale Quarries Limited, which operates a quarry at Vananda, Texada Island, British Columbia.

In many industries imported chalk whiting is essential. Imports of whiting, Gilder's whiting, Paris whiting and grade of prepared chalk amounted to $479,379 in 1950, compared with $436,006 in 1949. Most imports originated in United States, the United Kingdom and other European countries shipping the remainder.

*Uses, Specifications, and Prices*

Whiting substitute is used in making linoleum, oilcloth, certain rubber products, molded plastic articles, cleaning compounds, polish, putty and explosives, and as a filler in paper. Whiting substitute of high purity and excellent colour is also used as an extender in the paint industry. Factors governing selection for the latter use include particle shape and oil absorption.

Whiting substitute is one of several mineral fillers used in the rubber industry where the important factors are suitable fineness, workability, and the effect on the finished rubber. The fine particles should be readily dispersible and should form a ready bond with rubber.

In the paper industry whiting is used as a filler to increase opacity and improve the printing quality. Fineness is important.

Prices of limestone whiting 99½ per cent minus 325 mesh, bagged, in carload lots was $10 a ton f.o.b. U.S. points. Precipitated whiting was quoted in United States at $20 a ton carload lots f.o.b. works.

# III. FUELS

## COAL

Canadian production of coal reached a record of 19,139,112 tons in 1950 compared with 19,120,046 tons in 1949, the previous peak year. Alberta contributed 42 per cent of the output and Nova Scotia 34 per cent, the remainder being from Saskatchewan, British Columbia, and New Brunswick. About 59 per cent of the Canadian consumption of 44,874,000 tons of coal was imported compared with 55 per cent in 1949, when consumption amounted to 39,938,000 tons.

Strip mining of coal is practised in all coal-producing provinces, the amount so mined in 1950 being 5,856,127 tons or 30·6 per cent of the total output. In Saskatchewan about 98 per cent of the coal mined was produced by strip methods; in Alberta, 38 per cent; in New Brunswick, 56 per cent; and in British Columbia, 14 per cent.

### *Developments*

Faced with increased competition from oil and natural gas and to a lesser extent from imported solid fuels, the coal industry continued its efforts to produce better quality coals. Thus, during 1950, one company in Nova Scotia installed a Baum jig plant to clean the production from two mines and another installed a pneumatic heavy-medium plant for cleaning certain domestic sizes. Improvements were made at certain coal washeries in western Canada. A pneumatic cleaning plant was established at one mine that produces non-caking bituminous coal, and the installation of cleaning equipment in the Drumheller area, Alberta, was under consideration. In the Nordegg area in Alberta, a complete new plant was being constructed that will use wet cleaning entirely and will include thermal dryers to reduce the moisture content of all sizes.

In the Mountain Park area, Alberta, a plant addition was completed that will enable a doubling of production of briquettes from medium volatile coal, and construction of other plants for blending non-caking subbituminous coal with coking coal for the production of domestic briquettes was being considered. Subsequent to laboratory experimental work at the Mines Branch, Ottawa, plant tests were conducted in Alberta to determine the applicability of a process for briquetting wet coal fines for the production of railway fuel. The feasibility of such a process under certain conditions was demonstrated.

Use of the process developed in the Mines Branch several years ago for the improvement of blower coal by chemical treatment was continued in Quebec and Ontario.

The tables below, compiled from data supplied by the Dominion Bureau of Statistics and the Department of Transport, clearly indicate the increasing use of oil.

*Fuel Consumed by Railways*

(Mainly for locomotives)

| — | Coal (thousands of tons) | Fuel and diesel oil (millions imp. gals.) | * Heat equivalent of oil in terms of coal (thousands of tons) | Heat equivalent of oil as per cent of total coal and oil |
|---|---|---|---|---|
| 1940 | 7,818 | 55·3 | 376·8 | 4·6 |
| 1941 | 9,536 | 73·2 | 498·9 | 5·0 |
| 1942 | 10,614 | 73·9 | 503·7 | 4·5 |
| 1943 | 11,987 | 77·8 | 530·6 | 4·2 |
| 1944 | 11,993 | 60·3 | 411·1 | 3·3 |
| 1945 | 12,084 | 98·9 | 674·3 | 5·3 |
| 1946 | 11,632 | 102·6 | 699·5 | 5·7 |
| 1947 | 12,331 | 108·4 | 739·1 | 5·7 |
| 1948 | 12,422 | 113·7 | 775·2 | 5·9 |
| 1949 | 11,444 | 162·9 | 1,110·7 | 8·8 |
| 1950 | 10,966 | 245·8 | 1,675·9 | 13·3 |

* Estimated in terms of coal at 13,000 Btu/lb. taking oil at 9·33 lb./gal. with a calorific value of 19,000 Btu/lb.

*Fuel Consumed for Domestic and Building Heating*

(For installations consuming less than 500 tons per annum)

| — | Coal (thousands of tons) | Fuel oil* (millions imp. gals.) | Estimated heat equivalent of oil in terms of coal (thousands of tons) | Heat equivalent of oil as per cent of total coal and oil |
|---|---|---|---|---|
| 1941 | 12,163 | 146·8 | 1,001 | 7·6 |
| 1942 | 13,711 | 124·0 | 848 | 5·8 |
| 1943 | 14,981 | 95·4 | 650 | 4·2 |
| 1944 | 12,571 | 103·3 | 705 | 5·3 |
| 1945 | 13,498 | 143·8 | 980 | 6·8 |
| 1946 | 13,454 | 323·0 | 2,202 | 14·1 |
| 1947 | 13,117 | 343·0 | 2,338 | 15·1 |
| 1948 | 13,429 | 384·3 | 2,619 | 16·3 |
| 1949 | 12,473 | 445·5 | 3,037 | 19·6 |
| 1950 | 12,653 | ** | ** | — |

* Exclusive of stove oil.
** Indications are that there was a substantial increase over 1949 in fuel oil consumption.

From the above table it may be noted that, although the number of steam locomotives in service on Canadian railways in 1950 showed a slight increase over those being used in 1939, the number of Diesel locomotives in service increased from none in 1939 to approximately 350 in 1950, with the expectation of a further increase to 480 in 1951. Thus, although the quantity of locomotive coal consumed in 1950 was about the same as in 1939, there has been a steady changeover to Diesel locomotives to handle the marked increase in railway traffic in the intervening years.

*Production of Coal by Provinces**

(Tons of 2,000 pounds)

| Province | 1950 | | | | 1949 | | | |
|---|---|---|---|---|---|---|---|---|
| | Bituminous | Sub-bituminous | Lignitic | Total | Bituminous | Sub-bituminous | Lignitic | Total |
| Nova Scotia | 6,478,405 | ........... | ........... | 6,478,405 | 6,181,779 | ........... | ........... | 6,181,779 |
| New Brunswick | 607,116 | ........... | ........... | 607,116 | 540,806 | ........... | ........... | 540,806 |
| Saskatchewan | ........... | ........... | 2,203,223 | 2,203,223 | ........... | ........... | 1,870,487 | 1,870,487 |
| Alberta | 4,794,647** | 3,321,573 | ........... | 8,116,220 | 5,493,962** | 3,122,893 | ........... | 8,616,855 |
| British Columbia | 1,730,445 | ........... | ........... | 1,730,445 | 1,906,963 | ........... | ........... | 1,906,963 |
| Yukon | 3,703 | ........... | ........... | 3,703 | 3,156 | ........... | ........... | 3,156 |
| Canada total tons | 13,614,316 | 3,321,573 | 2,203,223 | 19,139,112 | 14,126,666 | 3,122,893 | 1,870,487 | 19,120,046 |
| $ | 89,409,538 | 16,686,164 | 4,044,697 | 110,140,399 | 91,710,666 | 15,670,525 | 3,533,930 | 110,915,121 |

* Coals classed according to A.S.T.M. Classification of Coal by Rank—A.S.T.M. Designation D388-38.
** Includes semi-anthracites from the Cascade area (1950 production, 346,339 tons; 1949 production, 304,743 tons).

*Imports of Coal for Consumption*

(Tons of 2,000 pounds)

| Country of origin | 1950 | | | 1949 | | |
|---|---|---|---|---|---|---|
| | Anthracite | Bituminous | Total | Anthracite | Bituminous | Total |
| United States.... | 3,890,254 | 22,538,403* | 26,428,657 | 3,618,490 | 18,072,272 | 21,690,762 |
| United Kingdom. | 395,867 | 28,007 | 423,874 | 326,645 | 4,812 | 331,457 |
| Other countries.. | 262 | 38 | 300 | ......... | 17 | 17 |
| Total....... | 4,286,383 | 22,566,448 | 26,852,831 | 3,945,135 | 18,077,101 | 22,022,236 |

* Includes briquettes and lignite: 191,134 tons of briquettes and 7,471 tons of lignite were imported from United States in 1950.

*Exports of Coal*

(Tons of 2,000 pounds)

| Destination | 1950 | 1949 |
|---|---|---|
| United States.......... | 347,849 | 319,360 |
| Brazil.......... | 34,005 | 38,958 |
| St. Pierre and Miquelon.......... | 13,093 | 9,162 |
| Fiji.......... | ........... | 18,194 |
| Newfoundland.......... | ........... | 43,111* |
| Other countries.......... | 14 | 3,258 |
| Total.......... | 394,961 | 432,043 |

* For first three months only.

*Nova Scotia and New Brunswick*

High- and medium-volatile bituminous coking coals are produced in the Sydney, Cumberland, and Pictou areas, and some non-coking bituminous coal is mined in the Inverness area. The production from Nova Scotia and New Brunswick is used mainly to supply the requirements of the railways of the area, the steel and paper industries, for local domestic use, and to produce electric power. Shipments of coal from Nova Scotia to various centres in central Canada amounted to over 2,500,000 tons in 1950.

*Ontario*

Lignite of lower grade than that in Saskatchewan occurs in the Onakawana area about 100 miles north and east of Kapuskasing, but there has been no commercial production.

*Saskatchewan*

Only lignite is produced, most of the output being from the Bienfait division of the Souris area, the other main producing fields being the Estevan and Roche Percée divisions of that area. Close to 65 per cent of the output is shipped to Manitoba for domestic and industrial use.

*Alberta*

Alberta produces almost all ranks of coal, including a small tonnage of semi-anthracite. Coking bituminous coal ranging from high to low volatile is produced in the Crowsnest, Nordegg, and Mountain Park areas. In the Lethbridge, Coalspur, Saunders, and several other areas of the foothills a lower rank bituminous non-coking coal is produced. The coal in the Drumheller, Edmonton, Brooks, Camrose, Castor, and Carbon areas is classed as subbituminous, and that in the Tofield, Redcliff, and several other areas is on the border of subbituminous and lignite. The Cascade areas was the only field that produced semi-anthracite in 1950. About 59 per cent of Alberta's output of coal in 1950 was bituminous and 41 per cent subbituminous and lignite, mainly the former.

*British Columbia*

Bituminous coking coal ranging from high to low volatile is mined on Vancouver Island and in the Crowsnest, Telkwa, and Nicola areas. Lesser quantities of subbituminous coal are produced, mainly in the Princeton field.

Consumption of briquettes in Canada decreased from 671,927 tons in 1949 to 643,325 tons in 1950. The consumption consisted of: 42,336 tons made from carbonized Saskatchewan lignite; 409,855 tons made from low-volatile bituminous and semi-anthracitic coals from the Nordegg and Cascade areas in Alberta, and from medium-volatile bituminous coal from the Crowsnest area of Alberta; and 191,134 tons imported from United States and prepared from low-volatile bituminous coals and anthracite, alone, and mixed.

## COKE

Production of coke from bituminous coal in 1950 was 3,964,676 tons compared with 3,864,603 tons in 1949. Coal processed for the manufacture of coke amounted to 5,282,347 tons, of which 1,297,913 tons was of Canadian origin and 3,984,434 tons was imported from United States. Petroleum coke produced at the refineries amounted to 121,990 tons compared with 117,369 tons in 1949.

Imports of coke totalled 642,254 tons, a decrease of over 74,000 tons from 1949, whereas exports increased from 294,753 tons in 1949 to 413,343 tons in 1950.

Most of the coke produced for the Canadian market is obtained from standard by-product coke ovens that process coal in large tonnages for use in the production of steel and non-ferrous metals or for domestic use. The retort coke, which is produced as a by-product of the gas industry, forms a small part of the total coke production and is used mainly to make carburetted water gas for distribution as city gas. The residual stocks of retort coke of about 20,000 tons a year are sold as domestic coke. Manufactured gas for large urban areas comes mainly from by-product coke ovens which also produce domestic coke prepared and sized in accordance with market requirements.

The increasing demand for metallurgical coke has resulted in the construction of new batteries of coke ovens in Ontario and in plans for the expansion of other coke oven plants. The new battery of ovens of Dominion Steel Foundries at Hamilton, Ontario, was under construction during the latter part of 1950.

Coke is produced from the several types of carbonization equipment in use throughout Canada. These include seven by-product coke oven plants, two beehive plants, one Curran-Knowles installation, seven continuous vertical retort plants, and eight installations of horizontal "D" retorts.

Approximately 80 per cent of the coal used in the production of coke in Canada is processed by five companies at plants in eastern Canada, namely: Dominion Steel and Coal corporation at Sydney, Nova Scotia, with an annual rated capacity of 813,000 tons of coal; Montreal Coke and Manufacturing Company at Ville La Salle in Quebec, with an annual rated capacity of 656,000 tons of coal (the company normally produces domestic coke and also supplies

*Production of Coke*

| | 1950 | | 1949 | |
|---|---|---|---|---|
| — | Short tons | $ | Short tons | $ |
| *Production from bituminous coal* | | | | |
| Ontario | 2,536,975 | 36,746,944 | 2,467,081 | 34,228,730 |
| Nova Scotia, New Brunswick, Quebec, and Newfoundland | 1,108,634 | 16,726,922 | 1,060,007 | 15,332,632 |
| Manitoba, Saskatchewan, Alberta, and British Columbia | 319,067 | 3,110,155 | 337,515 | 3,805,603 |
| Total | 3,964,676 | 56,584,021 | 3,864,603 | 53,366,965 |
| *Production of Pitch Coke* | 16,727 | 274,336 | 16,975 | 329,163 |
| *Bituminous coal used to make coke* | | | | |
| Imported | 3,984,434 | 41,258,627 | 3,883,397 | 39,224,125 |
| Canadian | 1,297,913 | 10,142,559 | 1,290,749 | 9,510,721 |
| Total | 5,282,347 | 51,401,186 | 5,174,146 | 48,734,846 |
| *Production of petroleum coke* | 121,990 | 1,139,638 | 117,369 | 1,118,234 |
| *Imports, all types,* from United States | 642,053 | 11,026,824 | 716,160 | 12,301,451 |
| *Exports, all types* | | | | |
| To: United States | 395,665 | 5,535,752 | 290,399 | 4,542,429 |
| Other countries | 17,678 | 785,453 | 4,354 | 191,316 |
| Total | 413,343 | 6,321,205 | 294,753 | 4,733,745 |

Montreal with gas); Algoma Steel Corporation Limited with a metallurgical coke plant at Sault Ste. Marie, Ontario, which has an annual rated capacity of 1,761,000 tons of coal; Hamilton By-Product Coke Ovens Limited at Hamilton, Ontario, with a rated capacity of 415,000 tons of coal a year; and the coke ovens of Steel Company of Canada Limited at Hamilton, with a rated capacity of 641,000 tons of coal a year.

The manufacture of beehive coke was continued on a much reduced scale in 1950 by two companies in western Canada, namely, International Coal and Coke Company Limited, and The Crowsnest Pass Coal Company Limited, in their respective plants at Coleman, Alberta, and at Michel, British Columbia.

## NATURAL GAS

Production of natural gas in Canada in 1950 amounted to 67,822,230 M cubic feet, an increase of 7,365,053 M cubic feet over 1949. Alberta contributed about 86 per cent of the output and Ontario, Saskatchewan, New Brunswick, and Northwest Territories, the remainder in that order.

Natural gas continued to be found in Alberta in almost every well drilled for oil. Throughout most of 1950 markets available to the established gas fields in the plains areas were fully supplied and there was little incentive to prospect for further gas reserves. Despite this, several gas discoveries of commercial importance were made in areas of Alberta stretching from the southeastern part of the province to the Peace River district. These discoveries are indicative of the large reserves that may reasonably be expected when natural gas is made the primary object of exploration.

*Production of Natural Gas in Canada by Provinces and Fields*

| — | 1950 | | 1949 | |
|---|---|---|---|---|
| | M cu. ft. | $ | M cu. ft. | $ |
| *Alberta* | | | | |
| Turner Valley | 28,846,738 | ........... | 27,312,300 | ........... |
| Viking-Kinsella | 18,908,554 | ........... | 14,682,529 | ........... |
| Medicine Hat | 3,784,895 | ........... | 3,483,451 | ........... |
| Redcliff | 1,436,145 | ........... | 1,368,230 | ........... |
| Leduc | 1,654,855 | ........... | 1,187,566 | ........... |
| Other fields | 3,972,789 | ........... | 3,145,703 | ........... |
| Total | 58,603,976 | 2,930,199* | 51,179,779 | 2,558,989* |
| *Ontario* | | | | |
| Kingsville, Tilbury, Romney and Raleigh | 1,761,648 | ........... | 2,268,746 | ........... |
| Zone | 439,299 | ........... | 681,940 | ........... |
| Dawn, Oil Springs, Kimball and Beecher | 2,375,620 | ........... | 1,798,924 | ........... |
| Haldimand | 1,584,476 | ........... | 1,684,216 | ........... |
| Welland | 548,806 | ........... | 455,461 | ........... |
| Other fields | 1,299,639 | ........... | 1,134,926 | ........... |
| Total | 8,009,488 | 3,203,795** | 8,024,213 | 8,826,634*** |
| *Saskatchewan* | 813,554 | 71,564 | 812,916 | 81,292 |
| *New Brunswick* | | | | |
| Stoney Creek | 361,877 | 214,665 | 375,035 | 146,864 |
| *Northwest Territories* | 33,335 | 12,818 | 65,234 | 6,523 |
| Grand Total | 67,822,230 | 6,433,041 | 60,457,177 | 11,620,302 |

* The value of production based on a well-head valuation of 5 cents per M cubic feet.
** Wholesale value of natural gas produced.
*** Retail value of natural gas produced.

### *Alberta*

About 90 per cent of the production came from five fields, including the Turner Valley and Viking-Kinsella fields, which together accounted for 80 per cent of the output. Several potentially important discoveries of natural gas were made. These included the Great Plains O'Meara Barrhead well, 55 miles northwest of Edmonton; Shell and B.A. Bluesky No. 1 well in the Peace River district; Shell and B.A. Whitelaw No. 1, 5 miles northwest of the Bluesky well, and other significant discoveries in the vicinities of Morinville, Legal, Athabasca, and Vegreville in the central plains area, and at Cessford, Drumheller, Bulwark, Youngstown, Rolling Hills, Hanna, Stettler, and Sibbald in south-central and southeastern Alberta.

The Turner Valley field is the major source of supply of natural gas for the city of Calgary and for other towns in southern Alberta using natural gas as the chief fuel. It was the only producer of natural gas in the foothills in 1950. Pincher Creek and Jumpingpound fields in the same general type of structure, each of which has very large gas reserves, were shut in pending a market for the gas.

Pincher Creek, Canada's largest gas field, 120 miles south of Calgary, was discovered in 1948 by Canadian Gulf Company when Gulf Pincher Creek No. 1 well obtained an indicated open flow of 55,000 M cubic feet of gas with 1,500 barrels of distillate a day from a porous section in the Palæozoic (Rundle) limestone between depths of 11,755 and 11,927 feet. Two additional wells were completed in 1949. The first, Gulf Walter Marr No. 1, on lsd. 1, sec. 29, tp. 4, rge. 29, W. 4th mer., was completed at a depth of 12,768 feet and on test yielded gas at a rate of 83,000 M cubic feet with 3,000 barrels of distillate a day. The second well, Gulf Fred Schremp No. 1, on lsd. 4, sec. 35, tp. 3, rge. 29, W. 4th mer., reached the Palæozoic at 12,370 feet but failed to find production and was abandoned. Another well, Gulf A. Bonertz No. 1, 2 miles southeast of the discovery well, was being drilled at the end of 1950.

The Pincher Creek wet gas field is believed to have a recoverable gas reserve exceeding 1,500,000,000 M cubic feet. The field seems to have possibilities of yielding upwards of 35,000,000 barrels of light crude oil and 5,000,000 tons of sulphur.

Jumpingpound field 20 miles west of Calgary was discovered by Shell Oil Company in 1944. The discovery well, Shell 4-24-J on lsd. 4, sec. 24, tp. 25, rge. 5, W. 5th mer., reached the Mississippian limestone at 9,618 feet and was completed at a depth of 9,947 feet. Two porous zones were found having a combined thickness of 140 feet. After acidization the measured flow of gas was 11,200 M cubic feet a day with a considerable quantity of naphtha. Three wells were drilled during the period 1945-47, of which one was abandoned, one found gas in the top of the porous Palæozoic section, and one yielded gas with condensate similar to that of the discovery well. A fifth well was being drilled at the end of 1950. Although the Jumpingpound field was capped pending a market for gas, arrangements were being made at the end of 1950 for the building of a pipeline from the field to Calgary and for making gas from this field available to Canadian Western Natural Gas Company for distribution throughout southern Alberta.

The Great Plains O'Meara Barrhead well, No. 4-14 on lsd. 4, sec. 14, tp. 58, rge. 5, W. 5th mer., obtained gas in Mississippian rocks. This well reached the top of the Mississippian at 3,965 feet and finished drilling at 4,004 feet. Casing was perforated at 3,970 to 3,976 feet and after acidizing, the well blew in with a flow of gas that increased from 677 to 6,249 M cubic feet a day.

The Shell and B.A. Bluesky No. 1 well, on lsd. 4, sec. 29, tp. 81, rge. 1, W. 6th mer., reached the Precambrian at 7,243 feet and was completed at a total depth of 7,255 feet. The top of what is believed to be Triassic strata was reached at 3,195 feet and drillstem tests of interval 3,199 to 3,226 feet gave gas at a rate of 1,248 M cubic feet a day. In addition, drillstem tests of Cretaceous interval 2,729 to 2,754 feet yielded a maximum gas flow of 4,520 M cubic feet a day. This well was still undergoing tests for potential at the end of 1950. Shell and B.A. Whitelaw No. 1 had an indicated gas flow of 7,020 M cubic feet a day in drillstem tests of interval 3,371 to 3,468 feet, believed also to be in sands of Triassic age.

Approximately 1,654,855 M cubic feet of gas was produced at the Leduc oil field in 1950 mostly from the D3 Devonian zone. In order to conserve gas, Imperial Oil Limited constructed a network of gas-gathering pipelines at the field and built a compressor and processing plant to recover natural gasoline, propane, and butane from the natural gas produced with the oil. The remaining "dry gas" was thus made available for domestic and industrial consumption or for return to the reservoir for pressure maintenance. The plant was designed to process 24,000 M cubic feet of gas daily and it is expected that 1¼ gallons per M cubic feet will be recovered, of which about one-half will be natural gasoline and the remainder propane and butane.

The question of export of natural gas from Alberta has been under consideration for several years. It involves the problem of preserving a volume of gas sufficient for Alberta's needs for an extended period of years, and of proving a reserve in excess of this amount that will be large enough to justify the large expenditures necessary to construct long-distance transmission lines.

To facilitate a more rapid development of additional gas reserves and thereby build up an exportable surplus in line with its policy that the interest of the people of Alberta would be served to best advantage if surplus gas were made available for sale outside the province, the Government of Alberta amended its gas exploration and leasing regulations making "gas only" rights in specific zones available for exploration and lease in large blocks on a drilling performance basis. However, even though reserves were to be increased before export of gas would be approved, the Government stated that, should the unsettled international situation develop so as to make the use of Alberta gas urgent for defence purposes, it would give immediate consideration to any official request for such from the proper authorities.

Pending the decision of the provincial government to permit such export in accordance with its aforementioned policy in regard to surplus supply, several companies are interested in exporting natural gas from Alberta. Westcoast Transmission Company Limited proposes to pipe gas to the west coast, and Western Prairie Gas Company, to Winnipeg with possible further eastward extension. The former company built a 17-mile, 4½-inch pipeline from the Pouce Coupé gas area to Dawson Creek, British Columbia, at the south end of the Alaska Highway, and this line went into operation on October 31, 1950.

A newly incorporated Alberta company, Alberta Interfield Gas Lines Limited, was formed to build a grid system of gas-gathering lines joining the various producing areas to towns near the lines and to gas-exporting companies.

Perhaps the largest natural gas export project planned to date is that of Canadian Delhi Oil Limited, subsidiary of Delhi Oil Corporation of Dallas, Texas. This company, which has undertaken exploration for gas in Alberta and in 1950 drilled several successful wells, proposes to build a pipeline from southern Alberta to eastern Canada to serve industrial and domestic markets in Saskatchewan, Manitoba, Ontario, and Quebec. The line would be over 2,000 miles long and would cost an estimated $250,000,000.

Alberta Natural Gas Company filed application with the Federal Board of Transport Commissioners for permission to build a pipeline from the Pincher Creek area via Crowsnest Pass, Kingsgate, British Columbia, across the state of Washington, and thence north to Vancouver.

Canadian-Montana Gas Company was formed to acquire the gas fields at Pakowki Lake and to build and operate gas-gathering and transmission lines from these fields to the Montana border. If export approval is obtained from the Alberta government this company plans to supply gas to the Montana Power Company to supplement present supplies of that company in Montana.

Following a request from the Canadian and United States governments, the Alberta government agreed to the building of a gas pipeline from the Pakowki gas area of southern Alberta to connect with lines in Montana that supply industries producing zinc, copper, and manganese in Great Falls, East Helena, Butte, and Anaconda. These minerals are important in North American defence and for this reason the export of 10,000,000 M cubic feet of gas a year for 5 years was authorized, the gas to be used only for Anaconda Copper Mining Company and American Smelting and Refining Company's defence needs. Canadian-Montana Gas Company will construct the pipeline and will operate the fields that will be acquired from McColl-Frontenac Oil Company Limited and Union Oil Company of California, the present owners.

*Ontario*

Development drilling in 1950 resulted in 142 gas wells, of which 124 were in the old Haldimand-Welland gas area in the Niagara Peninsula and the remaining 18 in the Mosald, Becher, and other small fields in the general area southwest of London. In the Niagara Peninsula production was from the Medina (Silurian) sandstone at depths ranging from 450 to 1,400 feet and the average initial open flow was 62 M cubic feet a day. In the area southwest of London production was from the Salina and Guelph (Silurian) formations at depths of 1,200 to 2,500 feet. The average initial open flow in this district was 825 M cubic feet a day.

Two small gas pools were discovered in 1950, one in Lambton county, 7 miles east of Corunna, and the other near Duthill, a short distance north of Wallaceburg. Two other small but deeper gas pools, both in the Guelph dolomite of Silurian age, were obtained, one in the Becher and the second in the Kimball field.

Natural gas production was again insufficient to meet the demand. Union Gas Company of Canada Limited imported some gas from United States during the summer, which it stored underground for use during periods of peak consumption in the winter. The company is planning to build a gas pipeline from southwestern Ontario to Hamilton and Toronto but this project will depend, in part at least, upon increased deliveries of gas from Panhandle Eastern Pipe Line Company of Texas.

*Saskatchewan*

Output came from the Lloydminster, Lone Rock, Unity, and Kamsack fields, with Lloydminster and Unity yielding approximately 95 per cent of the total. Only three new gas wells, all in the Lloydminster field, were brought in during 1950.

*New Brunswick*

Output was from the Stoney Creek oil and gas field, the only producing area in the province. Development drilling during 1950 resulted in two gas wells, and one dry hole.

## PEAT

Production of peat moss in Canada in 1950 amounted to 75,195 tons, a decrease of 6·3 per cent compared with 1949. This output came from thirty-seven producers, but 66 per cent of the production, came from five companies in the Fraser River delta in British Columbia and two in the Rivière du Loup area in Quebec.

*Production*

| — | 1950 | | | 1949 | | |
|---|---|---|---|---|---|---|
| | Producers | Short tons | $ | Producers | Short tons | $ |
| British Columbia | 13 | 45,565 | 1,498,219 | 16 | 44,581 | 1,508,093 |
| Quebec | 14 | 17,873 | 360,459 | 16 | 21,168 | 445,636 |
| Ontario | 5 | 5,613 | 206,625 | 4 | 7,381 | 210,008 |
| New Brunswick | 3 | 5,534 | 168,321 | 3 | 5,752 | 156,400 |
| Nova Scotia (and Manitoba) | 2 | 610 | 23,246 | 1 | 1,367 | 56,712 |
| Total | 37 | 75,195 | 2,256,870 | 40 | 80,249 | 2,376,849 |

Most of the production is exported to United States, two-thirds being for horticultural moss, and one-third for poultry and stable litter.

Peat moss is the dead fibrous moss that has been excavated from peat bogs, dried, shredded, and pressed into bales or smaller packages. Its value is dependent upon its highly absorptive nature, and its main uses are for stable bedding, poultry litter, and for soil conditioning.

Peat is widely distributed throughout Canada. In its natural state, it consists of about 90 per cent water and 10 per cent vegetable matter in various stages of decomposition and disintegration and generally occurs in two distinct forms, unhumified sphagnum or moss peat, and well humified grass or sedge peat, better known as fuel peat. Small amounts of peat fuel have been produced intermittently in Ontario and Quebec. In 1950 there was a small output at Gads Hill Station near Stratford, Ontario.

*British Columbia*

The peat operations in the Fraser River delta near New Westminster are the largest in Canada. From this small area thirteen companies in 1950 produced over 45,000 tons, considerably more than half the total Canadian production in that year. The largest producers are Western Peat Company Limited, Industrial Peat Limited, Coast Peat Company Limited, and Atkins and Durbrow Limited. Four bogs are under development, namely: Pitt Meadows, Byrne Road, Lulu Island, and Delta (Burns). These deposits are expected to last for from 10 to 15 years at the present rate of production.

*Manitoba*

Western Peat Company Limited is the only producer in Manitoba, having taken over the Julius or Shelley bog formerly operated by the Winnipeg Supply and Fuel Company Limited.

*Ontario*

The largest of the five producers was Atkins and Durbrow (Erie) Limited which works the Welland bog in Wainfleet and Humberstone townships, about 5 miles west of Port Colborne.

*Quebec*

The peat moss deposits now being developed in Quebec are mainly in the lower St. Lawrence region. In 1950 fourteen companies produced 17,873 tons, most of the production coming from Premier Peat Moss Corporation with operations at Rivière du Loup, Isle Verte, and Cacouna, and Tourbieres Rivière-Ouelle in the Rivière du Loup area.

*New Brunswick*

The most important peat moss deposits are in Northumberland and Gloucester counties on both shores of Miramichi Bay, and on Miscou, and Shippigan Islands. Three companies produced peat moss in 1950, namely: Fafard Peat Moss Company at Pokemouche; Western Peat Company at Shippigan; and Atlantic Peat Moss Company Limited on Shippigan Island. Their total production was 5,534 tons.

*Nova Scotia*

Annapolis Peat Moss Company Limited, which had started developing the Caribou bog near Berwick in 1949, produced a small tonnage of peat moss in 1950. The heavy rains accompanying the hurricane that struck this part of Nova Scotia in August 1949 ruined practically all the peat that had been cut and stacked during 1949, and were the cause of the small production reported for 1950.

### *Peat for Agricultural Uses*

A co-operative investigation was started in 1948 by the Department of Agriculture, and the former Department of Mines and Resources (now Mines and Technical Surveys) to test the value of humified peat as a source of organic matter for depleted and exhausted soils. As this is a long-term investigation, it will be some time before the actual effects can be accurately measured. However, an examination of the apple orchards where peat had been applied indicates that although peat alone has not yet effected any marked improvement, peat mixed with lime and/or fertilizer showed a marked improvement in soil fertility as noted where peat mixed with lime and/or fertilizer has been applied.

### *Price*

The price of peat moss varied in 1950 from $30 to $46 a ton, according to location. The average price for the Canadian output was $38 a ton.

## CRUDE PETROLEUM

Canada continued its outstanding progress in 1950 as an active and potential producer of crude oil. Output in Alberta, source of 95 per cent of Canada's oil production, averaged 75,604 barrels a day and totalled 27,595,616 barrels of crude oil and natural gasoline valued at $82,358,597, an increase of 36 per cent over the 1949 output of 20,246,392 barrels valued at $59,466,868.

Industry made a record expenditure of approximately $150,000,000 on exploration and development, with the result that new peaks were set in footage drilled, in well completions, and in discoveries made. Total footage drilled for development and exploratory wells in the Prairie Provinces reached 4,600,000 feet compared with 3,273,000 feet in 1949. One hundred and seventeen geophysical parties were in action, of which at least 105 were in Alberta where the greatest exploratory activity was in the central and south-central areas. Of the 117 parties, 108 were seismic, 8 gravity, and 1 magnetic. Several major companies did surface geological work, particularly in northern and northwestern Alberta and northeastern British Columbia.

Potential production at the end of 1950 was 185,000 barrels a day, or over 52 per cent of Canadian requirements, which were estimated at 355,000 barrels of crude oil a day in 1950. As this was much in excess of Prairie requirements, which averaged 70,000 barrels a day, there was in effect a surplus of oil in that region.

An outstanding development of the year was the construction of an 1,127-mile pipeline by Interprovincial Pipe Line Company, Limited from Edmonton to Superior, Wisconsin, passing through Regina, Saskatchewan, and Gretna in Manitoba, at an estimated cost of $90,000,000. Upon completion of the line in December 1950, the first oil from the Redwater field was delivered into storage at the Superior terminus, pending the opening of the navigation season when it will be taken by lake tanker to refineries in the Sarnia area of Ontario, which are capable of using 70,000 barrels of crude oil a day.

The pipeline is in three sections as follows: Edmonton to Regina, 450 miles of 20-inch diameter pipe; Regina to Gretna, Manitoba, 340 miles of 16-inch pipe; and Gretna to Superior, 360 miles of 18-inch pipe. Six pumping stations along the route provide an initial capacity of 90,000 barrels a day through the first section and about 70,000 barrels a day through the sections east of Regina. At the end of 1950, plans were being made to increase the initial capacity of 90,000 barrels a day to approximately 130,000 barrels a day by adding pumping stations and by "looping" along certain sections of the line.

At the Superior terminus, storage facilities with a capacity of 1,800,000 barrels were constructed to permit full use of the pipeline during the season closed to navigation on the Great Lakes. Two new tankers, the largest on the Great Lakes, were under construction at an estimated cost of $4,000,000 each. These were to be available for the transportation of oil from Superior to Sarnia upon the opening of the 1951 navigation season.

The marked increase in productive potential of the Prairie Provinces has also led to the building of a refinery at Winnipeg, to be completed in 1951 at a cost of $10,000,000; construction of a 75-mile, 10-inch connecting pipeline from Gretna to Winnipeg at a cost of $2,500,000; construction of a 30-mile, 16-inch pipeline from Redwater to Edmonton at a cost of $2,500,000; refinery construction and modernizing at several centres such as Edmonton, Ogden, Lloydminster, Moose Jaw, Regina, and at Froomfield near Sarnia, Ontario, at a cost of around $75,000,000 and construction of additional storage capacity at Sarnia.

*Crude Oil Production*

(In bbls. of 35 Imperial gallons)

| — | 1950 | 1949 |
|---|---|---|
| *Production* | | |
| *Alberta:* | | |
| Leduc | 10,604,494* | 9,688,784 |
| Redwater | 10,746,472 | 4,793,491 |
| Turner Valley | | |
| Crude oil | 3,344,007 | 3,826,543 |
| Natural gasoline | 431,362 | 477,446 |
| Lloydminster | 809,801 | 716,941 |
| Taber | 114,916 | 150,746 |
| Conrad | 110,062 | 139,728 |
| Princess | 122,909 | 121,227 |
| Vermilion | 49,041 | 86,933 |
| Golden Spike | 292,873 | 85,081 |
| Joseph Lake | 168,855 | 35,858 |
| Whitemud | 45,437 | 26,506 |
| Stettler | 246,198 | 15,725 |
| Normandville | 28,200 | 5,891 |
| Dina | 17,887 | 14,062 |
| Excelsior | 272,186 | 1,616 |
| Wainwright | 15,360 | 16,086 |
| Other areas | 175,556 | 43,728 |
| Total | 27,595,616 | 20,246,392 |
| *Saskatchewan* (Lloydminster) | 1,041,098 | 782,188 |
| *Ontario* | 250,655 | 260,670 |
| *Northwest Territories* | 186,729 | 155,528 |
| *New Brunswick* | 17,137 | 19,544 |
| Total bbl. | 29,091,235 | 21,464,322 |
| Total value | $84,762,000 | $61,590,000 |

* Includes 15,022 barrels of natural gasoline.

## Alberta

### *Oil Fields*

Nine oil discoveries were made in Alberta in 1950. These consisted of D2 and D3 Devonian oil at Duhamel and Big Valley; Devonian and Cretaceous oil at Acheson-Stony Plain; Cretaceous oil at Barons, Bulwark, Drumheller, and Ellerslie; Mississippian oil at Spring Coulee, and Triassic oil at Whitelaw in the Peace River district. Although further drilling is necessary to permit evaluation of their extent, these discoveries, together with extensions of previous fields, notably Leduc and Redwater, and other development drilling, are estimated to have increased existing recoverable oil reserves in Alberta by about 100,000,000 barrels to an estimated 1·2 billion barrels.

One thousand and twelve wells were completed, consisting of 788 field development wells and 224 exploratory ventures or wildcats. Development drilling in 1950 resulted in 719 oil wells, 19 gas wells, and 50 dry holes, and exploratory drilling in 34 oil wells, 21 gas and potential gas wells, and 169 failures. This compares with 784 completions of all types in 1949.

*Leduc-Woodbend Field.* One hundred and ninety-six wells were completed in the general Leduc-Woodbend field in 1950. This brought the total wells completed to 506 and resulted in the extension of the Leduc-Woodbend D2-D3 area to the north and of the D2 zone southwestward to the Calmar district. In addition, the D2-D3 Okalta pool and the D2 McLeod pool were discovered south and southeast, respectively, of the main Leduc area. Production amounted to 10,589,472 barrels of crude oil comprising 161,923 barrels from the Lower Cretaceous, 2,872,559 barrels from the D2 Devonian, and 7,554,990 barrels from the D3 Devonian reef zones. A total of 15,022 barrels of natural gasoline was also recovered.

*Redwater Field.* Development and extension of this D3 Devonian reef field discovered in 1948, 30 miles northeast of Edmonton, continued at an accelerated pace in 1950 and 470 wells were completed. Production reached 10,746,472 barrels, bringing the cumulative yield to the end of 1950 to 15,576,838 barrels of crude oil.

Extensions to the northwest (Opal) and to the southeast (Simmons) lengthened the field by several miles so that it is now 18 miles long with an average width of 4 miles. The outer limits of the field, particularly the northwest and southeast areas, have not yet been established. The D3 reef limestone occurs at a depth of 3,200 feet and typical wells have initial potentials of approximately 1,400 barrels a day of 35° A.P.I. gravity crude.

*Turner Valley Field.* Turner Valley, Canada's first major oil field, discovered in 1924 (gas condensate) and 1936 (crude oil) in the Alberta foothills, 40 miles southwest of Calgary, was the country's third producer in 1950 with 3,775,369 barrels of crude oil and natural gasoline. Cumulative yield to the end of 1950 was approximately 106,000,000 barrels of crude oil, the peak production being in 1942.

Two wells were drilled in 1950 in an attempt to extend the north end of the field. One of these, Home-Millardville No. 37, was abandoned at a depth of 9,718 feet, and the second, Home-Millardville No. 38, found oil with initial potential of 200 barrels a day at a depth of 9,059 feet. The field has 329 wells, 300 of which were operating at the end of 1950.

*Golden Spike Field.* Five wells, four of which were productive, were drilled in this field in 1950 to bring to a total of six the number of productive wells at the end of the year. One of these, Imperial-Golden Spike No. 5, obtained a record thickness of 593 feet of water-free oil-bearing D3 reef limestone, and was also the first well in which the D2 zone was found to be commercially productive in this field. It is noteworthy that this pool, as yet small in areal extent, has an average effective oil-saturated zone of over 400 feet. Production for 1950 was 292,873 barrels, bringing the cumulative yield for the field at the end of 1950 to 377,954 barrels.

The field was discovered in 1949, 6 miles west of the Leduc-Woodbend area, when the famous Golden Spike No. 1 (Imperial Schoepp No. 1) well penetrated a 544-foot section of oil-producing Devonian D3 reef limestone to give an initial potential of 12,000 barrels a day of 38° A.P.I. gravity oil. The discovery well was followed by the drilling of two dry holes and a second producer late in 1949.

*Campbell Field.* The discovery of the Campbell Lower Cretaceous field in June 1949, 8 miles northwest of Edmonton, was followed in 1950 by the drilling of 13 additional wells of which 10 were productive and 3 were abandoned. One well, Redwater-Leaseholds-Campbell No. 5, was drilled to a depth of 4,405 feet to test the underlying Devonian but without success. It was then plugged back to the Lower Cretaceous where an 18-hour pumping test indicated an initial potential of 105 barrels a day of 33° A.P.I. gravity crude. Production for 1950 was 60,012 barrels, bringing the cumulative yield to 64,697 barrels of oil.

*Joseph Lake Field.* The Joseph Lake Viking sand oil field, 18 miles southeast of Edmonton, developed rapidly in 1950 with the drilling of 26 wells to bring the total number of wells completed to 31 by the end of the year. Only one well, Joseph Lake No. 7 on the northwest side of the field, failed to find production. Superior-Joseph Lake No. 45, searching for the northeast limit of the pool, obtained flows of natural gas estimated at 2,250 to 3,500 M cubic feet a day. Thickness of the Viking sand ranges from 10 to 25 feet.

The discovery well (1949), which found production at 3,250 feet, was the first discovery of oil in commercial quantity in the Viking sand of Upper Cretaceous age. Drilling was continued without success to over 5,000 feet to test lower formations, although the D3 Devonian reef zone indicated small non-commercial shows of oil. Initial potential of the discovery well was around 520 barrels of 38° A.P.I. gravity crude daily, although some wells in which the productive sand is thicker have tested around 1,000 barrels a day. Most wells were flowing with low gas-oil ratio, but a few were currently on pump. The field is still undergoing rapid development and has not yet been delimited. Production in 1950 was 168,855 barrels to bring the cumulative yield to 204,713 barrels of oil at the end of 1950.

*Excelsior Field.* Thirty-one wells were completed in the Excelsior D2 Devonian reef field, 18 miles northeast of Edmonton, in 1950. Only five of these failed to find oil and were abandoned. Production in 1950 amounted to 272,186 barrels, bringing the cumulative yield at the end of the year to 273,802 barrels of oil.

The field was discovered by Imperial Oil Limited late in 1949 and by the end of that year two producers had been completed. The discovery well reached the top of the D2 zone at 3,810 feet and had about 40 feet of productive section with an initial potential of 1,150 barrels a day of 35° A.P.I. gravity crude. These first two wells were deepened without success, to test the underlying D3 zone.

*Stettler Field.* Production comes from the Lower Cretaceous sands and the D2 and D3 reef zones of the Devonian. Thirty wells were completed in 1950, six of which were abandoned as unsuccessful. Production totalled 246,198 barrels of crude oil.

The field was discovered by Canadian Gulf Company in 1949 when Gulf N. J. Ellis No. 4 obtained production in the two Devonian reef zones. This well reached the top of the D2 and D3 zones at 5,115 and 5,335 feet respectively and had a D3 pay thickness of 50 feet. Initial potential from D3 was 426 barrels of 28·6° A.P.I. gravity crude in 7½ hours.

Lower Cretaceous production is found 6½ miles northeast of the discovery location and 3 miles northeast of the present limit of the main field. The Lower Cretaceous is found at 4,100 feet. In addition to wells producing from the D2 and D3 reef zones separately, the field also has two dual producers from D2 and D3 and two Lower Cretaceous producers.

*Lloydminster Field.* The Lloydminster heavy crude oil field, which was discovered in 1939, underwent accelerated development in 1950 with the drilling of 112 wells, or 30 more than in 1949. Added incentive to production, which had been adversely affected by a surplus of heavy ends from the more recently discovered light crude fields, was brought about by a price increase for heavy 'black oil'.

Drilling in 1950 resulted in 88 oil producers, 4 gas wells, and 20 wells that were either abandoned or suspended. Activity was greater on the Saskatchewan side of the field where 60 wells were completed of which 47 were indicated oil producers, 3 were gas wells, and 10 were dry holes. Drilling on the Alberta side resulted in 52 completed wells comprising 41 indicated oil producers, 1 gas well, and 10 dry holes.

*Whitemud Pool.* The Whitemud Lower Cretaceous pool, 6 miles south of Edmonton, was discovered in 1949. Five wells were completed in 1950, only one of which obtained oil. This well went on pump in February 1950 but was abandoned in December. Of the remaining four completions, all of which were abandoned, two indicated natural gas flows of from 3,000 to 5,000 M cubic feet a day on drillstem tests, and one well, Shaw Whitemud No. 1, reported a blow of gas estimated at 6,000 M cubic feet a day with recovery of about 3 feet of naphtha at interval 4,002 to 4,015 feet. Average depth to oil, which is about 38° A.P.I. gravity, is around 4,000 feet and the productive zone averages 21 feet in thickness. Production in 1950 was 45,437 barrels of oil from two operating wells.

*Barrhead Area.* Two wells were drilled in the Barrhead district, 55 miles northwest of Edmonton, in 1950. The first, Great Plains-Barrhead No. 4-14, was completed as a potential gas well in the top of the Mississippian at depth of 3,976 feet, with initial potential of 6,249 M cubic feet a day, and the second was reported as standing at the end of the year. Production from this area in 1950 was 599 barrels of oil from one operating well.

Oil was discovered in the Mississippian in this area in 1949 by Stanolind Oil Company. The discovery well, Stanolind-Imperial Barrhead No. 1, is reported to have flowed at a rate of 36 barrels an hour on test. A second well also found Mississippian oil and flowed 28° A.P.I. gravity crude at a rate of 30 barrels an hour on 2-hour test from a depth of 3,980 feet.

*Other Fields.* Little or no drilling was done in several of the older fields, such as Armena, Conrad, Princess, Bon Accord, Taber, Wainwright, Volmer, Brooks, and Vermilion, and production in these areas showed a general decline.

### *Fields Discovered*

*Acheson-Stony Plain.* The Acheson-Stony Plain field was found in September 1950 by California-Standard Company and Imperial Oil Limited, who were carrying on structural and seismic exploration work on their jointly held reservations 8 miles west of Edmonton. Imperial-Stony Plain No. 1, on Indian Lands commenced drilling on June 18 and was completed August 10. Drilling was carried to a depth of 6,900 feet and the well was plugged back to 5,200 feet. It reached the top of the D3 Devonian reef zone at 5,120 feet, which proved to be but a few feet above the water line, and the well was placed on pump on September 24 with an initial potential of 154 barrels in 24 hours.

California-Standard Company commenced drilling its Acheson Province No. 1 well, 3½ miles northeast of the Imperial Stony Plain venture on July 7 and finished on September 2 at a total depth of 5,090 feet. The well reached the top of the D3 Devonian reef zone at 4,966 feet, and after opening about 121 feet of this zone it was placed on production with a rated initial potential of 1,200 barrels a day of 36° A.P.I. gravity crude. Both discovery wells indicated substantial volumes of natural gas on drillstem tests in the Cretaceous.

Central Leduc Wild No. 1, 1½ miles north of Imperial-Stony Plain No. 1, and 2 miles southwest of Acheson Province No. 1, was completed on September 17. This well found only 9 feet of D3 oil-saturated zone but was finished as an oil pumper from this zone. However, it obtained substantial natural gas flow in the Viking sand and commercial oil in both the Lower Cretaceous and the D2 Devonian reef zone.

At the end of 1950 the Acheson-Stony Plain field had 13 completions, of which 7 were abandoned. Production in 1950 totalled 6,230 barrels of oil from two wells in the Lower Cretaceous and 45,163 barrels from four wells in the D3 Devonian reef limestone.

*Duhamel Field.* Another important oil discovery was made in September 1950, with the drilling of Socony-Flint No. 1, 12 miles southwest of Camrose, and about 40 miles southeast of the Leduc field. The discovery well, drilled to a depth of 4,878 feet, reached the top of the D2 and D3 Devonian reef zones at 4,505 and 4,810 feet, respectively, and found commercial oil in each. A flow rate of 2,078 barrels a day of 35° A.P.I. crude was reported from D2, and 1,100 barrels a day from D3.

The first follow-up well, Socony-Camrose No. 1, 2 miles northeast of the discovery well, failed to find production and was abandoned at depth of 5,800 feet. This failure was followed by Socony-Duhamel No. 29-14, 2 miles north of the discovery. Drilled to a depth of 4,870 feet, it reached the top of the D2 and D3 zones at 4,410 and 4,701 feet, respectively, and proved to be larger than the discovery well. The D2 indicated 66 feet of gas cap followed by a 55-foot oil column. The D3 showed 7 feet of gas cap and 139 feet of oil-saturated zone above the water line. It was placed on production from the D3 reef zone with an initial potential of 1,944 barrels a day of 35·5° A.P.I. gravity crude oil. Two other wells, the first 2 miles east, and the second, 1 mile southwest, of the discovery well, were completed in 1950, but both failed to find production and were abandoned.

*Big Valley Field.* Canadian Gulf Company made another Devonian discovery that developed into a dual zone field 60 miles south of the Duhamel discovery and 17 miles south of the Stettler dual zone Devonian field. The discovery well, Gulf-Big Valley No. 7, was drilled to a depth of 5,435 feet. It reached the top of the D2 zone at 5,240 feet and had an indicated potential of approximately 2,000 barrels a day of 33° A.P.I. gravity crude from a 39-foot productive section. It reached the top of the D3 at 5,325 feet with an indicated productive section of 11 feet. The well was placed on production from the D3 zone with an initial potential of 960 barrels of 33·6° A.P.I. gravity crude daily.

The discovery was followed by the drilling of Gulf-Big Valley No. 9, and Gulf-Big Valley No. 3, ½ mile northeast and southwest respectively of the first well. Number 9 was completed in the D2 zone at 5,309 feet and placed on production at an initial yield of 1,920 barrels a day of 31° A.P.I. gravity crude. Gulf-Big Valley No. 3 was drilled to 5,365 feet. It reached the top of the D2 and D3 at 5,233 and 5,314 feet respectively, and was placed on production from the D2 reef zone. Two other wells were completed by the end of 1950 and were placed on production from the D2 reef zone. Recovery totalled 4,961 barrels of oil from the D2, and 5,254 barrels from the D3 Devonian zone.

### *Discovery Wells*

*Shell and B.A. Whitelaw No. 1.* Several other discoveries were made during the latter part of 1950. In the Peace River district, Shell and B.A. Whitelaw No. 1, 36 miles west-southwest of Peace River town, finished drilling in the Precambrian at 7,492 feet. Drillstem testing in what is believed to be Triassic sands from 3,371 to 3,468 feet, indicated a natural gas flow of 7,020 M cubic feet a day, and other substantial volumes of gas were reported from testing in the general section from 3,371 to 3,839 feet. Testing indicated free oil of 26° A.P.I. gravity in the interval 3,835 to 3,905 feet, thought to be Mississippian in age.

At the end of 1950, a total of 6,206 barrels of crude oil had been recovered.

*Barons No. 1.* Barons Oil Company discovered commercial oil on the southern plains, 80 miles southeast of Calgary and 225 miles south of the Joseph Lake Viking Sand oil field, in the Bow Island sand equivalent of the Viking Upper Cretaceous sand and long known as a natural gas reservoir. Barons No. 1 completed drilling at a total depth of 4,114 feet. About 5 feet of productive sand was opened from 4,109 feet and the well was placed on production after indicating an initial potential of 648 barrels a day on a 1-hour test. Gravity of the oil is 32·5° A.P.I. Production was 1,406 barrels at the end of 1950.

*Noco-Drumheller* No. 2. Noco-Drumheller No. 2, near Drumheller, 100 miles north of Barons, discovered oil in the basal Lower Cretaceous. The well was carried to a depth of 4,575 feet to test the underlying Rundle formation (Mississippian), and the top of the Rundle was reached at 4,562 feet. However, after failing to find oil at this horizon, the well was plugged back and casing was perforated in the Lower Cretaceous interval 4,449 to 4,464 feet. It was opened with an initial flow of 6 barrels an hour of 34° A.P.I. gravity crude.

*Fina Bulwark Province No. 1.* Fina Bulwark Province No. 1 well, made an oil strike in the Upper Cretaceous Viking sand, 75 miles northeast of Drumheller, in the Castor-Bulwark district. Drilling was completed in the Devonian at 3,910 feet, and the well was subsequently plugged back to 3,300 feet. The top of the Viking sand was reached at 2,910 feet and the well was placed on pump with an initial pumping rate of 41·3 barrels a day of 34·8° A.P.I. gravity oil.

*Pacific Petroleums C.P.R. L. Ellerslie No. 1.* Pacific Petroleums C.P.R. L. Ellerslie No. 1, 6 miles south of Edmonton and 3½ miles northeast of the Whitemud Lower Cretaceous field, obtained oil in the Lower Cretaceous at a depth of 3,912 feet The well was drilled to 5,330 feet but failed to get production in the Devonian and was plugged back to 3,946 feet. On a 2-hour test at 3,912·5 feet, the well flowed at a rate of 10 barrels an hour.

*Chip Lake No. 1.* Select Oils Limited made a "wet-gas" discovery at its Chip Lake No. 1 well at Chip Lake, 80 miles west of Edmonton, which finished drilling at a depth of 6,403 feet. On a 24-hour test the well is reported to have yielded 820 cubic feet of natural gas and 13 barrels of 53·9° A.P.I. gravity oil.

*National-Spring Coulee Malmberg No. 1.* Exploratory drilling in the Spring Coulee area, 30 miles south of Lethbridge resulted in an interesting discovery of oil in the Mississippian. National-Spring Coulee Malmberg No. 1, reached the top of the Rundle limestone at 5,870 feet, and completed drilling at 5,959 feet. Intermittent periods of testing carried on over several months gave encouraging results, and on September 19 the well pumped 40 barrels of crude.

At the end of 1950, three additional wells had been completed, of which one was abandoned, and two, the National-Centennial Nos. 1 and 2, 3 miles south of the discovery well, were placed on pump. National-Centennial No. 2 had an estimated initial potential of 50 barrels a day. Production to the end of 1950 was 4,604 barrels.

### Saskatchewan

The search for oil and gas during 1950 was the greatest in the history of the province and by the end of the year approximately 85 per cent of the surveyed part of the province, comprising 36,000,000 acres was under exploratory permit to 36 permit holders. Sixty wells were drilled in the Lloydminster field and over 40 completions were made in the search for new fields. A possible eastern extension of the Lloydminster-Lone Rock field was made by discovery of "black oil" in the Maidstone district. The finding of heavy crude oil in the Albercan-Crown No. 22-35-26 well, 90 miles southeast of Lloydminster, may result in the discovery of a new field. This well, reported to have been completed at 3,100 feet, was plugged back to 2,678 feet. It had 1,400 feet of 12° A.P.I. gravity oil which was not lowered by bailing at a rate of 35 barrels a day.

### Manitoba

Interest in the oil possibilities of the southwestern part of Manitoba increased greatly during 1950. Large areas of Crown and freehold land were taken under exploratory permit and lease, and seismic surveys were made. Exploratory drilling was done in the Lyleton, Brandon, and Hartney districts, and structure drilling in the Russell district. Perhaps the most important and encouraging result was obtained at the Souris Valley Oil Company's Downey No. 1 well in the extreme southwest part of the province. This well reached the top of the Mississippian limestone at 3,222 feet. The limestone was cored at 3,223 to 3,228 feet and much of this core exhibited fine pinpoint porosity saturated with light "live" oil. Drillstem test of interval 3,221 to 3,228 feet gave 30 feet of fluid consisting of slightly oil-cut drilling mud with no indication of salt water. This oil "show" is significant in that it indicates oil has been formed in this part of the province and may be reasonably expected in commercial quantity under favourable stratigraphic and structural conditions.

### Northwest Territories

The Norman Wells field continued to supply local requirements only. Production from the field in 1950 was 186,729 barrels of crude oil.

### British Columbia

There was a marked increase in activity in the search for oil and gas in British Columbia. The provincial department of Lands and Forests issued 84 exploration permits covering 8,250,000 acres, bringing the total area thus held to 10,412,276 acres. Most of this land is in the general Peace River region of northeastern British Columbia, but the Queen Charlotte Islands as well as the Cariboo, New Westminster, and Kootenay districts also received attention.

Although exploratory work was largely geological, several wildcat wells were drilled during 1950. Royalite Queen Charlotte No. 1 on Skidegate Inlet, and Phillips Lone Mountain No. 1, 60 miles south of Dawson Creek, which were both commenced in 1949, were completed and abandoned at depths of 3,512 and 9,121 feet, respectively. Important tests spudded and completed during 1950 include Phillips Lone Mountain No. 2, three-quarters of a mile southeast of No. 1 well and abandoned at 1,573 feet, and Pacific Sunrise No. 1, 18 miles northwest of Dawson Creek, abandoned at 2,682 feet. Two other tests, Phillips Diaber No. 1 in unsurveyed territory 70 miles northwest of Fort St. John, and Kersley-Province of B.C. No. 1, south of Quesnel in the Cariboo district, were being drilled at the end of 1950. In addition, several stratigraphic test wells were drilled in the Dawson Creek area.

### Ontario

Production in Ontario has been continuous since 1861, with a cumulative yield to the end of 1950 of about 31,000,000 barrels of oil. It comes from southwestern Ontario where oil seepages were observed as early as 1858. No new oil discoveries were made during 1950.

In 1950, 336 wells were completed, of which 277 were development wells and 59, exploratory tests. Most of the development drilling took place in the Haldimand-Welland, Becher, and Mosald fields and resulted in 10 oil wells, 142 gas wells, and 125 dry holes.

Ninety-one dry holes and 124 gas wells were completed in the Haldimand-Welland gas area of the Niagara Peninsula, where gas was obtained in the Medina formation (Silurian) at depths of 450 to 1,400 feet. Average initial open flow was 62 M cubic feet a day.

Drilling in the Becher, Mosald, and other small fields in Kent, Lambton, and Essex counties resulted in 23 dry holes, 7 oil wells and 18 gas wells. Production here is from the Salina-Guelph (Silurian) beds at depths of 1,200 to 2,500 feet. The average initial yield for oil wells was 15 barrels a day.

Only three exploratory tests were drilled to the basement or to the immediately overlying "basal beds". Two of these were stratigraphic tests on Manitoulin Island and the information afforded by this drilling will aid in evaluating the possibilities of the Ordovician section in this region. The provincial government drilled a stratigraphic test in the Hudson Bay Lowland region at Piskoshi Point on the west coast of James Bay. This well had reached a depth of 1,465 feet on October 1, 1950.

### New Brunswick

All the production of oil is from the Stoney Creek oil and gas field discovered in 1909, 9 miles south of Moncton. A total of 17,137 barrels of 37° A.P.I. gravity oil was recovered in 1950, bringing the cumulative yield to approximately 500,000 barrels. Three development wells, resulting in two gas producers and one dry hole, were drilled in the field in 1950. Exploratory drilling was confined to two wells: Shell-Dorchester No. 1, 9 miles south of the Stoney Creek field, was abandoned at 8,229 feet, and Shell-Abougoggin No. 1, 30 miles east of Moncton, finished drilling at 1,030 feet and was abandoned.